UL 58

STANDARD FOR SAFETY

Steel Underground Tanks for Flammable and Combustible Liquids

UL Standard for Safety for Steel Underground Tanks for Flammable and Combustible Liquids, UL 58

Tenth Edition, Dated January 31, 2018

Summary of Topics

This New Edition of UL 58 is being issued to address the editorial maintenance of UL Standards for Safety.

No Text on This Page

UL 58

Standard for Steel Underground Tanks for Flammable and Combustible Liquids

The First through Third editions were titled Construction and Performance of Underground Storage Tanks.

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The Department of Defense (DoD) has adopted UL 58 on January 21, 1992 . The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

No Text on This Page

CONTENTS

INTRODUCTION

1 Scope

1.1 These requirements cover horizontal atmospheric-type steel tanks intended for the storage underground of flammable and combustible liquids.

1.2 These requirements cover single wall tanks, secondary containment tanks, multiple compartment single wall and multiple compartment secondary containment tanks.

1.3 The tanks covered by these requirements are intended for installation in accordance with the National Fire Protection Association Standard for the Installation of Oil-Burning Equipment, NFPA 31, the Flammable and Combustible Liquids Code, NFPA 30, the Automotive and Marine Service Station Code, NFPA 30A, the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37, the Fire Code, NFPA 1, and the International Fire Code, published by the International Code Council.

1.4 Tanks covered by these requirements are cylindrical tanks that are fabricated, inspected, and tested for leakage before shipment from the factory as completely assembled vessels.

1.5 These requirements do not apply to tanks covered by the Standard for Welded Steel Tanks for Oil Storage, API 650, nor tanks intended for use in chemical and petrochemical plants.

1.6 This Standard does not cover corrosion protection which may be required by local, state or federal authorities. Corrosion protection systems installed at the factory on carbon steel underground storage tanks are covered in the Standard for External Corrosion Protection System for Steel Underground Storage Tanks, UL 1746.

2 Units of Measurements

2.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component.

3.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

3.3 A component shall be used in accordance with its rating established for the intended conditions of use.

3.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

5 Glossary

5.1 For the purpose of this standard, the following definitions apply.

5.2 TYPE I TANK – A primary tank wrapped by an exterior steel shell that is in direct contact with the primary tank; where, the exterior shell is wrapped from 300 to 360 degrees of the primary tank circumference.

5.3 TYPE II TANK – An outer tank physically separated from the inner primary containment tank by standoffs; where, the inner tank is completely contained within the outer tank.

CONSTRUCTION

ALL TANKS

6 Capacities and Dimensions

6.1 Capacities, dimensions, and construction details shall comply with the applicable requirements of this standard.

6.2 Tables 1 and 2 of Appendix A give capacities for cylindrical tanks in gallons per foot of length and in liters per meter of length. For a tank with conical heads, the total capacity is obtained by adding one-third the height of the heads to the shell length. For a compartment tank, the total tank capacity is the sum of the capacity of each compartment.

6.3 The total capacity of a tank shall not be:

a) less than the rated nominal capacity and

b) more than 105 percent of the rated nominal capacity.

6.4 The total capacity is to be determined at the level of the lowest opening when the tank is in the intended installation position.

6.5 The overall length of a tank shall not be greater than 8 times its diameter.

7 Steel Thickness

7.1 General

7.1.1 Tanks shall comply with the Roark Equation or the External Pressure Test described in 20.1.

7.1.2 The minimum steel shell thickness for a primary tank is 0.123 inches (3.12 mm). The minimum steel shell thickness for a secondary tank is 0.093 inches (2.36 mm).

7.1.3 The minimum head thicknesses for all tanks, except the outer head of Type I tanks, are noted in Table 7.1. The minimum head thicknesses for the outer head of Type I tanks are noted in Table 7.2.

7.1.4 When the external pressure test, described in 20.1 is conducted successfully, the minimum steel thickness for the shell is reduced 25% from the calculated value using the Roark equation for the same length and diameter tanks.

Exception: Tanks with a length to diameter ratio exceeding 6 to 1 shall not have reductions in the shell thickness.

Table 7.1
Tank head thickness

Tank diameter,		Minimum head thickness,	
Inches	(m)	Inches	(mm)
Up to 64	(Up to 1.62)	.123	(3.12)
64.1 to 90	(1.63 to 2.28)	.167	(4.24)
90.1 to 126	(2.29 to 3.20)	.240	(6.10)
126.1 to 144	(3.20 to 3.66)	.302	(7.67)

Table 7.2
Type I tank outer head thickness

Tank diameter		Minimum head thickness	
Inches	(m)	Inches	(mm)
Up to 64	(Up to 1.62)	0.123	(3.12)
64.1 to 96	(1.63 to 2.44)	0.167	(4.24)
96.1 to 144	(2.45 to 3.66)	0.240	(6.10)

7.2 Roark equation

7.2.1 The calculated pressure from the Roark equation shall be equal to or greater than the external pressure at the bottom of the tank surrounded by only water and submerged 5 feet (1.52 m) or at a depth equal to the manufacturer's specified maximum burial depth, whichever is greater. The buckling pressure shall be calculated using the following equation:

$$\textit{Roark equation:} \quad P = \left[.807 E_s \, t_s^2 / (Lr)\right] \left[(1 - u^2)^{-3} \, (t_s / r)^2\right]^{.25}$$

in which:

P is buckling pressure, psi

E_s is modulus of elasticity of steel (29.5 x 10^6 psi for structural grade A36 carbon steel)

t_s is thickness of steel tank shell (inches)

L is length of tank (inches)

r is radius of tank (inches), and

u is Poisson's Ration (0.287 for structural grade A36 carbon steel)

Reference: Roark's Formulas for Stress and Strain, 6th Edition, Warren Young, Table 35, Case 19b, Page 690

7.2.2 Using the Roark formula, minimum steel shell thickness ($t_{s\ min}$) or the maximum tank length (L_{max}) can be calculated using the following equations, respectively:

$$t_{s\ min} = \left[\left(P_1 Lr^{3/2} (1 - u^2)^{3/4}\right) / (.807\ E_s)\right]^{.4}$$

$$L_{max} = [.807E_s t_s^2 / P_1 r][(1 - u^2)^{-3}(t_s / r)^2]^{.25}$$

in which:

P_1 is calculated external pressure at the bottom of a submerged tank in water, psi. The water depth equals 5 feet (1.52 m) or the maximum burial depth for the tank, whichever is greater, plus the tank diameter.

