

General Safety & Health Standards
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Flammable and Combustible Liquids 220

220. FLAMMABLE AND COMBUSTIBLE LIQUIDS

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220. FLAMMABLE AND COMBUSTIBLE LIQUIDS: (7-1-97)

01. Scope: (7-1-97)

a. Flammable and combustible liquid use and storage 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)

b. This section applies to the handling, storage and use of flammable and combustible liquids with a flashpoint below two-hundred (200) degrees Fahrenheit. (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. Aerosol is a material which is dispensed from its container as a mist, spray, or foam by a propellant under pressure. (7-1-97)

b. Atmospheric Tank is a storage tank which has been designed to operate at pressures from atmospheric through zero point five (0.5) p.s.i.g. (7-1-97)

c. Automotive Service Station is that portion of property where flammable or combustible liquids used as motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles and shall include any facilities available for the sale and service of tires, batteries, and accessories, and for minor automotive repairs, painting, body, and fender work are excluded. (7-1-97)

d. Barrel is a volume of forty-two (42) U. S. Gallons. (7-1-97)

e. Basement is a story of a building or structure having one-half (1/2) or more of its height below ground level and to which access for fire fighting purposes is unduly restricted. (7-1-97)

f. Boiling Point of a liquid is at a pressure of fourteen-point-seven (14.7) pounds per square inch absolute (p.s.i.a.). For purposes of this section, where an accurate boiling point is unavailable for the material in question or for mixtures which do not have a constant boiling point, the ten (10) percent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D-86-62, may be used as the boiling point of the liquid. (7-1-97)

g. Boil over is the expulsion of crude oil (or certain other liquids) from a burning tank. The light fractions of the crude oil burn off producing a heat wave in the residue which on reaching a water strata may result in the expulsion of a portion of the contents of the tank in the form of a froth. (7-1-97)

h. Class I liquids are classified as flammable liquids and are divided into three (3) sub-classes as follows: Class IA shall include liquids having flashpoints below seventy-three (73) degrees Fahrenheit (twenty-two-point-eight (22.8) degrees Celsius) and having a boiling point below one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius); Class IB shall include liquids having flashpoints below seventy-three (73) degrees Fahrenheit (twenty-two-point-eight (22.8) degrees Celsius) and having a boiling point at or above one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius); Class IC shall include liquids having flashpoints at or above seventy-three (73) degrees Fahrenheit (twenty-two-point-eight (22.8) degrees Celsius) and below one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius). (7-1-97)

i. Class II Liquids are classified as combustible liquids and shall include those liquids with flashpoints at or above one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius) and below one-hundred-forty (140) degrees Fahrenheit (sixty (60)degrees Celsius) except any mixture having components with flashpoints of two-hundred (200) degrees Fahrenheit (ninety-three-point-three (93.3) degrees Celsius) or higher, the volume of which make up ninety-nine (99) percent or more of the total volume of the mixture. (7-1-97)

j. Class III Liquids are classified as combustible liquids and shall include those with flashpoints at or above one-hundred-forty (140) degrees Fahrenheit (sixty (60) degrees Celsius) Class III liquids are sub-divided into two subclasses: Class IIIA Liquids shall include those with flashpoints at or above one-hundred-forty (140) degrees Fahrenheit (sixty (60) degrees Celsius) and below 200-degrees Fahrenheit (93.3-degrees Celsius) except any mixture having components with flashpoints of two-hundred (200) degrees Fahrenheit (ninety-three-point-three (93.3) degrees Celsius) or higher, and the total volume of which makes up ninety-nine (99) percent or more of the total volume of the mixture. Class IIIB Liquids shall include those with flashpoints at or above two-hundred (200) degrees Fahrenheit (ninety-three-point-three (93.3) degrees Celsius) This section does not cover Class IIIB liquids. Where the term Class III liquids is used in this section, it shall mean only Class IIIA liquids. (7-1-97)

k. Closed Container is a container so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at most ordinary temperatures. (7-1-97)

l. Combustible Liquid is any liquid having a flashpoint at or above one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius) Combustible liquids shall be divided into two classes, Class II and Class III liquids. When a combustible liquid is heated for use to within thirty (30) degrees Fahrenheit (sixteen-point-seven (16.7) degrees Celsius) of its flashpoint, it shall be handled in accordance with the requirements for the next lower class of liquids (7-1-97)

m. Container is any can, barrel, or drum. (7-1-97)

n. Crude Petroleum is a hydrocarbon mixtures that has a flash point below one-hundred-fifty (150) degrees Fahrenheit and which has not been processed in a refinery. (7-1-97)

o. Distillery is where flammable or combustible liquids produced by fermentation are concentrated, and where the concentrated products may also be mixed, stored, or packaged. (7-1-97)

p. Fire Area is an area of a building separated from the remainder of the building by construction having a fire resistance of at least one (1) hour, and having all communicating openings properly secured and protected by an assembly which has a fire resistant rating of at least, but not restricted to, one (1) hour. (7-1-97)

q. Fire Resistance or Fire Resistive Construction is construction which is resistant to the spread of fire should this danger sometime arise. (7-1-97)

r. Flammable Aerosol is an aerosol which is required to be labeled as "flammable" under the Federal Hazardous Substances Labeling Act, (15 U.S.C. 1261). For the purposes of this section, such aerosols are considered to be Class IA liquids. (7-1-97)

s. Flammable Liquid is any liquid having a flashpoint below one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius), except any mixture having components with flashpoints of one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight

(37.8) degrees Celsius) or higher, the total of which make up ninety-nine (99) percent or more of the total volume of the mixture. Flammable liquids shall be known as Class I Liquids. (7-1-97)

t. Flashpoint is the minimum temperature at which the liquid in question gives off a vapor within a test vessel in sufficient enough concentration to form an ignitable mixture with air near the surface of the liquid, and this shall be determined as follows: For a liquid which has a viscosity of not less than forty-five (45) SUS at one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius) does not contain suspended solids, and does not have that tendency to form a film on the surface of the liquid, while under pressure and while under test, the procedure specified in the Standard Method of Test for Flashpoint by Tag Closed Tester (ASTM D-56-70) shall be used; For a liquid which has a viscosity of forty-five (45) SUS or more at one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius) or contains suspended solids, or has a tendency to form a surface film while under test, the Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester (ASTM D-93-71) shall be used, except that the methods specified in Note 1 to Section 1.1 of ASTM 3-93-71 may be used for the respective materials specified in the Note; For a liquid that is a mixture of compounds that have different volatilities and flashpoints its flashpoint shall be determined by using the procedure specified in this subsection above on the liquid in the form it is shipped. If the flashpoint, as determined by this test, is one-hundred (100) degrees Fahrenheit (thirty-seven-point-eight (37.8) degrees Celsius) or higher, an additional flashpoint determination shall be run on a sample of the liquid evaporated to ninety (90) percent of its original volume, and the lower value of the two (2) tests shall be considered the flashpoint of the material. Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified in this subsection. (7-1-97)

u. Liquid is any material which has a fluidity greater than that of three (300) penetration asphalt when tested in accordance with ASTM Test for Penetration for Bituminous Materials, D-5-65. When not otherwise identified, the term liquid shall include both flammable and combustible liquids. (7-1-97)

v. Low-Pressure Tank is a storage tank which has been designed to operate at pressure above zero-point-five (0.5) p.s.i.g. but not more than fifteen (15) p.s.i.g. (7-1-97)

w. Marine service station is that portion of a property where flammable or combustible liquids used as fuel are stored and dispensed from fixed equipment on shore, piers, wharves, or floating craft, and shall include all facilities used in connection therewith. (7-1-97)

x. Mercantile occupancy is the use of a building or structure or any portion thereof for the displaying, selling, or buying of goods, wares, or merchandise. (7-1-97)

y. Office occupancy is the use of a building or structure or any portion thereof for the transaction of business, or the rendering or receiving of professional services. (7-1-97)

z. Piping systems consist of pipe, tubing flanges, bolting, gaskets, valves, fittings, the pressure containing parts of other components such as expansion joints and strainers, and devices which

serve such purposes as mixing, separating, snubbing, distribution, metering, or controlling flow. (7-1-97)

aa. Portable tank is a closed container having a liquid capacity over 60-U. S. Gallons and not intended for fixed installation. (7-1-97)

bb. Pressure vessel is a storage tank or vessel which has been designed to operate at pressures above fifteen (15) p.s.i.g. (7-1-97)

cc. Protection for Exposure is adequate fire protection for structures on property adjacent to tanks, where there are employees of the establishment. (7-1-97)

dd. Safety Can is an approved metal container, of not more than five (5) gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure. (7-1-00)

ee. Storage the keeping of flammable or combustible liquids in a tank or in a container that complies with this section. (7-1-97)

ff. "SUS" is Saybolt Universal Seconds as determined by the Standard Method of Test for Saybolt Viscosity (ASTM D-88-56), and may be determined by use of the SUS Conversion tables specified in ASTM Method D-2161-66 following determination of viscosity in accordance with the procedures specified in the Standard Method of Test for Viscosity of Transparent and Opaque Liquids (ASTM D 445-65). (7-1-97)

gg. Unstable (reactive) Liquid is a liquid which in the pure state or as commercially produced or transported will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature. (7-1-97)

hh. Vapor Pressure is the pressure, measured in pounds per square inch (absolute) exerted by a volatile liquid as determined by the "Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method), "American Society for Testing and Materials ASTM D-323-68. (7-1-97)

ii. Ventilation as specified in this section is for the prevention of fire and explosion. It is considered adequate if it is sufficient to prevent assimilation of significant quantities of vapor-air mixtures in concentration over one-fourth (1/4) of the lower flammable limit. (7-1-97)

jj. Viscous is a viscosity of forty-five (45) SUS or more. NOTE: The volatility of liquids is increased when artificially heated to temperatures equal to or higher than the flashpoints. When so heated, Class II and III liquids shall be subject to the applicable requirements for Class I or II liquids. These standards may also be applied to high flashpoint liquids when so heated even though these same liquids when not heated are outside of its scope. (7-1-97)

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

a. Cabinets, tanks, storage rooms, and storage locations shall be labeled "Flammable -- Keep Fire Away", and meet specifications for color coding and signage set forth in section 170 of this standard. (7-1-97)

b. Adequate precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, static, electrical and mechanical sparks, spontaneous ignition, including heat-producing chemical reactions, and radiant heat. (7-1-97)

c. Class I liquids shall not be dispensed into containers unless the nozzle and container are electrically inter-connected and grounded. Where the metallic floor plate on which the container stands while filling is electrically connected to the fill stem or where the fill stem is bonded to the container during filling operations by means of a bond wire, the provisions of these standards shall be deemed to have been complied with. (7-1-97)

d. Rooms in which Class I liquids are stored or handled shall be heated only by means not constituting a source of ignition, such as steam or hot water. Rooms containing heating appliances involving sources of ignition shall be located and arranged to prevent entry of flammable vapors. (7-1-97)

e. Class I liquids shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein. (7-1-97)

f. Containers of Class I liquids shall not be drawn from or filled within buildings unless provision is made to prevent the accumulation of flammable vapors in hazardous concentrations. Where mechanical ventilation is required, it shall be kept in operation while flammable liquids are being handled. (7-1-97)

g. Class I liquids shall not be handled, drawn, or dispensed where flammable vapors may reach a source of ignition. Smoking shall be prohibited except in designated localities. "No Smoking" signs shall be conspicuously posted where hazard from flammable liquid vapors is normally present. (7-1-97)

