WAC 296-24-33005 Tank storage. (1) **Design and construction of tanks.**

(a) **Materials.**

(i) Tanks must be built of steel except as provided in (a)(ii) through (v) of this subsection.

(ii) 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 must be of noncombustible construction.

(iii) Tanks built of materials other than steel must be designed to specifications embodying principles recognized as good engineering design for the material used.

(iv) Unlined concrete tanks may be used for storing flammable liquids having a gravity of 40°API or heavier. Concrete tanks with special lining may be used for other services provided the design is in accordance with sound engineering practice.

(v) Tanks may have combustible or noncombustible linings.

(vi) You must require special engineering consideration if the specific gravity of the liquid to be stored exceeds that of water or if the tanks are designed to contain flammable liquids at a liquid temperature below 0°F.

(b) **Fabrication.**

(i) Tanks may be of any shape or type consistent with sound engineering design.

(ii) Metal tanks must be welded, riveted, and caulked, brazed, or bolted, or constructed by use of a combination of these methods. Filler metal used in brazing must be nonferrous metal or an alloy having a melting point above 1000°F and below that of the metal joined.

(c) **Atmospheric tanks.**

(i) Atmospheric tanks must be built in accordance with acceptable good standards of design. Atmospheric tanks may be built in accordance with:

(A) Underwriters' Laboratories, Inc., Subjects No. 142, Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids, 1968; No. 58, Standards for Steel Underground Tanks for Flammable and Combustible Liquids, Fifth Edition, December 1961; or No. 80, Standard for Steel Inside Tanks for Oil-Burner Fuel, September 1963.

(B) American Petroleum Institute Standards No. 650, Welded Steel Tanks for Oil Storage, Third Edition, 1966.

(C) American Petroleum Institute Standards No. 12B, Specification for Bolted Production Tanks, Eleventh Edition, May 1958, and Supplement 1, March 1962; No. 12D, Specification for Large Welded Production Tanks, Seventh Edition, August 1957; or No. 12F, Specification for Small Welded Production Tanks, Fifth Edition, March 1961. Tanks built in accordance with these standards must be used only as production tanks for storage of crude petroleum in oil-producing areas.

(ii) Tanks designed for underground service not exceeding 2,500 gallons capacity may be used aboveground.

(iii) Low-pressure tanks and pressure vessels may be used as atmospheric tanks.

(iv) You must not use atmospheric tanks for the storage of a flammable liquid at a temperature at or above its boiling point.

(d) **Low pressure tanks.**

(i) The normal operating pressure of the tank must not exceed the design pressure of the tank.

(ii) Low-pressure tanks must be built in accordance with acceptable standards of design. Low-pressure tanks may be built in accordance with:

(A) American Petroleum Institute Standard No. 620, Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Third Edition, 1966.

(B) The principles of the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessels Code, 1968.

(iii) Atmospheric tanks built according to the Underwriters' Laboratories, Inc., requirements in (c)(i) of this subsection may be used for operating pressures not exceeding 1 p.s.i.g. and must be limited to 2.5 p.s.i.g. under emergency venting conditions. Pressure vessels may be used as low-pressure tanks.

(e) **Pressure vessels.**

(i) The normal operating pressure of the vessel must not exceed the design pressure of the vessel.

(ii) Pressure vessels must be built in accordance with the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessel Code, 1968.

(f) **Provisions for internal corrosion.** When tanks are not designed in accordance with the American Petroleum Institute, American Society of Mechanical Engineers, or the Underwriters' Laboratories, Inc.'s standards, or if corrosion is anticipated beyond that provided for in the design formulas used, you must provide additional metal thickness or suitable protective coatings or linings to compensate for the corrosion loss expected during the design life of the tank.

(2) **Installation of outside aboveground tanks.**

(a) **Location with respect to property lines and public ways.**

(i) Every aboveground tank for the storage of flammable liquids, except those liquids with boil-over characteristics and unstable liquids, operating at pressures not in excess of 2.5 p.s.i.g. and equipped with emergency venting which will not permit pressures to exceed 2.5 p.s.i.g. must be located in accordance with Table H-5.

(ii) Every aboveground tank for the storage of flammable liquids, except those liquids with boil-over characteristics and unstable flammable liquids, operating at pressures exceeding 2.5 p.s.i.g. or equipped with emergency venting which will permit pressures to exceed 2.5 p.s.i.g. must be located in accordance with Table H-6.