E_s is Modulus of Elasticity of steel, (29.5 x 10^6 psi for structural grade A36 carbon steel),

t_s is thickness of steel tank shell (inches),

L is length of tank (inches),

r is radius of tank (inches), and

u is Poisson's Ratio (0.287 for structural grade A36 carbon steel)

Note – Values for "E_s and "u" for other than A36 structural grade carbon steel shall be from recognized technical reference books or established by an engineering evaluation of the material.

7.2.3 The equivalent steel thickness (t_{eq}) for a Type I double wall steel tank is ($t_{inner}^{2.5} + t_{outer}^{2.5}$)$^{.4}$. This value is substituted into Roark's Equation.

7.2.4 The steel thickness for the inner and outer walls of a Type II tank is calculated independently using Roark's Equation.

7.3 Stiffeners

7.3.1 With the addition of one stiffener to the midpoint of a tank, the tank length can be increased 25%. When two stiffeners are placed at the 1/3 and 2/3 positions of a tank, the tank length can be increased 40%. With reference to 6.5, the overall length of a tank shall not be greater than 8 times its diameter. Other arrangements of stiffeners shall require an engineering evaluation. The thickness for the shell shall not be less than that specified by the Roark Equation for any tank with a length to diameter ratio exceeding 6 to 1.

7.3.2 Stiffeners shall be intermittently welded with 1 inch (25.4 mm) spots, not over 12 inches (304.8 mm) apart, and extend 360 degrees around the tank. The stiffeners shall have an opening at the top and bottom so that liquid and vapor can move past the stiffeners.

7.3.3 The required moment of inertia (I_{req}) of the stiffener is described below:

$$I_{req} = (0.11PLD^3) / E_s \ in^4$$

in which:

P is calculated external pressure at the bottom of a submerged tank in water. The water depth equals 5 feet (1.52 m) or the maximum burial depth for the tank, whichever is greater, plus the tank diameter. psi

L is rib spacing (inches)

D is outer diameter of tank (inches), and

E_s is modulus of steel (29.5 x 10^6 psi for structural grade A36 carbon steel)

The moment of inertia of the stiffener shall be verified from tables or calculations from recognized technical reference books, or the tank with stiffeners shall be subjected to the External Pressure Test, Section 20.

7.3.4 A bulkhead is to be treated as a stiffener.

7.3.5 The minimum steel thickness of a tank with stiffeners shall be in accordance with 7.1.2 and 7.1.3.

8 Lift Lugs

8.1 Lift lugs, when provided, shall comply with the load test requirements in Section 21, Lift Lugs, and the marking requirements in 23.7.

9 Materials

9.1 A tank shall be constructed of commercial or structural grade carbon steel or of Type 304 or 316 stainless steel, as noted in 9.2 and 9.3. Only new material shall be used.

9.2 Carbon steel shall:

a) Comply with the Specification for Carbon Structural Steel, ASTM A36-91; or Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality, ASTM A569/A569M-91a; or Specification for Hot-Rolled Carbon Steel Sheet and Strip, Commercial Quality, Heavy Thickness Coils (Formerly Plate), ASTM A635/635M-92; or

b) Have:

1) a carbon content of 0.3 percent or less, or a carbon equivalency of 0.53 percent or less, and

2) mechanical strength and welding characteristics at least equivalent to one of the steels specified in 9.2(a).

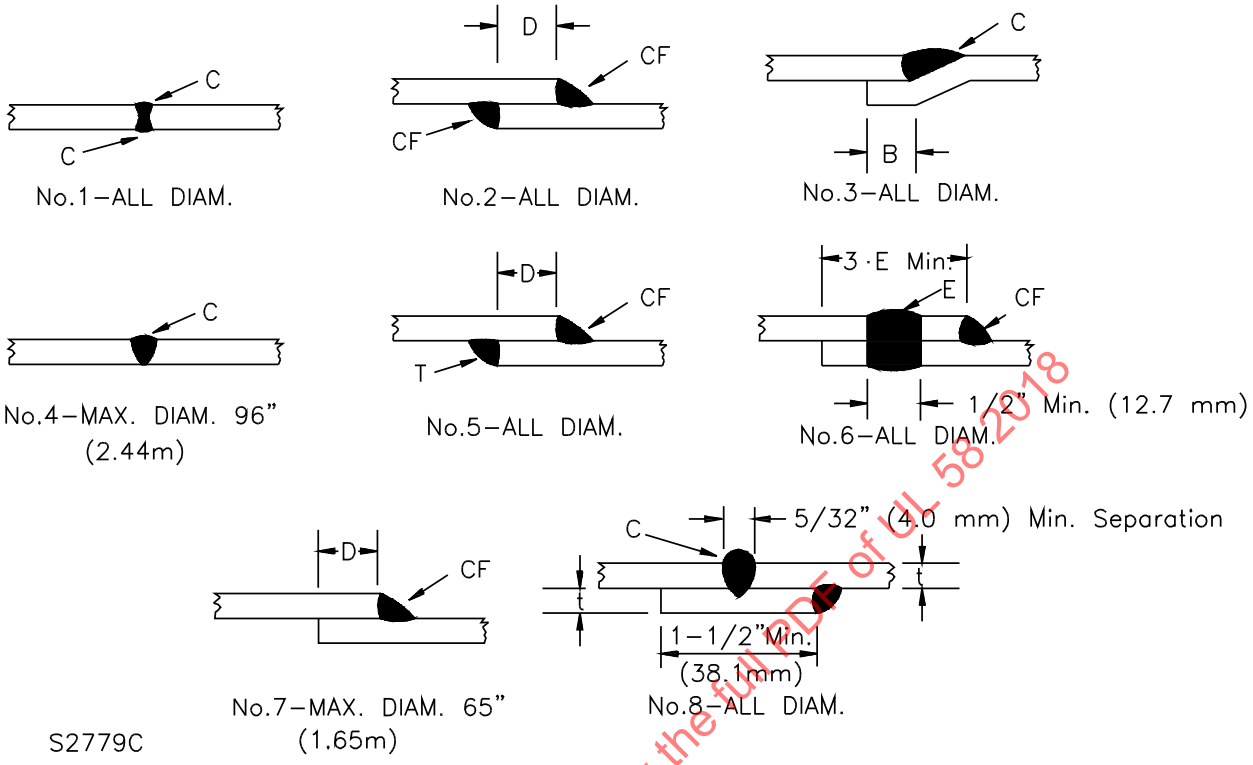
9.3 Stainless steel shall comply with the Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip, ASTM A167-92b; or Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels, ASTM A240-92b.