04. Design and Construction of Tanks: (7-1-97)

a. Tanks shall be built of steel except as provided in sub-section 220.04.b. through sub-section 220.04.e. of this section. (7-1-97)

b. Tanks may be built of materials other than steel for installation underground or if required by the properties of the liquid stored. Tanks located above ground or inside buildings shall be of noncombustible construction. (7-1-97)

c. Tanks built of materials other than steel shall be designed to specifications embodying principles recognized as good engineering design for the material used. (7-1-97)

- d.** Unlined concrete tanks may be used for storing flammable or combustible liquids having a gravity of forty (40) degrees API or heavier. Concrete tanks with special lining may be used for other services provided the design is in accordance with sound engineering practice. (7-1-97)
- e.** Special engineering consideration shall be required if the specific gravity of the liquid to be stored exceeds that of water or if the tanks are designed to contain flammable or combustible liquids at a liquid temperature below zero (0) degrees Fahrenheit (minus-seventeen-point-eight (-17.8) degrees Celsius). (7-1-97)
- f.** Tanks may be of any shape or type consistent with sound engineering design. (7-1-97)
- g.** Metal tanks shall be welded, riveted and caulked, brazed, bolted, or constructed by use of a combination of these methods. Filler metal used in brazing shall be nonferrous metal or an alloy having a melting point above one-thousand (1000) degrees Fahrenheit and below that of the metal jointed. (7-1-97)
- h.** Atmospheric tanks shall be built in accordance with acceptable good standards of design. Atmospheric tanks may be built in accordance with: Underwriters' Laboratories, Inc., Subjects No. 142, Standard for Steel Above-ground Tanks for Flammable and Combustible Liquids; No. 58, Standards for Steel Underground Tanks for Flammable and Combustible Liquids, 5th Edition; No. 80, Standard for Steel Inside Tanks for Oil-burner fuel; American Petroleum Institute Standards No.12A, Specification for Oil Storage Tanks with Riveted Shells, or No. 650 Welded Steel Tanks for Oil Storage 1966; American Petroleum Institute Standards No. 12B, Specification for Bolted Production Tanks; No. 12D Specification for Large Welded Production Tanks; or No. 12F, Specification for Small Welded Production Tanks; Tanks built in accordance with these standards shall be used only as production tanks for storage of crude petroleum in oil producing areas. (7-1-97)
- i.** Low-pressure tanks and pressure vessels may be used as atmospheric tanks. (7-1-97)
- j.** Tanks designed for underground service not exceeding two-thousand-five-hundred (2,500) gallons capacity may be used above-ground. (7-1-97)
- k.** Atmospheric tanks shall not be used for the storage of a flammable or combustible liquid at a temperature at or above its boiling point. (7-1-97)
- l.** The normal operating pressure of a low pressure tanks shall not exceed the design pressure of the tank. (7-1-97)
- m.** Low-pressure tanks shall be built in accordance with acceptable standards of design. Low-pressure tanks may be built in accordance with: American Petroleum Institute Standard No. 620, Recommended Rules for the Design and Construction of Large, Welded, Low-pressure Storage Tanks, or the principles of the ASME Boiler and Pressure Vessels Code for Unfired Pressure Vessels. (7-1-97)

n. Atmospheric tanks built according to the Underwriter's Laboratories, Inc., requirements in sub-section 220.04.h. of this section may be used for operating pressures not exceeding one (1) p.s.i.g. and shall be limited to two-point-five (2.5) p.s.i.g. under emergency venting conditions. Pressure Vessels may be used as low-pressure tanks. (7-1-97)

o. The normal operating pressure of the pressure vessel shall not exceed the design pressure of the vessel. Pressure Vessels shall be built in accordance with the ASME Boiler and Pressure Vessel Code for Unfired Pressure Vessels. (7-1-97)

p. When tanks are not designed in accordance with the American Petroleum Institute, American Society of Mechanical Engineers, or the Underwriter's Laboratories, Inc., Standards, or if corrosion is anticipated beyond that provided for in the design formulas used, additional metal thickness or suitable protective coatings or linings shall be provided to compensate for the corrosion loss expected during the design life of the tank. (7-1-97)

05. Installation of Outside Above-Ground Tanks: (7-1-97)

a. The distance between any two (shell to shell) flammable or combustible liquid storage tanks shall not be less than three (3) feet. (7-1-97)

b. The distance between any two (2) adjacent tanks shall not be less than one-sixteenth (1/6) the sum of their diameters and in no case less than three (3) feet. When the diameter of one (1) tank is less than one-half (1/2) the diameter of the adjacent tank, the distance between the two (2) tanks shall not be less than one-half (1/2) the diameter of the smaller tank and in no case less than three (3) feet. (7-1-97)

c. Where unstable or combustible liquids are stored, the distance between such tanks shall not be less than one-half (1/2) the sum of their diameters. (7-1-97)

d. When tanks are compacted in three or more rows or in an irregular pattern, greater spacing or other means shall be provided so that inside tanks are accessible for fire fighting purposes. (7-1-97)

e. The minimum separation between a liquid gas container and a flammable or combustible liquid storage tank shall be twenty (20) feet, except in the case of flammable or combustible liquid tanks operating at pressures exceeding two-point-five (2.5) p.s.i.g. or equipped with emergency venting which will permit pressures to exceed two-point-five (2.5) p.s.i.g. in which case the provisions of sub-section 220.05.a & b. of this section shall apply. Suitable means shall be taken to prevent the accumulation of flammable or combustible liquids under adjacent liquefied petroleum gas containers such as by diversion curbs or grading. When flammable or combustible liquid storage tanks are within a diked area, the liquefied petroleum gas containers shall be outside the diked area and at least ten (10) feet away from the centerline of the wall of the diked area. The foregoing provisions shall not apply when liquefied petroleum gas containers of one-hundred-twenty-five (125) gallons or less capacity are installed adjacent to fuel oil supply tanks of five-hundred-fifty (550) gallons or less capacity. (7-1-97)

f. Every outside above-ground tank shall be separated from important buildings on the same property by distances not less than those specified in sub-section 220.05.a through 220.05.e of this section, whichever is applicable. The appropriate distance column to be used in Table 220.05-A shall be the column reading "Minimum Distance in Feet From Nearest Side of Any Public Way or From Nearest Important Building". (7-1-97)

TABLE 220.05-A		
Capacity tank gallons	Minimum distance in feet from property line which may be built upon, including the opposite side of a public way	Minimum distance in feet from nearest side of any public way or from nearest important building
275 or less	5	5
276 to 750	10	5
751 to 12,000	15	5
12,001 to 30,000	20	5
30,001 to 50,000	30	10
50,001 to 100,000	50	15
100,001 to 500,000	80	25
500,001 to 1,000,000	100	35
1,000,001 to 2,000,000	135	45
2,000,001 to 3,000,000	165	55
3,000,001 or above	175	60

g. Atmospheric storage tanks shall be adequately vented to prevent the development of vacuum or pressure sufficient to distort the roof of a cone roof tank or exceed the design pressure in the case of other atmospheric tanks, as a result of filling, emptying, and atmospheric temperature changes. (7-1-97)

h. Normal vents shall be sized either in accordance with: the American Petroleum Institute Standard 2000, Venting Atmospheric and Low-Pressure Storage Tanks; other accepted standard; or shall be at least as large as the filling or withdrawal connection, whichever is larger but in no case less than one and one-fourth (1 1/4) inch normal inside diameter. (7-1-97)

i. Low-pressure tanks and pressure vessels shall be adequately vented to prevent development of pressure or vacuum, as a result of filling, emptying, and atmospheric temperature changes, from exceeding the design pressure of the tank or vessel. Protection shall also be provided to prevent over-pressure from any pump discharging into the tank or vessel when the pump discharge pressure can exceed the design pressure of the tank or vessel. (7-1-97)

j. If any tank or pressure vessel has more than one fill or withdrawal connection and simultaneous filling or withdrawal can be made, the vent size shall be based on the maximum anticipated simultaneous flow. (7-1-97)

k. Unless the vent is designed to limit the internal pressure of two-point-five (2.5) p.s.i. or less, the outlet of vents and vent drains shall be arranged to discharge in such a manner as to prevent localized overheating of any part of the tank in the event vapors from such vents are ignited. (7-1-97)

l. Tanks and pressure vessels storing Class IA liquids shall be equipped with venting devices which shall be normally closed except when venting to pressures or vacuum conditions. Tanks and pressure vessels storing Class IB and IC liquids shall be equipped with venting devices which shall be normally closed except when venting under pressure or vacuum conditions, or with approved flame arresters. Exception: Tanks of three-thousand (3,000) bbls. capacity or less containing crude petroleum in crude-producing areas; and, outside above-ground atmospheric tanks under one-thousand (1,000) gallons capacity containing other than Class IA Flammable liquids may have open vents. (7-1-97)

m. Flame arresters or venting devices required in sub-section 220.05 of this section may be omitted for Class IB and IC liquids where conditions are such that their use may, in case of obstruction, result in tank damage. (7-1-97)

n. Every above-ground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires. (7-1-97)

o. In a vertical tank the construction referred to in sub-section 220.05.n. above may take the form of a floating roof, lifter roof, a weak roof-to-shell seam, or other approved pressure relieving construction. The weak roof-to-shell seam shall be constructed to fail preferential to any other seam. (7-1-97)

p. Where entire dependence for emergency relief is placed upon pressure relieving devices, the total venting capacity of both normal and emergency vents shall be enough to prevent rupture of the shell or bottom of the tank if vertical, or of the shell or heads if horizontal. If unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation, or self-reactivity shall be taken into account. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table 220.05-B except as provided in sub-section 220.05.r. and sub-section 220.05.s. of this section. Such device may be a self-closing manhole cover, or one using long bolts that permit the cover to lift under internal pressure, or an additional or large relief valve or valves. The wetted area of the tank shall be calculated on the basis of fifty-five (55) percent of the total exposed area of a sphere or spheroid, seventy-five (75)

percent of the total exposed area of a horizontal tank and the first thirty (30) feet above grade of the exposed shell area of a vertical tank. (7-1-97)

TABLE 220.05-B					
WETTED AREA VERSUS CUBIC FEET FREE AIR PER HOUR					
Square feet	CFH	Square feet	CFH	Square feet	CFH
20	21,100	160	168,000	800	462,000
30	31,600	180	190,000	900	493,000
40	42,100	200	211,000	1,000	524,000
50	52,700	250	239,000	1,200	557,000
60	63,200	300	265,000	1,400	587,000
70	73,700	350	288,000	1,600	614,000
80	84,200	400	312,000	1,800	639,000
90	94,800	500	354,000	2,000	662,000
100	105,000	600	392,000	2,400	704,000
120	126,000	700	428,000	2,800 and over	742,000
140	147,000				

q. For Tanks and storage vessels designed for pressure over one (1) p.s.i.g. the total rate of venting shall be determined in accordance with Table 220.05-A, except that when the exposed wetted area of the surface is greater than 2,800-square feet, the total rate of venting shall be calculated by the following formula:

$$CFH = 1,107A(0.82)$$

Where:

