

Specification for Field-welded Tanks for Storage of Production Liquids

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Contents

	Page
1 Scope	1
1.1 General	1
1.2 Compliance	1
2 Normative References	1
3 Terms and Definitions	2
4 Materials	3
4.1 General	3
4.2 Plates	3
4.3 Sheets	3
4.4 Welding Electrodes	3
4.5 Structural Shapes	4
4.6 Piping	4
4.7 Flanges	4
4.8 Couplings	4
4.9 Bolting	4
5 Design	4
5.1 General	4
5.2 Tank Size	5
5.3 Weld Size	5
5.4 Joints	6
5.5 Bottom Design	6
5.6 Shell Design	8
5.7 Roof Design	9
5.8 Cleanout	10
5.9 Connections	10
5.10 Center Roof Nozzle	11
5.11 Center Support	11
5.12 Anti-channel Drain Baffle	11
5.13 Downcomer Pipe	12
5.14 Walkways, Stairways, and Ladders	12
6 Venting Requirements	12
6.1 Normal Venting	12
6.2 Emergency Venting	12
7 Construction, Testing, and Painting	12
7.1 Construction	12
7.2 Welding	12
7.3 Testing	13
7.4 External Painting	13
7.5 Internal Coating	13
7.6 Clean Up	13
8 Marking	13
9 Inspection and Rejection	14
9.1 Inspection Notice	14
9.2 Inspection	14
9.3 Rejection	14

Contents

Page

Annex A (informative) Use of Monogram by Licensees	15
Annex B (normative) Walkways, Stairways, and Ladders	18
Annex C (informative) Suggestions for Ordering Field-welded Tanks	20

Figures

5.1 Tank Dimensions	7
5.2 Cone Bottom	8
5.3 Gauge/Thief Hatch Cutout Details	11
8.1 Nameplate Format	14

Tables

5.1 Tank Dimensions	5
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Introduction

This specification is under the jurisdiction of the API Subcommittee on Aboveground Storage Tanks.

This specification is based on the accumulated knowledge and experience of purchasers and manufacturers of field-welded steel storage tanks of various sizes and capacities for internal pressures approaching atmospheric. This publication provides a purchase specification to facilitate the manufacture and procurement of storage tanks for production service, such as storage of crude oil, condensate, hydrocarbon products, and nonpotable water. If tanks are purchased in accordance with this specification, the purchaser is expected to specify certain basic requirements.

This specification shall become effective on the date printed on the cover.

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Specification for Field Welded Tanks for Storage of Production Liquids

1 Scope

1.1 General

This specification covers material, design, fabrication, and testing requirements for vertical, cylindrical, aboveground, closed top, welded steel storage tanks in various standard sizes and capacities for internal pressures of approximately atmospheric, not to exceed those listed in Table 5.1, Column 2.

This specification provides the oil production industry with tanks of adequate safety and reasonable economy for use in the storage of crude petroleum and other liquids commonly handled and stored by the production segment of the industry. This specification is for the convenience of purchasers and manufacturers in ordering and fabricating tanks.

1.2 Compliance

The manufacturer is responsible for complying with all provisions of this specification. The purchaser may make any investigation necessary to be satisfied that the manufacturer is in compliance and may reject any material that does not comply with this specification. It is urged that the purchaser exercise this right by providing an inspection independent of any supervisory inspection furnished by the manufacturer, and that the purchaser's inspector closely monitor all of the details of shop fabrication and/or field construction and testing herein specified that may affect the integrity and safety of the completed structure.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies including any amendments.

API Specification 5L, *Specification for Line Pipe*

API Standard 650, *Welded Tanks for Oil Storage*

API Recommended Practice 652, *Lining of Aboveground Petroleum Storage Tank Bottoms*

API Standard 2000, *Venting Atmospheric and Low-pressure Storage Tanks*

ASME Boiler and Pressure Vessel Code, Section IX ¹, *Welding, Brazing, and Fusing Qualifications*

ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard*

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded*

ASTM A36/A36M ², *Standard Specification for Carbon Structural Steel*

ASTM A53/A53M, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*

ASTM A106/A106M, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*

¹ ASME International, 2 Park Avenue, New York, New York 10016-5990, www.asme.org.

² ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

ASTM A123/A123M, *Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*

ASTM A307, *Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength*

ASTM A333/A333M, *Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness*

ASTM A516/A516M, *Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service*

ASTM A529/A529M, *Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality*

ASTM A563, *Standard Specification for Carbon and Alloy Steel Nuts*

ASTM A1011/A1011M, *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength*

AWS A5.1³, *Specification for Mild Steel Arc-Welding Electrode*

AWS A5.18/A5.18M:2005, *Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding*

AWS D1.1, *Structural Welding Code—Steel*

AWS D1.6, *Structural Welding Code—Stainless Steel*

NACE SP0178-2007⁴, *Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service*

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply to joints.

3.1

double-welded butt joint

A joint between two abutting parts lying in approximately the same plane welded from both sides. A joint with filler metal added from one side only is considered equivalent to a double-welded butt joint when means are provided for a complete penetration and reinforcement on both sides of the joint.

3.2

single-welded butt joint with backing

A joint between two abutting parts lying in approximately the same plane and welded from one side only, with a backing strip, bar, or other suitable material.

3.3

double-welded lap joint

A joint between two overlapping members in which the overlapped edges of both members are welded with fillet welds.

3.4

single-welded lap joint

A joint between two overlapping members in which the overlapped edge of one member is welded with a fillet weld.

³ American Welding Society, 8669 NW 36th Street, #130, Miami, Florida 33166-6672, www.aws.org.

⁴ NACE International, 1440 South Creek Drive, Houston, Texas 77084-4906, www.nace.org.

3.5**butt weld**

A weld placed in a groove between abutting members. Grooves may be square, V-shaped (single or double), or U-shaped (single or double).

3.6**fillet weld**

A weld of approximately triangular cross section joining two surfaces approximately at right angles to each other, as in a lap joint, tee joint, or corner joint.

