

UL 142

Steel Aboveground Tanks for Flammable and Combustible Liquids

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Underwriters Laboratories Inc. (UL)
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Northbrook, IL 60062-2096

UL Standard for Safety for Steel Aboveground Tanks for Flammable and Combustible Liquids, UL 142

Ninth Edition, Dated December 28, 2006

Revisions: This Standard contains revisions through and including December 15, 2007.

Summary of Topics

Revisions to the ninth edition of UL 142 are being published to address numerous issues that were discussed at past STP 142 meetings. These revisions include:

- 1. Revision to the scope for clarification***
- 2. Revisions to glossary terms***
- 3. Revisions to requirements regarding capacity and dimensions***
- 4. Revisions to requirements regarding bracings***
- 5. Revisions to requirements regarding tank bottoms and supports***
- 6. Revisions to requirements regarding manways***
- 7. Revision to requirement regarding normal and emergency venting***
- 8. Addition of a weld joint design for Figure 6.3***
- 9. Addition of a lift lug test***
- 10. Deletion of the Canadian Requirements Comparison Guide (CRG)***

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The following table lists the future effective dates with the corresponding reference.

Future Effective Dates	References
December 15, 2009	Paragraphs 8.1, 9.1, 9.1.1, 9.2, 9.4, 13.1.2, 13.3.1, 13.3.6, 13.4.1, 13.4.2, 13.4.4, 15.1.2, 15.1.3, 15.4.2, 21.3, 31.2.6, 44A.1, 44A.2, 44A.3, Tables 13.1, 13.3, 21.1, 31.1, A2, A3, and Figures 6.3, 7.1, 7.2, 9.1, 9.2, 9.3, 9.4, 13.1, 13.2,

The new and revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated April 6, 2007, August 31, 2007, and September 21, 2007.

The revisions dated December 15, 2007 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfonet.ul.com/ulforeword.html>.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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This Standard consists of pages dated as shown in the following checklist:

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1

UL 142

Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids

The first edition was titled Horizontal and Vertical Aboveground Storage Tanks for Hazardous Liquids. The second edition was titled Aboveground Storage Tanks for Hazardous Liquids.

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Ninth Edition

December 28, 2006

The most recent designation of ANSI/UL 142 as an American National Standard (ANSI) occurred on December 12, 2007. The ANSI approval for this standard does not include the cover page, transmittal pages, or the title page.

This ANSI/UL Standard for Safety, which consists of the Ninth edition with revisions through December 15, 2007, is under continuous maintenance, whereby each revision is ANSI approved upon publication.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

The Department of Defense (DoD) has adopted UL 142 on August 11, 1989. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements. 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 <http://csds.ul.com>.

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APPENDIX A Capacity and Wetted Area Tables

INTRODUCTION

1 Scope

1.1 These requirements cover steel primary, secondary and diked type atmospheric storage tanks intended for noncorrosive, stable flammable and combustible liquids that have a specific gravity not exceeding 1.0 in aboveground applications.

1.1 revised December 15, 2007

1.1.1 Each tank type may be fabricated in a combination of various shapes (cylindrical, rectangular or obround) and orientations (horizontal, vertical) with or without multiple compartments, as covered in this Standard.

1.1.1 added December 15, 2007

1.2 These tanks are intended for installation and use in accordance with the Flammable and Combustible Liquids Code, NFPA 30; the Standard for Installation of Oil-Burning Equipment, NFPA 31; the Motor Fuel Dispensing Facilities and Repair Garages, NFPA 30A; the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37; the Uniform Fire Code, NFPA 1; and the International Fire Code published by the International Code Council.

1.2 revised December 15, 2007

1.3 The tanks covered by these requirements are fabricated, inspected and tested for leakage before shipment from the factory as completely assembled vessels.

1.3 revised December 15, 2007

1.4 These requirements do not apply to tanks covered by the Specification for Field-Welded Tanks for Storage of Production Liquids, API 12D; and the Specification for Shop-Welded Tanks for Storage of Production Liquids, API 12F.

1.4 revised December 15, 2007

1.5 Deleted December 15, 2007

1.6 These requirements do not cover special evaluations for resistance to hurricanes, tornadoes, earthquakes, floods, or other natural disasters; or resistance to vehicle impact.

1.6 revised December 15, 2007

1.7 These requirements do not cover portable tanks intended for transporting flammable or combustible liquids (such as shipping containers), or mobile use applications (such as mounted on a trailer). These types of products are covered by separate UN, DOT, or equipment product standards.