CFH = Venting Requirement, in cubic feet of free air per hour

A = Exposed Wetted Surface, in square feet

NOTE: The foregoing formula is based on $Q = 21,000A (0.82)$. (7-1-97)

r. The total emergency relief venting capacity for any specific stable liquid may be determined by the following formula:

$$V=1337$$

$$L \sqrt{M}$$

Where:

V = Cubic Feet of Free Air per Hour from Table 220.05.b

L = Latent Heat of Vaporization of Specific Liquid in B.T.U. per Pound

M = Molecular Weight of Specific Liquids (7-1-97)

s. The required air flow rate of sub-section 220.05.p. or sub-section 220.05.r of this section may be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only one (1) factor may be used for any one (1) tank zero-point-five (0.5) for drainage in accordance with sub-section 220.05.aa. of this section for tanks over two-hundred (200) sq. feet of wetted area; zero-point-three (0.3) for approved water spray; zero-point-three (0.3) for approved insulation; zero-point-fifteen (0.15) for approved water spray with approved insulation. (7-1-97)

t. The outlet of all vents and vent drain on tanks equipped with emergency venting to permit pressures exceeding two-point-five (2.5) p.s.i.g. shall be arranged to discharge in such a way as to prevent localized overheating of any part of the tank, in the event vapors from such vents are ignited. (7-1-97)

u. Each tank venting device shall have stamped on it the opening pressure, the pressure at which the valve reaches the full open position, and the flow capacity at the latter pressure, expressed in cubic feet per hour of air at sixty (60) degrees Fahrenheit and at a pressure of fourteen-point-seven (14.7) p.s.i.a. (7-1-97)

v. The flow capacity of tank venting devices twelve (12) inches and smaller in nominal pipe size shall be determined by actual test of each type and size of vent. These flow tests may be conducted by the manufacturer if certified by a qualified impartial observer, or may be conducted by an outside agency. The flow capacity of tank venting devices larger than twelve (12) inches nominal pipe size, including manhole covers with long bolts or equivalent, may be calculated provided that the opening pressure is actually measured, the rating pressure and corresponding free orifice area are stated, the work "calculated" appears on the nameplate and the computation is based on a flow coefficient of zero-point-five (0.5) applied to the rated orifice area. (7-1-97)

w. Vent piping shall be constructed in accordance with sub-section 220.11 of this section. (7-1-97)

x. Where vent pipe outlets for tanks storing Class I liquids are adjacent to buildings or public ways, they shall be located so that the vapors are released at a safe point outside of buildings and not less than twelve (12) feet above the adjacent ground level. In order to aid their dispersion, vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so that flammable vapors will not be trapped by eaves or other obstructions and shall be at least five (5) feet from building openings. (7-1-97)

y. When tank vent piping is manifold, pipe sizes shall be such as to discharge within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are subject to the same fire exposure. (7-1-97)

z. The area surrounding a tank or a group of tanks shall be provided with drainage as in sub-section 220.05.aa. of this section or shall be diked as provided in sub-section 220.05.bb. of this section to prevent accidental discharge of liquid from endangering adjoining property or reaching waterways. (7-1-97)

aa. Where protection of adjoining property or waterways is by means of a natural or manmade drainage system, such a system shall comply with the following: A slope of not less than one (1) percent away from the tank toward the drainage system shall be provided. The drainage system shall terminate in vacant land, other areas, or in an impounding basin having a capacity not smaller than that of the largest tank served. This termination area and the route of the drainage system shall be so located that if the flammable or combustible liquids in the drainage system are ignited, the fire will not seriously expose tanks or adjoining property. The drainage system, including automatic drainage pumps shall not discharge to adjoining property, natural water courses, public sewers, or public drains unless the discharge of flammable or combustible liquids would not constitute a hazard, or the system is so designed that it will not permit flammable or combustible liquids to be released. (7-1-97)

bb. Where protection of adjoining property or waterways is accomplished by retaining the liquid around the tank by means of a dike, the volume of the diked area shall comply with the following requirements: Except as provided herein, the volumetric capacity of the diked area shall not be less than the greatest amount of liquid that can be released from the largest tank within the diked area, assuming a full tank. The capacity of the diked area enclosing more than one tank shall be calculated by deducting the volume of the tanks other than the largest tank below the height of the dike. For a tank or group of tanks with fixed roofs containing crude petroleum with Boil Over characteristics, the volumetric capacity of the diked area shall be not less than the capacity of the largest tank served by the enclosure, assuming a full tank. The capacity of the diked enclosure shall be calculated by deducting the volume below the height of the dike of all tanks within the enclosure. Walls of the diked area shall be of earth, steel, concrete, or solid masonry designed to be liquid tight and to withstand a full hydrostatic head. Earthen walls three (3) feet or more in height shall have a flat section at the top not less than two (2) feet wide. The slope of an earthen wall shall be consistent with the angle of repose of the material of which the wall is constructed. The walls of the diked area shall be restricted to an average height of six (6) feet above interior grade. Where provision is made for draining water from diked area, drainage shall be provided at a uniform slope of not less than one (1) percent away from tanks toward a sump, drain box, or other safe means of disposal located at the greatest practical distance from the tank. Such drains shall normally be controlled in a manner so as to prevent flammable or combustible liquids from entering natural water courses, public sewers, or public drains, if their presence would constitute a hazard. Control of drainage shall be accessible under fire conditions. The drainage channels or intermediate curbs shall be located between tanks so as to take full advantage of the available space with due regard for the individual tank capacities. Intermediate curbs, where used, shall be not less than eighteen (18) inches in height. (7-1-97)

cc. Connections for all tank openings shall be vapor tight and liquid tight. (7-1-97)

dd. Each connection to an above-ground tank through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Such valves, when external, and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary, they shall be suitable for the pressures, structural stresses, and temperatures involved, including fire exposures. (7-1-97)

ee. Each connection below the liquid level through which liquid does not normal flow shall be provided with a liquid tight closure. This may be a valve, plug, blind, or a combination of these. (7-1-97)

ff. Openings for gaging shall be provided with a vapor tight cap or cover. (7-1-97)

gg. For Class IB and Class IC liquids other than crude oil, gasoline and asphalt, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity. A fill pipe entering the top of a tank shall terminate within six (6) inches of the bottom of the tank and shall be installed to avoid excessive vibration. (7-1-97)

hh. Filling and emptying connections which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than five (5) feet away from any building opening. Such connection shall be closed and liquid tight when not in use. The connection shall be properly identified. (7-1-97)

06. Installation of Underground Tanks: (7-1-97)

a. Location. Excavation for underground storage tanks shall be made with due care to avoid undermining of foundations of existing structures. Underground tanks or tanks under buildings shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the tank. The distance from any part of a tank storing Class I liquids to the nearest wall of any basement or pit shall be not less than one (1) foot, and to any property line that may be built upon, not less than three (3) feet. The distance from any part of a tank storing Class II or Class III liquids to the nearest wall of any basement, pit or property line shall not be less than one (1) foot. (7-1-97)

b. Underground tanks shall be set on firm foundations and surrounded with at least six (6) inches of noncorrosive, inert materials such as clean sand, earth, or gravel well stamped in place. The tank shall be placed in the hole with care since dropping or rolling the tank into the hole can break a weld, puncture, damage the tank, or scrape off the protective coating of coated tanks. Tanks shall be covered with a minimum of two (2) feet of earth or shall be covered with not less than one (1) foot of earth on top of which shall be placed a slab of reinforced concrete not less than four (4) inches thick. When underground tanks are or are likely to be, subject to traffic, they shall be protected against damage from vehicles passing over them by at least three (3) feet of earth cover, or eighteen (18) inches of well-tamped earth, plus six (6) inches of reinforced concrete or eight (8) inches of asphaltic concrete. When asphaltic or reinforced concrete paving

is used as part of the protection, it shall extend at least one (1) foot horizontally beyond the outline of the tank in all directions. (7-1-97)

c. Where an underground storage tank could become buoyant due to a rise in the level of the water table the tank shall be anchored in place. (7-1-97)

d. Corrosion protection for the underground storage tank and its piping shall be provided by one or more of the following methods: use of protective coatings or wrappings; cathodic protection; or corrosion resistant construction materials. (7-1-97)

e. Vent pipes from underground storage tanks storing Class I liquids shall be so located that the discharge point is outside of buildings, higher than the fill pipe opening, and not less than twelve (12) feet above the adjacent ground level. Vent pipes shall discharge only upward in order to disperse vapors. Vent pipes two (2) inches or less in nominal inside diameter shall not be obstructed by devices that will cause excessive back pressure. Vent pipe outlets shall be so located that flammable vapors will not enter building openings, or be trapped under eaves or other obstructions. If the vent pipe is less than ten (10) feet in length, or greater than two (2) inches in nominal inside diameter, the outlet shall be provided with a vacuum and pressure relief device or shall be an approved flame arrester located in the vent line at the outlet or within the approved distance from the outlet. (7-1-97)

f. Each tank shall be vented through piping adequate in size to prevent blow-back of vapor liquid at the fill opening while the tank is being filled. Vent pipes shall be not less than one-fourth (1/4) inch nominal inside diameter, see Table 220.06-A. (7-1-97)

TABLE 220.06-A			
VENT LINE DIAMETERS			
Maximum Flow	Pipe Length ¹		
GPM	50'	100'	200'
	Inches	Inches	Inches
100	1 1/4	1 1/4	1 1/4
200	1 1/4	1 1/4	1 1/4
300	1 1/4	1 1/4	1 1/2
400	1 1/4	1 1/2	2
500	1 1/2	1 1/2	2
600	1 1/2	2	2
700	2	2	2

800	2	2	3
900	2	2	3
1,000	2	2	3
¹ Vent lines of 50 ft., 100 ft., and 200 ft. of pipe plus 7 ells.			

