

UL 142

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Steel Aboveground Tanks for Flammable and Combustible Liquids

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety
for
Steel Aboveground Tanks for Flammable and Combustible Liquids, UL 142

Seventh Edition, Dated April 1, 1993

Revisions: This Standard contains revisions through and including July 22, 1998.

A change is indicated by a note following the affected item. The note is preceded and followed by an asterisk.

The new and revised requirements are substantially in accordance with UL's Bulletin on this subject dated July 22, 1998. The bulletin is now obsolete and may be discarded.

The revisions dated July 22, 1998 include a reprinted title page (page 1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety has been adopted by the Department of Defense.

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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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.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 and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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UL 142

Standard for

Steel Aboveground Tanks for Flammable and Combustible Liquids

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Seventh Edition

April 1, 1993

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

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.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

Section 1 effective April 1, 1994

1.1 These requirements cover steel atmospheric tanks intended for aboveground storage of noncorrosive, stable flammable, and combustible liquids that have a specific gravity not exceeding that of water.

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; and the Automotive and Marine Service Station Code, NFPA 30A.

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

1.4 These requirements do not apply to tanks covered by the Standard for Welded Steel Tanks for Oil Storage, ANSI/API 650; 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.

1.5 These requirements do not cover seismic loading.

1.6 Geometries or special constructions not specifically covered in these requirements shall be investigated on an individual basis.

1.7 A product that contains features, characteristics, components, materials, or systems new or different from those in use when the standard was developed, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this standard.

2 General

Section 2 effective April 1, 1994

2.1 Units of Measurement

2.1.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

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

Section 3 effective April 1, 1994

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

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

3.3 CLOSED TOP DIKE – A diked aboveground tank with protection on the top of the dike to keep precipitation, debris, or other elements from entering the diked area.

3.4 DIKED ABOVEGROUND TANK FOR FLAMMABLE LIQUIDS – A primary containment aboveground tank within a steel dike intended to contain product resulting from a spill, tank leak, or rupture. Diked aboveground tank types include: closed top dike and open top dike.

3.5 DIKED SECONDARY CONTAINMENT ABOVEGROUND TANK FOR FLAMMABLE LIQUIDS – A secondary containment aboveground tank (as defined in 3.8) within a steel dike intended to contain product resulting from a spill, tank leak, or rupture. Diked secondary aboveground tank types include: closed top dike and open top dike.

3.6 OPEN TOP DIKE – A diked aboveground tank in which the dike is open to the elements at the top.

3.7 PRIMARY CONTAINMENT ABOVEGROUND TANK FOR FLAMMABLE LIQUIDS – A steel, single-wall atmospheric tank intended for stationary installation having a liquid capacity exceeding 60 U.S. gallons (227 liters) for aboveground storage (primary containment) of flammable and combustible liquids. Primary containment aboveground tank types include: horizontal cylindrical, vertical cylindrical, and rectangular.

3.8 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.

CONSTRUCTION – ALL TANKS

4 Capacities and Dimensions

Section 4 effective April 1, 1994

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 110 percent of the rated nominal capacity.

5 Materials

Section 5 effective April 1, 1994

5.1 A tank shall be constructed of commercial or structural grade carbon steel or stainless steel, as noted in 5.2 and 5.3. Only new material shall be used.

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

a) Comply with the Specification for Structural Steel, ASTM A36M-91; or Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip (Commercial Quality), ASTM A569M-91a; or Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Carbon, Hot-Rolled, ASTM A635M-91a.

b) Have a carbon content of 0.3 percent or less, or a carbon equivalency of 0.53 percent or less, and mechanical strength and welding characteristics at least equivalent to one of the steels specified in (a).

5.3 Stainless steel shall comply with the Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip, ASTM A167-91; or Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels, ASTM A240-91a.