1.7 revised December 15, 2007

2 General

2.1 Units of Measurement

2.1.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.2 Undated references

2.2.1 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.

3 Glossary

3.1 For the purpose of this standard the following definitions apply.

3.1.1 ABOVEGROUND TANK (ABOVEGROUND STORAGE TANK or AST) – A storage tank that is intended for installation above grade, at grade or below grade without backfill.

3.1.1 added December 15, 2007

3.2 ATMOSPHERIC TANK – A storage tank that has been designed to operate at pressures from – 0.5 psig to 1.0 psig (– 3.4 kPa to 6.9 kPa) measured at the top of the tank.

3.2 revised December 15, 2007

3.3 *Deleted December 15, 2007*

3.3.1 DIKE – A single wall construction forming a bottom and sides with open or closed top intended to provide secondary containment of aboveground tank(s) but not intended to be pressurized for leak testing. Dike types include combinations of rectangular or cylindrical shapes or horizontal or vertical orientations. Open top dike constructions do not have covers to prevent precipitation or debris from entering the dike area. Closed top dike constructions have covers to resist precipitation or debris from entering the dike area.

3.3.1 added December 15, 2007

3.4 DIKED TANK – A primary or secondary containment tank within a steel open or closed dike intended to provide at least 110 percent containment capacity of the primary tank(s) and spill containment.

3.4 revised December 15, 2007

3.5 *Deleted December 15, 2007*

3.6 EMERGENCY VENT – A storage tank opening or device that automatically relieves excessive internal pressure due to an external fire exposure or blockage of the normal vent.

3.6 revised December 15, 2007

3.6.1 INTERSTITIAL SPACE (ANNULAR SPACE or INTERSTICE) – A space between the walls of a multiple wall tank that is capable of communicating fluid from a leak in an adjacent wall to a collection point for monitoring.

3.6.1 added December 15, 2007

3.7 NORMAL VENT – A storage tank opening or device that automatically relieves internal pressure or vacuum during normal storage (atmospheric pressure equalization) and during normal operations (fill or withdraw). Normal vents are designed so as not to exceed 1.0 psig (6.9 kPa) pressure and minus 0.5 psig (minus 3.4 kPa) in the tank.

3.7 revised December 15, 2007

3.8 Deleted December 15, 2007

3.8.1 PERFORMANCE TESTS – A complete evaluation conducted on a limited quantity of representative tanks. These tests are intended to verify compliance with all applicable performance requirements in a standard.

3.8.1 added December 15, 2007

3.8.2 PRIMARY CONTAINMENT – The ability of a tank design and construction to contain a liquid while in normal use.

3.8.2 added December 15, 2007

3.9 PRIMARY CONTAINMENT TANK – The wall of a tank construction that provides primary containment.

3.9 revised December 15, 2007

3.9.1 PRODUCTION TESTS – A limited evaluation conducted on each tank prior to shipping. These tests are intended to verify compliance with production requirements in a standard, such as leakage.

3.9.1 added December 15, 2007

3.9.2 SECONDARY CONTAINMENT – The ability of a tank design or construction to contain a liquid only in abnormal use (from primary containment leakage or rupture).

3.9.2 added December 15, 2007

3.10 SECONDARY CONTAINMENT ABOVEGROUND TANK FOR FLAMMABLE LIQUIDS – A primary containment aboveground tank contained within a steel secondary containment shell forming an interstitial (annular) space, which is capable of being monitored for leakage into the space from either the interior or exterior walls. Secondary containment aboveground tank types include: horizontal cylindrical, vertical cylindrical, and rectangular.

3.10 revised December 15, 2007

3.11 STORAGE TANK (TANK) – A vessel having a liquid capacity that exceeds 60 gal (230 L), is intended for stationary installation, and is not used for processing.

3.11 revised December 15, 2007

3.12 TANK ACCESSORY – Optional devices or components of an aboveground tank intended to provide a specific function, such as walking or climbing access, load bearing support, spill containment, venting or heating.

3.12 added December 15, 2007

CONSTRUCTION – ALL TANKS

4 Capacities and Dimensions

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

4.2 Capacities per foot of length or height of cylindrical shells are given in Table A1 of Appendix A for convenience in checking capacities of tanks of various diameters.