3.7**full-fillet weld**

A fillet weld whose size is equal to the thickness of the thinner member joined.

3.8**groove weld**

Weld beads that are deposited in a groove between two members to be joined.

3.9**tack weld**

A weld made to hold parts of a weldment in proper alignment until the final welds are made.

4 Materials**4.1 General**

The materials listed in this section have been selected to provide adequate strength and reasonable service life. Other materials having mechanical properties equal to or greater than these listed may be used by agreement between the purchaser and the manufacturer. Where higher strength materials are used, the minimum thicknesses called for in this specification shall not be reduced.

4.2 Plates

4.2.1 Plates shall conform to ASTM A36/A36M or ASTM A516/A516M.

4.2.2 Shell plates for which minimum thicknesses have been fixed for practical reasons (greater than required by computation) and that will not underrun the required computed thickness by more than 0.01 in., as well as all roof and bottom plates, may be purchased on a weight basis. The plate thicknesses or weights, as stipulated herein are minimums; thicker or heavier material may be required in the order at the option of the purchaser.

4.2.3 Rimmed or capped steels are not permitted.

4.3 Sheets

4.3.1 Sheets shall conform to ASTM A1011/A1011M, open-hearth process and basic oxygen process. Sheets may be ordered on a weight or thickness basis at the option of the tank manufacturer.

4.3.2 Rimmed or capped steels are not permitted.

4.4 Welding Electrodes

4.4.1 Tanks and their structural attachments shall be welded by the shielded metal arc, gas metal arc, gas tungsten arc, oxyfuel, flux-cored arc, submerged arc, electroslag, or electrogas process using suitable equipment. Use of the oxyfuel, electroslag, or electrogas process shall be by agreement between the manufacturer and the purchaser. Use of the oxyfuel process is not permitted when impact testing of the material is required. All tank welding shall be performed by a manual, semiautomatic arc, machine, or automatic welding, in accordance with the welding procedure specifications (WPS) as described in

Section IX of the ASME Code. Welding shall be performed in a manner that ensures complete fusion with the base metal.

4.4.2 Welding procedures for ladder and platform assemblies, handrails, stairways, and other miscellaneous assemblies, but not their attachments to the tank, shall comply with either AWS D1.1; AWS D1.6; or Section IX of the ASME Code, including the use of standard WPSs.

4.5 Structural Shapes

Structural shapes shall be of the open hearth, electric furnace, or basic oxygen process and shall conform to ASTM A36/A36M or ASTM A529/A529M.

4.6 Piping

Piping shall conform to API Specification 5L, Grade A or B; ASTM A53/A53M; ASTM A333/A333M; or ASTM A106/A106M.

4.7 Flanges

Hub slip-on welding and welding-neck flanges shall conform to the material requirements for forged carbon steel flanges as specified in ASME B16.5.

4.8 Couplings

Couplings for threaded connections may be supplied with or without recesses, complying with the dimensional, physical and chemical requirements of the latest edition of API Specification 5L, Grade B. Alternatively, couplings may comply with the latest edition of ASME B16.11 for steel pipe couplings.

4.9 Bolting

4.9.1 Bolting shall conform to ASTM A307, Grade A or B.

4.9.2 Nuts, when used with bolting, shall conform to ASTM A563.

4.9.3 Unless otherwise specified on the purchase order, black finish bolts and nuts shall be furnished.

4.9.4 When specified to be galvanized, bolts and nuts shall be zinc coated in accordance with ASTM A123/A123M.

4.9.5 Alternative materials and/or finish, conforming to recognized standards for bolting, may be furnished by agreement between the purchaser and the manufacturer.

5 Design

5.1 General

Tanks covered by this specification have been designed using established engineering calculations to determine minimum metal thickness and bolting requirements for each size tank filled with water (62.37 lb/ft³ at 60°F) and at the internal pressures specified in Table 5.1, Column 2. In order to ensure structural stability and integrity, additional metal thickness has been added to that determined by calculation. The minimum metal thickness, specified in Table 5.1, shall not be decreased.

NOTE For pressures beyond those stated in Table 5.1 or for other conditions not covered by this specification, API 650, Annex F should be used for the design.

5.2 Tank Size

Tanks under this specification shall be furnished in the sizes and dimensions as stipulated in Table 5.1 and Figure 5.1, and as specified on the purchase order.

Table 5.1—Tank Dimensions (see Figure 5.1)

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Nominal Capacity (bbl)	Design Pressure (oz/in. ²) ^a		Approximate Working Capacity (bbl) (See NOTE)	Nominal Outside Diameter (ft, in.) A	Nominal Height (ft, in.) B	Height of Overflow-line Connection ^b (ft, in.) C	Height of Walkway Lugs (ft, in.) D	Location of Fill-line Connection ^b (in.) E	Size of Connections (in.)
	a Pressure	b Vacuum							
High-500	8	1/2	479	15, 6	16, 0	15, 6	13, 7	14	4
750	8	1/2	746	15, 6	24, 0	23, 6	21, 7	14	4
Low-500	6	1/2	407	21, 6	8, 0	7, 6	5, 7	14	4
High-1000	6	1/2	923	21, 6	16, 0	15, 6	13, 7	14	4
1500	6	1/2	1438	21, 6	24, 0	23, 6	21, 7	14	4
Low-1000	4	1/2	784	29, 9	8, 0	7, 6	5, 7	14	4
2000	4	1/2	1774	29, 9	16, 0	15, 6	13, 7	14	4
3000	4	1/2	2764	29, 9	24, 0	23, 6	21, 7	14	4
5000	3	1/2	4916	38, 8	24, 0	23, 6	21, 7	14	4
10,000	3	1/2	9938	55, 0	24, 0	23, 6	21, 7	14	4
Tolerance	—		—	—	—	± 1/8 in	± 1/8 in	± 1/8 in	—

NOTE The approximate working capacities shown in Column 3 apply to flat-bottom tanks. Cone-bottom tanks have 6 in. greater working height than the corresponding flat-bottom tanks. The approximate increase in capacity is 17 bbl for the 15 ft, 6 in. diameter tanks, 32 bbl for the 21 ft, 6 in. diameter tanks, 62 bbl for the 29 ft, 9 in. diameter tanks, 104 bbl for the 38 ft, 8 in. diameter tanks, and 208 bbl for the 55 ft diameter tanks.