(iii) Every aboveground tank for the storage of flammable liquids with boil-over characteristics must be located in accordance with Table H-7.

(iv) Every aboveground tank for the storage of unstable liquids must be located in accordance with Table H-8.

(v) Reference minimum distances for use in Tables H-5 to H-8 inclusive.

(vi) Where end failure or horizontal pressure tanks and vessels may expose property, you must place the tank with the longitudinal axis parallel to the nearest important exposure.

TABLE H-5

Type of tank	Protection	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 and shall be not less than 5 feet.
Floating roof ———	Protection for exposures.	1/2 times diameter of tank but need not exceed 90 ft.	1/6 times diameter of tank but need not exceed 30 ft.
	None ————	Diameter of tank but need not exceed 175 ft.	1/6 times diameter of tank but need not exceed 30 ft.
Vertical with weak roof to shell seam	Approved foam or inerting system on the tank.	1/2 times diameter of tank but need not exceed 90 ft. and shall not be less than 5 ft.	1/6 times diameter of tank but need not exceed 30 ft.
	Protection for exposures.	Diameter of tank but need not exceed 175 ft.	1/3 times diameter of tank but need not exceed 60 ft.
	None ————	2 times diameter of tank but need not exceed 350 ft.	1/3 times diameter of tank but need not exceed 60 ft.
Horizontal and vertical, with emergency relief venting to limit pressures to 2.5 p.s.i.g.	Approved inerting system on the tank or approved foam system on vertical tanks.	1/2 times Table H-9 but shall not be less than 5 ft.	1/2 times Table H-9.
	Protection for exposures.	Table H-9 ———	Table H-9
	None ————	2 times table ——	Table H-9

TABLE H-6

Type of tank	Protection	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.
Any type -	Protection for exposures.	1 1/2 times Table H-9 but shall not be less than 25 ft.	1 1/2 times Table H-9 but shall not be less than 25 ft.
	None ————	3 times Table H-9 but shall not be less than 50 ft.	1 1/2 times Table H-9 but shall not be less than 25 ft.

TABLE H-7

Type of tank	Protection	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.
Floating roof ———	Protection for exposures.	Diameter of tank but need not exceed 175 ft.	1/3 times diameter of tank but need not exceed 60 ft.
	None ————	2 times diameter of tank but need not exceed 350 ft.	1/3 times diameter of tank but need not exceed 60 ft.

Type of tank	Protection	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.
Fixed roof———	Approved foam or inerting system.	Diameter of tank but need not exceed 175 ft.	1/3 times diameter of tank but need not exceed 60 ft.
	Protection for exposures.	2 times diameter of tank but need not exceed 350 ft.	2/3 times diameter of tank but need not exceed 120 ft.
	None ———	4 times diameter of tank but need not exceed 350 ft.	2/3 times diameter of tank but need not exceed 120 ft.

TABLE H-8

Type of tank	Protection	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.
Floating roof———	Protection for exposures.	Diameter of tank but need not exceed 175 ft.	1/3 times diameter of tank but need not exceed 60 ft.
	None ———	2 times diameter of tank but need not exceed 350 ft.	1/3 times diameter of tank but need not exceed 60 ft.
Fixed roof———	Approved foam or inerting system.	Diameter of tank but need not exceed 175 ft.	1/3 times diameter of tank but need not exceed 60 ft.
	Protection for exposures.	2 times diameter of tank but need not exceed 350 ft.	2/3 times diameter of tank but need not exceed 120 ft.
	None ———	4 times diameter of tank but need not exceed 350 ft.	2/3 times diameter of tank but need not exceed 120 ft.

TABLE H-9

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 more	———	175	60

(b) **Spacing (shell-to-shell) between aboveground tanks.**

(i) The distance between any two flammable liquid storage tanks must not be less than three feet.

(ii) Except as provided in (b)(iii) of this subsection, the distance between any two adjacent tanks must not be less than one-sixth the sum of their diameters. When the diameter of one tank is less than

one-half the diameter of the adjacent tank, the distance between the two tanks must not be less than one-half the diameter of the smaller tank.

(iii) Where crude petroleum in conjunction with production facilities are located in noncongested areas and have capacities not exceeding 126,000 gallons (3,000 barrels), the distance between such tanks must not be less than three feet.