4.3 The total (actual) 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.

4.3 effective June 28, 2007

5 Materials

5.1 A tank shall be constructed of commercial or structural grade carbon steel per 5.2 or Type 304 or 316 stainless steel per 5.3. Only new material shall be used.

5.1 effective June 28, 2007

5.2 Carbon steel shall be in accordance with (a), (b), or both:

- a) Comply with the Specification for Carbon Structural Steel, ASTM A36M; or Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, ASTM A1011/A1011M; or Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled, ASTM A635/A635M.
- b) Have a carbon content of 0.3 percent or less, or a carbon equivalency (CE) of 0.53 percent or less as determined by the formula below, and mechanical strength and welding characteristics at least equivalent to one of the steels specified in 5.2(a).

$$CE = C + (Mn + Si)/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$$

in which:

(C = Carbon, Mn = Manganese, Si = Silicone, Cr = Chromium, Mo = Molybdenum, V = Vanadium, Ni = Nickel and Cu = Copper)

5.2 effective June 28, 2007

5.3 Stainless steel shall comply with the Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip, ASTM A167; or Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels, ASTM A240/A240M.

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5.4 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 plate or sheet not less than 3/8 inch (9.5 mm) from a cut edge and not less than 3/4 inch (19.1 mm) from a mill edge.

6 Joints

6.1 Joint types for specific tank geometries shall be selected from Table 6.1 and shall comply with the constructions referenced in the appropriate Figures.

Table 6.1
Joint types

Tank type	Joint types				
	Shells Figure 6.1	Heads Figure 6.2	Bottom Figure 6.3	Roof Figure 6.4	Corner Figure 6.5
Horizontal cylindrical (primary and secondary)	All ^a	All	—	—	—
Vertical cylindrical (primary and secondary)	All ^a	—	All	All	—
Rectangular (primary and secondary)	All	—	—	—	All
Diked (open and closed top)	All	—	—	—	All
^a Shell joint #6 shall not be used on tanks with a diameter greater than 65 inches (1.65 m) unless it is used on the shell of the secondary containment tank where the secondary containment shell is in direct contact with the primary tank.					

Figure 6.1
Shell joints



NO. 1

Double-welded U, V, bevel, or square groove butt joint.



NO. 2

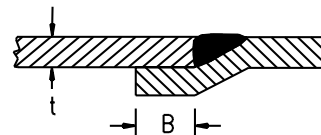
Full penetration and complete fusion.



NO. 3

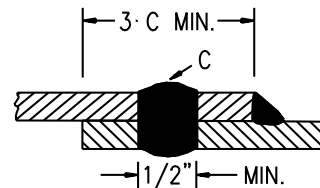
Double-welded full fillet lap joint, or single-welded full fillet lap joint on outside with 1-inch (25.4-mm) intermittent weld spaced not over 12 inches (0.3 m) on inside; minimum overlap, "A" – 1/2 inch (12.7 mm) for tank diameters 48 inches (1.2 m) or less, 3/4 inch (19.1 mm) for tank diameters over 48 inches (1.2 m).

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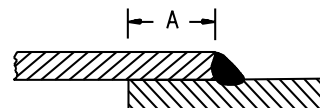
NO. 4

Groove weld equivalent in thickness to "t"; full penetration and complete fusion; minimum overlap, "B" – 1/2 inch (12.7 mm).



NO. 5

Full fillet weld on outside; "C" is 1/2 inch (12.7 mm) minimum diameter lock weld spaced not over 12 inches.



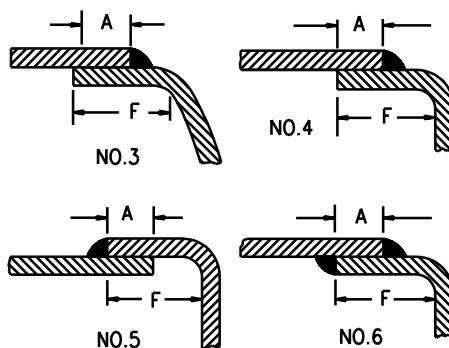
NO. 6

Single-welded full fillet lap joint; minimum overlap, "A" – 1/2 inch (12.7 mm) for tank diameters 48 inches (1.2 m) or less, 3/4 inch (19.1 mm) for tank diameters over 48 inches (1.2 m). This joint shall not be used on tanks with a diameter greater than 65 inches (1.65 m) unless it is used on the shell of the secondary containment tank where the secondary containment shell is in direct contact with the primary tank.