^a See 5.7.5 for frangible roof limitations.

^b *Viscous oil option.* When so specified on the purchase order, tanks shall be furnished for viscous oil service. On such tanks, dimension C of the overflow-line connections shall be 6 in. less than shown in Column 6 above, and dimension E of the fill-line connection shall be 6 in., ± 1/8 in.

5.3 Weld Size

Weld size shall be based on the following dimensions.

5.3.1 Groove Welds

Groove weld size shall be based on joint penetration (depth of chamfering plus the root penetration when specified).

5.3.2 Fillet Welds

5.3.2.1 For equal leg fillet welds, weld size shall be based on: the leg length of the largest isosceles right triangle that can be inscribed within the fillet-weld cross section.

5.3.2.2 For unequal leg fillet welds, weld size shall be based on: the leg lengths of the largest right triangle that can be inscribed within the fillet-weld cross section.

5.4 Joints

5.4.1 General

See Section 3 for the definitions of terms related to joints as used in this specification.

5.4.2 Joint Restrictions

The following restrictions on the type and size of joints or welds shall apply.

5.4.2.1 Tack welds shall not be considered as having any strength value in the finished structure.

5.4.2.2 The minimum size of fillet welds shall be as follows:

- a) Plate $\frac{3}{16}$ in., in thickness: full-fillet welds;
- b) Plates over $\frac{3}{16}$ in. thick: not less than one-third the thickness of the thinner plate at the joint, with a minimum of $\frac{3}{16}$ in., except as otherwise noted.

5.4.2.3 Single-welded lap joints shall not be used on shell plates.

5.5 Bottom Design

5.5.1 Type

Tank bottoms shall be flat or of the cone design, as specified on the purchase order. In addition, if cone bottoms are used, they shall conform to Figure 5.2.

