

Table 2-1

Stable Liquids (Operating Pressure 2.5 psig or Less) (17.24 kPa)

Type of Tank	Protection	Minimum Distance in Feet from Property Line Which Is or Can Be Built Upon, Including the Opposite Side of a Public Way and Shall Be Not Less Than 5 Feet	Minimum Distance in Feet from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property and Shall Be Not Less Than 5 Feet
Floating Roof [See 2-2.1.1(a)]	Protection for Exposures*	1/2 times diameter of tank	1/6 times diameter of tank
	None	Diameter of tank but need not exceed 175 feet	1/6 times diameter of tank
Vertical with Weak Roof to Shell Seam (See 2-2.1.1)	Approved foam or inerting system on tanks not exceeding 150 feet in diameter**	1/2 times diameter of tank	1/6 times diameter of tank
	Protection for Exposures*	Diameter of tank	1/8 times diameter of tank
	None	2 times diameter of tank but need not exceed 350 feet	1/8 times diameter of tank
Horizontal and Vertical with Emergency Relief Venting To Limit Pressures to 2.5 psig	Approved inerting system on the tank or approved foam system on vertical tanks	1/2 times Table 2-6	1/2 times Table 2-6
	Protection for Exposures*	Table 2-6	Table 2-6
	None	2 times Table 2-6	Table 2-6

SI Units: 1 ft = 0.3048 m.

*See definition for "Protection for Exposures."

**For tanks over 150 ft in diameter use "Protection for Exposures" or "None" as applicable.

be involved in fire because the only place where an ignitable mixture exists is the narrow space above the oil surface within the seal itself.

Such tanks are unlikely to be ignited by flaming brands because such brand would rarely fall close to the seal space. A floating roof tank is unlikely to be ignited by a direct stroke of lightning unless the roof is almost at the top of the tank. As first marketed, floating roof tanks were occasionally ignited by an electrical charge on the roof surface which was released coincident with a lightning stroke. This charge could escape from the roof to the shell, producing a spark in the seal space, and igniting a small fire around the rim of the roof. Corrective measures, currently followed to guard against such an incident, involve placing metallic conductors (shunts) between the rim of the floating roof and the metallic parts of the seal which bear against the tank shell. Such measures have seemed to be largely effective. In any event, a fire in the seal space of a floating roof tank can often be extinguished by hand extinguishers or by small equipment manually applied. Of still greater importance is the fact that if a floating roof sinks, it interferes with the thermal insulation of the oil and obstructs development of a boil-over.

For all of the preceding reasons, a vertical steel tank with a floating roof is given a preferred rating from the standpoint of exposing surrounding property to fire. This preferred rating applies if the floating roof is surmounted with a fixed roof with adequate ventilation.

Note that a floating roof containing combustible flotation components [2-2.1.1(b)] which are subject to destruction from a seal fire is not classified as a floating roof.

Fixed Roofs. A fixed roof tank is any tank that has a metallic roof other than a covered floating roof. Open top tanks are not recognized in the Code.

Other Tanks. The second category listed in column 1 of Table 2-1 covers vertical tanks with fixed roofs having weak roof-to-shell seams. These tanks are assigned a slightly greater spacing requirement. Many large vertical tanks have an inherently weak roof attachment. Other tanks can have this feature incorporated in the design. (See Figure 2-2.)

The third category includes both horizontal and vertical tanks with emergency relief capabilities (other than a weak roof-to-shell attachment) capable of limiting the tank pressure to 2.5 psig under fire exposure conditions. In the absence of adequate pressure relief, these tanks are not immune to failure if unwetted portions of the shell are weakened by flame contact. Therefore, greater spacing requirements are assigned. Tanks which can be subjected to pressures greater than 2.5 psig under fire exposure conditions are covered by Table 2-2.

Tanks without some form of roof are not recognized in the Code.

Protection

Protection for exposures is defined in Section 1-2. The intent is that if a fire should occur in the tank, there will be some fire fighting equipment available to prevent the ignition of adjacent property by cooling it with water. It is assumed that the fire can safely burn out and that no attempt will be made to extinguish the tank fire.