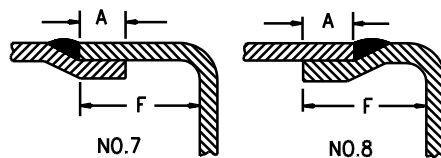
Figure 6.2
Head joints for horizontal cylindrical tanks



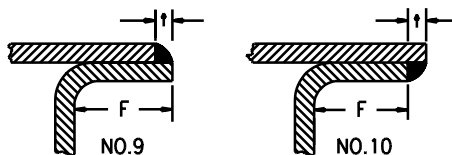
Double-welded U, V, bevel or square groove butt joint; full penetration and complete fusion.



Single-welded full fillet lap joint, single-welded full fillet lap joint on outside with 1-inch (25.4 mm) intermittent weld spaced not over 12 inches (0.3 m) on inside, or double-welded full fillet lap joint; minimum overlap, "A" - 1/2 inch (12.7 mm); "F" is five times head thickness or greater, but not less than 1/2 inch (12.7 mm).



Groove weld equivalent in thickness to that of head or shell; minimum overlap, "A" - 1/2 inch (12.7 mm); "F" is five times head thickness or greater, but not less than 1/2 inch (12.7 mm).



Full fillet weld; "t" - not less than thickness of shell; "F" is five times head thickness or greater, but not less than 1/2 inch (12.7 mm).

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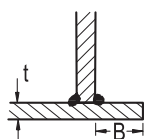


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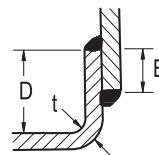
Figure 6.3
Bottom joints for vertical cylindrical tanks

Revised Figure 6.3 effective December 15, 2009

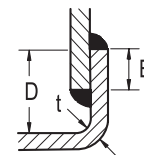


NO. 1

Double-welded full fillet joint; minimum overlap, "B" - 1/2 inch (12.7 mm) or 1-1/2 t, whichever is greater.

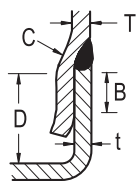


NO. 2



NO. 3

Double-welded full fillet lap joint; minimum overlap, "B" - 1/2 inch (12.7 mm) or 1-1/2 t, whichever is greater; "D" is 5 t or greater, but not less than 1 inch (25.4 mm).



NO. 4

Groove weld at least equivalent in thickness to that of thinner member joined; minimum overlap, "B" - 1/2 inch (12.7 mm) or 1-1/2 t, whichever is greater; depth of offset, "C" - equals T; "D" is 5t or greater, but not less than 1/2 inch (12.7 mm).



NO. 5

Double-welded U, V, bevel, or square groove butt joint; full penetration and complete fusion.

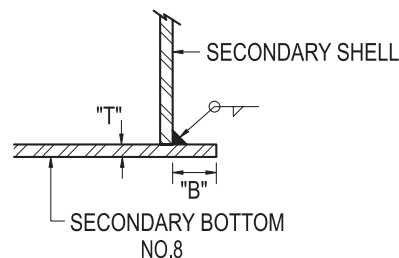


NO. 6



NO. 7

Single-welded full fillet lap joint, single-welded full fillet lap joint on outside with 1-inch (25.4 mm) intermittent weld spaced not over 12 inches (0.3 m) on inside; minimum overlap, "A" - 1/2 inch (12.7 mm); "F" is five times head thickness or greater, but not less than 1/2 inch (12.7 mm).



NO. 8

Welded full fillet joint
"B" = 1/2 inch (12.7mm) or 1 1/2 T, whichever is greater.

