

# **Specification for Shop Welded Tanks for Storage of Production Liquids**

API SPECIFICATION 12F  
TWELFTH EDITION, OCTOBER 2008

EFFECTIVE DATE: APRIL 1, 2009



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**Upstream Segment**

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# Specification for Shop Welded Tanks for Storage of Production Liquids

## 1 Scope

### 1.1 General

This specification covers material, design, fabrication, and testing requirements for shop-fabricated vertical, cylindrical, aboveground, closed top, welded steel storage tanks in various standard sizes and capacities for internal pressures approximately atmospheric, not to exceed those listed in Table 1, Column 2.

This specification is designed to provide 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 of the provisions of this specification. The purchaser may make any investigation necessary to be satisfied of this compliance by the manufacturer and may reject any material that does not comply with this specification. It is urged that the purchaser avail him/herself of this right and furnish his/her own inspection independently of any supervisory inspection furnished by the manufacturer, and that the purchaser's inspector follow closely all the details of shop fabrication and/or field construction and testing herein specified which affect the integrity and safety of the completed structure.

## 2 References

API Specification 5L, *Specification for Line Pipe*

API Standard 2000, *Venting Atmospheric and Low-Pressure Storage Tanks: Nonrefrigerated and Refrigerated*

ASME B1.1 <sup>1</sup>, *Unified Inch Screw Threads (UN and UNR Thread Form)*

ASME B16.5, *Pipe Flanges and Flanged Fittings*

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

ASME B18.2.1, *Square and Hex Bolts and Screws, Inch Series*

ASME B18.2.2, *Square and Hex Nuts*

ASME B31.1, *Process Piping*

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

ASTM A36 <sup>2</sup>, *Standard Specification for Carbon Structural Steel*

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

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

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<sup>1</sup> ASME International, 3 Park Avenue, New York, New York 10016, [www.asme.org](http://www.asme.org).

<sup>2</sup> ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, [www.astm.org](http://www.astm.org).

ASTM A153, *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*

ASTM A283, *Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality*

ASTM A285, *Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength*

ASTM A307, *Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength*

ASTM A1011, *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*

ASTM B454, *Specification for Mechanically Deposited Coatings/Cadmium/Zinc on Ferrous Metal*

AWS A 5.1<sup>3</sup>, *Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding*

NFPA No. 30<sup>4</sup>, *Flammable and Combustible Liquids Code*

### 3 Definitions

#### 3.1

##### **butt weld**

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

#### 3.2

##### **double-welded butt joint**

A joint between two abutting parts lying in approximately the same plane and welded from both sides.

NOTE A joint with filler metal added from one side only is considered equivalent to a double-welded butt joint when means are provided for accomplishing complete penetration and reinforcement on both sides of the joint.

#### 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

##### **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.

#### 3.5

##### **full-fillet weld**

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

#### 3.6

##### **tack weld**

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

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<sup>3</sup> American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126, [www.aws.org](http://www.aws.org).

<sup>4</sup> National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02169-7471, [www.nfpa.org](http://www.nfpa.org).

## **4 Material**

### **4.1 General**

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**

Plates shall conform to the latest edition of one of the following ASTM standards: ASTM A36, ASTM A283 (Grade C or D), and ASTM A285 (Grade C).

Shell plates for which minimum thicknesses have been fixed for practical reasons (greater than required by computation) and which will not under run 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 on the order at the option of the purchaser.

### **4.3 Sheets**

Sheets shall conform to the latest revision of ASTM A1011, Grade C or D, open-hearth process and basic oxygen process. Sheets may be ordered on a weight or thickness basis, at the option of the tank manufacturer.

### **4.4 Welding Electrodes**

Manual arc-welding electrodes shall conform to the E60 and E70 Series of Classification (suitable for the electric current characteristics, the position of welding, and other conditions of intended use) in the latest edition of AWS A 5.1.

### **4.5 Structural Shapes**

Structural shapes shall be of open-hearth, electric-furnace, or basic oxygen process and shall conform to the latest edition of ASTM A36.

### **4.6 Piping**

Pipe shall conform to Grade A or B of the latest edition of API 5L, ASTM A53, or ASTM A106.

### **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 recess, complying with the dimensional, physical and chemical requirements of the latest edition of API 5L, Grade B. Alternatively, couplings may comply with the latest edition of ASME B16.11.