(7-1-97)

g. Vent pipes from tanks storing Class II or Class III flammable liquids shall terminate outside of the building and higher than the fill pipe opening. Vent outlets shall be above normal snow level. They may be fitted with return bends, course screens, or other devices to minimize ingress or foreign material. (7-1-97)

h. Vent piping shall be constructed in accordance with sub-section 220.11 of this section. Vent pipes shall be so laid as to drain toward the tank without sags or traps in which liquid can collect. They shall be located so that they will not be subjected to physical damage. The tank end of the vent pipe shall enter the tank through the top. (7-1-97)

i. When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are filled simultaneously. (7-1-97)

j. Connections for all tank openings shall be vapor or liquid tight. (7-1-97)

k. Openings for manual gaging, if independent of the fill pipe shall be provided with a liquid-tight cap or cover. If inside a building, each such opening shall be protected against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device. (7-1-97)

l. Fill and discharge lines shall enter tanks only through the top. Fill lines shall be sloped toward the tank. (7-1-97)

m. For Class IB and IC liquids other than crude oils, gasolines, and asphalt, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within six (6) inches of the bottom of the tank. (7-1-97)

n. Filling and emptying connections which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than five (5) feet away from any building openings. Such connection shall be closed and liquid-tight when not in use. The connection shall be properly identified. (7-1-97)

07. Installation of Tanks Inside of Buildings: (7-1-97)

- a.** Tanks shall not be permitted inside of buildings except in industrial operations areas, bulk facilities, and service stations. (7-1-97)
- b.** Vents for tanks inside of buildings shall be as provided in sub-section 220.05.g. through sub-section 200.05.x. and sub-section 220.06.a. through sub-section 220.06.n. of this section, except that emergency venting by the use of weak roof seams on tanks shall not be permitted. Vents shall discharge vapors outside of buildings. (7-1-97)
- c.** Vent piping shall be constructed in accordance with sub-section 220.11 of this section. (7-1-97)
- d.** Connections for all tank openings shall be vapor or liquid tight. (7-1-97)
- e.** Each connection to a tank inside of buildings through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Such valves, when external, and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary they shall be suitable for the pressures, structural stresses, and temperatures involved, including fire exposures. (7-1-97)
- f.** Flammable or combustible liquid tanks located inside of buildings except in one (1) story buildings designed and protected for flammable or combustible liquids storage shall be provided with an automatic closing heat actuated valve on each withdrawal connection below the liquid level, except for connections used for emergency disposal, to prevent continued flow in the event of fire in the vicinity of the tank. This function may be incorporated in the valve required in sub-section 220.07.e. of this section, and if a separate valve, shall be located adjacent to the valve required in sub-section 220.7.e of this section. (7-1-97)
- g.** Openings for manual gaging, if independent of the fill pipe (see sub-section 220.07.h. of this section), shall be provided with a vapor tight cap or cover. Each such opening shall be protected against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device. (7-1-97)
- h.** For Class IB and IC liquids other than crude oil, gasoline, and asphalt, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within six (6) inches of the bottom of the tank. (7-1-97)
- i.** The fill pipe inside of the tank shall be installed to avoid excessive vibration of the pipe. (7-1-97)
- j.** The inlet of the fill pipe shall be located outside of buildings at a location free from any source of ignition and not less than five (5) feet away from any building opening. The inlet of the fill pipe shall be closed and liquid tight when not in use. The fill connection shall be properly identified. (7-1-97)

k. Tanks inside buildings shall be equipped with a device, or other means shall be provided, to prevent overflow into the building. (7-1-97)

08. Supports, Foundations, and Anchorage for all Tank Locations: (7-1-97)

a. Tank supports shall be installed on firm foundations. Tank supports shall be of concrete, masonry, or protected steel. Single wood timber supports (not cribbing) laid horizontally may be used for outside above-ground tanks if not more than twelve (12) inches high at their lowest point. (7-1-97)

b. Steel supports or exposed piling shall be protected by materials having a fire resistance rating of not less than two (2) hours, except that steel saddles need not be protected if less than twelve (12) inches high at their lowest point. Water spray protection or its equivalent may be used in lieu of fire resistive materials to protect supports. (7-1-97)

c. The design of the supporting structure for tanks such as spheres shall receive special engineering consideration. (7-1-97)

d. Every tank shall be so supported as to prevent the excessive concentration of loads on the supporting portion of the shell. (7-1-97)

e. Tanks shall rest on the ground or on foundations made of concrete, masonry, piling, or steel. Tank foundations shall be designed to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation. (7-1-97)

f. Where a tank is located in an area that may be subjected to flooding, the applicable precautions outlined as follows: No above-ground vertical storage tank containing a flammable or combustible liquid shall be located so that the allowable liquid level within the tank is below the established maximum flood stage, unless the tank is provided with a guiding structure such as described herein. Independent water supply facilities shall be provided at locations where there is no ample and dependable public water supply available for loading partially empty tanks with water. In addition to the preceding requirements, each tank so located that more than seventy (70) percent but less than one-hundred (100) percent of its allowable liquid storage capacity will be submerged at the established maximum flood stage, shall be safeguarded by one of the following methods: Tank shall be raised or its height shall be increased, until its top extends above the maximum flood stage a distance equivalent to thirty (30) percent or more of its allowable liquid storage capacity. Provided, however, that the submerged part of the tank shall not exceed two-and one-half (2 1/2) times the diameter. Or, as an alternative to the foregoing, adequate noncombustible structural guides, designed to permit the tank to float vertically without loss of product, shall be provided. (7-1-97)

g. Each horizontal tank so located that more than seventy (70) percent of its storage capacity will be submerged at the established flood stage, shall be anchored, attached to a foundation of concrete or of steel and concrete, of sufficient weight to provide adequate load for the tank when filled with flammable or combustible liquid and submerged by flood waters to the established flood stage, or adequately secured by other means. (7-1-97)

- h.** Spherical and spheroidal tanks shall be protected by applicable methods as specified for either vertical or horizontal tanks. (7-1-97)
- i.** At locations where there is no ample and dependable water supply, or where filling of underground tanks with liquid is impracticable because of the character of their contents, their use, or for other reasons, each tank shall be safeguarded against movement when empty and submerged by high ground water or flood waters by anchoring, weighing with concrete or other approved solid loading material, or securing by other means. Each such tank shall be so constructed and installed that it will safely resist external pressures due to high ground water or flood waters. (7-1-97)
- j.** At locations where there is an ample and dependable water supply available, underground tanks containing flammable or combustible liquids, so installed that more than seventy (70) percent of their storage capacity will be submerged at the maximum flood stage, shall be so anchored weighted or secured by other means, as to prevent movement of such tanks when filled with flammable or combustible liquids, and submerged by flood waters to the established flood stage. (7-1-97)
- k.** Pipe connections below the allowable liquid level in a tank shall be provided with valves or cocks located as closely as practicable to the tank shell. Such valves and their connections to tanks shall be of steel or other material suitable for use with the liquid being stored. Cast iron shall not be used. (7-1-97)
- l.** At locations where an independent water supply is required, it shall be entirely independent of public power and water supply. Independent source of water shall be available when flood waters reach a level not less than ten (10) feet below the bottom of the lowest tank on a property. (7-1-97)
- m.** The self-contained power and pumping unit shall be so located or so designed that pumping into tanks may be carried on continuously throughout the rise in flood waters from a level ten (10) feet below the lowest tank to the level of the potential flood stage. (7-1-97)
- n.** Capacity of the pumping unit shall be such that the rate of rise of water in all tanks shall be equivalent to the established potential average rate of rise of flood waters at any stage. (7-1-97)
- o.** Each independent pumping unit shall be tested periodically to insure that it is in satisfactory operating condition. (7-1-97)
- p.** Structural guides for holding floating tanks above their foundations shall be so designed that there will be no resistance to the free rise of a tank and shall be constructed of noncombustible material. (7-1-97)
- q.** The strength of the structure shall be adequate to resist lateral movement of a tank subject to a horizontal force in any direction equivalent to not less than twenty-five (25) pounds per square foot acting on the projected vertical cross-sectional area of the tank. (7-1-97)

r. Where tanks are situated on exposed points or bends in a shoreline where swift currents in floodwater will be present, the structures shall be designed to withstand a unit force of not less than fifty (50) pounds per square foot. (7-1-97)

s. The filling of a tank to be protected by water loading shall be started as soon as flood waters reach a dangerous flood stage. The rate of filling shall be at least equal to the rate of rise of the flood waters (or the established average potential rate of rise). (7-1-97)

t. Sufficient fuel to operate the water pumps shall be available at all times to insure adequate power to fill all tanks with water. (7-1-97)

u. All valves on connecting pipelines shall be closed and locked in closed position when water loading has been completed. (7-1-97)

v. Where structural guides are provided for the protection of floating tanks, all rigid connections between tanks and pipelines shall be disconnected and blanked off or banded before the flood waters reach the bottom of the tank, unless control valves and their connections to the tank are of a type designed to prevent breakage between the valve and the tank shell. (7-1-97)

w. All valves attached to tanks other than those used in connection with water loading operations shall be closed and locked. (7-1-97)

x. If a tank is equipped with a swing line, the swing pipe shall be raised to and secured at its highest position. (7-1-97)

y. Detailed printed instructions of what to do in flood emergencies shall be properly posted. (7-1-97)

z. Operators and other employees depended upon to carry out such instructions are thoroughly informed as to the location and operation of such valves and other equipment necessary to effect these requirements. (7-1-97)

aa. Tank supports and connections shall be designed to resist damage as a result of earthquake shocks. (7-1-97)

09. Sources of Ignition: (7-1-97)

a. In locations where flammable vapors may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, light, smoking, cutting and welding, hot surfaces, frictional heat, sparks, (static, electrical, and mechanical), spontaneous ignition, chemical and physical chemical reactions, and radiant heat. (7-1-97)

10. Testing: (7-1-97)

a. All tanks, whether shop built or field erected shall be strength tested before they are placed in service in accordance with the applicable sections of the Code under which they were built. The American Society of Mechanical Engineers (ASME) Code stamp, American Petroleum Institute (API) monogram, or the label of the Underwriters' Laboratories, Inc., on a tank shall be evidence of compliance with this strength test. Tanks not marked in accordance with the above Code sections shall be strength tested before they are placed in service in accordance with good engineering principles and reference shall be made to the references on testing in the Codes listed in sub-section 220.05.h., sub-section 220.05.m., and sub-section 220.05.o. of this section. (7-1-97)

b. When the vertical length of the fill and vent pipes is such that when filled with liquid the static head imposed upon the bottom of the tank exceeds ten (10) pounds per square inch, the tank and related piping shall be tested hydrostatically to a pressure equal to the static head thus imposed. (7-1-97)

c. In addition to the strength test called for in sub-section a. and b. above, all tanks and connections shall be tested for tightness. Except for underground tanks, this tightness test shall be made at operating pressure with air, inert gas, or water prior to placing the tank in service. In the case of field-erected tanks, the strength test may be considered to be the test for tank tightness. Underground tanks and piping, before being covered, enclosed, or placed in use, shall be tested for tightness hydrostatically, or with air pressure at not less than three (3) pounds per square inch and not more than five (5) pounds per square inch. (7-1-97)

d. All leaks or deformations shall be corrected in an acceptable manner before the tank is placed in service. Mechanical caulking is not permitted for correcting leaks in welded tanks except pinhole leaks in the roof. (7-1-97)

e. Tanks to be operated at pressures below their design pressure may be tested by the applicable provisions of sub-section a. or b. above. (7-1-97)