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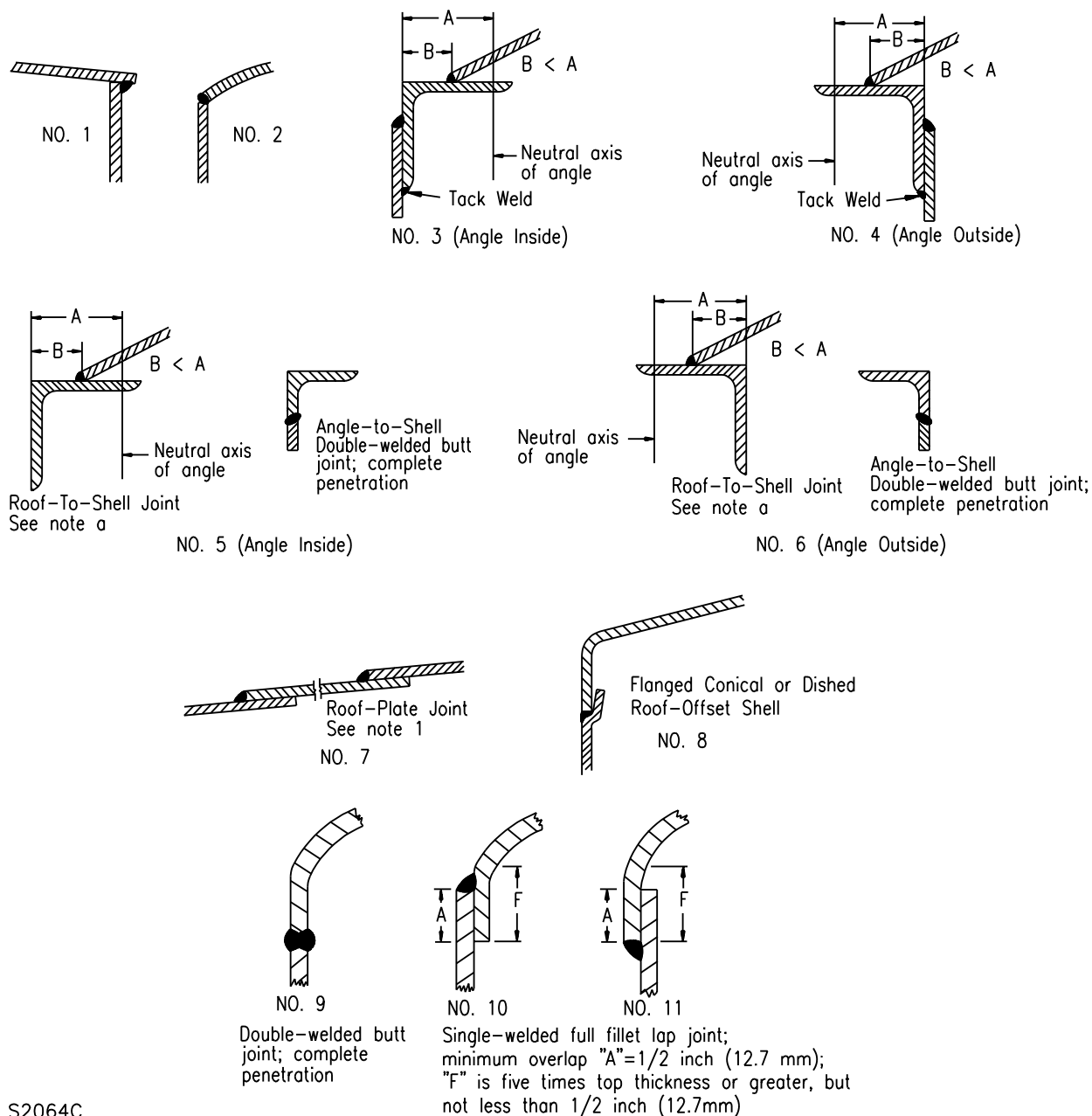


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Figure 6.4
Roof joints for vertical cylindrical tanks

Figure 6.4 effective June 28, 2007



S2064C

NOTE – Unless otherwise indicated, all welds are to be full fillet welds, at least the thickest of the thinnest material.

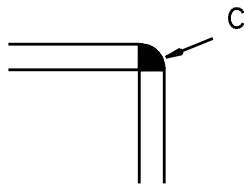
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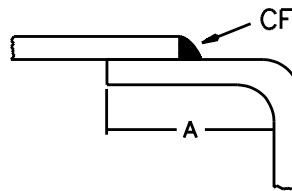
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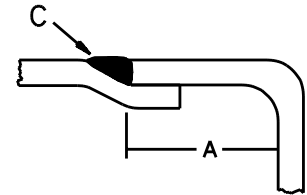
Figure 6.5
Corner joints