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

Section 6 effective April 1, 1994

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

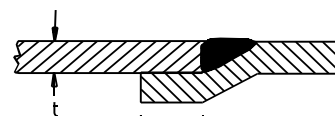
Tank type	Joint types				
	Shells Figure 6.1	Heads Figure 6.2	Bottom Figure 6.3	Roof Figure 6.4	Corner Figure 6.5
Horizontal cylindrical (primary and secondary)	All ^a	All	—	—	—
Vertical cylindrical (primary and secondary)	All ^a	—	All	All	—
Rectangular (primary and secondary)	All	—	—	—	All
Diked (open 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.



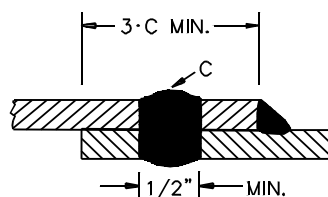
NO. 4

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



NO. 2

Full penetration and complete fusion.



NO. 5

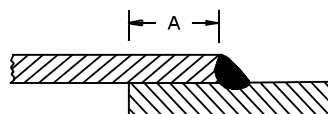
Full fillet weld on outside; "C" is 1/2 inch (12.7 mm) minimum diameter lock weld spaced not over 12 inches.



NO. 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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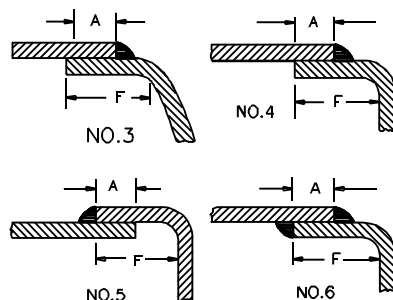
NO. 6

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.

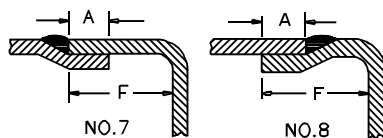
Figure 6.2
Head joints for horizontal cylindrical tanks



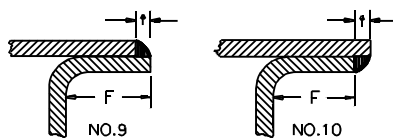
Double-welded U, V, bevel or square groove butt joint; full penetration and complete fusion.



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).



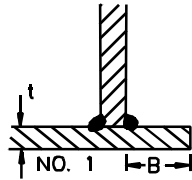
Groove weld equivalent in thickness to that of head or shell; minimum overlap, "A" – 1/2 inch (12.7 mm); "F" is five times head thickness or greater, but not less than 1/2 inch (12.7 mm).



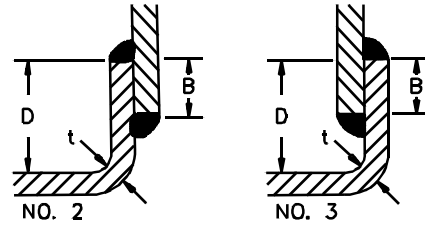
Full fillet weld; "t" – not less than thickness of shell; "F" is five times head thickness or greater, but not less than 1/2 inch (12.7 mm).

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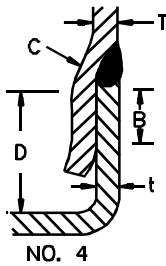
Figure 6.3
Bottom joints for vertical cylindrical tanks



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



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).