11. Piping, Valves, and Fittings: (7-1-97)

a. The design (including selection of materials) fabrication, assembly, test, and inspection of piping systems containing flammable or combustible liquids shall be suitable for the expected working pressures and structural stresses. Conformity with the applicable provisions of Pressure Piping, ANSI B31 series and the provisions of this section shall be considered prima facie evidence of compliance with the foregoing provisions. (7-1-97)

b. This subsection does not apply to the following: tubing or casing on any oil or gas wells and any piping connected directly thereto; motor vehicle, aircraft, boat, or portable or stationary engines; piping within the scope of any applicable Boiler and Pressure Vessel Code. (7-1-97)

c. Materials for piping, valves or fittings shall be steel, nodular iron or malleable iron, except as provided below. (7-1-97)

d. EXCEPTIONS: Materials other than steel, nodular iron, or malleable iron may be used underground or if required by the properties of the flammable or combustible liquid handled. Material other than steel, nodular iron or malleable iron shall be designed to specifications embodying principles recognized as good engineering practices for the material used. (7-1-97)

e. Piping, valves, and fittings may have combustible or noncombustible linings. (7-1-97)

f. When low-melting point materials such as aluminum and brass or materials that soften on fire exposure such as plastics or non-ductile materials such as cast iron, necessary special consideration shall be given to their behavior on fire exposure. If such materials are used in above-ground piping systems or inside buildings, they shall be suitably protected against fire exposure or so located that any spill resulting from the failure of these materials could not unduly expose person, important buildings, or structures or can be readily controlled by remote valves. (7-1-97)

g. Joints shall be made liquid tight. Welded or screwed joints or approved connectors shall be used. Threaded joints and connections shall be made up tight with a suitable lubricant or piping compound. Pipe joints dependent upon the friction characteristics of combustible materials for mechanical continuity of piping shall not be used inside buildings. They may be used outside of buildings above or below ground. If used above ground, the piping shall either be secured to prevent disengagement at the fitting or the piping system shall be so designed that any spill resulting from such disengagement could not unduly expose person or important buildings or structures and could be readily controlled by remote valves. (7-1-97)

h. Piping systems shall be substantially supported and protected against physical damage and excessive stresses arising from settlement, vibrations, expansion, contraction, or seismic activity. (7-1-97)

i. All piping for flammable or combustible liquids both above ground and under ground where subject to external corrosion, shall be painted or otherwise protected. (7-1-97)

j. Piping systems shall contain a sufficient number of valves to operate the system properly and to protect the plant. Piping systems in connection with pumps shall contain a sufficient number of valves to control properly the flow of liquid in normal operation and in the event of physical damage. Each connection to pipelines, by which equipment such as tank cars, or tank vehicles discharge liquids by means of pumps into storage tanks, shall be provided with a check valve for automatic protection against back flow if the piping arrangement is such that back flow from the system is possible. (7-1-97)

k. All piping before being covered, enclosed, or placed in use shall be hydrostatically tested to one-hundred-fifty (150) percent of the maximum anticipated pressure of the system, or pneumatically tested to one-hundred-ten (110) percent of the maximum anticipated pressure of the system, but not less than five (5) pounds per square inch gage at the highest point of the system. This test shall be maintained for a sufficient time to complete visual inspection of all joints and connections but for at least ten (10) minutes. (7-1-97)

12. Containers and Portable Tanks: (7-1-97)

a. This subsection shall apply only to the storage of flammable or combustible liquids in drums or other containers (including flammable aerosols) not exceeding sixty (60) gallon individual capacity and those portable tanks not exceeding six-hundred-sixty (660) gallons individual capacity. (7-1-97)

b. EXCEPTIONS: This subsection shall not apply to the following: (7-1-97)

i. Class I or Class II liquids in the fuel tanks of a motor vehicle, aircraft, boat, or portable or stationary engine; (7-1-97)

ii. Beverages when packaged in individual containers not exceeding one (1) gallon in size. (7-1-97)

c. Only approved containers and portable tanks shall be used. Metal containers and portable tanks meeting the requirements of and containing products authorized by Chapter I, Title 49 of the Code of Federal Regulations, (regulations issued by the Hazardous Material Regulations Board, Department of Transportation), shall be deemed to be acceptable. (7-1-97)

d. Each portable tank shall be provided with one (1) or more devices installed in the top with sufficient emergency venting capacity to limit internal pressure under fire exposure conditions to ten (10) p.s.i.g. or thirty (30) percent of the bursting pressure of the tank, whichever is greater. The total venting capacity shall be not less than that specified in sub-section 220.05.p. or q. of this section. At least one (1) pressure-actuated vent having a minimum capacity of six-thousand (6,000) cubic feet of free air (fourteen-point-seven (14.7) p.s.i.a. and sixty (60) degrees Fahrenheit) shall be used. It shall be set to open at not less than five (5) p.s.i.g. If fusible vents are used, they shall be actuated by elements that operate at a temperature not exceeding three-hundred (300) degrees Fahrenheit. (7-1-97)

e. Flammable and combustible liquid containers shall be in accordance with Table 220.12-A, except that glass or plastic containers of no more than one-half (1/2) gallon capacity may be used for a Class IA or IB flammable liquid if: such liquid either would be rendered unfit for its intended use by contact with metal or would excessively corrode a metal container so as to create a leakage hazard; and the user's process either would require more than one (1) pint of Class IA liquid or more than one (1) quart of a Class IB liquid of a single assay lot to be used at one (1) time, or would require the maintenance of an analytical standard liquid of a quality which is not met by the specified standards of liquids available, and the quantity of the analytical standard liquid required to be used in any one (1) control process exceeds one-sixteenth (1/16) the capacity of the container allowed under Table 220.12-A for the class or liquid. (7-1-97)

TABLE 220.12-A

MAXIMUM ALLOWABLE SIZE OF CONTAINERS AND PORTABLE TANKS

Container Type	Flammable Liquids			Combustible Liquids	
	Class IA	Class IB	Class IC	Class II	Class III
Glass or approved plastic	1 pt.	1 qt.	1qt.	1 qt.	1 qt.
Metal (other than DOT drums)	1 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Safety cans	2 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Metal drums (DOT spec.)	60 gal.	60 gal.	60 gal.	60 gal.	60 gal.
Approved portable tanks	660 gal.	660 gal.	660 gal.	660 gal.	660 gal.

f. Not more than sixty (60) gallons of Class I or Class II liquids nor more than one-hundred (120) gallons of Class III liquids may be stored in a storage cabinet. (7-1-97)

g. Storage cabinets shall be designed and constructed to limit the internal temperature to not more than three-hundred-twenty-five (325) degrees Fahrenheit when subjected to a ten (10) minute fire test using the standard time-temperature curve as set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251. (7-1-97)

h. Cabinets shall be labeled "FLAMMABLE -- KEEP FIRE AWAY", to meet specifications set forth in section 170 of this standard. (7-1-97)

i. Metal cabinets constructed in the following manner shall be deemed to be in compliance. The bottom, top, door and sides of cabinet shall be at least no. 18 gage sheet iron and double walled with one and one-half (1 1/2) inch air space. Joints shall be riveted, welded or made tight by some equally effective means. The door shall be provided with a three (3) point latch, and the door sill shall be raised at least two (2) inches above the bottom of the cabinet. (7-1-97)

j. Wooden cabinets constructed in the following manner shall be deemed in compliance . The bottom, sides, and top shall be constructed of an approved grade of plywood at least one (1) inch in thickness, which shall not break down or delaminate under fire conditions. All joints shall be rebated and shall be fastened in two (2) directions with flathead wood screws. When more than one door is used, there shall be a rebated overlap of not less than one (1) inch. Hinges shall be mounted in such a manner as not to lose their holding capacity due to loosening or burning out of the screws when subjected to the fire test. (7-1-97)

13. Inside Storage Rooms. (7-1-97)

a. Inside storage rooms shall be constructed to meet the required fire-resistive rating for their use. Such construction shall comply with the test specifications set forth in Standard Methods of

Fire Tests of Building Construction and Materials, NFPA 251. Automatic sprinkler system, where required, shall be designed and installed in an acceptable manner. Openings to other rooms or buildings shall be provided with noncombustible liquid-tight raised sills or ramps at least four (4) inches above the surrounding floor. Openings shall be provided with approved self-closing fire doors. The room shall be liquid tight where the walls join the floor. A permissible alternate to the sill or ramp is an open grated trench inside of the room which drains to a safe location (not the sewerage system). Where other portions of the building or other properties are exposed, windows shall be protected as set forth in the Standard for Fire Doors and Windows NFPA no. 80, for Class E or F openings. Wood at least one (1) inch nominal thickness may be used for shelving, racks, dunnage, scuff-boards, floor overlay, and similar installations. (7-1-97)

b. Storage in inside storage rooms shall comply with Table 220.13-A. (7-1-97)

TABLE 220.13-A			
STORAGE IN INSIDE ROOMS			
Fire protection ¹ provided	Fire resistance	Maximum size	Total allowable quantities (gals./sq. ft./ floor area)
Yes	2 hours	500 sq. ft.	10
No	2 hours	500 sq. ft.	4
Yes	1 hour	150 sq. ft.	5
No	1 hour	150 sq. ft.	2
¹ Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.			

(7-1-97)

c. Electrical wiring and equipment located in inside storage rooms used for Class I liquids shall be approved under section 150 of this standard and the National Electric Code (NEC) for Class I Division 2 Hazardous Location; for Class II and Class III liquids, shall be approved for general use. (7-1-97)

d. Every inside storage room shall be provided with either a gravity or a mechanical exhaust ventilation system. Such system shall be designed to provide for a complete change of air within the room at least six (6) times per hour. If a mechanical exhaust system is used, it shall be controlled by a switch located outside of the door(s). The ventilation equipment and any lighting fixtures shall be operated by the same switch. A pilot light shall be installed adjacent to the switch if Class I flammable liquids are dispensed within the room. Where gravity ventilation is provided the fresh air intake, as well as the exhaust outlet from the rooms, shall be on the exterior of the building in which the room is located. (7-1-97)

e. In every inside storage room there shall be maintained one clear aisle at least three (3) feet wide. Containers over thirty (30) gallons capacity shall not be stacked one upon the other. Dispensing shall be by approved pump or self-closing faucet only. (7-1-97)

14. Storage Inside a Building: (7-1-97)

a. Flammable or combustible liquids, including stock for sale, shall not be stored so as to limit use of exits, stairways, or areas normally used for the safe egress of people. (7-1-97)

b. The storage of flammable or combustible liquids in containers or portable tanks shall comply with sub-section 220.12. of this section. (7-1-97)

c. Storage of Class I and II over ten (10) gallons shall be prohibited in office occupancies, except that which is required for maintenance and operation of building and operation of equipment. Such storage shall be kept inclosed metal containers stored in a storage cabinet or in safety cans or in an inside storage room not having a door that opens into that portion of the building used by the public. (7-1-97)

d. Storage in mercantile occupancies and other retail stores shall be as follows:

In rooms or areas accessible to the public, storage shall be limited to quantities needed for display and normal merchandising purposes but shall not exceed two (2) gallons per square foot of gross floor area. The gross floor area used for computing the maximum quantity permitted shall be considered as that portion of the store actually being used for merchandising flammable and combustible liquids. Where the aggregate quantity of additional stock exceeds sixty (60) gallons of Class IA, of one-hundred (120) gallons of class IB, or one-hundred-eighty (180) gallons of Class IC, or two-hundred-forty (240) gallons of Class II or five-hundred (500) gallons of Class III liquids, or any combination of Class I and Class II liquids exceeding two-hundred-forty (240) gallons, it shall be stored in a room or portion of the building that complies with the construction provisions for an inside storage room as prescribed in sub-section 220.13 of this section. For water miscible liquids, these quantities may be doubled. Containers in a display area shall not be stacked more than three (3) feet or two (2) containers high, whichever is greater, unless the stacking is done on fixed shelving or is otherwise satisfactorily secured. Shelving shall be of stable construction, or sufficient depth and arrangement such that containers displayed thereon shall not be easily displaced. Leaking containers shall be removed to a storage room or taken to a safe location outside the building and the contents transferred to an undamaged container. (7-1-97)

e. Storage in general purpose public warehouses shall be in accordance with Table 220.14-A or 220.14-B and in buildings or in portions of such buildings cut off by standard fire-walls. Material creating no fire exposure hazard to the flammable or combustible liquids may be stored in the same area. (7-1-97)