(iv) Where unstable flammable liquids are stored, the distance between such tanks must not be less than one-half the sum of their diameters.

(v) When tanks are compacted in three or more rows or in an irregular pattern, you must provide greater spacing or other means so that inside tanks are accessible for firefighting purposes.

(vi) The minimum separation between a liquefied petroleum gas container and a flammable liquid storage tank must be twenty feet, except in the case of flammable liquid tanks operating at pressures exceeding 2.5 p.s.i.g. or equipped with emergency venting which will permit pressures to exceed 2.5 p.s.i.g. in which case the provisions of (b)(i) and (ii) of this subsection must apply. You must take suitable means to prevent the accumulation of flammable liquids under adjacent liquefied petroleum gas containers such as by diversion curbs or grading. When flammable liquid storage tanks are within a diked area, the liquefied petroleum gas containers must be outside the diked area and at least ten feet away from the centerline of the wall of the diked area. The foregoing provisions must not apply when liquefied petroleum gas containers of 125 gallons or less capacity are installed adjacent to fuel oil supply tanks of 550 gallons or less capacity.

(c) **Location of outside aboveground tanks with respect to important buildings on same property.** You must separate every outside aboveground tank from important buildings on the same property by distances not less than those specified in (a)(i) through (iv) of this subsection, whichever is applicable. The appropriate distance column in Tables H-5, H-6, H-7, H-8, or H-9, that you must use is the one reading: "Minimum distance in feet from nearest side of any public way or from nearest important building."

(d) **Normal venting for aboveground tanks.**

(i) You must adequately vent atmospheric storage tanks 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 or emptying, and atmospheric temperature changes.

(ii) Normal vents must be sized either in accordance with: (A) The American Petroleum Institute Standard 2000 (1968), Venting Atmospheric and Low-Pressure Storage Tanks; or (B), other accepted standard; or (C) must be at least as large as the filling or withdrawal connection, whichever is larger but in no case less than 1 1/4 inch nominal inside diameter.

(iii) You must adequately vent low-pressure tanks and pressure vessels to prevent development of pressure or vacuum, as a result of filling or emptying and atmospheric temperature changes, from exceeding the design pressure of the tank or vessel. Protection must 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.

(iv) 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 must be based on the maximum anticipated simultaneous flow.

(v) Unless the vent is designed to limit the internal pressure 2.5 p.s.i. or less, the outlet of vents and vent drains must 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.

(vi) Tanks and pressure vessels storing Category 1 flammable liquids must be equipped with venting devices which must be normally closed except when venting to pressures or vacuum conditions. Tanks and pressure vessels storing Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100°F (37.8°C) liquids must be equipped with venting devices which must be normally closed except when venting under pressure or vacuum conditions, or with approved flame arresters.

Exemption: Tanks of 3,000 bbls. (barrels) capacity or less containing crude petroleum in crude-producing areas; and, outside aboveground atmospheric tanks under 1,000 gallons capacity containing other than Category 1 flammable liquids may have open vents. (See (2)(f)(ii) of this section.)

(vii) Flame arresters or venting devices required in (e)(vi) of this subsection may be omitted for Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100°F (37.8°C) where conditions are such that their use may, in case of obstruction, result in tank damage.

(e) **Emergency relief venting for fire exposure for aboveground tanks.**

(i) Every aboveground storage tank must have some form of construction or device that will relieve excessive internal pressure caused by exposure fires.

(ii) In a vertical tank the construction referred to in (e)(i) of this subsection 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 must be constructed to fail preferential to any other seam.

(iii) Where entire dependence for emergency relief is placed upon pressure relieving devices, the total venting capacity of both normal and emergency vents must 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, you must take into account the effects of heat or gas resulting from polymerization, decomposition, condensation, or self-reactivity. The total capacity of both normal and emergency venting devices must be not less than that derived from Table H-10 except as provided in (e)(v) and (vi) of this subsection. 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 larger relief valve or valves. You must calculate the wetted area of the tank on the basis of 55% of the total exposed area of a sphere or spheroid, 75% of the total exposed area of a horizontal tank and the first thirty feet above grade of the exposed shell area of a vertical tank.