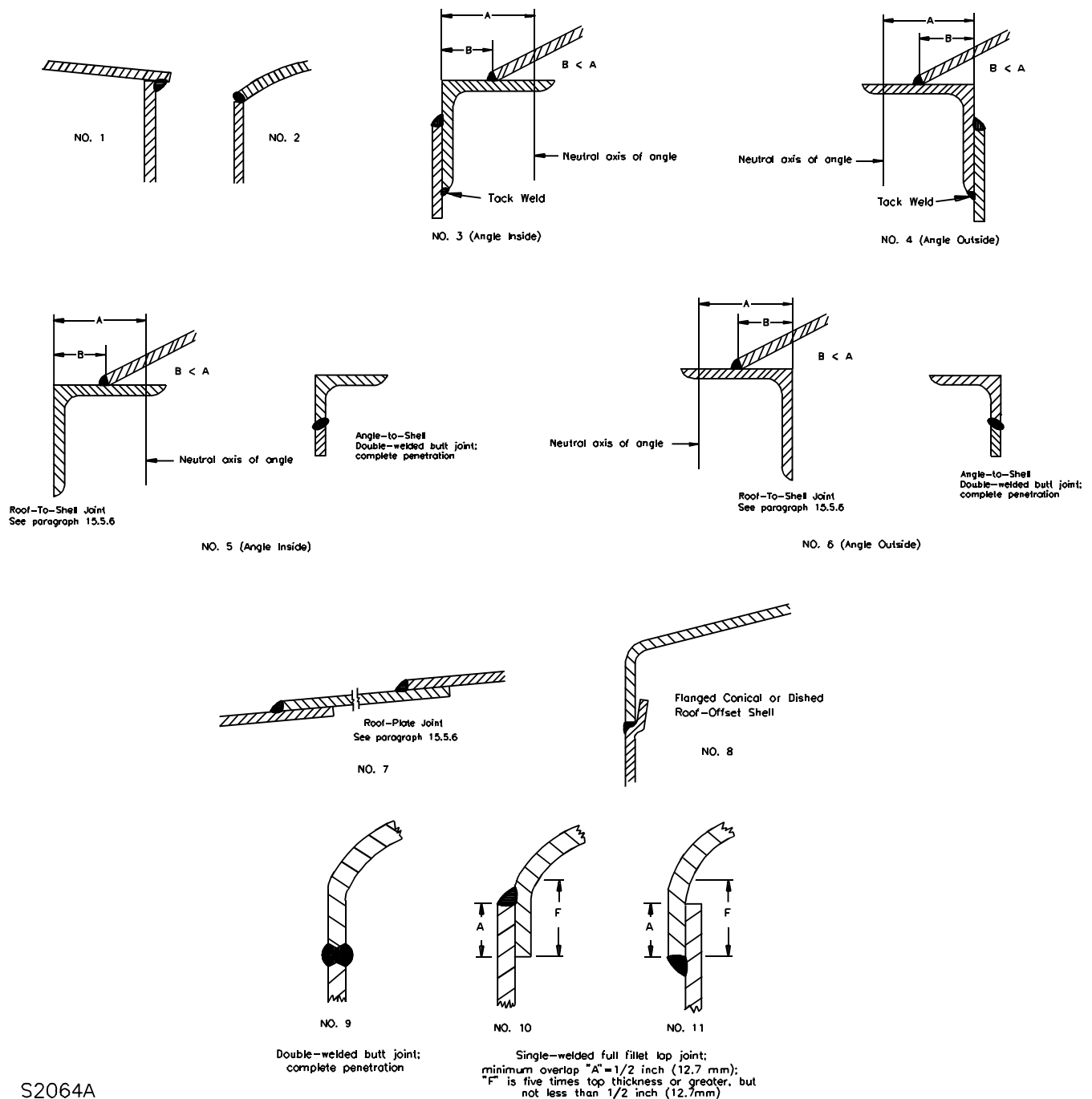
Groove weld at least equivalent in thickness to that of thinner member joined; minimum overlap, "B" – 1/2 inch (12.7 mm) or 1-1/2 t, whichever is greater; depth of offset, "C" – equals T; "D" is 5 t or greater, but not less than 1/2 inch (12.7 mm).



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

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Figure 6.4
Roof joints for vertical cylindrical tanks