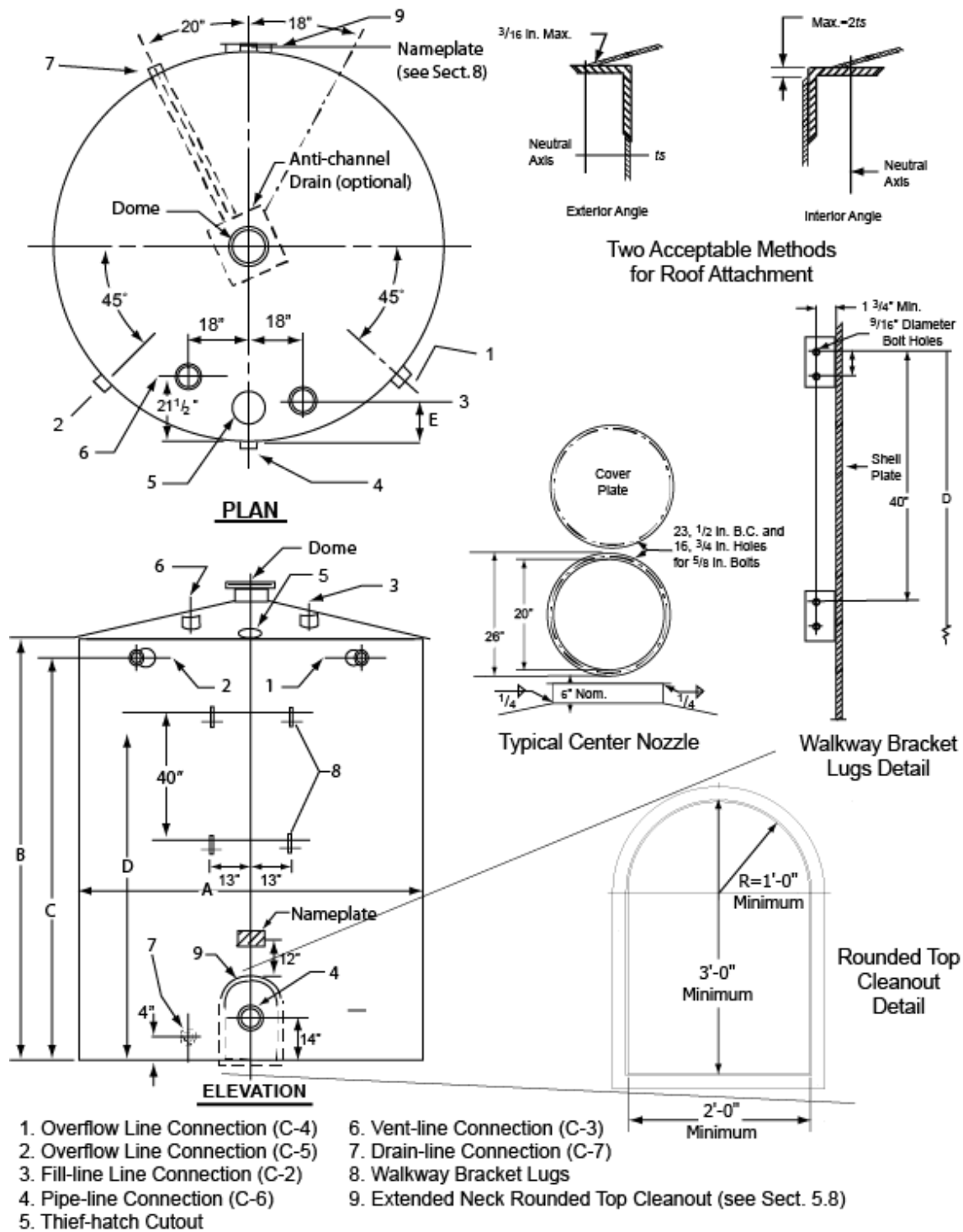


Figure 5.1—Tank Dimensions

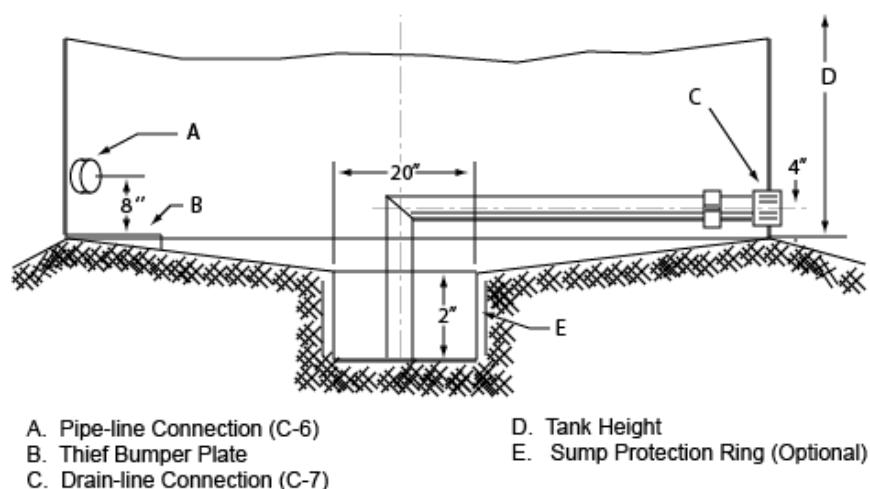


Figure 5.2—Cone Bottom

5.5.2 Thickness

The thickness of bottom plates shall be $\frac{1}{4}$ in. (10.20 lb/ft²) nominal, except that the sump of the cone bottom shall be $\frac{3}{8}$ in. (15.30 lb/ft²) nominal.

5.5.3 Bottom Joints

Bottom joints shall be double-welded butt joints, single-welded butt joints with backing, or single-welded full-fillet lap joints with a $1\frac{1}{4}$ in. minimum lap when tack welded. In addition, butt joints, if used, shall have complete weld penetration.

5.5.4 Shell Attachment

Tank bottoms shall be attached to tank shells by using full-fillet welds, both inside and outside.

5.6 Shell Design

5.6.1 Shell Plates

5.6.1.1 Thickness

5.6.1.1.1 The thickness of shell plates shall be either $\frac{3}{16}$ in. (7.65 lb/ft²) nominal, or $\frac{1}{4}$ in. (10.20 lb/ft²) nominal, as specified on the purchase order.

5.6.1.1.2 The thickness of the first 8 ft of shell plates for 10,000 bbl tanks shall not be less than $\frac{1}{4}$ in. (10.20 lb/ft²).

5.6.1.2 The width of the shell plates shall be determined by the manufacturer, but preferably should not be less than 60 in.

5.6.2 Shell Joints

Shell-plate joints shall be double-welded butt joints with complete penetration.

5.6.3 Compression Ring

The shell shall be fitted with a top angle having minimum dimensions of $2\frac{1}{2}$ in. x $2\frac{1}{2}$ in. x $\frac{1}{4}$ in. The angle may project either inside or outside, and may be attached either by full-fillet welds on both sides where the angle abuts the shell or by a full penetration butt weld between the top shell plate and the top angle.

5.7 Roof Design

5.7.1 Type

The roof shall be of the cone type with a slope of 1 in 12, and shall be furnished with a center roof nozzle and a center roof support.

- a) For roofs 15 ft. 6 in., in diameter, added structural supports in the form of rafters shall be provided if the thickness of the roof is less than $\frac{1}{4}$ in. nominal. Roofs having a $\frac{1}{4}$ in. thickness do not require additional structural supports unless needed for site load conditions.
- b) For roofs larger than 15 ft. 6 in. in diameter, added structural supports in the form of rafters shall be provided.

5.7.2 Thickness

The thickness of roof plates shall be either $\frac{3}{16}$ in. (7.65 lb/ft²) nominal, or $\frac{1}{4}$ in. (10.20 lb/ft²) nominal, as specified on the purchase order.

5.7.3 Roof Joints

Roof joints shall be double-welded butt joints, single-welded butt joints with backing, or single-welded full-fillet lap joints with a $1\frac{1}{4}$ in. minimum lap when tack welded. In addition, butt joints, if used, shall have complete weld penetration.

5.7.4 Shell Attachment

The tank roof shall be attached to the tank shell by full fillet welds, both inside and outside, except as provided in 5.7.5.

5.7.5 Shell Attachment for Frangible Roofs

When specified by the purchaser, the tank may be provided with a frangible roof. In that case, the design pressure shall not exceed the weight of the roof, including rafters, if external. The roof shall be attached to the compression ring by a single-fillet weld not to exceed $\frac{3}{16}$ in. and applied to the top side only. Internal rafters, if used, shall not be welded to the roof plates. The applicable requirements of API 650 shall apply for frangible roof design.

5.7.6 Roof Support

In addition to the dead load, roof supports shall be designed to support a live load of 20 lb/ft². Allowable design stresses shall be as follows.

Rolled Structural Shapes:

Tension, psi, max	20,000
Bending, psi, max	20,000
Compression, psi, max	<u>20,000</u>
	$1 + L^2/20,000 r^2$

L/r ratio, max 200

where

- L is the unbraced length in inches;
r is the governing radius of gyration, in inches.

Formed Sections:

Basic design stress, psi, max 18,000

Column footings:

Soil-bearing load, psf, max 4000 (based on max. water load plus super-imposed roof load).

5.8 Cleanout

Tanks shall be furnished with an extended-neck cleanout having a minimum opening of 24 in. wide by 36 in. high. The top of the cleanout shall be rounded with a minimum 12 in. radius. The thickness and shape of the neck shall be designed to completely reinforce the shell course, or additional external compensation shall be added. The bottom of the cleanout shall be flush with the bottom of the tank. Cover plates may be one piece or two pieces, as specified on the purchase order. Handles for lifting the cleanout cover plate(s) shall be furnished.