TABLE 220.14-A
INDOOR CONTAINER STORAGE

Class liquid	Storage level	Protected storage maximum per pile		Unprotected storage maximum per pile	
		Gal.	Ht.	Gal.	Ht.
IA	Ground and upper floors	2,750 (50)	3 ft (1)	660 (12)	3 ft. (1)
	Basement	Not permitted		Not permitted	
IB	Ground and upper floors	5,500 (100)	6 ft. (2)	1,375 (25)	3 ft. (1)
	Basement	Not permitted		Not permitted	
IC	Ground and upper floors	16,500 (300)	6 ft. (2)	4,125 (75)	3 ft. (1)
	Basement	Not permitted		Not permitted	
II	Ground and upper floors	16,500 (300)	9 ft. (3)	4,125 (75)	9 ft. (3)
	Basement	5,500 (100)	9 ft. (3)	Not permitted	
III	Ground and upper floors	55,000 (1,000)	15 ft. (5)	13,750 (250)	12 ft. (4)
	Basement	8,250 (450)	9 ft. (3)	Not permitted	
<p>Note 1: When 2 or more classes of materials are stored in a single pile, the maximum gallonage permitted in that pile shall be the smallest of the 2 or more separate maximum gallonages.</p>					
<p>Note 2: Aisles shall be provided so that no container is more than 12 ft.</p>					

from an aisle. Main aisles shall be at least 8 ft. wide and side aisles at least 4 ft. w

(Numbers in parentheses indicate corresponding number of 55-gal. drums.)

Note 3: Each pile shall be separated from each other by at least 4 ft.

TABLE 220.14-B					
INDOOR PORTABLE TANK STORAGE					
Class liquid	Storage level	Protected storage maximum per pile		Unprotected storage maximum per pile	
		Gal.	Ht.	Gal.	Ht.
IA	Ground and upper floors	Not permitted		Not permitted	
	Basement	Not permitted		Not permitted	
IB	Ground and upper floors	20,000	7 ft.	2,000	7 ft.
	Basement	Not permitted		Not permitted	
IC	Ground and upper floors	40,000	14 ft.	5,500	7 ft.
	Basement	Not permitted		Not permitted	
II	Ground and upper floors	40,000	14 ft.	5,500	7 ft.
	Basement	20,000	7	Not	

			ft.	permitted	
III	Ground and upper floors	60,000	14 ft.	22,000	7 ft.
	Basement	20,000	7 ft.	Not permitted	
Note 1: When 2 or more classes of materials are stored in a single pile, the maximum gallonage permitted in that pile shall be the smallest of the 2 or more separate maximum gallonages.					
Note 2: Aisles shall be provided so that no portable tank is more than 12 ft. from an aisle. Main aisles shall be at least 8 ft. wide and side aisles at least 4 ft. wide.					
Note 3: Each pile shall be separated from each other by at least 4 ft.					

f. Flammable and combustible liquid warehouses or storage buildings located fifty (50) feet or less from a building or line of adjoining property that may be built upon, the exposing wall shall be a blank wall having a fire-resistance rating of at least two (2) hours. (7-1-97)

g. The total quantity of liquids within warehouses or storage buildings shall not be restricted, but the arrangement of storage shall comply with tables 220.14A and 220.14-B. (7-1-97)

h. Containers in piles within warehouses or storage buildings shall be separated by pallets or dunnage where necessary to provide stability and to prevent excessive stress on container walls. (7-1-97)

i. Portable tanks within warehouses or storage buildings stored over one tier high shall be designed to nest securely, without dunnage and adequate materials handling equipment shall be available to handle tanks safely at the upper tier level. (7-1-97)

j. In warehouses or storage buildings no pile shall be closer than three (3) feet to the nearest beam, chord, girder, or other obstruction, and shall be three (3) feet below sprinkler deflectors or discharge orifices of water spray, or other over head fire protection systems. (7-1-97)

k. Aisles of at least three (3) feet wide shall be provided where necessary for reasons of access to doors, windows or standpipe connections. (7-1-97)

15. Storage Outside of Buildings: (7-1-97)

a. Storage outside buildings shall be in accordance with Table 220.15-A and 220.15-B and subsections 220.15.b. and d. of this section. (7-1-97)

TABLE 220.15-A

OUTDOOR CONTAINER STORAGE

1 Class	2 Maximum per pile (see note 1)	3 Distance between piles (see note 2)	4 Distance to property line that can be built upon (see notes 3 & 4)	5 Distance to street, alley, public way (see note 4)
	gal.	ft.	ft.	ft.
IA	1,100	5	20	10
IB	2,200	5	20	10
IC	4,400	5	20	10
II	8,800	5	10	5
III	22,000	5	10	5

Note 1: When 2 or more classes of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the 2 or more separate gallonages.

Note 2: Within 200 ft. of each container, there shall be 12 ft. wide access way to permit approach of fire control apparatus.

Note 3: The distances listed apply to properties that have protection for exposures as defined. If there are exposures, and such protection for exposures does not exist, the distances in column 4 shall be doubled.

Note 4: When total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 may be reduced 50 percent, but not less than 3 ft.

TABLE 220.15-B

OUTDOOR PORTABLE TANK STORAGE

1 Class	2 Maximum per pile	3 Distance between piles	4 Distance to property line that can be built upon	5 Distance to street, alley, public way
	gal.	ft.	ft.	ft.
IA	2,200	5	20	10

IB	4,400	5	20	10
IC	8,800	5	20	10
II	17,600	5	10	5
III	44,000	5	10	5

Note 1: When 2 or more classes of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the 2 or more separate gallonages.

Note 2: Within 200 ft. of each portable tank, there shall be a 12 ft. wide access way to permit approach of fire control apparatus.

Note 3: The distances listed apply to properties that have protection for exposures as defined. If there are exposures, and such protection for exposures does not exist, the distances in column 4 shall be doubled.

Note 4: When total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 may be reduced 50 percent, but not less than 3 ft.

b. A maximum of one-thousand-one-hundred (1,100) gallons of flammable or combustible liquids may be located adjacent to buildings located on the same premises and under the same management, provided the following: The building shall be a one (1) story building devoted principally to the handling and storing of flammable or combustible liquids or the building shall have two (2) hour fire-resistive exterior walls having no opening within ten (10) feet of such storage. Where quantity stored exceeds one-thousand-one-hundred (1,100) gallons, or the afore mentioned provisions of this subsection cannot be met, a minimum distance of ten (10) feet between buildings and nearest container of flammable or combustible liquid shall be maintained. (7-1-97)

c. The storage area shall be graded in a manner to divert possible spills away from buildings or other exposures or shall be surrounded by a curb at least six (6) inches high. When curbs are used, provisions shall be made for draining of accumulations of ground or rain water or spills of flammable or combustible liquids. Drains shall terminate at a safe location and shall be accessible to operation under fire conditions. (7-1-97)

d. The storage area shall be protected against tampering or trespassers where necessary and shall be kept free of weeds, debris, and other combustible material not necessary to the storage. (7-1-97)

16. Fire Control: (7-1-97)

a. Suitable fire control devices, such as small hose or portable fire extinguishers shall be available at locations where flammable or combustible liquids are stored. (7-1-97)

- b.** At least one portable fire extinguisher having a rating of not less than 40-B units shall be located outside of, but not more than ten (10) feet from, the door opening into any room used for storage. (7-1-97)
- c.** At least one portable fire extinguisher having a rating of not less than 40-B units must be located not less than ten (10) feet, nor more than twenty-five (25) feet, from any Class I or Class II liquid storage area located outside of a storage room but inside a building. (7-1-97)
- d.** When sprinklers are provided, they shall be installed in accordance with section 063 of this standard. (7-1-97)
- e.** Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas. (7-1-97)
- f.** Materials which will react with water shall not be stored in the same room with flammable or combustible liquids. (7-1-97)

17. Industrial Operations: (7-1-97)

- a.** This subsection shall apply to those industrial operations where: the use of flammable or combustible liquids is incidental to the principle operation, such as automobile assembly, construction of electronic equipment, furniture manufacturing, or other similar activities, or where flammable or combustible liquids are handled or used only in unit physical operations such as mixing, drying, evaporating, filtering, distillation, and similar operations which do not involve chemical reaction. This section shall not involve chemical plants, refineries, or distilleries. (7-1-97)
- b.** The quantity of liquid that may be located outside of an inside storage room or storage cabinet in a building or in anyone fire area of a building shall not exceed: (7-1-97)
 - i.** Twenty-five (25) gallons of Class IA liquids in containers; (7-1-97)
 - ii.** One-hundred-twenty (120) gallons of Class IB, IC, II or III liquids in containers; (7-1-97)
 - iii.** Six-hundred-sixty (660) gallons of Class IB, IC, II, or III liquids in a single portable tank. (7-1-97)
- c.** Where large quantities of flammable or combustible liquids are necessary, storage may be in tanks which shall comply with the applicable requirements of sub-section 220.04 of this section. (7-1-97)
- d.** Areas in which flammable or combustible liquids are transferred from one tank or container to another container shall be separated from other operations in the building by adequate distance or by construction having adequate fire resistance. Drainage or other means shall be provided to control spills. Adequate natural or mechanical ventilation shall be provided. (7-1-97)

e. Flammable liquids shall be kept in covered containers when not actually in use. (7-1-97)

f. Where flammable or combustible liquids are used or handled, except in closed containers, means shall be provided to dispose promptly and safely of leakage or spills. (7-1-97)

g. Class I liquids may be used only where there are no open flames or other sources of ignition within the possible path of vapor travel. (7-1-97)

h. Flammable or combustible liquids shall be drawn from or transferred into vessels, containers or portable tanks within a building only through a closed piping system, from safety cans, by means of a device drawing through the top, or from a container or portable tanks by gravity through an approved self-closing valve. Transferring by means of air pressure on the container or portable tanks shall be prohibited. (7-1-97)

i. Industrial operations shall be located so that each building or unit of equipment is accessible from at least one side for fire fighting and fire control purposes. (7-1-97)

j. Buildings shall be located with respect to lines of adjoining property which may be built upon as set forth in accordance with Table 220.17-A. (7-1-97)

TABLE 220.17-A		
Processing vessels with emergency relief venting to permit pressure	Stable Liquids	Unstable liquids
Not in excess of 2.5 p.s.i.g.	Table 220.05-A	2 1/2 times Table 220.05-A
Over 2.5 p.s.i.g.	1 1/2 times Table 220.05-A	4 times Table 220.05-A

k. EXCEPTION: The distance required in sub-section 220.17.j. of this section may be waived when the vessels are housed within a building and the exterior wall facing the line of adjoining property which may be built upon is a blank wall having a fire-resistance rating of not less than two (2) hours. When Class IA or unstable liquids are handled, the blank wall shall have explosion resistance in accordance with good engineering practices. (7-1-97)

l. Areas where unstable liquids are handled or small scale unit chemical processes are carried on shall be separated from the remainder of the facility by a fire wall of two (2) hour minimum fire resistance rating. (7-1-97)