9.4 The thickness of steel is to be determined by five micrometer readings equally spaced along the edge of the full piece as rolled. Thickness is to be determined on the sheet not less than 3/8 inch (9.5 mm) from a cut edge and not less than 3/4 inch (19 mm) from a mill edge.

10 Shell Joints

10.1 A shell joint of a tank shall be one of the constructions illustrated in Figure 10.1.

Figure 10.1
Shell joints



B – Overlap – 1/2 inch (12.7 mm) minimum.

C – Continuous welds.

CF – All lap welds shall be continuous full fillet welds.

D – Overlap – 1/2 inch (12.7 mm) minimum for diameters 48 inches (1.2 m) or less; 3/4 inch (19.1 mm) minimum for diameters over 48 inches.

E – 1/2 inch (12.7 mm) minimum diameter lock weld, not over 12 inches (305 mm) apart.

T – Tack weld 1 inch (25 mm) spots, not over 12 inches (305 mm) apart.

t – Thickness of backup bar to be same as shell thickness.

a – No. 7 weld shall not be used for double wall tanks.

b – Shell joint No. 4 shall not be used on a tank larger than 96 inches (2.44 m) in diameter.

c – Shell joint No. 7 shall not be used on a single wall tank larger than 65 inches (1.65 m) in diameter.

11 Heads and Head Joints

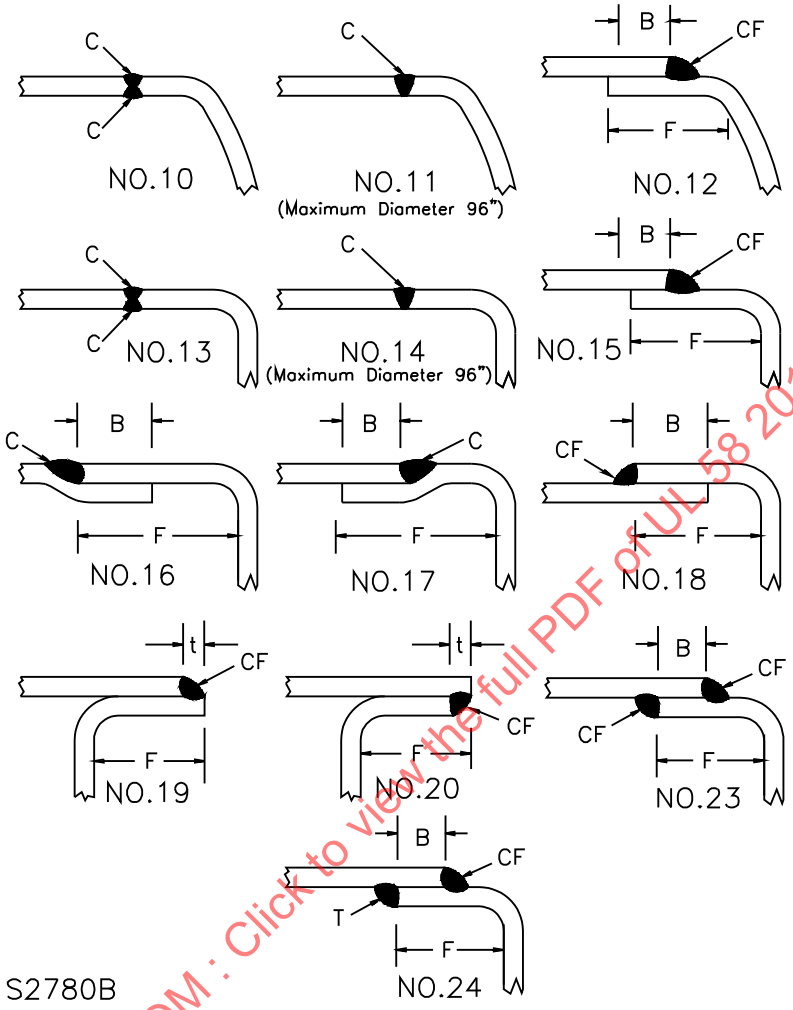
11.1 A head of a tank shall be constructed of not more than two pieces for diameters of 48 inches (1.22 m) or less, three pieces for diameters ranging from 49 to 96 inches (1.24 to 2.44 m), and four pieces for diameters ranging from 97 to 144 inches (2.46 to 3.66 m). When two or more pieces are used, joints shall comply with Figure 10.1, No.1.

11.2 A head of a tank shall be flat, dished, or conical.

11.3 The knuckle radius shall be greater than or equal to 2 times the head plate thickness. A head of a tank shall be attached to the shell by one of the joints illustrated in Figure 11.1.