TABLE 10
WETTED AREA VERSUS CUBIC FEET
FREE AIR PER HOUR
(14.7 psia and 60°F)

Square feet	CFH	Square feet	CFH	Square feet	CFH
20	21,100	200	211,000	1,000	524,000
30	31,600	250	239,000	1,200	557,000
40	42,100	300	265,000	1,400	587,000

Square feet	CFH	Square feet	CFH	Square feet	CFH
50	52,700	350	288,000	1,600	614,000
60	63,200	400	312,000	1,800	639,000
70	73,700	500	354,000	2,000	662,000
80	84,200	600	392,000	2,400	704,000
90	94,800	700	428,000	2,800	742,000
100	105,000	800	462,000	and	
120	126,000	900	493,000	over	
140	147,000	1,000	524,000		
160	168,000				
180	190,000				
200	211,000				

(iv) For tanks and storage vessels designed for pressure over 1 p.s.i.g., you must determine the total rate of venting in accordance with Table H-10, except that when the exposed wetted area of the surface is greater than 2,800 square feet, you must calculate the total rate of venting 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 $Q = 21{,}000A^{0.82}$.

(v) The total emergency relief venting capacity for any specific stable liquid may be determined by the following formula:

Cubic feet of free air per hour = V

$$V = \frac{1337}{L\,M}$$

V = Cubic feet of free air per hour from Table H-10.

L = Latent heat of vaporization of specific liquid in B.t.u. per pound.

M = Molecular weight of specific liquids.

(vi) The required airflow rate of (e)(iii) or (v) of this subsection may be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only one factor may be used for any one tank.

0.5 for drainage in accordance with (2)(g)(ii) of this section for tanks over 200 square feet of wetted area.

0.3 for approved water spray.

0.3 for approved insulation.

0.15 for approved water spray with approved insulation.

(vii) You must arrange the outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding 2.5 p.s.i.g. 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.

(viii) Each commercial tank venting device must 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, ex-

pressed in cubic feet per hour of air at 60°F and at a pressure of 14.7 p.s.i.a.

(ix) You must determine the flow capacity of tank venting devices 12 inches and smaller in nominal pipe size 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 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 word "calculated" appears on the nameplate, and the computation is based on a flow coefficient of 0.5 applied to the rated orifice area.

(f) **Vent piping for aboveground tanks.**

(i) Vent piping must be constructed in accordance with WAC 296-24-33007 of this section.

(ii) Where vent pipe outlets for tanks storing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100°F (37.8°C), are adjacent to buildings or public ways, you must locate them so that the vapors are released at a safe point outside of buildings and not less than twelve feet above the adjacent ground level. In order to aid their dispersion, vapors must be discharged upward or horizontally away from closely adjacent walls. Vent outlets must be located so that flammable vapors will not be trapped by eaves or other obstructions and must be at least 5 feet from building openings.

(iii) When tank vent piping is manifolded, pipe sizes must 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.

(g) **Drainage, dikes, and walls for aboveground tanks.**

(i) **Drainage and diked areas.** You must provide the area surrounding a tank or a group of tanks with drainage as in (g)(ii) of this subsection, or you must dike as provided in (g)(iii) of this subsection, to prevent accidental discharge of liquid from endangering adjoining property or reaching waterways.

(ii) **Drainage.** Where protection of adjoining property or waterways is by means of a natural or man-made drainage system, such systems must comply with the following:

(A) You must provide a slope of not less than 1% away from the tank toward the drainage system.

(B) The drainage system must terminate in vacant land or other area 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 must be so located that, if the flammable liquids in the drainage system are ignited, the fire will not seriously expose tanks or adjoining property.

(C) The drainage system, including automatic drainage pumps, must not discharge to adjoining property, natural water courses, public sewers, or public drains unless the discharge of flammable liquids would not constitute a hazard, or the system is so designed that it will not permit flammable liquids to be released.

(iii) **Diked areas.** 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 must comply with the following requirements:

(A) Except as provided in (g)(iii)(B) of this subsection, the volumetric capacity of the diked area must 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. You must calculate the capacity of the diked area enclosing more than one tank by deducting the volume of the tanks other than the largest tank below the height of the dike.

(B) For a tank or group of tanks with fixed roofs containing crude petroleum with boilover characteristics, the volumetric capacity of the diked area must be not less than the capacity of the largest tank served by the enclosure, assuming a full tank. You must calculate the capacity of the diked enclosure by deducting the volume below the height of the dike of all tanks within the enclosure.