- m.** Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire. (7-1-97)
- n.** Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators. (7-1-97)
- o.** The industrial operation shall be designed and operated to prevent the normal discharge of flammable or combustible liquids into public waters, public sewers, or adjoining property. (7-1-97)
- p.** Areas as defined in this sub-section using Class I liquids shall be ventilated at a rate of not less than one (1) cubic foot per minute per square foot of solid floor area. This shall be accomplished by natural or mechanical ventilation with discharge or exhaust to a safe location outside of the building. Provisions shall be made for introduction of makeup air in such a manner as not to short circuit the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect. (7-1-97)
- q.** Equipment used in a building and the ventilation of the building shall be designed so as to limit flammable vapor-air mixtures under normal operation conditions to the interior of equipment, and to not more than five (5) feet from equipment which exposes Class I liquids to the air. Examples of such equipment are dispensing stations, open centrifuges, plate and frame filters, open vacuum filters, and surfaces of open equipment. (7-1-97)
- r.** The storage, transfer, and handling of liquid shall comply with other portions of this section along with the following: (7-1-97)
- i.** An approved flexible connector may be used where vibration exists or where frequent movement is necessary; (7-1-97)
- ii.** An approved hose may be used at transfer stations; piping containing flammable or combustible liquids shall be identified; (7-1-97)
- iii.** The transfer of large quantities of flammable or combustible liquids shall be through piping by means of pumps or water displacement; (7-1-97)
- iv.** Except as required in process equipment, gravity flow shall not be used; (7-1-97)
- v.** The use of compressed air as a transferring medium is prohibited; (7-1-97)
- vi.** Positive displacement pumps shall be provided with pressure relief discharging back to the tank or to pump suction; (7-1-97)
- vii.** Equipment shall be designed and arranged to prevent the unintentional escape of liquids and vapors and to minimize the quantity escaping in the event of accidental release. (7-1-97)

s. Rooms in which flammable or combustible liquids are stored or handled by pumps shall have exit facilities arranged to prevent occupants from being trapped in the event of fire. (7-1-97)

t. Where the vapor space of equipment is usually within the flammable range, the probability of explosion damage to the equipment can be limited by inerting, by providing an explosion suppression system, or by designing the equipment to contain the peak explosion pressure which may be modified by explosion relief. Where the special hazards of operation, sources of ignition, or exposures indicate a need, consideration shall be given to providing protection by one or more of the above means. (7-1-97)

u. Portable fire extinguishment and control equipment shall be provided in such quantities and types as are needed for the special hazards of operations and storage. (7-1-97)

v. Water shall be available in volume and at an adequate pressure to supply water hose streams, foam-producing equipment, automatic sprinklers, or water spray systems as the need is indicated by the special hazards of operations, dispensing, and storage. (7-1-97)

w. Special extinguishing equipment such as that utilizing foam, inert gas, or dry chemical shall be provided as the need is indicated by the special hazards of operations, dispensing, and storage. (7-1-97)

x. Where the need is indicated by special hazards of operation, flammable or combustible liquid processing equipment, major piping, and supporting steel shall be protected by approved water spray, deluge systems, approved fire resistant coating, insulation, or any combination of these. (7-1-97)

y. All facility fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition, and will serve their purpose in time of emergency. (7-1-97)

18. Electrical: (7-1-97)

a. All electrical wiring and equipment shall be installed according to the requirements of section 150 of this standard and the National Electrical Code (NEC). (7-1-97)

b. Locations where flammable vapor-air mixtures may exist under normal operations shall be classified Class I Division I according to the requirements of section 150 of this standard and the National Electrical Code (NEC). For those pieces of equipment installed in accordance with subsection 220.17.q., the Division I area shall extend five (5) feet in all directions from all points of vapor liberation. All areas within pits shall be classified Division I if any part of the pit is within a Division I or II classified area, unless the pit is provided with mechanical ventilation. (7-1-97)

c. Locations where flammable vapor-air mixtures may exist under abnormal conditions and for a distance beyond Division I locations shall be classified Division II according to the requirements of section 150 of this standard and the National Electrical Code (NEC). These locations include an area within twenty (20) feet horizontally, three (3) feet vertically beyond a Division I area,

and up to three (3) feet above floor or grade level within twenty-five (25) feet, if indoors, or ten (10) feet if outdoors, from any pump, bleeder, withdrawal fitting, meter, or similar device handling Class I liquids. Pits provided with adequate mechanical ventilation within a Division I or II area shall be classified Division II. If class II or Class III liquids only are handled, then ordinary electrical equipment is satisfactory though care shall be used in locating electrical apparatus to prevent hot metal from falling into open equipment. (7-1-97)

d. Where the provisions of sub-section 220.18.a., b., and c. of this section require the installation of electrical equipment suitable for Class I, Division I or Division II locations, ordinary electrical equipment including switch gear may be used if installed in a room or enclosure which is maintained under positive pressure with respect to the hazardous area. Ventilation makeup air shall be uncontaminated by flammable vapors. (7-1-97)

e. So far as it applies Table 220.05-A shall be used to delineate and classify hazardous areas for the purpose of installation of electrical equipment under normal circumstances. In Table 224.18-A a classified area shall not extend beyond an unpierced wall, roof, or other solid partition. The area classifications listed shall be based on the premise that the installation meets the applicable requirements of this section in all respects. (7-1-97)

TABLE 220.18-A		
ELECTRICAL EQUIPMENT HAZARDOUS AREAS		
LOCATION	NEC Class I Group D Division	EXTENT OF CLASSIFIED AREA
Tank vehicle and tank car:¹		
Loading through open dome	I	Within 3 feet of edge of dome, extending in all directions.
	II	Area between 3 feet and 5 feet from edge of dome, extending in all directions
Loading through bottom connections with atmospheric venting	I	Within 3 feet of point of venting to atmosphere, extending in all directions.
	II	Area between 3 feet and 5 feet from point of venting to atmosphere, extending in all directions. Also up to 18 inches above grade within a horizontal radius of 10 feet from point of loading connection.
Loading through closed dome with atmospheric venting	I	Within 3 feet of open end of vent, extending in all directions.
	II	Area between 3 feet and 5 feet from open end of vent, extending in all directions. Also within 3 feet of edge of

		dome, extending in all directions.
Loading through closed dome with vapor recovery	II	Within 3 feet of point of connection of both fill and vapor lines, extending in all directions
Bottom loading with vapor recovery or any bottom unloading	II	Within 3 feet of point of connections extending in all directions. Also up to 18 inches above grade within horizontal radius of 10 feet from point of connection.
Drum and container filling:		
Outdoors, or indoors with adequate ventilation.	I	Within 3 feet of vent and fill opening, extending in all directions.
	II	Area between 3 feet and 5 feet from vent or fill opening, extending in all directions. Also up to 18 inches above floor or grade level within a horizontal radius of 10 feet from vent or fill opening.
Tank - Aboveground		
Shell, ends, or roof and dike area	II	Within 10 feet from shell, ends, or roof of tank. Area inside dikes to level of top of dike.
Vent	I	Within 5 feet of open end of vent, extending in all directions.
	II	Area between 5 feet and 10 feet from open end of vent, extending in all directions.
Floating roof	I	Area above the roof and within the shell.
Pits		
Without mechanical ventilation	I	Entire area within pit if any part is within a Division I or II classified area.
With mechanical ventilation	II	Entire area within pit if any part is within a Division I or II classified area.
Containing valves, fittings, or piping, and not within a Division I or II classified area.	II	Entire pit.
Pumps, bleeders, withdrawal fittings, meters, and similar devices		

Indoors	II	Within 5 feet of any edge of such devices, extending in all directions. Also up to 3 feet above floor or grade level within 25 feet horizontally from any edge of such devices.
Outdoors	II	Within 3 feet of any edge of such devices, extending in all directions. Also up to 18 inches above grade level within 10 feet horizontally from any edge of such devices.
Storage and repair garage for tank vehicles	I	All pits or spaces below floor level.
	II	Area up to 18 inches above floor or grade level for entire storage or repair garage.
Drainage ditches, separators, impounding basins	II	Area up to 18 inches above ditch, separator, or basin. Also up to 18 inches above grade within 15 feet horizontally from any edge.
Garages for other than tank vehicles	Ordinary	If there is any opening to these rooms within the extent of an outdoor classified area, the entire room shall be classified the same as the area classification at the point of the opening.
Out door drum storage	Ordinary	
Indoor warehousing where there is not flammable liquid transfer	Ordinary	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb or partition did not exist.
Office and rest rooms	Ordinary	
¹ When classifying the extent of the area, consideration shall be given to the fact that tank cars or tank vehicles may be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used.		

19. Repairs to Equipment: (7-1-97)

a. Hot work, such as welding or cutting operations, use of spark producing power tools, and chipping operations shall be permitted only under supervision of an individual in responsible charge. The individual in responsible charge shall make an inspection of the area to be sure that it is safe for the work to be done and that safe procedures will be followed for the work specified. (7-1-97)

20. Housekeeping: (7-1-97)

- a. Maintenance and operating practices shall be in accordance with established procedures which will tend to control leakage and prevent the accidental escape of flammable or combustible liquids. Spills shall be cleaned up promptly. (7-1-97)
- b. Adequate aisles shall be maintained for unobstructed movement of personnel and so that fire protection equipment can be brought to bear on any part of flammable or combustible liquid storage, use, or any unit physical operation. (7-1-97)
- c. Combustible waste material and residues in a building or unit operating areas shall be kept to a minimum, stored in covered metal receptacles, and disposed of daily. (7-1-97)
- d. Ground area around buildings and unit operation areas shall be kept free of weeds, trash, or other unnecessary combustible materials. (7-1-97)
- e. Crankcase drainings and flammable or combustible liquid spills shall be cleaned up promptly and shall not be dumped into sewers. (7-1-97)
- f. Crankcase drainings and flammable or combustible liquid shall be stored in accordance with the provisions of this section in tanks or drums until removed from the premises. (7-1-97)

21. Tank Vehicle and Tank Car Loading and Unloading: (7-1-97)

- a. Tank vehicle and tank care loading or unloading facilities shall be separated from above-ground tanks, warehouses, other buildings or nearest line of adjoining property which may be built upon by a distance of twenty-five (25) feet for Class I liquids and fifteen (15) feet for Class II and Class III liquids measured from the nearest position of any fill stem. Buildings for pumps or shelters for personnel may be a part of the facility. (7-1-97)

22. Service stations. (7-1-97)

- a. Above-ground tanks, located in an adjoining bulk plant, may be connected by piping to service station underground tanks if, in addition to valves at above-ground tanks, a valve is also installed within control of service station personnel. (7-1-97)
- b. Apparatus dispensing class I liquids into the fuel tanks of motor vehicles of the public shall not be located at a bulk facility unless separated by a fence or similar barrier from the area in which bulk operations are conducted. (7-1-97)
- c. The provisions of this section shall not prohibit the dispensing of flammable liquids in the open from a tank vehicle to a motor vehicle or aircraft. Such dispensing shall be permitted provided: The tank vehicle complies with the requirements covered in the Standard on Tank Vehicles for Flammable Liquids, NFPA 385. The dispensing is done on premises not open to the public. The dispensing hose does not exceed fifty (50) feet in length. The dispensing nozzle is a listed automatic-closing type without a latch-open device. Both vehicles are grounded and the vehicles are bonded to each other. (7-1-97)