11.4 A conical head shall have a height of not less than one-twelfth the diameter of the tank.

Figure 11.1
Head joints for all diameter tanks



B – Overlap – 1/2 inch (12.7 mm) minimum.

C – Continuous welds.

CF – Shall be continuous full fillet welds.

F – Not less than five times head thickness – minimum 1/2 inch (12.7 mm).

T – Tack weld 1 inch (25 mm) spots, not over 12 inches (305 mm) apart.

t – Minimum, 1 X shell thickness.

Height of cones heads – not less than one-twelfth diameter.

Height of dished heads shall conform to Table 11.1.

11.5 The depth of dish of a dished head shall not be less than that specified in Table 11.1

Table 11.1
Dished heads – minimum height of dish

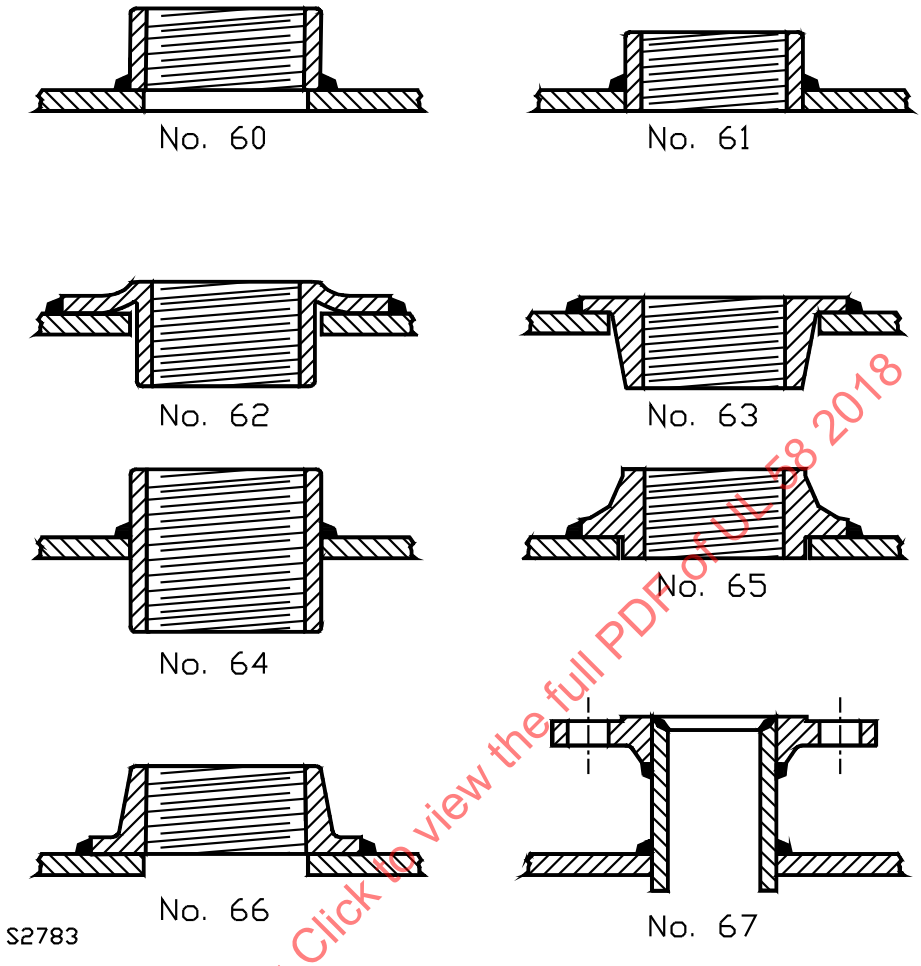
Diameter		Minimum dish	
Inches	(m)	Inches	(mm)
Up to 60	(Up to 1.52)	1-1/2	(38)
61 – 72	(1.55 – 1.83)	2	(51)
73 – 84	(1.85 – 2.13)	2-1/2	(64)
85 – 96	(2.16 – 2.44)	3-1/2	(89)
97 – 108	(2.46 – 2.74)	4-1/2	(114)
109 – 120	(2.77 – 3.05)	5-1/2	(140)
121 – 132	(3.07 – 3.35)	7	(178)
133 – 144	(3.38 – 3.66)	8	(203)

12 Pipe Connections

12.1 A pipe connection shall be provided by welding to the tank a standard threaded pipe coupling, a threaded flange, or a standard half pipe nipple, or by a bolted and gasketed flanged connection welded to a pipe nipple that in turn, is welded to the tank. All threads shall be standard NPT.

12.2 Conventional types of pipe connections are illustrated in Figure 12.1.

Figure 12.1
Pipe connections



All welds are to be full fillet welds, at least 1/8 inch (3.2 mm) radius.

No. 60 – Half pipe coupling.

No. 61 – Half pipe coupling.

No. 62 – Pressed steel, hub inside tank only.

No. 63 – Forged steel, hub inside tank.

No. 64 – Full pipe coupling.

No. 65 – Forged steel, with pilot.

No. 66 – Forged steel, without pilot.

No. 67 – Standard pipe nipple and welding flange.

12.3 The minimum length of thread in a pipe connection shall be specified in Table 12.1.

12.4 A pressed-steel pipe-connecting fitting shall be:

a) Installed with the hub section on the inside of the tank only and

b) Of the form illustrated in No. 62 of Figure 12.1.

The minimum thickness of the flange section shall be as specified in Table 12.1.