(C) Walls of the diked area must be of earth, steel, concrete or solid masonry designed to be liquidtight and to withstand a full hydrostatic head. Earthen walls three feet or more in height must have a flat section at the top not less than two feet wide. The slope of an earthen wall must be consistent with the angle of repose of the material of which the wall is constructed.

(D) You must restrict the walls of the diked area to an average height of six feet above interior grade.

(E) Where provision is made for draining water from diked areas, you must provide drainage at a uniform slope of not less than 1% away from tanks toward a sump, drainbox, or other safe means of disposal located at the greatest practical distance from the tank. You must normally control such drains in a manner so as to prevent flammable liquids from entering natural water courses, public sewers, or public drains, if their presence would constitute a hazard. Control of drainage must be accessible under fire conditions.

(F) You must not permit any loose combustible material, empty or full drum or barrel, within the diked area.

(G) You must subdivide each diked area containing two or more tanks preferably by drainage channels or at least by intermediate curbs in order to prevent spills from endangering adjacent tanks within the diked area as follows:

(I) When storing normally stable liquids in vertical cone roof tanks constructed with weak roof-to-shell seam or approved floating roof tanks or when storing crude petroleum in producing areas in any type of tank, one subdivision for each tank in excess of 10,000 bbls. and one subdivision for each group of tanks (no tank exceeding 10,000 bbls. capacity) having an aggregate capacity not exceeding 15,000 bbls.

(II) When storing normally stable flammable liquids in tanks not covered in (g)(iii)(G)(I) of this subsection, one subdivision for each tank in excess of 100,000 gallons (2,500 bbls.) and one subdivision for each group of tanks (no tank exceeding 100,000 gallons capacity) having an aggregate capacity not exceeding 150,000 gallons (3,570 bbls.).

(III) When storing unstable liquids in any type of tank, one subdivision for each tank except that tanks installed in accordance with the drainage requirements of NFPA 15-1969, Standard for Water Spray Fixed Systems for Fire Protection must require no additional subdivision.

(IV) The drainage channels or intermediate curbs must 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, must be not less than eighteen inches in height.

(h) **Tank openings other than vents for aboveground tanks.**

(i) Connections for all tank openings must be vaportight and liquidtight. Vents are covered in (d) through (f) of this subsection.

(ii) You must provide each connection to an aboveground tank through which liquid can normally flow 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 must be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary, they must be suitable for the pressures, structural stresses, and temperatures involved, including fire exposures.

(iii) You must provide each connection below the liquid level through which liquid does not normally flow with a liquidtight closure. This may be a valve, plug, or blind, or a combination of these.

(iv) You must provide openings for gaging with a vapor tight cap or cover.

(v) For Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100°F (37.8°C), other than crude oils, gasolines, and asphalts, you must design and install the fill pipe so as to minimize the possibility of generating static electricity. A fill pipe entering the top of a tank must terminate within six inches of the bottom of the tank and must be installed to avoid excessive vibration.

(vi) You must locate filling and emptying connections which are made and broken outside of buildings at a location free from any source of ignition and not less than five feet away from any building opening. Such connection must be closed and liquidtight when not in use. The connection must be properly identified.

(3) **Installation of underground tanks.**

(a) **Location.** You must do excavation for underground storage tanks with due care to avoid undermining of foundations of existing structures. You must locate underground tanks or tanks under buildings 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 Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100°F (37.8°C), to the nearest wall of any basement or pit must be not less than one foot, and to any property line that may be built upon, not less than 3 feet. The distance from any part of a tank storing Category 3 flammable liquids with a flashpoint at or above 100°F (37.8°C) or Category 4 flammable liquids to the nearest wall of any basement, pit or property line must not be less than one foot.

(b) **Depth and cover.** You must set underground tanks on firm foundations and surrounded with at least 6 inches of noncorrosive, inert materials such as clean sand, earth, or gravel well tamped in place. You must place the tank in the hole with care since dropping or rolling the tank into the hole can break a weld, puncture or damage the tank, or scrape off the protective coating of coated tanks. You must cover tanks with a minimum of 2 feet of earth or with not less than one foot of earth, on top of which must be placed a slab of reinforced concrete not less than 4 inches thick. When underground tanks are, or are likely to be, subject to traffic, you must protect them against damage from vehicles passing over them by at least 3 feet of earth cover, or 18 inches of well-tamped earth, plus 6 inches of reinforced concrete or 8 inches of asphaltic concrete. When asphaltic or reinforced concrete paving is used as part of the protection, it must extend at least one foot horizontally beyond the outline of the tank in all directions.