5.9 Connections

5.9.1 Tanks shall be provided with inlet and outlet connections, as shown in Table 5.1 and Figure 5.1. Unless otherwise specified by the purchaser, connections shall be full couplings and shall be attached to the tank member by full-fillet welds on both inside and outside surfaces, with equal projections inside and outside the tank, except that half-couplings may be used for the C-4 and C-5 overflow line connections and the C-6 pipe-line connection (see Figure 5.1) at the option of the manufacturer. Additional or fewer connections of other sizes or locations may be provided, if agreed upon between the purchaser and the manufacturer.

5.9.2 When flanges or other types of connections are specified, the nozzle neck shall be a minimum standard weight pipe and attached by full-fillet welds both inside and outside. The bolting pattern for gauge/thief hatches shall conform to one of those shown in Figure 5.3. Gauge/thief hatches, when used, should be 8 in. x 22 in. obround for pressures up to and including 4 oz/in.² and 8 in. round for pressures greater than 4 oz/in.².

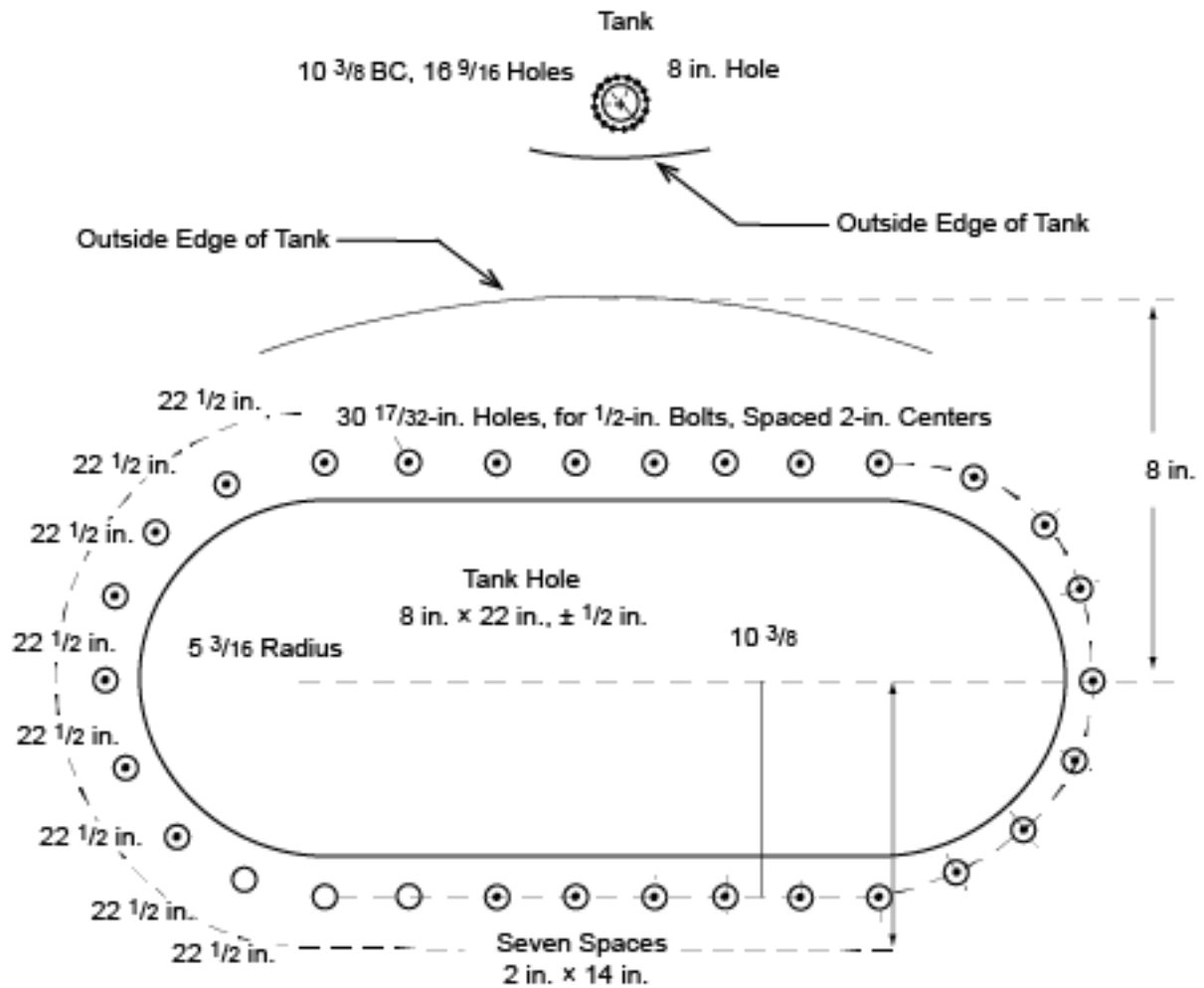


Figure 5.3—Gauge/Thief Hatch Cutout Details

5.9.3 The purchaser shall provide full details of external piping loads or vibration expected to be imposed on the connections in the liquid section of the shell. The manufacturer shall provide additional reinforcement of those openings, when required.

5.10 Center Roof Nozzle

The center roof nozzle shall be fabricated from $\frac{1}{4}$ in. material and shall be installed as shown in Figure 5.1. The cover shall be provided with a gasket of $\frac{3}{16}$ in. minimum thickness and compatible with the stored product.

5.11 Center Support

All tanks shall be provided with either a structural-type or a pole-type center support, suitably attached to the rafter structure and to a bearing plate seal welded to the bottom. When cone bottoms are furnished, the center support shall not interfere with the function of the sump.

5.12 Anti-channel Drain Baffle

An anti-channel drain baffle conforming to the following requirements shall be furnished, if specified on the purchase order.