### **4.9 Bolting**

Tank bolting  $\frac{1}{2}$  in. in diameter to and including  $\frac{1}{2}$  in. in length shall conform to the requirements given in Annex A. All other bolting shall conform to the latest revision of ASTM A307, Grade A or B. Unless otherwise specified on the

purchase order, black-finish bolts and nuts shall be furnished. When specified to be galvanized, bolts and nuts shall be zinc-coated in accordance with Annex A or the applicable ASTM specification. 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 specifications for each size tank filled with water (62.37 lb/ft<sup>3</sup> @ 60°F) and at the internal pressure specified in Table 1, Column 2. In order to assure structural stability and integrity, additional metal thickness has been added to that determined by calculation. The minimum metal thickness specified in this standard shall in no case be decreased.

### **5.2 Joint Design Definitions**

Definitions in Section 3 shall apply to tank-joint designs.

### **5.3 Size of Weld**

The size of a weld shall be based on the following dimensions:

- a) groove-weld: the joint penetration (depth of chamfering plus the root penetration when specified);
- b) fillet weld: for equal leg fillet welds, the leg length of the largest isosceles right-triangle which can be inscribed within the fillet-weld cross-section; while for unequal leg fillet welds, the leg lengths of the largest right-triangle which can be inscribed within the fillet-weld cross-section.

### **5.4 Joint Restrictions**

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

- a) tack welds shall not be considered as having any strength value in the finished structure;
- b) the minimum size of fillet welds shall be as follows: plate  $\frac{3}{16}$  in. in thickness, full-fillet welds; 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.;
- c) single-welded joints shall not be permissible on tank bottoms, shells, or decks.

### **5.5 Size**

Tanks under this specification shall be furnished in the sizes and dimensions as stipulated in Table 1, Column 1 through Column 7, and Figure 1, as specified on the purchase order.

### **5.6 Bottom Type Design**

The tank bottom shall be flat, or of the Type A (unskirted) or Type B (skirted) cone design, as specified on the purchase order. Type A and Type B cone bottoms shall conform to Figure 2 and Figure 3, respectively.



**Table 1—Tank Dimensions (See Figure 1)**

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Capacity bbl	Design Pressure oz/in. <sup>2</sup>	Approximate Working Capacity bbl (See Note)	Outside Diameter ft, in. A	Height ft B	Height of Overflow Connection ft, in. C	Height of Walkway Lugs ft, in. D	Location of Fill-line Connection <sup>a</sup> in. E	Size of Connections in.	
	Pressure, Vacuum							C-1, C-2, C-3, C-7	C-4, C-5, C-6
90	16, 1/2	72	7, 11	10	9, 6	7, 7	14	3	3
100	16, 1/2	79	9, 6	8	7, 6	5, 7	14	3	3
150	16, 1/2	129	9, 6	12	11, 6	9, 7	14	3	3
200	16, 1/2	166	12, 0	10	9, 6	7, 7	14	3	4
210	16, 1/2	200	10, 0	15	14, 6	12, 7	14	3	4
250	16, 1/2	224	11, 0	15	14, 6	12, 7	14	4	4
300	16, 1/2	266	12, 0	15	14, 6	12, 7	14	4	4
400	16, 1/2	366	12, 0	20	19, 6	17, 7	14	4	4
500	16, 1/2	466	12, 0	25	24, 6	22, 7	14	4	4
500	8, 1/2	479	15, 6	16	15, 6	13, 7	14	4	4
750	8, 1/2	746	15, 6	24	23, 6	21, 7	14	4	4
Tolerance (all sizes)			± 1/8 in.	± 3/8 in.	± 1/8 in.	± 1/8 in.	± 1/8 in.		

NOTE The approximate working capacities shown in Column 3 apply to flat-bottom tanks.

Type A (unskirted) cone-bottom tanks have 6 in. more working height than the corresponding flat-bottom tanks. The approximate increase is 4 bbl for the 7-ft, 11-in. diameter tanks, 6 bbl for the 9-ft, 6-in. diameter tanks, 7 bbl for the 10-ft diameter tanks, 8 bbl for the 11-ft diameter tanks, 10 bbl for the 12-ft diameter tanks, and 17 bbl for the 15-ft, 6-in. diameter tanks.

Type B (skirted) cone-bottom tanks have 8 in. less working height than the corresponding flat-bottom tanks. The approximate decrease in capacity is 6 bbl for the 7-ft, 11-in. diameter tanks, 8 bbl for the 9-ft, 6-in. diameter tanks, 9 bbl for the 10-ft diameter tanks, 11 bbl for the 11-ft diameter tanks, 13 bbl for the 12-ft diameter tanks, and 15 bbl for the 15-ft, 6-in. diameter tanks.

<sup>a</sup> *Viscous Oil Option.* When so specified on the purchaser 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, Table 1 and dimension E of the fill-line connection shall be 6 in., ± 1/8 in.