(c) **Corrosion protection.** You must provide corrosion protection for the tank and its piping by one or more of the following methods:

(i) Use of protective coatings or wrappings;

(ii) Cathodic protection; or,

(iii) Corrosion resistant materials of construction.

(d) **Vents.**

(i) **Location and arrangement of vents for Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100°F (37.8°C).** Vent pipes from tanks storing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100°F (37.8°C), must be located so that the discharge point is outside of buildings, higher than the fill pipe opening, and not less than 12 feet above the adjacent ground level. Vent pipes must discharge only upward in order to disperse vapors. Vent pipes 2 inches or less in nominal inside diameter must not be obstructed by devices that will cause excessive back pressure. Vent pipe outlets must be located so that flammable vapors will not enter building openings, or be trapped under eaves or other obstructions. If the vent pipe is less than 10 feet in length, or greater than 2 inches in nominal inside diameter, the outlet must be provided with a vacuum and pressure relief device or there must be an approved flame arrester located in the vent line at the outlet or within the approved distance from the outlet.

(ii) **Size of vents.** You must vent each tank shall be vented through piping adequate in size to prevent blow-back of vapor or liquid at the fill opening while the tank is being filled. Vent pipes must be not less than one and one-fourth inch nominal inside diameter.

TABLE H-11

VENT LINE DIAMETERS

Maximum flow GPM	Pipe length*		
	50 feet	100 feet	200 feet
	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

* Vent lines of 50 ft., 100 ft., and 200 ft. of pipe plus 7 ells.

(iii) **Location and arrangement of vents for Category 3 flammable liquids with a flashpoint at or above 100°F (37.8°C) or Category 4 flammable liquids.** Vent pipes from tanks storing Category 3 flammable liquids with a flashpoint at or above 100°F (37.8°C) or Category 4 flammable liquids must terminate outside of the building and higher than the fill pipe opening. Vent outlets must be above normal snow level. They may be fitted with return bends, coarse screens or other devices to minimize ingress of foreign material.

(iv) Vent piping must be constructed in accordance with WAC 296-24-33007. Vent pipes must be laid so as to drain toward the tank without sags or traps in which liquid can collect. You must locate

them so that they will not be subjected to physical damage. The tank end of the vent pipe must enter the tank through the top.

(v) When tank vent piping is manifolded, pipe sizes must 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.

(e) **Tank openings other than vents.**

(i) Connections for all tank openings must be vapor or liquid tight.

(ii) You must provide openings for manual gaging, if independent of the fill pipe, with a liquid-tight cap or cover. If inside a building, you must protect each such opening against liquid overflow and possible vapor release by means of a spring-loaded check valve or other approved device.

(iii) Fill and discharge lines must enter tanks only through the top. Fill lines must be sloped toward the tank.

(iv) For Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100°F (37.8°C), other than crude oils, gasolines, and asphalts, you must design and install the fill pipe so as to minimize the possibility of generating static electricity by terminating within six inches of the bottom of the tank.

(v) You must locate filling and emptying connections which are made and broken outside of buildings at a location free from any source of ignition and not less than five feet away from any building opening. Such connection must be closed and liquidtight when not in use. The connection must be properly identified.

(4) **Installation of tanks inside of buildings.**

(a) **Location.** You must not permit tanks inside of buildings except as provided in WAC 296-24-33011 and 296-24-33015 through 296-24-33019.

(b) **Vents.** Vents for tanks inside of buildings must be as provided in subsections (2)(d), (e), (f)(ii) and (3)(d) of this section, except that emergency venting by the use of weak roof seams on tanks must not be permitted. Vents must discharge vapors outside the buildings.

(c) **Vent piping.** Vent piping must be constructed in accordance with WAC 296-24-33007.

(d) **Tank openings other than vents.**

(i) Connections for all tank openings must be vapor or liquid-tight. Vents are covered in (b) of this subsection.

(ii) You must provide each connection to a tank inside of buildings through which liquid can normally flow 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 must be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary, they must be suitable for the pressures, structural stresses, and temperatures involved, including fire exposures.