Table 12.1
Pipe connections

Pipe size[a] nominal	Minimum length of thread		Minimum thickness of flange section of pressed-steel fittings	
Inches	Inches	(mm)	Inches	mm
1/8	1/4	(6.4)		
1/4	3/8	(9.5)		
3/8	3/8	(9.5)		
1/2	1/2	(12.7)		
3/4	5/8	(15.9)	0.123	(3.12)
1	5/8	(15.9)	0.138	(3.51)
1-1/4	11/16	(17.5)	0.138	(3.51)
1-1/2	3/4	(19.1)	0.138	(3.51)
2	3/4	(19.1)	0.138	(3.51)
2-1/2	1	(25.4)	0.167	(4.24)
3	1	(25.4)	0.167	(4.24)
3-1/2	1	(25.4)	0.167	(4.24)
4	1-1/8	(28.6)	0.167	(4.24)
5	1-3/16	(30.2)		
6	1-1/4	(31.7)		
8	1-3/8	(34.9)		

[a] Standard for Welded and Seamless Wrought Steel Pipe, ANSI B36.10-1979(R1995).

12.5 A half pipe nipple shall be welded to the tank as illustrated in No. 67 of Figure 12.1.

12.6 Except as indicated in 12.7 and 12.8, all openings in a tank shall be located in the top, parallel with the longitudinal axis of the tank.

12.7 When the application of a tank is such that pipe-connecting openings in the top are required to be grouped, the openings shall be located off center of the longitudinal axis under the conditions specified in 12.8.

12.8 No opening in the shell of a tank shall be located more than 12 inches (305 mm) from the longitudinal centerline of the top, and the upper end of the pipe coupling or other pipe-connecting fitting welded to the tank shall terminate above the top of the shell.

12.9 All openings in a tank shall be closed with wooden plugs, metal covers, plastic thread protectors, or the equivalent, to protect the threads and exclude foreign matter while the tank is in storage or in transit.

12.10 Each tank shall have a pipe connection of a size not less than that specified in Table 12.2 for attachment of a vent pipe.

Table 12.2
Size of vent-pipe fitting

Capacity of tank		Nominal pipe size[a] inches
U.S. Gallons	(L)	
0 to 500	(Up to 1895)	1-1/4
500 to 3000	(1900 to 11355)	1-1/2
3001 to 10000	(11360 to 37855)	2
10001 to 20000	(37860 to 75710)	2-1/2
20001 to 35000	(75715 to 132490)	3
35001 to 50000	(132495 to 189270)	4

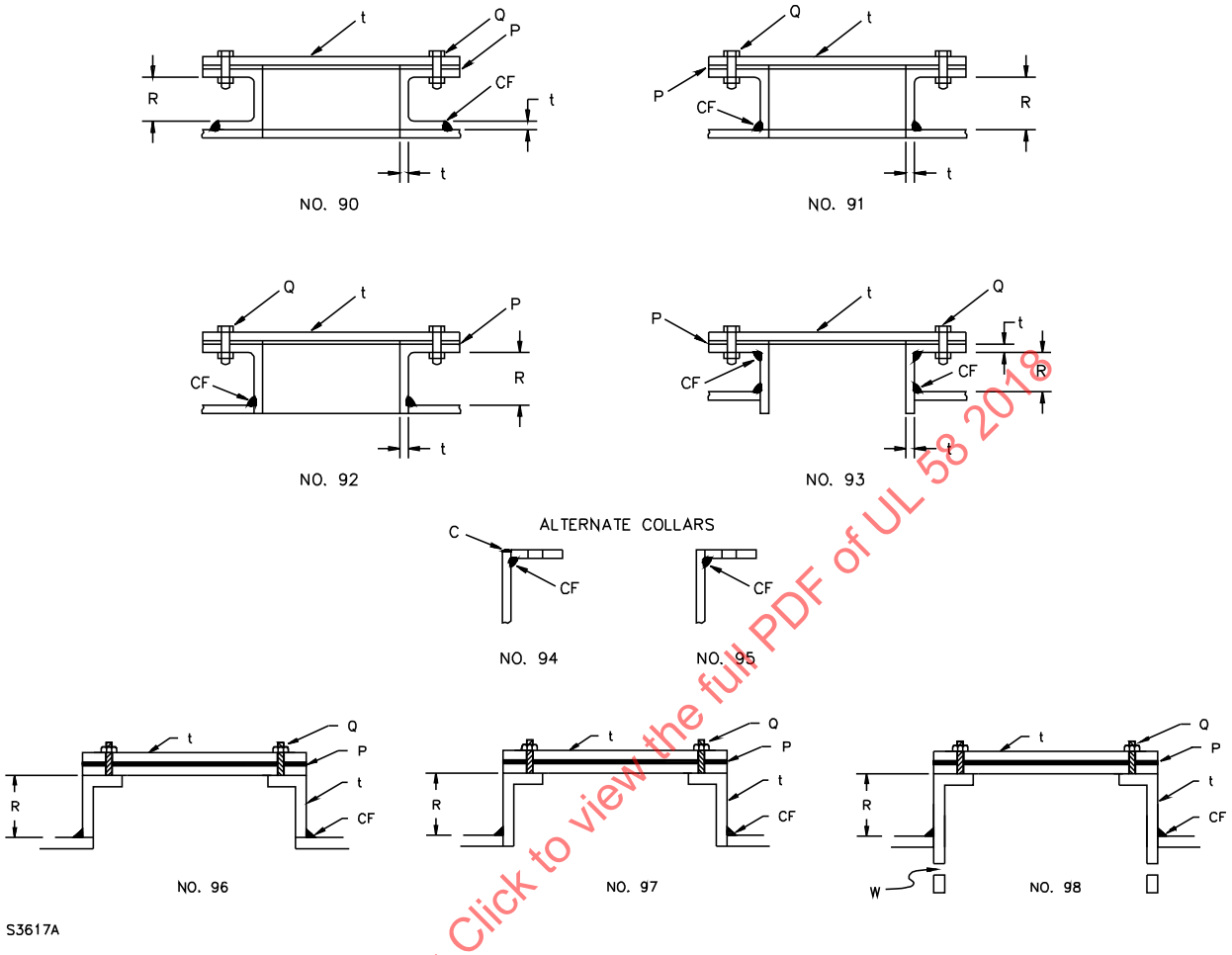
[a] Standard for Welded and Seamless Wrought Steel Pipe, ANSI B36.10-1979(R1995).