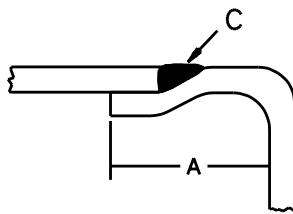
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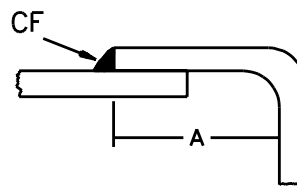
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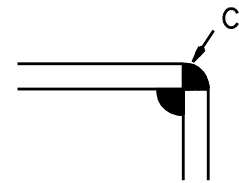
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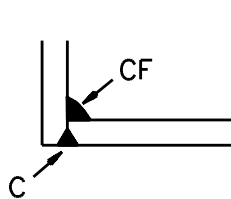
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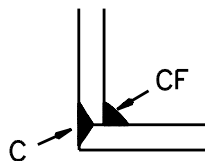
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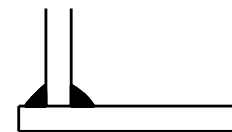
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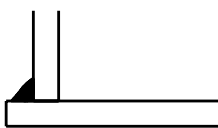
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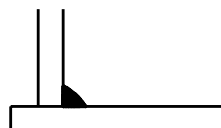
NO. 8



NO. 9



NO. 10



NO. 11



NO. 12

SM518A

C – Continuous weld.

CF – Shall be continuous full fillet welds.

A – Not less than 1/2 inch (12.7 mm).

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7 Tank Connections

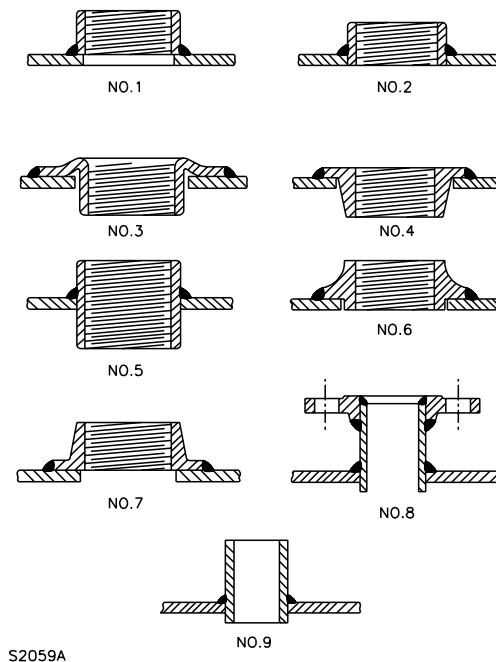
7.1 A tank connection shall be provided for each opening as illustrated in Figure 7.1 or 7.2 by:

- a) Welding a steel pipe coupling, threaded steel flange, or standard pipe nipple to the tank or
- b) A steel flange welded to a length of pipe that, in turn, is welded to the tank.

The reinforcing plates illustrated in Figure 7.2 are optional.

Figure 7.1
Pipe connections

Revised Figure 7.1 effective December 15, 2009



No. 1 – Half pipe coupling.

No. 2 – Half pipe coupling.

No. 3 – Pressed steel, hub inside tank only.

No. 4 – Forged steel, hub inside tank.

No. 5 – Full pipe coupling.

No. 6 – Forged steel, with pilot.

No. 7 – Forged steel, without pilot.

No. 8 – Standard pipe nipple and welding flange.

No. 9 – Standard pipe nipple – may be unthreaded.