(iii) You must provide flammable liquid tanks located inside of buildings, except in one-story buildings designed and protected for flammable liquid storage, 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 (d)(ii) of this subsection, and if a separate valve, must be located adjacent to the valve required in (d)(ii) of this subsection.

(iv) You must provide openings for manual gaging, if independent of the fill pipe (see (d)(vi) of this subsection), with a vaportight cap or cover. You must protect each such opening against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device.

(v) For Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100°F (37.8°C) liquids other than crude oils, gasolines, and asphalts, you must design and install the fill pipe so as to minimize the possibility of generating static electricity by terminating within 6 inches of the bottom of the tank.

(vi) You must install the fill pipe inside of the tank to avoid excessive vibration of the pipe.

(vii) The inlet of the fill pipe must be located outside of buildings at a location free from any source of ignition and not less than five feet away from any building opening. You must close the inlet of the fill pipe and ensure it is liquidtight when not in use. You must properly identify the fill connection.

(viii) You must equip tanks inside buildings with a device, or other means must be provided, to prevent overflow into the building.

(5) **Supports, foundations, and anchorage for all tank locations.**

(a) **General.** You must install tank supports on firm foundations. Tank supports must be of concrete, masonry, or protected steel. Single wood timber supports (not cribbing) laid horizontally may be used for outside aboveground tanks if not more than 12 inches high at their lowest point.

(b) **Fire resistance.** You must protect steel supports or exposed piling by materials having a fire resistance rating of not less than 2 hours, except that steel saddles need not be protected if less than 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.

(c) **Spheres.** You must give the design of the supporting structure for tanks such as spheres special engineering consideration.

(d) **Load distribution.** Every tank must be so supported as to prevent the excessive concentration of loads on the supporting portion of the shell.

(e) **Foundations.** Tanks must rest on the ground or on foundations made of concrete, masonry, piling, or steel. You must design tank foundations to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation.

(f) **Flood areas.** Where a tank is located in an area that may be subjected to flooding, you must observe the applicable precautions outlined in (f) of this subsection.

(i) You must not locate any aboveground vertical storage tank containing a flammable liquid 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 in (f)(xiii), (xiv) and (xv) of this subsection.

(ii) You must provide independent water supply facilities at locations where there is no ample and dependable public water supply available for loading partially empty tanks with water.

(iii) In addition to the preceding requirements, you must safeguard each tank so located that more than 70%, but less than 100%, of its allowable liquid storage capacity will be submerged at the established maximum flood stage, by one of the following methods: You must raise the tank, or you must increase its height, until its top extends

above the maximum flood stage a distance equivalent to 30% or more of its allowable liquid storage capacity: Provided, however, That the submerged part of the tank must not exceed 2 1/2 times the diameter. Or, as an alternative to the foregoing, you must provide adequate noncombustible structural guides, designed to permit the tank to float vertically without loss of product.

(iv) You must ensure that each horizontal tank so located that more than 70% of its storage capacity will be submerged at the established flood stage, is 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 liquid and submerged by flood waters to the established flood stage, or adequately secured by other means.

(v) You must protect spherical and spheroidal tanks by applicable methods as specified for either vertical or horizontal tanks.

(vi) 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, you must safeguard each tank against movement when empty and submerged by high groundwater or flood waters by anchoring, weighting with concrete or other approved solid loading material, or securing by other means. Each such tank must be so constructed and installed that it will safely resist external pressures due to high groundwater or flood waters.

(vii) You must ensure that at locations where there is an ample and dependable water supply available, underground tanks containing flammable liquids, so installed that more than 70% of their storage capacity will be submerged at the maximum flood stage, are so anchored, weighted, or secured by other means, as to prevent movement of such tanks when filled with flammable liquids, and submerged by flood waters to the established flood stage.

(viii) You must provide pipe connections below the allowable liquid level in a tank with valves or cocks located as closely as practicable to the tank shell. Such valves and their connections to tanks must be of steel or other material suitable for use with the liquid being stored. You must not use iron.

(ix) At locations where an independent water supply is required, it must be entirely independent of public power and water supply. Independent source of water must be available when flood waters reach a level not less than 10 feet below the bottom of the lowest tank on a property.

(x) You must locate or design self-contained power and pumping unit so that pumping into tanks may be carried on continuously throughout the rise in flood waters from a level 10 feet below the lowest tank to the level of the potential flood stage.