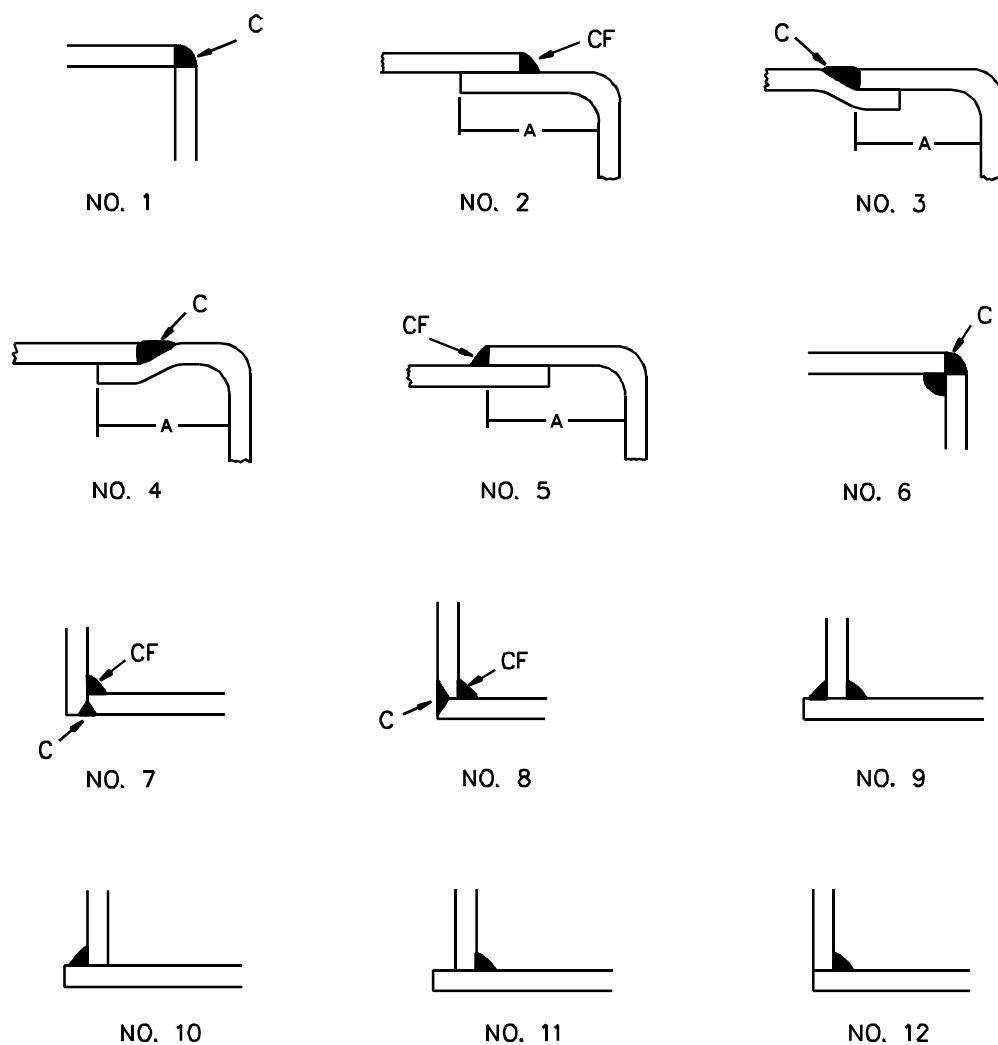


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Unless otherwise indicated, all welds are to be full fillet welds, at least 1/8-inch (3.2-mm) radius.

Figure 6.4 revised July 22, 1998

Figure 6.5
Corner joints



SM518A

C – Continuous weld.

CF – Shall be continuous full fillet welds.

A – Not less than 1/2 inch (12.7 mm).