NOTES –

1 All welds are to be full fillet welds.

2 Pipe connections Nos. 8 and 9 may be trimmed flush.

3 Pipe connections Nos. 3, 4, 5, 8, and 9 may be seal welded on the opposite side of the weld shown.

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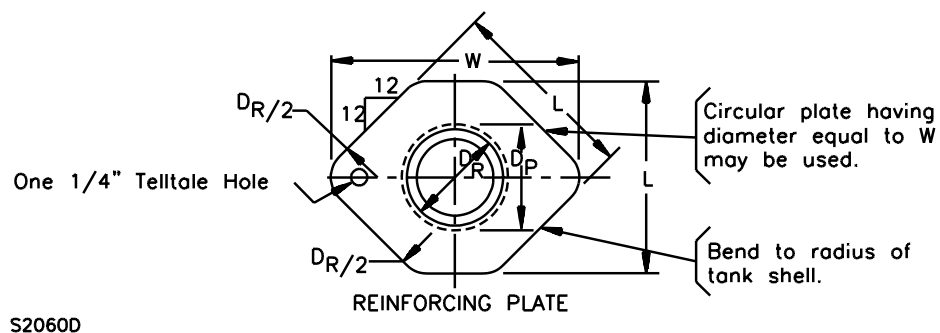
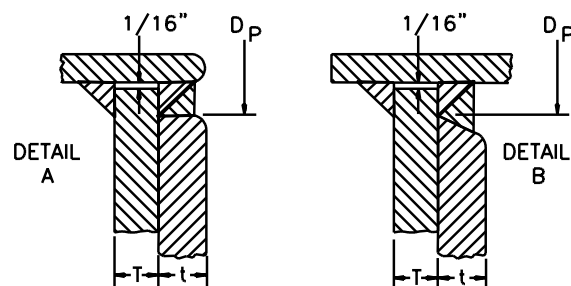
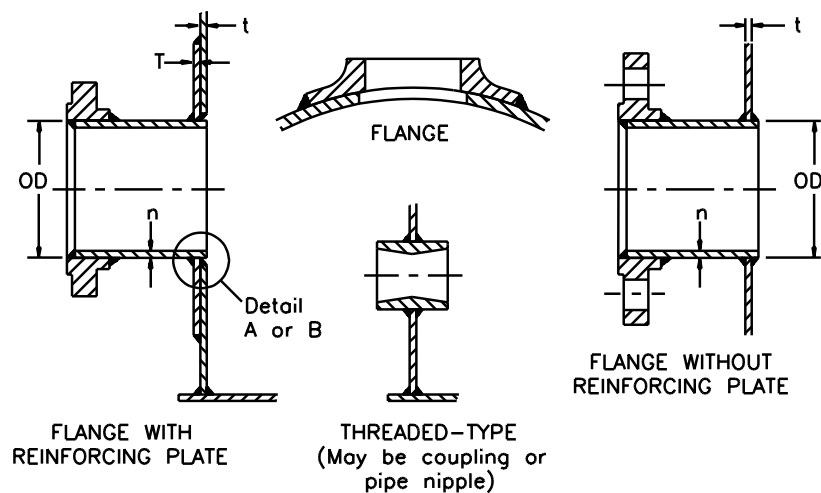


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Figure 7.2
Top or shell connections (See Table 7.1)

Revised Figure 7.2 effective December 15, 2009



S20600

NOTES –

- 1 All welds are to be full fillet welds.
- 2 D_P is the outside diameter of the pipe plus 5/8 inch (0.63 mm).
- 3 For SI units, 1 inch = 25.4 mm.

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Table 7.1
Top or shell connections (See Figure 7.2)
All dimensions in inches

Table 7.1 effective June 28, 2007

Size of connection	Outside diameter of pipe	Minimum thickness of flanged connection, pipe wall ^a (n)	Diameter of hole in reinforcing plate (D _R)	Length of side of reinforcing plate (L)	Width of reinforcing plate (W)
24	24	0.375	24-1/2	49-1/2	60
22	22	0.375	22-1/8	45-1/2	55-1/4
20	20	0.375	20-1/8	41-1/2	50-1/2
18	18	0.375	18-1/8	37-1/2	45-3/4
16	16	0.375	16-1/8	33-1/2	40-3/4
14	14	0.375	14-1/8	29-1/2	36
12	12-3/4	0.375	12-7/8	27	33
10	10-3/4	0.365	10-7/8	23	28-1/4
8	8-5/8	0.322	8-3/4	19	23-1/4
6	6-5/8	0.280	6-3/4	15-3/4	19-1/2
4	4-1/2	0.237	4-5/8	12	15-1/4
3	3-1/2	0.216	3-5/8	10-1/2	13-1/2
2	2-3/8	0.154	2-1/2	—	—
1-1/2	1.90	0.145	2	—	—

NOTE – For SI units, 1 inch = 25.4 mm.

^a Schedule 40 (standard) fittings, for sizes up to 12-inch, inclusive; for over 12- to 24-inch, inclusive, refer to the latest edition of ASTM A53/A53M, A134, A135, or A139. Pipe made from formed plate electrically butt-welded may be substituted for any of the above-mentioned pipe sections.

7.2 Connections in the roof of vertical tanks shall be as illustrated in Figure 7.1, 7.2, or 7.3. Connections in the shell of a vertical tank shall be in accordance with specifications in Figure 7.2. The reinforcing plates illustrated in Figures 7.2 and 7.3 are optional.

7.3 Hub slip-on welding and a welding-neck flange shall comply with the dimensional and material requirements for forged carbon steel flanges as specified in the Standard for Pipe Flanges and Flanged Fittings, ASME B16.5.