- a) The periphery of the baffle, in plain view, shall be 64 in.

- b) The height of the baffle from the inside surface of the tank bottom to the top of the baffle shall be 5 1/4 in. minimum.
- c) The baffle shall be equipped with spacers so that the bottom edge of the baffle is 1 in. above the tank bottom.
- d) A drain line shall be provided from the baffle to the tank shell. The line size shall be 4 in. nominal.
- e) The baffle shall be attached to the tank bottom by a J-bolt passing through an eye retainer welded to the tank bottom and also by the line connection to the tank shell. The baffle shall not be welded to the tank bottom.

5.13 Downcomer Pipe

A downcomer pipe shall be installed, if requested by the purchaser. Design of downcomer shall be by agreement between the purchaser and the manufacturer.

5.14 Walkways, Stairways, and Ladders

Walkways, stairways, and ladders, if provided, shall conform to Annex B.

6 Venting Requirements

6.1 Normal Venting

A C-3 vent line connection (see Figure 5.1) is provided for normal inbreathing and outbreathing due to temperature changes and to liquid movement in and out of the tank. This connection should be fitted with a pressure-vacuum valve properly sized in accordance with API 2000. The pressure setting should be from 2 oz/in.² to 4 oz/in.² less than the opening pressure of devices used for emergency venting.

6.2 Emergency Venting

When storage tanks containing flammable liquids are exposed to fire, the venting rate may be in excess of that resulting from a combination of normal thermal effects and oil movement. Unless tanks are installed in remote locations, the purchaser shall provide or cause to be provided pressure-relieving devices that will provide capacity in addition to normal venting to meet the requirements of API 2000. The opening pressure of such devices shall not exceed the design pressure of the tank on which the devices are installed. The maximum internal pressure under relieving conditions should not exceed that tabulated in column 2a or 2b of Table 5.1. Pressure-relieving devices may take the form of larger or additional vent valves or additional thief hatches.

7 Construction, Testing, and Painting

7.1 Construction

Tank construction shall be completed in the field in accordance with the applicable sections of this specification, using acceptable industry practices. When agreed upon between the purchaser and the manufacturer, tanks may be completely fabricated in the manufacturer's shop prior to delivery to the field location.

7.2 Welding

Welding procedures shall be established and welding operators qualified by the manufacturer. Qualification of welders in accordance with the applicable parts of the latest edition of Section IX of the ASME *Boiler & Pressure Vessel Code* is recommended.

7.3 Testing

7.3.1 Bottoms of field erected tanks shall be tested by applying a vacuum to the joints and using soap suds, linseed oil, or other suitable material for the detection of leaks. The completed tank shall be tested by filling it with water for a period of not less than 12 hours, and testing the roof either by applying air pressure or by vacuum testing the joints. Test water shall be provided and removed by the purchaser, unless otherwise agreed upon. Alternatively, if so agreed upon between the purchaser and the manufacturer, the tank may be tested with air pressure at 1½ times the design pressure of the tank (see 5.1 and 5.7.5).

CAUTION When testing with air, adequate valves, regulators, and pressure relief devices shall be used to prevent overpressure or permanent deformation.

7.3.2 Testing and the repair of any defects shall be completed before connecting any piping to the tank.

NOTE See API Standard 650 for additional information and requirements for vacuum testing of welded joints.

7.4 External Painting

After erection, tanks shall be cleaned of rust, grease, scale, and weld spatter. Preparation for coating and the application of primer or finish coatings shall be by agreement between the purchaser and the manufacturer.

7.5 Internal Coating

Where internal coating is required, the procedures and methods outlined in API RP 652 or NACE SP0178-2007 are recommended as a minimum requirement. Coating application, including surface preparation, shall be performed in accordance with the coating manufacturer's specifications. Other coatings and methods may be used by agreement between the purchaser and manufacturer.

7.6 Clean Up

Upon completion of erection, the manufacturer or erector shall remove or dispose of all rubbish and other unsightly material resulting from the work and shall leave the premises in as good a condition or better than what it was at the start of the work.

8 Marking

8.1 Tanks manufactured in accordance with this specification shall be identified by a nameplate bearing the information shown in Figure 8.1.

8.2 The nameplate shall be stamped, etched, or embossed on corrosion-resistant material and permanently attached to a bracket or backing plate of ferrous material. Alternatively, nameplate information may be die-stamped on a steel plate. In addition, the bracket, backing plate, or nameplate shall be seal welded to the tank shell in the location shown in Figure 5.1.


 12D	MANUFACTURER	_____
	SERIAL NUBER	_____
	NOMINAL DIAMETER	_____
	NOMINAL HEIGHT	_____
	NOMINAL CAPACITY	_____ (BBL)
	BOTTOM THICKNESS	_____ TYPE _____
	SHELL THICKNESS	_____
	ROOF THICKNESS	_____
	DESIGN PRESSURE	_____ (OZ.)
	ERECTED BY	_____

Figure 8.1—Nameplate Format

9 Inspection and Rejection

9.1 Inspection Notice

When the inspector representing the purchaser desires to inspect tanks purchased or witness any specified tests, reasonable notice shall be given concerning the time at which such inspection should be made.

9.2 Inspection

9.2.1 The inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, and to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford without charge all reasonable facilities to satisfy the inspector that the material is being manufactured in accordance with this specification.

9.2.2 All inspections should be made at the place of manufacture prior to shipment, unless otherwise specified on the purchase order, and shall be so conducted so as not to interfere unnecessarily with the manufacturer's operations.

9.3 Rejection

Material that shows physical defects on initial inspection or subsequent to acceptance at the manufacturer's work or that proves defective when properly applied in service may be rejected and the manufacturer notified. If tests that require the destruction of material are made at any location other than the place of manufacture, the purchaser shall pay for the material complying with all of the provisions of the specification, but shall not pay for any material that fails to meet the specification.