- d.** Class I liquids shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein. (7-1-97)
- e.** Accurate inventory records shall be maintained and reconciled on all flammable or combustible liquid storage tanks for possible indication of leakage from tanks or piping. (7-1-97)
- f.** When installation of tanks in accordance with sub-section 220.05. through 220.06 of this section, is impractical because of property or building limitations, tanks for flammable or combustible liquids may be installed in buildings if properly enclosed. The enclosure shall be substantially liquid and vapor tight without backfill. Sides, top, and bottom of the enclosure shall be of reinforced concrete at least six (6) inches thick, with openings for inspection through the top only. Tank connections shall be so piped or closed that neither vapors nor liquid can escape into the enclosed space. Means shall be provided whereby portable equipment may be employed to discharge to the outside any liquid or vapors which might accumulate should leakage occur. (7-1-97)
- g.** At automotive service stations provided in connection with tenant or customer parking facilities at or below grade level in large buildings of commercial, mercantile, or residential occupancy, tanks containing Class I liquids, installed of necessity in accordance with sub-section 220.22.f. above, shall not exceed ten-thousand (10,000) gallons individual or forty-thousand (40,000) gallons aggregate capacity. (7-1-97)
- h.** Except where stored in tanks as provided in sub-section 220.22.f. of this section, no Class I liquids shall be stored within any service station building except in closed containers of aggregate capacity not exceeding sixty (60) gallons capacity. One container not exceeding sixty (60) gallons capacity equipped with an approved pump is permitted. (7-1-97)
- i.** Class I liquids may be transferred from one container to another in lubrication or service rooms of a service station building provided the electrical installation complies with Table 220.18-A and provided that any heating equipment complies with sub-section 220.03.d. of this section. (7-1-97)
- j.** Class II and Class III liquids may be stored and dispensed inside service station buildings from tanks of not more than one-hundred-twenty (120) gallons capacity each. (7-1-97)
- k.** Containers shall be clearly marked with the name of the product contained. (7-1-97)
- l.** No delivery of any Class I liquid shall be made into portable containers unless the container is constructed of metal has a tight closure with screwed or spring cover, and is fitted with a spout or so designed that the contents can be poured without spilling. (7-1-97)
- m.** Service stations not accessible to or open to the public do not require an attendant or supervisor. Such stations may be used by commercial, industrial, governmental, or manufacturing establishments. (7-1-97)

- n.** Dispensing devices at automotive service stations shall be so located that all parts of the vehicle being serviced will be on the premises of the service station. (7-1-97)
- o.** Approved dispensing units may be located inside of buildings. The dispensing area shall be separated from other areas in an approved manner. The dispensing unit and its piping shall be mounted on a concrete island and protected against collision damage by suitable means and shall be located in a position where it cannot be struck by a vehicle descending a ramp or other slope out of control. The dispensing area shall be provided with an approved mechanical or gravity ventilation system. When dispensing units are located below grade, only approved mechanical ventilation shall be used and the entire dispensing area shall be protected by an approved automatic sprinkler system. Ventilating systems shall be electrically interlocked with gasoline dispensing units so that the dispensing units cannot be operated unless the ventilating fan motors are energized. (7-1-97)
- p.** A clearly identified and easily accessible switch(es) or a circuit breaker(s) shall be provided at a location remote from dispensing devices, including remote pumping systems, to shut off the power to all dispensing devices in the event of an emergency. (7-1-97)
- q.** Class I liquids shall be transferred from tanks only by means of fixed manual or powered pumps so designed and equipped as to allow control of the flow and prevent leakage or accidental discharge. (7-1-97)
- r.** Only listed devices may be used for dispensing class I liquids. No such device shall be used if it shows evidence of having been dismantled. Every dispensing device for Class I liquids installed after December 31, 1978, shall contain evidence of listing so placed that any attempt to dismantle the device will result in damage to such evidence, visible without disassembly or dismantling of the nozzle. (7-1-97)
- s.** Class I liquids shall not be dispensed by pressure or gravity from drums, barrels, tanks, and similar containers. Approved pumps taking suction through the top of the container with approved self-closing nozzles shall be used. (7-1-97)
- t.** The dispensing units, except those attached to containers, shall be mounted on a concrete island and protected against collision damage by suitable means. Dispensing units and their containers shall be protected against collision damage by suitable means. Waste oil containers shall be protected against collision damage by suitable means. (7-1-00)
- u.** Pumps for remote pumping systems shall be designed or equipped so that no part of the system will be subjected to pressures above its allowable working pressure. Pumps installed above grade, outside of buildings, shall be located not less than ten (10) feet from lines of adjoining property which is or may be built upon, and not less than five (5) feet from any building opening. When an outside pump location is impractical, pumps may be installed inside of buildings as provided for dispensers in sub-section 220.22.o. of this section, or in pits as provided in sub-section 220.22.v. of this section. Pumps shall be substantially anchored and protected against physical damage by vehicles. (7-1-97)

v. Pits for subsurface pumps or piping manifolds of submersible pumps shall withstand the external forces to which they may be subjected without damage to the pump, tanks, or piping. The pit shall be no larger than necessary for inspection and maintenance and shall be provided with a fitted cover. (7-1-97)

w. A control shall be provided that will permit the remote pump to operate only when a dispensing nozzle is removed from its bracket on the dispensing unit and the switch on this dispensing unit is manually actuated. This control shall also stop the remote pump when all nozzles have been returned to their brackets. (7-1-97)

x. An approved impact valve, incorporating a fusible link, designed to close automatically in the event of severe impact or fire exposure shall be properly installed in the dispensing supply line at the base of each individual dispensing device. (7-1-97)

y. After the completion of the installation, including any paving, that section of the pressure piping system between the pump discharge and the connection for the dispensing facility shall be tested for at least thirty (30) minutes at the maximum operating pressure of the system. Such tests shall be repeated at five (5) year intervals thereafter. (7-1-97)

z. Hose-nozzle valves of either the manual or automatic closing type for dispensing Class I liquids into a fuel tank or into a container shall be manually held open during the dispensing operation except as herein provided, a listed automatic type nozzle with hold-open latch is permitted. (7-1-97)

aa. Emergency controls shall be installed at an acceptable location, but controls shall not be more than one-hundred (100) feet from dispensers. (7-1-97)

bb. Instructions for the operation of dispensers shall be conspicuously posted. (7-1-97)

cc. In addition to the previous restrictions of this section, the following shall apply: there shall be no smoking or open flames in the areas used for fueling, servicing fuel systems for internal combustion engines, and receiving or dispensing of flammable or combustible liquids. Conspicuous and legible signs prohibiting smoking shall be posted within sight of the customer being served. The motors of all equipment being field shall be shut off during the fueling operation. (7-1-97)

dd. Provisions shall be made in the area where Class I liquids are dispensed to prevent spilled liquids from flowing into the interior of service station buildings. Such provision may be by grading driveways, raising door sills, or other equally effective means. (7-1-97)

ee. Each service station shall be provided with at least one (1) fire extinguisher having a minimum approved classification of 20 B, C (thirty (30) pound) located so that an extinguisher will be within fifty (50) feet of each pump, dispenser, underground fill pipe opening, and lubrication or service room. (7-1-97)

23. Marine Service Stations: (7-1-97)

- a.** The dispensing area shall be located away from other structures so as to provide room for safe ingress and egress of craft to be fueled. Dispensing units shall in all cases be at least twenty (20) feet from any activity involving fixed sources of ignition. (7-1-97)
- b.** Dispensing shall be by approved dispensing units with or without integral pumps and may be located on open piers, wharves, floating docks, on shore, or on piers of the solid fill type. (7-1-97)
- c.** Dispensing nozzles shall be automatic-closing without a hold-open latch. (7-1-97)
- d.** Tanks and pumps not integral with the dispensing unit, shall be on shore or on a pier of the solid fill type, except as provided below. Pumps shall be substantially anchored and protected against physical damage by vehicles. (7-1-97)
- e.** Where a shore location would require excessively long supply lines to dispensers, tanks may be installed on a pier provided that applicable portions of this section relative to spacing, diking, and piping, are complied with and the quantity so stored does not exceed one-thousand-one-hundred (1,100) gallons aggregate capacity. (7-1-97)
- f.** Shore tanks supplying marine service stations may be located above-ground where rock ledge or high water table make underground tanks impractical. (7-1-97)
- g.** Where tanks are at an elevation which would produce gravity head on the dispensing unit, the tank outlet shall be equipped with a pressure control valve positioned adjacent to and outside the tank block valve specified in Subsection 220.05.dd. of this section, so adjusted that liquid cannot flow by gravity from the tank in case of piping or hose failure. (7-1-97)
- h.** Piping between wharf tanks and dispensing units shall be as described in sub-section 220.11 of this section, except that, where dispensing is from a floating structure, suitable lengths of oil-resistant flexible hose may be employed between the shore piping and the piping on the floating structure as made necessary by change in water level or shoreline. (7-1-97)
- i.** A readily accessible valve to shut off the supply from shore shall be provided in each pipeline at or near the approach to the pier and at the shore end of each pipeline adjacent to the point where flexible hose is attached. (7-1-97)
- j.** Piping shall be located so as to be protected from physical damage. (7-1-97)
- k.** Piping handling Class I liquids shall be grounded to control stray currents. (7-1-97)
- l.** In addition to the previous restrictions of this section, the following shall apply: there shall be no smoking or open flames in the areas used for fueling, servicing fuel systems for internal combustion engines, and receiving or dispensing of flammable or combustible liquids. Conspicuous and legible signs prohibiting smoking shall be posted within sight of the customer being served. The motors of all equipment being field shall be shut off during the fueling operation. (7-1-97)

m. Each marine service station shall be provided with at least one fire extinguisher having a minimum approved classification of twenty (20) B, C (thirty (30) pound) located so that an extinguisher will be within fifty (50) feet of each pump, dispenser, and fill pipe opening. (7-1-97)

24. Heating Equipment: (7-1-97)

a. Heating equipment may be installed in a special room separated from an area classified by Table 220.18-A by walls having a fire resistance rating of at least one (1) hour and without any openings in the walls within eight (8) feet of the floor into an area classified in Table 220.18-A. This room shall not be used for combustible storage and all air for combustible purposes shall come from outside the building. (7-1-97)

b. Heating equipment using gas or oil fuel may be installed in the work areas, lubrication, sales, or service room where there is no dispensing or transferring of Class I liquids provided the bottom of the combustion chamber is at least eighteen (18) inches above the floor and the heating equipment is protected from physical damage by vehicles. Heating equipment using gas or oil fuel listed for use in garages may be installed in the lubrication or service room where Class I liquids are dispensed provided the equipment is installed at least eight (8) feet above the floor. (7-1-97)

c. Electrical heating equipment shall conform to sub-section 220.18 of this section. (7-1-97)

221. -- 239. (RESERVED)