12.11 An opening for connection of a vent pipe which is located in a manway cover shall be grouped with at least one other opening.

13 Manways

13.1 A manway, when provided in a tank, shall be located above the highest intended liquid level and shall be of the bolted-cover type as illustrated in Figure 13.1.

Figure 13.1
Conventional manways



C – Continuous weld.

CF – Continuous full fillet weld.

P – Gasket material, 1/8 inch (3.2 mm) thick minimum - ring or face gasket.

Q – Minimum, 1/2 inch (12.7 mm) bolts spaced 4 inch (102 mm) centers maximum.

R – Minimum, 2 inches (51 mm) for tanks 6 feet (1.8 m) in diameter or larger.

t – Not less than 0.167 inch (4.50 mm) thick.

w – Optional weep holes. Two provided, minimum 1/4 inch (6.4 mm) diameter through hole, adjacent to the tank shell at the highest point of the tank

Note – Manways may have a single or double cover.

13.2 A manway-cover joint shall be provided with a gasket of material that complies with the requirements in the Standard for Gaskets and Seals, UL 157 and shall not be less than 1/8 inch (3.2 mm) thick. The gaskets are evaluated for specific end-use applications (i.e. gasoline, gasoline-alcohol blends, fuel oil and kerosene) as described in Table 4.2 of UL 157.

14 Striker Plates

14.1 A tank shall have a striker plate of steel at least 0.240 inch (6.10 mm) thick. Each striker plate shall be at least 8 inches (204 mm) wide, and at least 64 square inches (0.04 m^2) in area directly centered under:

a) Each opening, or

b) One opening that is marked as specified in 23.3.

15 Compartment Tanks

15.1 Bulkheads of a compartment tank shall be constructed so that any leakage through joints shall not result in leakage from one compartment to another. See Figure 15.1 for acceptable bulkhead constructions.

15.2 A single bulkhead of a compartment tank, illustrated in No. 101 and No. 102 of Figure 15.1, shall be constructed of one piece of material and shall be flat or dished. The height of a dished bulkhead shall not be less than that specified in Table 11.1.

15.3 A bulkhead of a double bulkhead tank, illustrated in No. 100 of Figure 15.1, shall be constructed of not more than two pieces for diameters of 48 inches (1.22 m) or less, three pieces for diameters ranging from 49 to 96 inches (1.24 to 2.44 m), and four pieces for diameters ranging from 97 to 144 inches (2.46 to 3.66 m). When two or more pieces are used, joints shall comply with the requirements for shell joints in Figure 10.1, No. 1.

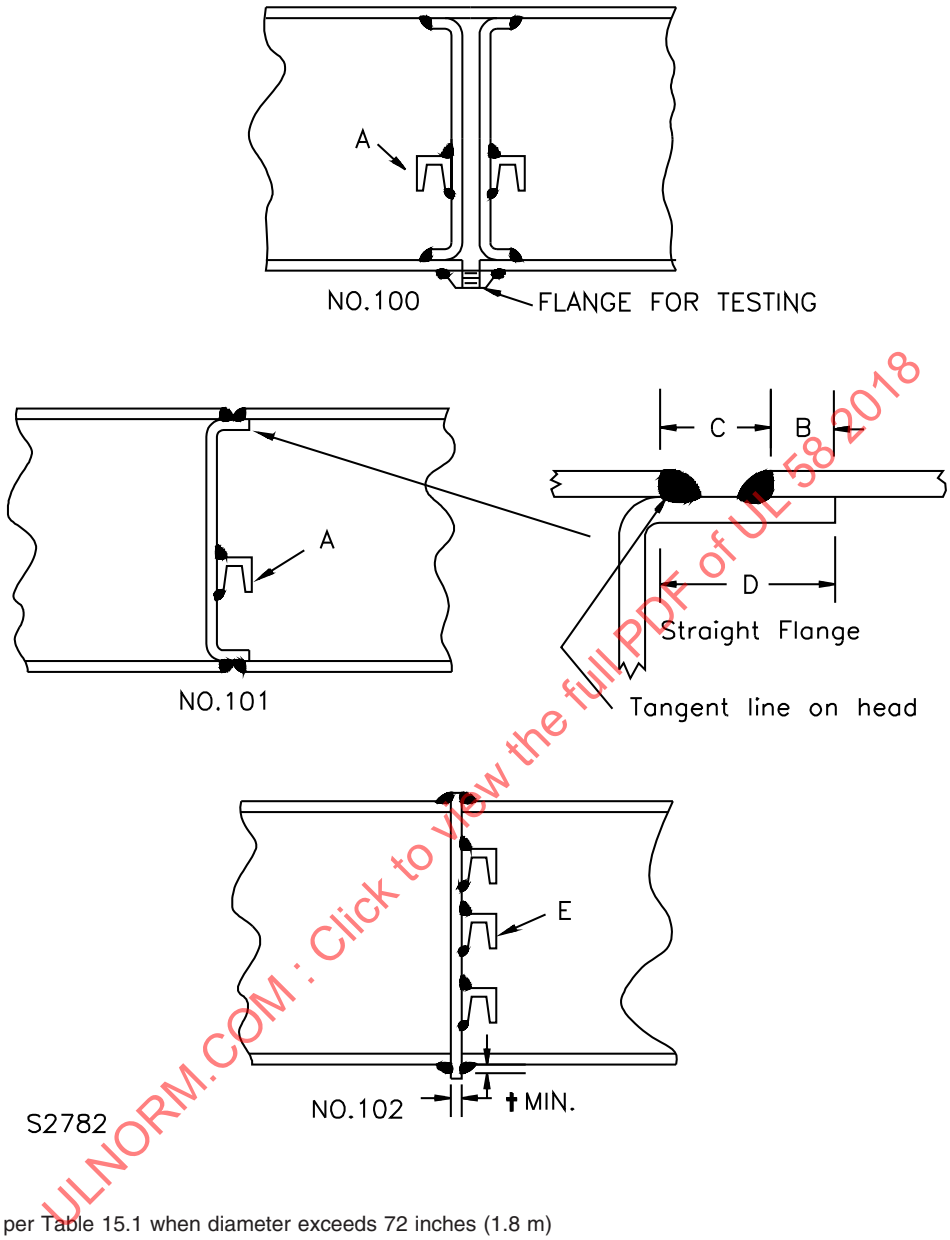
15.4 The minimum thickness of metal employed for a bulkhead shall comply with Table 7.1

15.5 A flanged flat bulkhead of a compartment tank more than 72 inches (1.83 m) in diameter shall be made of steel not less than 0.302 inch (7.67 mm) thick or it shall be braced as illustrated in Figure 15.2 and shall comply with Table 15.1.