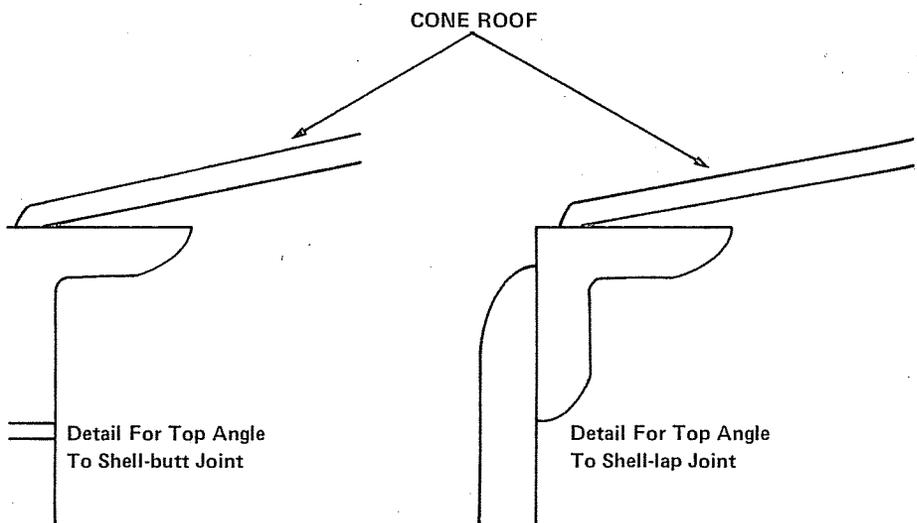


Figure 2-2. In a fire emergency, the design of a weak roof-to-shell seam allows the roof to tear free from the shell prior to the failure of any other seam. This type of construction is acceptable for relieving excessive internal pressure caused by exposure fires.

The next category concerns tanks equipped with an inerting system or with an approved foam extinguishing system — the latter being considered inapplicable for tanks exceeding 150 ft (46 m) in diameter because of logistic problems.

The third category is identical, except that the 150 ft (46 m) in diameter limitation has disappeared.

Minimum Distance to Property Lines

These two columns deal with slightly different situations. In the first, permanent structures can be built adjacent to the property line. In the second, intervening space is assured because of a public right of way, easement, railroad right of way, etc. In no case can a tank be placed less than 5 ft (1.5 m) from a property line. Spacing is prescribed as a function of tank diameter and tank construction, assuming that the effects of a fire will spread outside the limits of the owner's property, as influenced by the tank construction. The recognition of the type of liquid stored is covered in Sections 2-2, 2-3, and 2-4.

All of the preceding spacings have been carefully developed through fire experience over the 70 years or more since the Code was first conceived. Spacing distances to adjoining property, and also between tanks (Table 2-7), have occasionally been decreased over the years as the mechanism of fire spread has become better understood through years of experiment and experience.

Increased spacing for all types of tanks and all conditions is required because a tank operating at a pressure greater than 2.5 psig can create a more sudden and violent incident upon release of vapor than one operating at a lower pressure. Such an incident might include the failure of a tank by sudden tear-

Table 2-2

Stable Liquids (Operating Pressure Greater Than 2.5 psig) (17.24 kPa)

Type of Tank	Protection	Minimum Distance in Feet from Property Line Which Is or Can 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 on the Same Property
Any Type	Protection for Exposures*	1½ times Table 2-6 but shall not be less than 25 feet	1½ times Table 2-6 but shall not be less than 25 feet
	None	3 times Table 2-6 but shall not be less than 50 feet	1½ times Table 2-6 but shall not be less than 25 feet

SI Units: 1 ft = 0.3048 m.

*See Definition for "Protection for Exposures."

Table 2-3

Boil-over Liquids

Type of Tank	Protection	Minimum Distance in Feet from Property Line Which Is or Can Be Built Upon, Including the Opposite Side of a Public Way and Shall Be Not Less Than 5 Feet	Minimum Distance in Feet from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property and Shall Be Not Less Than 5 Feet
Floating Roof [See 2-2.1.1(a)]	Protection for Exposures*	½ times diameter of tank	¼ times diameter of tank
	None	Diameter of tank	¼ times diameter of tank
Fixed Roof [See 2-2.1.4(a)]	Approved foam or inerting system	Diameter of tank	⅓ times diameter of tank
	Protection for Exposures*	2 times diameter of tank	⅔ times diameter of tank
	None	4 times diameter of tank but need not exceed 350 feet	⅔ times diameter of tank

SI Units: 1 ft = 0.3048 m.

*See definition for "Protection for Exposures."

ing of the roof or shell, as a result of heating and softening of the metal from direct flame contact.

The phenomenon of a "boil-over" was discussed following 2-2.1.1.

Boiling results when heat is transmitted to the contents of a tank by the flame-exposed shell. The tank is usually intact and may not be involved in fire, other than vapor burning at the vent. If the tank has a weak roof-to-shell connection or is adequately vented, no liquid spill is likely. The fire can burn out without serious incident.

By contrast, a *boil-over* results from fire in an open top tank, not from surrounding fire on the ground. A tank having a fixed roof cannot burn unless the roof has been removed, as by explosion. If the roof has been removed and the tank contains an oil having boil-over characteristics, one or more boil-overs will likely occur. The increased spacing required by Table 2-3 reflects the need for safeguarding adjoining structures against this contingency.

Tanks containing unstable liquids (as defined in Section 1-2) are unpredictable as to performance during fire exposure. For this reason, greater spacings are required.

Tanks storing Class IIIB liquids are rarely involved in fire, and spacing requirements are minimized.

2.7 Where two tank properties of diverse ownership have a common boundary, the authority having jurisdiction may, with the written consent of the owners of the two properties, substitute the distances provided in 2-2.2.1 through 2-2.2.6 for the minimum distances set forth in 2-2.1.

This simply says that, where owners agree, each may accept the risk from the fire on the other's property to the same extent that he accepts the risk from his own.

2.8 Where end failure of horizontal pressure tanks and vessels can expose the property, the tank shall be placed with the longitudinal axis parallel to the nearest radiant exposure.