(xi) Capacity of the pumping unit must be such that the rate of rise of water in all tanks must be equivalent to the established potential average rate of rise of flood waters at any stage.

(xii) You must test each independent pumping unit periodically to ensure that it is in satisfactory operating condition.

(xiii) You must ensure that structural guides for holding floating tanks above their foundations are designed so that there will be no resistance to the free rise of a tank, and that they are constructed of noncombustible material.

(xiv) The strength of the structure must be adequate to resist lateral movement of a tank subject to a horizontal force in any direc-

tion equivalent to not less than 25 pounds per square foot acting on the projected vertical cross-sectional area of the tank.

(xv) Where tanks are situated on exposed points or bends in a shoreline where swift currents in flood waters will be present, the structures must be designed to withstand a unit force of not less than 50 pounds per square foot.

(xvi) The filling of a tank to be protected by water loading must be started as soon as flood waters reach a dangerous flood stage. The rate of filling must be at least equal to the rate of rise of the floodwaters (or the established average potential rate of rise).

(xvii) Sufficient fuel to operate the water pumps must be available at all times to insure adequate power to fill all tankage with water.

(xviii) All valves on connecting pipelines must be closed and locked in closed position when water loading has been completed.

(xix) Where structural guides are provided for the protection of floating tanks, all rigid connections between tanks and pipelines must be disconnected and blanked off or binded before the floodwaters 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.

(xx) All valves attached to tanks other than those used in connection with water loading operations must be closed and locked.

(xxi) If a tank is equipped with a swing line, the swing pipe must be raised to and secured at its highest position.

(xxii) **Inspections.** The director or their designated representative must make periodic inspections of all plants where the storage of flammable liquids is such as to require compliance with the foregoing requirements, in order to assure the following:

(A) That all flammable liquid storage tanks are in compliance with these requirements and so maintained.

(B) That detailed printed instructions of what to do in flood emergencies are properly posted.

(C) That station 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.

(g) **Earthquake areas.** In areas subject to earthquakes, the tank supports and connections must be designed to resist damage as a result of such shocks.

(6) **Sources of ignition.** In locations where flammable vapors may be present, you must take precautions to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, and mechanical), spontaneous ignition, chemical and physical-chemical reactions, and radiant heat.

(7) **Testing.**

(a) **General.** You must perform strength testing on all tanks, whether shop built or field erected, 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 must be evidence of compliance with this strength test. You must perform strength testing on tanks not marked in accordance with the above codes before they are placed in service in accordance with good engineering principles and

you must make reference to the sections on testing in the codes listed in (l)(c)(i), (d)(ii) or (e)(ii) of this section.

(b) **Strength.** 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 pounds per square inch, you must test the tank and related piping hydrostatically to a pressure equal to the static head thus imposed.

(c) **Tightness.** In addition to the strength test called for in (a) and (b) of this subsection, you must test all tanks and connections for tightness. Except for underground tanks, you must make this tightness test 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. You must test underground tanks and piping, before being covered, enclosed, or placed in use, for tightness hydrostatically, or with air pressure at not less than three pounds per square inch and not more than five pounds per square inch.

(d) **Repairs.** You must correct all leaks or deformations 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.

(e) **Derated operations.** Tanks to be operated at pressures below their design pressure may be tested by the applicable provisions of (a) or (b) of this subsection based upon the pressure developed under full emergency venting of the tank.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-03-159, § 296-24-33005, filed 1/23/18, effective 2/23/18; WSR 15-24-100, § 296-24-33005, filed 12/1/15, effective 1/5/16. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060 and 29 C.F.R. 1910 Subpart Z. WSR 14-07-086, § 296-24-33005, filed 3/18/14, effective 5/1/14. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060. WSR 06-05-027, § 296-24-33005, filed 2/7/06, effective 4/1/06. Statutory Authority: Chapter 49.17 RCW. WSR 94-15-096 (Order 94-07), § 296-24-33005, filed 7/20/94, effective 9/20/94; WSR 88-23-054 (Order 88-25), § 296-24-33005, filed 11/14/88; Order 76-6, § 296-24-33005, filed 3/1/76; Order 73-5, § 296-24-33005, filed 5/9/73 and Order 73-4, § 296-24-33005, filed 5/7/73.]