Annex A **(informative)**

Use of API Monogram by Licensees

A.1 Scope

The API Monogram® is a registered certification mark owned by the American Petroleum Institute (API) and authorized for licensing by the API Board of Directors. Through the API Monogram Program, API licenses product manufacturers to apply the API Monogram to **new** products which comply with product specifications and have been manufactured under a quality management system that meets the requirements of API Q1. API maintains a complete, searchable list of all Monogram licensees on the API Composite List website (www.api.org/compositelist).

The application of the API Monogram and license number on products constitutes a representation and warranty by the licensee to API and to purchasers of the products that, as of the date indicated, the products were manufactured under a quality management system conforming to the requirements of API Q1 and that the product conforms in every detail with the applicable standard(s) or product specification(s). API Monogram program licenses are issued only after an on-site audit has verified that an organization has implemented and continually maintained a quality management system that meets the requirements of API Q1 and that the resulting products satisfy the requirements of the applicable API product specification(s) and/or standard(s). Although any manufacturer may claim that its products meet API product requirements without monogramming them, only manufacturers with a license from API can apply the API Monogram to their products.

Together with the requirements of the API Monogram license agreement, this annex establishes the requirements for those organizations who wish to voluntarily obtain an API license to provide API monogrammed products that satisfy the requirements of the applicable API product specification(s) and/or standard(s) and API Monogram Program requirements.

For information on becoming an API Monogram Licensee, please contact API, Certification Programs, 1220 L Street, N. W., Washington, DC 20005 or call 202-682-8145 or by email at certification@api.org.

A.2 Normative References

API Q1, *Specification for Quality Management System Requirements for Product Manufacturing for the Petroleum and Natural Gas Industry*

A.3 Terms and Definitions

For purposes of this annex, the following terms and definitions apply:

A.3.1 API Monogrammable Product

Product that has been **newly** manufactured by an API licensee utilizing a fully implemented API Q1 compliant quality management system and that meets all the API specified requirements of the applicable API product specification(s) and/or standard(s).

A.3.2 API Specified Requirements

Requirements, including performance and licensee-specified requirements, set forth in API Q1 and the applicable API product specification(s) and or standard(s).

NOTE Licensee-specified requirements include those activities necessary to satisfy API specified requirements.

A.3.3 API Product Specification

Prescribed set of rules, conditions, or requirements attributed to a specified product which address the definition of terms; classification of components; delineation of procedures; specified dimensions; manufacturing criteria; material requirements, performance testing, design of activities; and the measurement of quality and quantity with respect to materials; products, processes, services, and/or practices.

A.3.4 Licensee

Organization that has successfully completed the application and audit process and has been issued a license by API.

A.3.5 Design Package

Records and documents required to provide evidence that the applicable product has been designed in accordance with API Q1 and the requirements of the applicable product specification(s) and/or standard(s).

A.4 Quality Management System Requirements

An organization applying the API Monogram to products shall develop, maintain, and operate at all times a quality management system conforming to API Q1.

A.5 Control of the Application and Removal of the API Monogram

Each licensee shall control the application and removal of the API Monogram in accordance with the following:

- a) Products that do not conform to API specified requirements shall not bear the API Monogram.
- b) Each licensee shall develop and maintain an API Monogram marking procedure that documents the marking/monogramming requirements specified by this annex and any applicable API product specification(s) and/or standard(s). The marking procedure shall:
 - 1) define the authority responsible for application and removal of the API Monogram;
 - 2) define the method(s) used to apply the Monogram;
 - 3) identify the location on the product where the API Monogram is to be applied;
 - 4) require the application of the licensee's license number and date of manufacture of the product in conjunction with the use of the API Monogram;
 - 5) require that the date of manufacture, at a minimum, be two digits representing the month and two digits representing the year (e.g. 05-12 for May 2012) unless otherwise stipulated in the applicable API product specification(s) or standard(s); and
 - 6) require application of the additional API product specification(s) and/or standard(s) marking requirements.
- c) Only an API licensee may apply the API Monogram and its designated license number to API monogramable products.
- d) The API Monogram license, when issued, is site-specific and subsequently the API Monogram shall only be applied at that site specific licensed facility location.
- e) The API Monogram may be applied at any time appropriate during the production process but shall be removed in accordance with the licensee's API Monogram marking procedure if the product is

subsequently found to be out of conformance with any of the requirements of the applicable API product specification(s) and/or standard(s) and API Monogram Program.

For certain manufacturing processes or types of products, alternative API Monogram marking procedures may be acceptable. Requirements for alternative API Monogram marking are detailed in the API Policy, *API Monogram Program Alternative Marking of Products License Agreement*, available on the API Monogram Program website at <http://www.api.org/alternative-marking>.

A.6 Design Package Requirements

Each licensee and/or applicant for licensing must maintain a current design package for all of the applicable products that fall under the scope of each Monogram license. The design package information must provide objective evidence that the product design meets the requirements of the applicable and most current API product specification(s). The design package(s) must be made available during API audits of the facility.

In specific instances, the exclusion of design activities is allowed under the Monogram Program, as detailed in *Advisory # 6*, available on API Monogram Program website at <http://www.api.org/advisories>.

A.7 Manufacturing Capability

The API Monogram Program is designed to identify facilities that have demonstrated the ability to manufacture equipment that conforms to API specifications and/or standards. API may refuse initial licensing or suspend current licensing based on a facility's level of manufacturing capability. If API determines that additional review is warranted, API may perform additional audits (at the organization's expense) of any subcontractors to ensure their compliance with the requirements of the applicable API product specification(s) and/or standard(s).

A.8 API Monogram Program: Nonconformance Reporting

API solicits information on products that are found to be nonconforming with API specified requirements, as well as field failures (or malfunctions), which are judged to be caused by either specification deficiencies or nonconformities with API specified requirements. Customers are requested to report to API all problems with API monogrammed products. A nonconformance may be reported using the API Nonconformance Reporting System available at <http://compositelist.api.org/ncr.asp>.