7.4 If a welding coupling is used, it shall comply with the Standard for Forged Steel Fittings, Socket Welding and Threaded, ASME B16.11, or the Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints, ASTM A865.

7.5 A threaded connection shall provide a minimum length of thread as specified in Table 7.4.

7.6 A pressed-steel-pipe-connecting fitting shall be installed with the hub section on the inside of the tank as illustrated in Detail 3 of Figure 7.1. The thickness of the flange shall not be less than specified in Table 7.1.

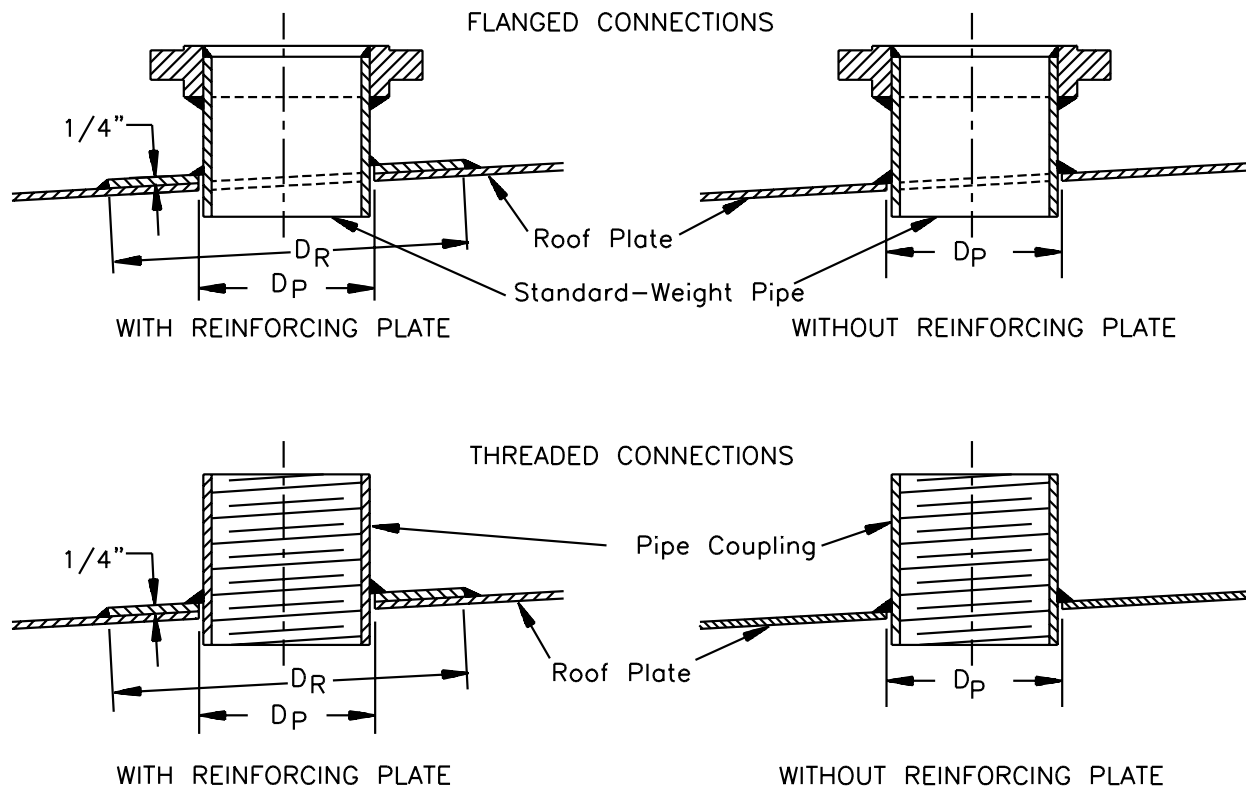
7.7 All pipe connection openings in a tank shall be protected with wooden or plastic plugs, metal covers, or their equivalent, to protect threads and exclude foreign matter while in storage or in transit.

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Figure 7.3
Roof connections for vertical tanks (roof nozzles) [See Tables 7.2 and 7.3]



S2065F

NOTES –

- 1 When roof nozzle is used for venting purposes, it shall be trimmed flush with reinforcing plate or roof line. Axis of connections is to be vertical. All welds shall be full fillet welds.
- 2 If reinforcing plates are used, they shall be of a thickness equal to or greater than the roof thickness.
- 3 For SI units, 1 inch = 25.4 mm

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