Figure 6.5 revised July 22, 1998

7 Tank Connections

Section 7 effective April 1, 1994

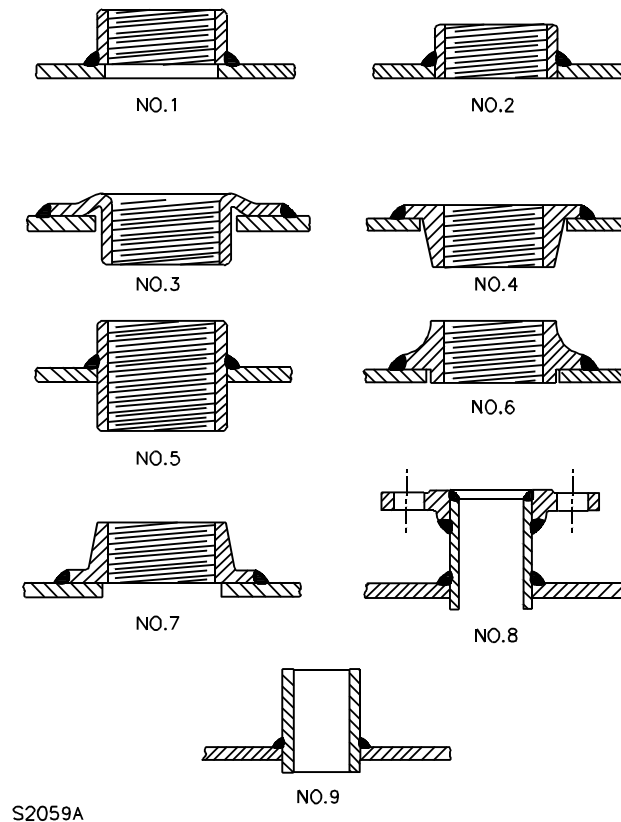
7.1 A tank connection shall be provided for each opening as illustrated in Figure 7.1 or 7.2 by:

- 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.

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Figure 7.1
Pipe connections



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.

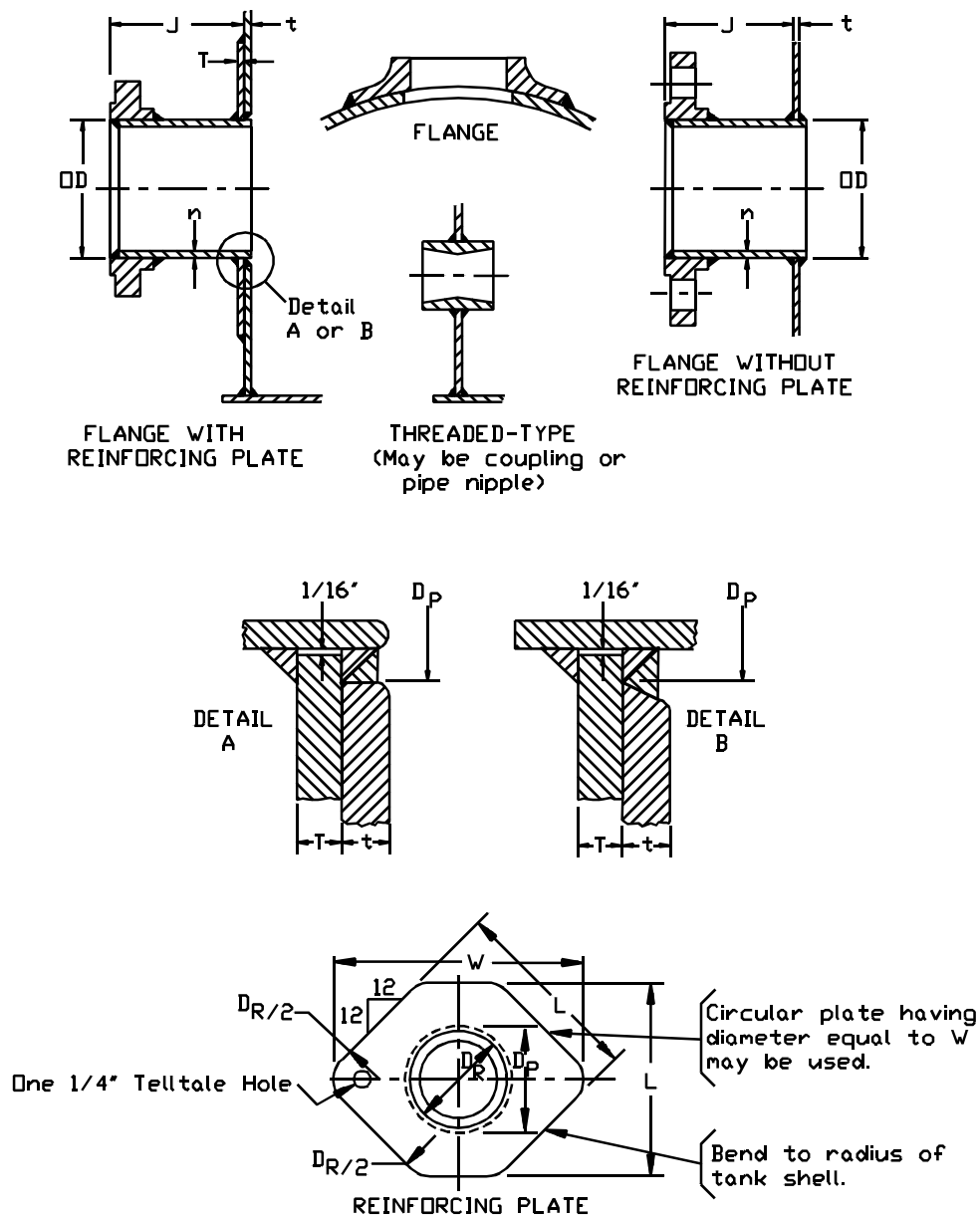
No. 9 – Standard pipe nipple – may be unthreaded.