Annex B

(normative)

Walkways, Stairways, and Ladders

B.1 General

Walkways and stairways furnished to this specification shall be constructed from prefabricated components designed to be field erected alongside of tanks or similar structures. All material shall comply with the applicable parts of Section 4.

NOTE Walkways, platforms, and stairways or ladders are intended to provide access to devices on or near the roof within easy reach from the ladder or platform and not for employee egress onto the roof itself. When individuals are required to have access to the roof, the design shall specify the additional allowable loading per square foot and suitable guard railings should be installed to prevent falling.

B.2 Walkways

Walkways shall consist of tread (decking) sections, railing assemblies, and toe boards designed and assembled so that the completed structure will support a uniform load of 50 lb/ft² or a concentrated load of 1000 lb at any place on the span without deflecting more than $\frac{1}{360}$ th of the unsupported span length. The maximum span between tank brackets or ground supports shall be 25 ft. Where intermediate supports are required, the vertical members shall terminate at the top rail. The base for ground supports shall be of concrete or other suitable permanent foundation.

B.3 Treadway

The treadway shall be a minimum of 26 in. wide. Tread shall be uniformly perforated from the bottom with shaped punches to form a non-skid surface. Optionally, at the request of the purchaser, the deck of treadway sections may be fabricated from structural expanded metal or grating to avoid the buildup of snow or ice.

B.4 Railings

B.4.1 Railings shall consist of posts, horizontal braces, sway (truss) braces, gusset plates, toe boards, and a midrail and top rail. Railings shall be assembled so that the top rail is 42 in. above the treadway.

B.4.2 The completed structure, when assembled, shall be capable of withstanding a concentrated force of 200 lb applied in any direction at any point on the top rail.

B.5 Toeboards

Toeboards shall be installed on all open sides (except at the entrance of stairways or ladders) to provide an installed height of 4 in above the treadway.

B.6 Midrail

The midrail shall be installed approximately halfway between treadway and top rail. Where the midrail projects into a walkway area, the ends shall be formed to a smooth contour.

B.7 Brackets

Each tank shall be equipped with two bracket assemblies securely bolted to the lugs specified in Figure 5.1. The brackets shall be installed to provide a 26 in. wide access to the tank at any point of the attachment.

B.8 Stairways

B.8.1 Stairways, when required for access to the walkway sections, shall be designed for field erection and shall be capable of supporting a minimum of 100 lb per linear foot of tread width, or a concentrated load of 1000 lb at any point on the stairway without deflecting more than $\frac{1}{360}$ th of the unsupported stairway length.

B.8.2 Stairway width shall be a minimum of 26 in.

B.8.3 Stairways shall be designed and installed to have an angle of 45° with the horizontal, unless otherwise specified by the purchaser. When installed at 45°, the stairway shall have a run and rise of 8 $\frac{1}{2}$ in., with a nominal tread width of not less than 8 in. Other uniform rise and tread combinations which will produce a stairway within angles to the horizontal between 30° and 50° are acceptable, as long as all other requirements of this specification are met.

B.8.4 The rise height and tread width shall be uniform throughout any stairway, including any foundation used as one or more steps.

B.8.5 Railings shall be installed on both sides of stairways and shall be designed so that the completed assembly will withstand a minimum of 200 lb force in any direction applied at any point on the top rail. Top rails shall be installed so that the top rail is not less than 30 in., or more than 37 in., measured vertically from the upper surface of the nose of a tread. Protection against falling between the stairway runners and the top rail shall be provided.

B.8.6 The juncture of the top rail of the stair railing shall make a smooth transition with the top rail of the walkway railing, preferably through the use of a structural gusset member.

B.8.7 Spiral stairways attached to brackets on the circumference of the tank may be used in lieu of straight stairways, provided all of the above requirements are met, with exception that railings are required only on the outside of the stairway. The run of the stair tread will depend on the radius of the exterior arc, and the minimum effective tread shall be 7 in., measured 13 in. from the exterior arc. Spiral stairways are not recommended for installation on tanks less than 15.5 ft. in diameter.

B.9 Ladders

B.9.1 Fixed industrial ladders may be used in lieu of stairways. The use of a platform is optional with the purchaser, but when used, the platform shall have the minimum dimensions of 26 in. by 30 in., with standard railings, except at the entrance to the ladder.

B.9.2 Ladders, when used, shall be substantially anchored with the center of the run at least 7 in. from the surface of the tank or other obstruction.

B.9.3 Ladder rungs shall be a minimum of $\frac{3}{4}$ in., in diameter, spaced a maximum of 12 in., center-to-center, with a minimum clear length of 16 in., and designed to support a minimum load of 200 lb.

B.9.4 Open ladders may be used to climb a maximum of 20 ft, and caged ladders or acceptable safety slide devices should be used when the climbing height is between 20 ft and 30 ft.

Annex C

(informative)

Suggestions for Ordering Field-welded Tanks

When placing orders for tanks to be manufactured in accordance with the stipulations of API Specification 12D, purchasers should specify the following on their purchase order.

Specification	API Specification 12D
Number of tanks	
Nominal Capacity	Table 5.1, Column 1
Size	5.2
Outside diameter	Table 5.1, Column 4
Height of shell	Table 5.1, Column 5
Type of bottom	5.5.1
Shell plate thickness	5.6.1.1
Roof plate thickness	5.7.2
Delivery date and shipping instructions	
Inspection by purchaser	9.2

The purchaser should also state on the purchase order requirements concerning the following stipulations, which are optional with the purchaser.

Bolting	4.9
Viscous oil options	Table 5.1, Footnote b
Cleanout cover-plate design	5.8
Anti-channel drain baffle	5.12
Downcomer pipe and design	5.13
Walkways, stairways, and ladders	Annex B

Attention is also called to the following stipulations, which are subject to agreement between the purchaser and manufacturer.

Materials	4.1
Alternative bolting materials and/or finish	4.9.5
Additional connections	5.9.1
Finish coats of paint	7.4
Internal coating	7.5



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