15.6 A flanged flat bulkhead 72 inches (1.83 m) or less in diameter does not require bracing.

15.7 Surface bracing for unflanged flat bulkheads shall be as illustrated in No. 102 of Figure 15.1 and shall comply with Table 15.2.

Figure 15.1
Bulkheads for compartment tanks



A – Bracing as per Table 15.1 when diameter exceeds 72 inches (1.8 m)

B – 1/2 inch (12.7 mm) minimum

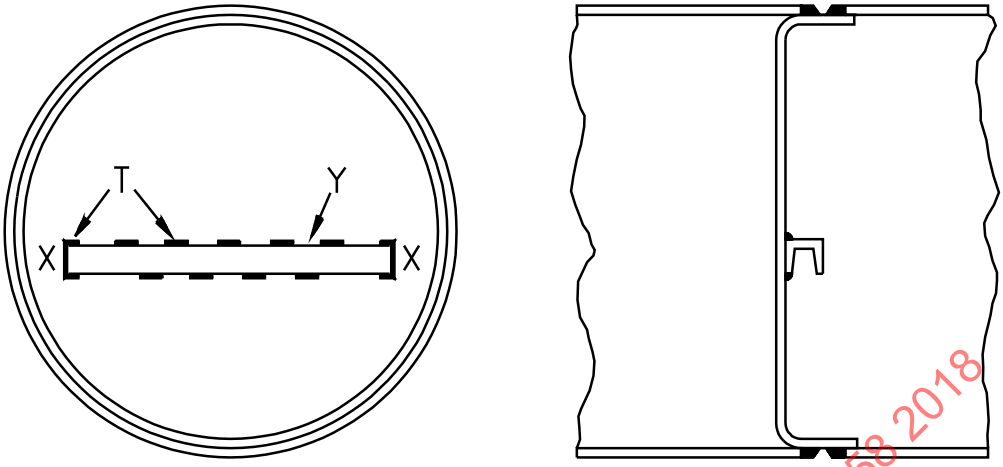
C – 3/4 inch (19.1 mm) minimum

D – 1-1/4 inch (31.8) mm minimum

E – Bracing as per Table 15.2. This bulkhead is not acceptable for Type I double wall tanks.

Note – Flange for testing may be located anywhere on the tank circumference, between two bulkheads.

Figure 15.2
Surface bracing for flanged flat bulkheads



T – Tack welds, not over 12 inches (0.3m) apart.
X – Not over 4 inches (102mm) from shell.
Y – Bracing [locate 6 inches (152mm) below center of head].

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Table 15.1
Surface bracing for flanged flat bulkheads

Diameter head		I-Beams	Channels
Inches	(m)	Section modulus(s) In.^{3}	Section modulus(s) In.^{3}
72 – 84	(1.83 – 2.13)	1.7[a]	1.1[a]
85 – 96	(2.16 – 2.44)	1.7[a]	1.9[a]
97 – 108	(2.46 – 2.74)	3.0[a]	3.0[a]
109 – 120	(2.77 – 3.05)	4.8[a]	3.0[a]
121 – 132	(3.07 – 3.35)	4.8[a]	4.3[a]
133 – 144	(3.38 – 3.66)	4.8[a]	4.3[a]

[a] Flange of I-beam or channel welded to bulkhead.

Table 15.2
Surface bracing for unflanged flat bulkheads

Diameter Head		Channels		Angles	
Inches	(m)	Size	Section Modulus(s) In.^{3}	Sizes, Inches	Min. Section Modulus(s) In.^{3}
Up to 60	(Up to 1.52)	3 inches – 4.1 pounds	1.1[a]	2 by 2 by 3/8 or 2-1/2 by 2-1/2 by 1/4	0.35
61 – 72	(1.55 – 1.83)	3 inches – 4.1 pounds	1.1[a]	3 by 3 by 7/16 or 3-1/2 by 3-1/2 by 5/16	0.95
73 – 84	(1.85 – 2.13)	4 inches – 5.4 pounds	1.9[a]	3-1/2 by 3-1/2 by 1/2 or 4 by 4 by 3/8	1.50
85 – 96	(2.16 – 2.44)	5 inches – 6.7 pounds	3.0[a]	4 by 4 by 1/2 or 5 by 3-1/2 by 3/8	2.00[a]
97 – 108	(2.46 – 2.74)	5 inches – 6.7 pounds	3.0[a]	4 by 4 by 3/4 or 6 by 4 by 3/8	2.80[a]
109 – 120	(2.77 – 3.05)	6 inches – 8.2 pounds	4.3[a]	5 by 5 by 5/8 or 6 by 4 by 1/2	3.90[a]
121 – 132	(3.07 – 3.35)	7 inches – 9.8 pounds	6.0[a]	5 by 5 by 3/4 or 6 by 4 by 9/16	4.50[a]
133 – 144	(3.38 – 3.66)	7 inches – 9.8 pounds	6.0[a]	5 by 5 by 3/4 or 6 by 4 by 9/16	4.50[a]

Note – See Figure 15.1 No. 102.

[a] Short leg of angle or flange of channel welded to head or bulkhead.