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

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

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

Figure 7.2
Top or shell connections
(See Table 7.1)



All welds are to be full fillet welds, at least 1/8-inch (3.2-mm) radius.
 D_p is the outside diameter of the pipe plus 5/8 inch (0.63mm).

For SI units 1 inch = 25.4mm

S2060B

Figure 7.2 revised July 22, 1998

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

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	0.50	24-1/2	49-1/2	60
22	22	0.50	22-1/8	45-1/2	55-1/4
20	20	0.50	20-1/8	41-1/2	50-1/2
18	18	0.50	18-1/8	37-1/2	45-3/4
16	16	0.50	16-1/8	33-1/2	40-3/4
14	14	0.50	14-1/8	29-1/2	36
12	12-3/4	0.50	12-7/8	27	33
10	10-3/4	0.50	10-7/8	23	28-1/4
8	8-5/8	0.50	8-3/4	19	23-1/4
6	6-5/8	0.432	6-3/4	15-3/4	19-1/2
4	4-1/2	0.337	4-5/8	12	15-1/4
3	3-1/2	0.300	3-5/8	10-1/2	13-1/2
2	2-3/8	0.218	2-1/2	—	—
1-1/2	1.90	0.200	2	—	—

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

^a Extra-strong pipe, for sizes up to 12-inch, inclusive; for over 12- to 24-inch, inclusive, refer to the latest edition of ASTM A-53, A-134, A-135, or A-139. 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, Steel Nickel Alloy and Other Special Alloys, ANSI/ASME B16.5-88.