This requirement is based on the fact that a horizontal pressure tank exposed to fire is likely to travel (rocket) axially upon failure. Application of this rule involves the difficult decision as to what structure constitutes the nearest important risk. An office building on the same property or any occupied buildings on adjoining property would both be considered "important exposures." A tank containing flammable liquids might also be so considered.

Spacing (Shell-to-Shell) Between Any Two Adjacent Aboveground Tanks.

2.1 Tanks storing Class I, II or IIIA stable liquids shall be separated in accordance with Table 2-7, except as provided in 2-2.2.2.

Table 2-4 Unstable Liquids

Type of Tank	Protection	Minimum Distance in Feet from Property Line Which Is or Can 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 on the Same Property
Horizontal and Vertical Tanks with Emergency Relief Venting to Permit Pressure Not in Excess of 2.5 psig	Tank protected with any one of the following: Approved water spray, Approved inerting, Approved insulation and refrigeration, Approved barricade	Table 2-6 but not less than 25 feet	Not less than 25 feet
	Protection for Exposures*	2½ times Table 2-6 but not less than 50 feet	Not less than 50 feet
	None	5 times Table 2-6 but not less than 100 feet	Not less than 100 feet
Horizontal and Vertical Tanks with Emergency Relief Venting to Permit Pressure Over 2.5 psig	Tank protected with any one of the following: Approved water spray, Approved inerting, Approved insulation and refrigeration, Approved barricade	2 times Table 2-6 but not less than 50 feet	Not less than 50 feet
	Protection for Exposures*	4 times Table 2-6 but not less than 100 feet	Not less than 100 feet
	None	8 times Table 2-6 but not less than 150 feet	Not less than 150 feet

SI Units: 1 ft = 0.3048 m.

*See definition for "Protection for Exposures."

Table 2-5 Class IIIB Liquids

Capacity Gallons	Minimum Distance in Feet from Property Line Which Is or Can 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 on the Same Property
12,000 or less	5	5
12,001 to 30,000	10	5
30,001 to 50,000	10	10
50,001 to 100,000	15	10
100,001 or more	15	15

SI Units: 1 ft = 0.3048 m; 1 gal = 3.785 L.

Table 2-6
Reference Table for Use in Tables 2-1 to 2-4

Capacity Tank Gallons	Minimum Distance in Feet from Property Line Which Is or Can 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 on the Same Property
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

SI Units: 1 ft = 0.3048 m; 1 gal = 3.785 L.

A minimum spacing between tanks storing stable liquids is given in Table 2-7. The minimum of 3 ft (0.91 m) is based on the need for access for maintenance and painting, and for application of cooling streams. Spacing for larger tanks is an arbitrary fraction of tank diameters, adequate to permit an orderly and safe arrangement for pipe lines, and to prevent spread of fire from one tank to another. Spacing alone is not a safeguard against fire spread from spilled liquid, control of which is covered in 2-2.3. Exceptions to the preceding

Table 2-7

Minimum Tank Spacing (Shell-to-Shell)

	Floating Roof Tanks	Fixed Roof Tanks	
		Class I or II Liquids	Class IIIA Liquids
All tanks not over 150 feet diameter	$\frac{1}{6}$ sum of adjacent tank diameters but not less than 3 feet	$\frac{1}{6}$ sum of adjacent tank diameters but not less than 3 feet	$\frac{1}{6}$ sum of adjacent tank diameters but not less than 3 feet
Tanks larger than 150 feet diameter			
If remote impounding is in accordance with 2-2.3.2	$\frac{1}{6}$ sum of adjacent tank diameters	$\frac{1}{4}$ sum of adjacent tank diameters	$\frac{1}{6}$ sum of adjacent tank diameters
If impounding is around tanks in accordance with 2-2.3.3	$\frac{1}{4}$ sum of adjacent tank diameters	$\frac{1}{3}$ sum of adjacent tank diameters	$\frac{1}{4}$ sum of adjacent tank diameters

SI Units: 1 ft = 0.3048 m.

follow. (For problem-solving situations concerning spacing requirements, see Figures 2-3 and 2-4.)

2-2.2.2 Crude petroleum tanks having individual capacities not exceeding 126,000 gal (3,000 barrels), when located at production facilities in isolated locations, need not be separated by more than 3 ft (0.91 m).

This exception is made because in a location without close neighbors it would be illogical to require large spacing between several tanks where a single tank storing the same quantity of oil would be permissible in view of lack of exposure to neighboring property. Thus, tanks may be placed close together, as a single risk, resulting in economics to piping and supervision, without increasing the risk to others.

2-2.2.3 Tanks used only for storing Class IIIB liquids may be spaced no less than 3 ft (0.91 m) apart unless within a diked area or drainage path for a tank storing a Class I or II liquid, in which case the provisions of Table 2-7 apply.

Close spacing for tanks storing Class IIIB liquids is permitted because of the low risk of ignition of the stored product.

2-2.2.4 For unstable liquids, the distance between such tanks shall not be less than one-half the sum of their diameters.

Spacing is required to be greater for the reason previously discussed under 2-2.1.5.