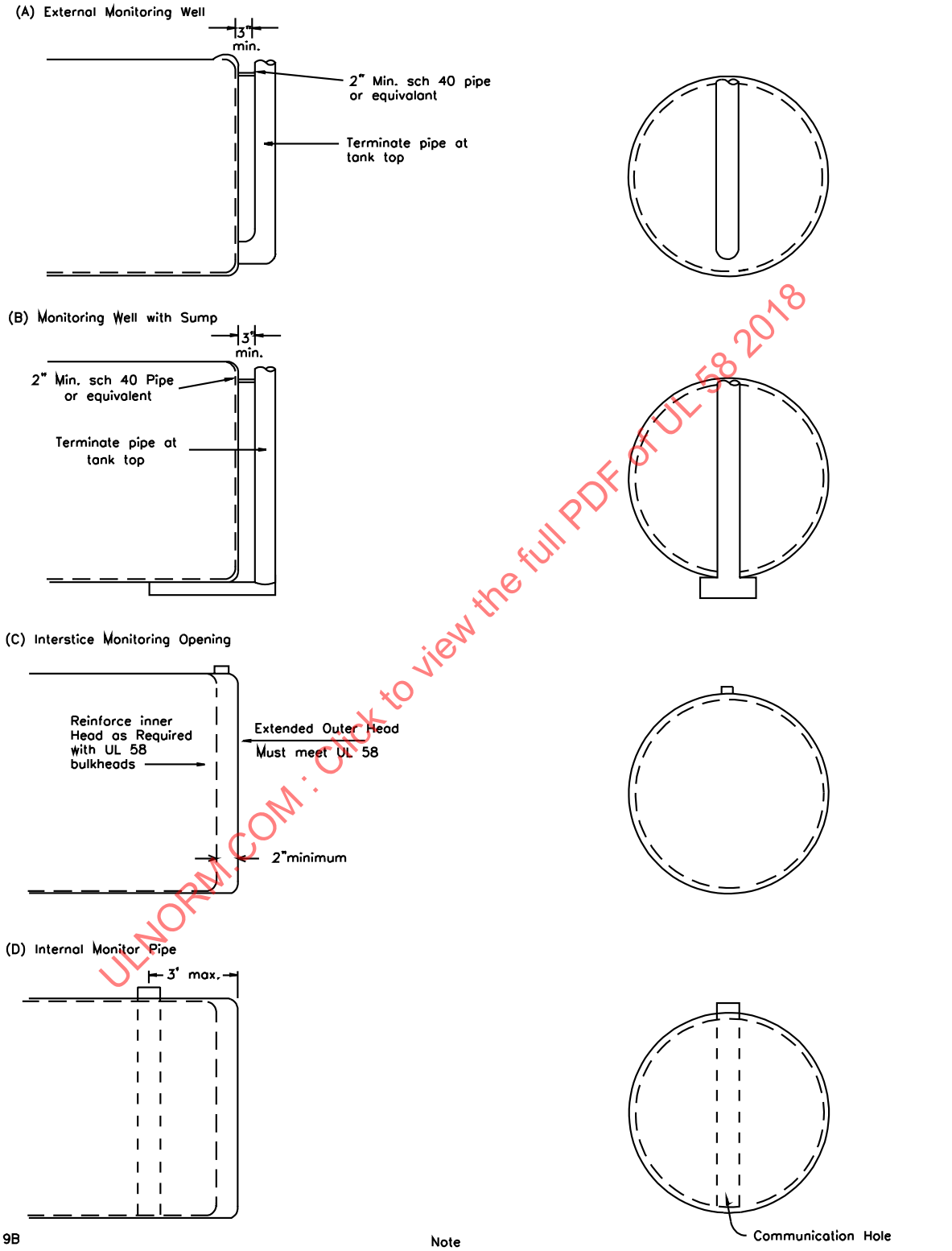
SECONDARY CONTAINMENT TANKS

16 Interstitial Monitor Access

16.1 All secondary containment tanks shall be capable of being monitored for leakage from the interior or exterior into the annulus area.

16.2 Monitoring-well pipe and fittings shall be attached to the tank in such a manner so as not to affect the structural integrity of the tank. See Figure 16.1. Other designs of interstitial monitor access will require an engineering investigation.

Figure 16.1
Monitor access for secondary containment



Note

1) An additional Interstitial monitoring port can be incorporated for purpose of removing combustible vapors in case of breach.

16.3 For 360° containment, all monitoring pipe connections to the inner tank, shall be welded to both the inner tank and the outer wrap where it exits the tank.

17 Construction

17.1 An inner head of a secondary containment tank which is not in direct contact with the outer head shall be constructed of not more than three pieces for tank diameters of 48 to 96 inches (1.2 to 2.4 m); and four pieces for diameters of 97 to 144 inches (2.42 to 3.6 m). When two or more pieces are used, joints shall comply with Figure 10.1, No.1.

17.2 An inner head of a secondary containment tank which is not in direct contact with the outer tank head shall be flat-flanged or dished.

17.3 A flanged flat inner head of a secondary containment tank more than 72 inches (1.8 m) in diameter which is not in direct contact with the outer tank head shall be made of not less than .302-inch (7.67-mm) thick material or it shall be braced in accordance with Figure 15.2 and Table 15.1.

17.4 A flanged flat inner head shall have an inside knuckle radius equal to at least 1.5 times the head thickness.

17.5 The depth of dish of a dished inner head shall not be less than that specified in Table 11.1.

17.6 Standoffs shall provide a defined annular space between the primary and secondary tank. Examples of standoffs are 3 x 1.5 inches (76.2 x 38.1 mm) channels at 4.1 pounds per foot (6.1 kg per meter), or larger with minimum material specifications equal to A-36 carbon steel, mesh material, and lap welds.

17.7 The channel standoffs shall be placed longitudinally, Figure 17.1. Channel standoffs placed circumferentially requires an engineering evaluation.