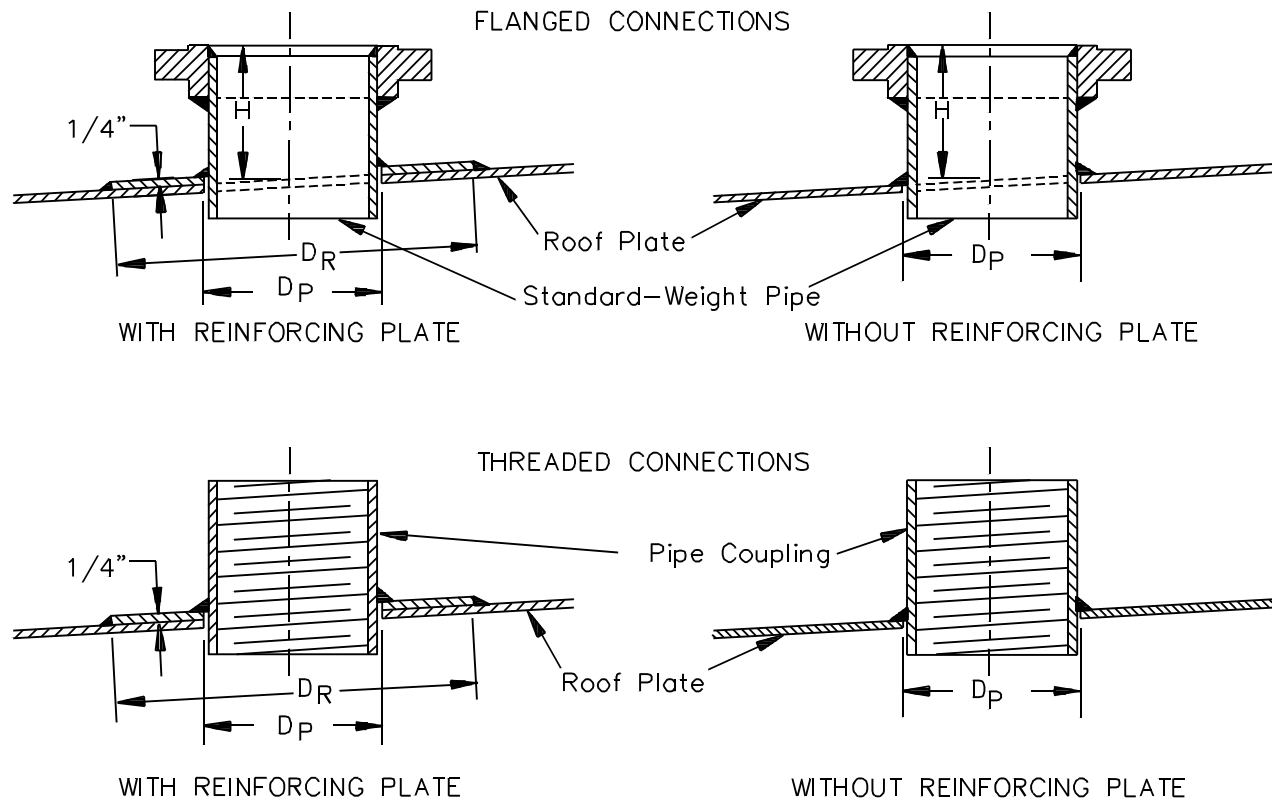
7.4 If a welding coupling is used, it shall comply with the Standard for Forged Steel Fittings, Socket Welding and Threaded, ANSI/ASME B16.11-91, or the Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints, ASTM A865-89.

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.

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



For SI units 1 inch = 25.4 mm

S2065A

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.

If reinforcing plates are used, they shall be of a thickness equal to or greater than the roof thickness.

Figure 7.3 revised July 22, 1998

Table 7.2
Flanged roof connections
(See Figure 7.3)

Nominal size of nozzle, inches ^a	Maximum diameter of hole in roof plate or reinforcing plate (D _P), inches ^a	Outside diameter of reinforcing plate (D _R), inches ^a
1-1/2	DO ^b + 0.100	5
2	DO + 0.125	7
3	DO + 0.125	9
4	DO + 0.125	11
6	DO + 0.125	15
8	DO + 0.250	18
10	DO + 0.250	22
12	DO + 0.250	24
^a For SI units, 1 inch = 25.4 mm.		
^b DO is the outside diameter of the pipe neck in inches.		

Table 7.2 revised July 22, 1998

Table 7.3
Threaded roof connections
(See Figure 7.3)

Nominal size of nozzle, inches ^a	Maximum diameter of hole in roof plate or reinforcing plate (D _P), inches ^a	Outside diameter of reinforcing plate (D _R), inches ^a
3/4	DO ^b + 0.100	4
1	DO + 0.100	4-1/2
1-1/2	DO + 0.100	5
2	DO + 0.125	7
3	DO + 0.125	9
4	DO + 0.125	11
6	DO + 0.125	15
8	DO + 0.250	18
10	DO + 0.250	22
12	DO + 0.250	24
^a For SI units, 1 inch = 25.4 mm.		
^b DO is the outside diameter of the coupling in inches.		