## 5.7 Thickness

The thickness of bottom plates shall be 1/4 in. (10.20 lb/ft<sup>2</sup>) nominal, except the sump of the Type A cone bottom which shall be 3/8 in. (15.30 lb/ft<sup>2</sup>) nominal.

## 5.8 Joints in Bottom Plates

Bottom joints shall be double-welded butt joints with complete penetration.

## 5.9 Shell Attachments

The tank bottom shall be attached to the tank shell, if the bottom is flanged, by a double-welded butt joint with complete penetration, or by a double-welded, full-fillet lap joint; or, if the bottom is not flanged, by full-fillet welds, both inside and outside.

## 5.10 Shell Thickness Design

The thickness of shell plates shall be either 3/16 in. (7.65 lb/ft<sup>2</sup>) nominal, or 1/4 in. (10.20 lb/ft<sup>2</sup>) nominal, as specified on the purchase order. The width of shell plates shall be determined by the manufacturer, but preferably should be not less than 60 in.

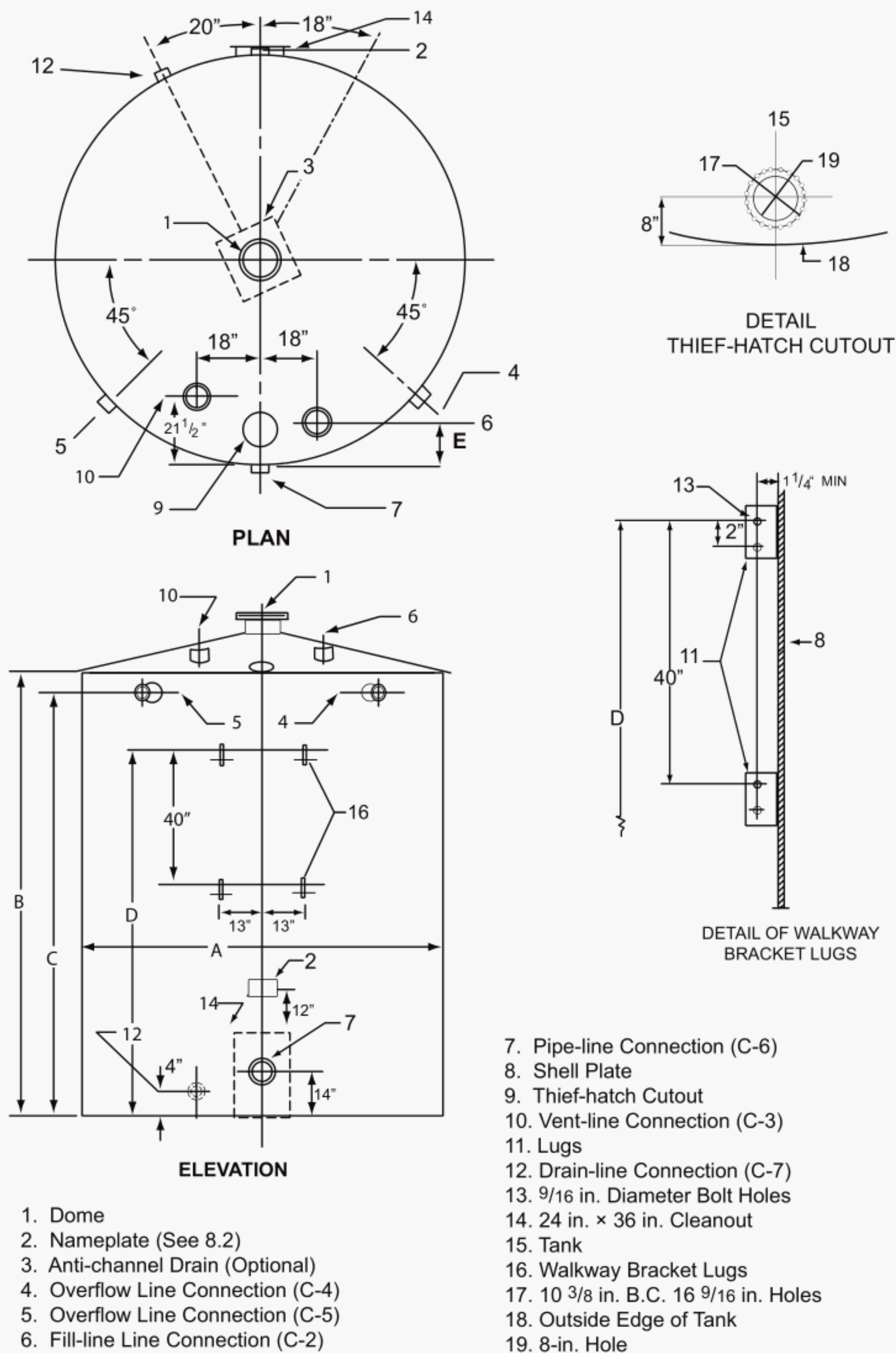
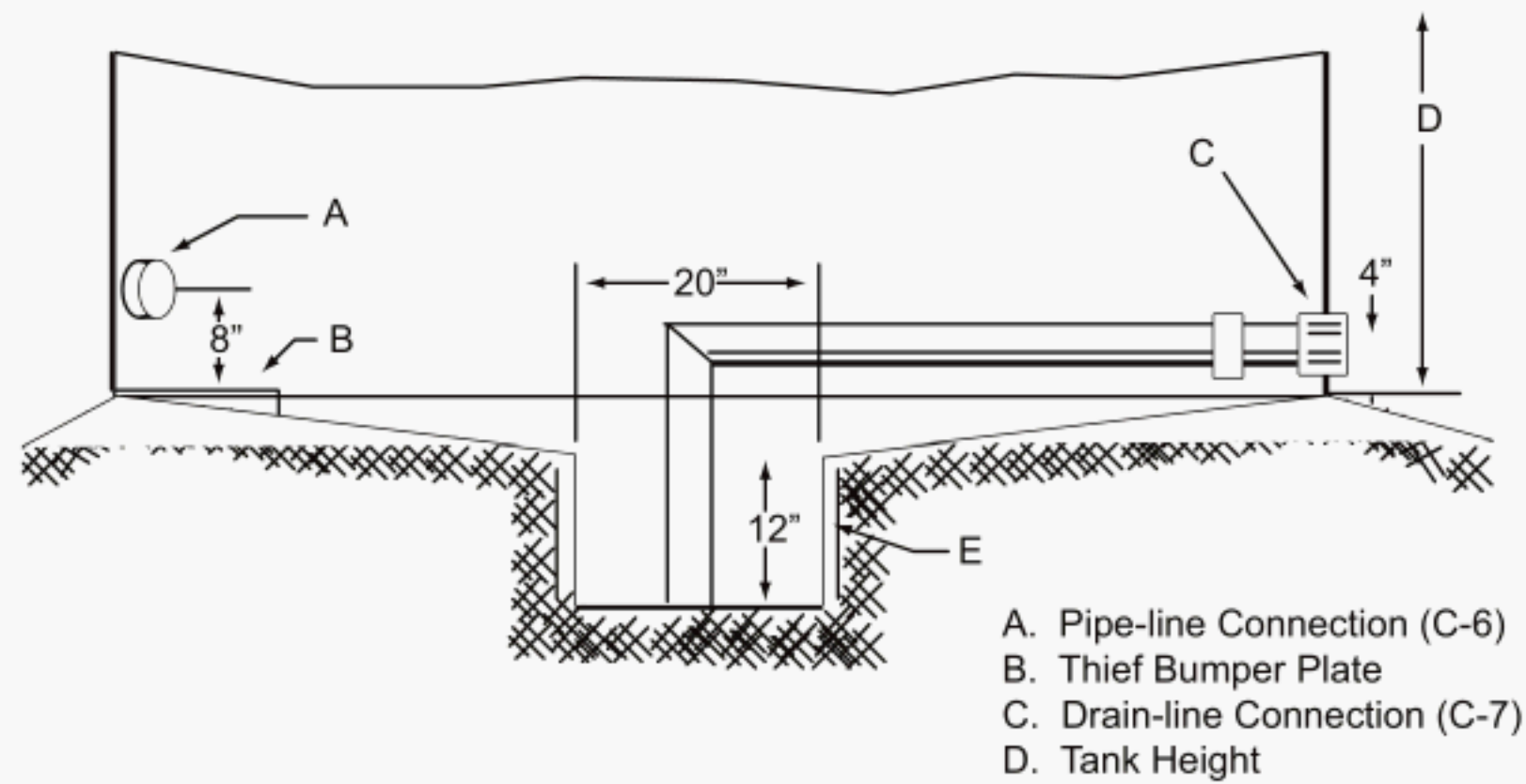
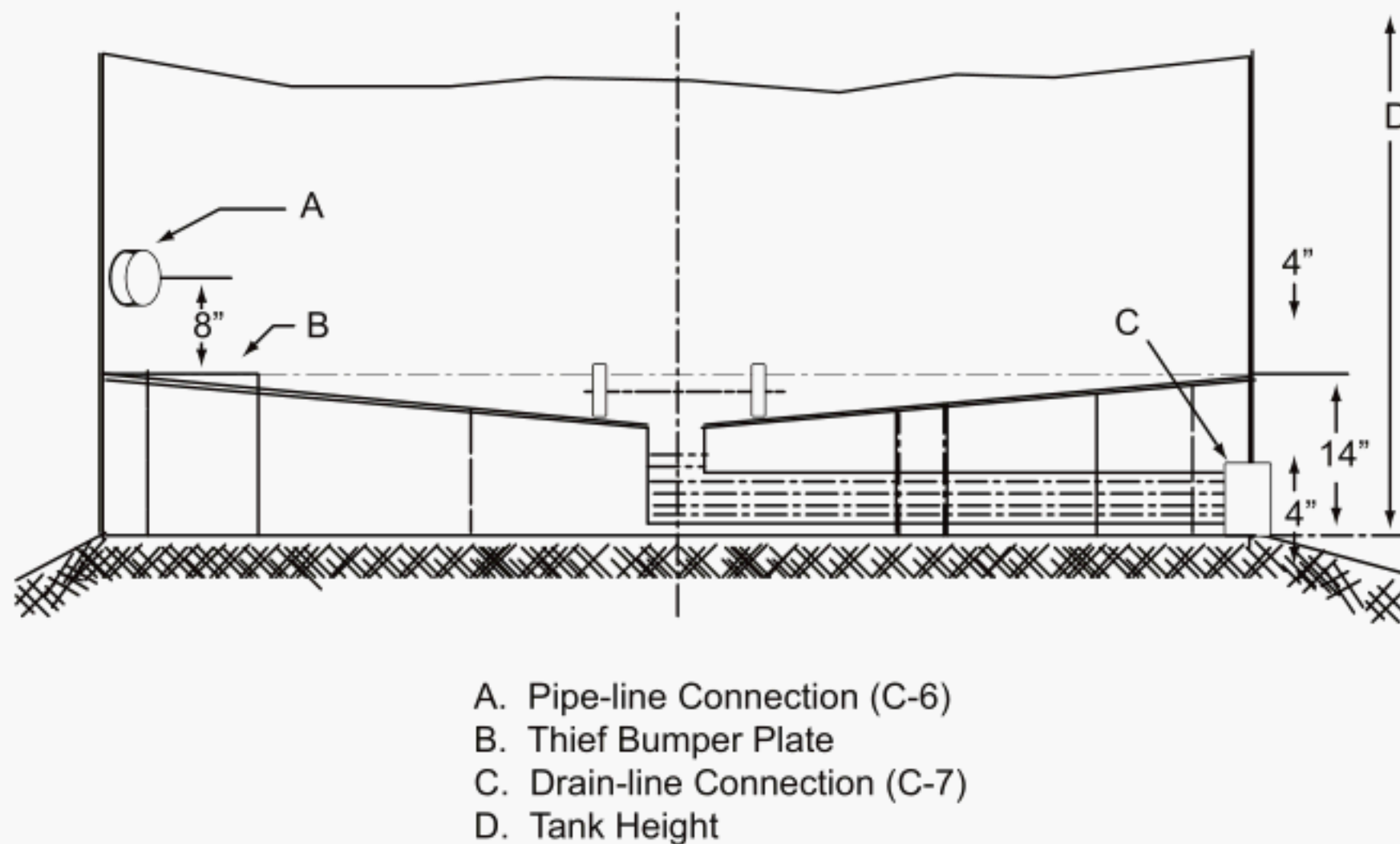


Figure 1—Tank Dimensions—See Table 1



**Figure 2—Type A (Unskirted) Cone Bottom**



**Figure 3—Type B (Skirted) Cone Bottom**

### 5.11 Shell Joints

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

### 5.12 Deck Type Design

The deck shall be of the self-supporting, cone type, with a slope of 1 in. in 12 in.

### 5.13 Thickness

The thickness of deck plates shall be the same as the thickness of the shell plates, except that for 15 ft, 6 in. diameter tanks the deck shall be  $\frac{1}{4}$  in. nominal unless added structural supports in the form of rafters are provided.

### 5.14 Deck Joints

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



### **5.15 Shell Attachment**

The tank deck shall be attached to the tank shell, if the deck is flanged, by a double-welded butt joint with complete penetration, or by a double-welded, full-fillet lap joint; or, if the deck is not flanged, by full-fillet welds, both inside and outside.

### **5.16 Cleanout Design**

Tanks shall be furnished with a 24-in. × 36-in. extended-neck cleanout, located as shown in Figure 1 and conforming to Figure 4. Cleanout cover plates shall be of one-piece construction, except that, if so specified on the purchase order they shall be of two-piece construction with a horizontal lap seam having one row of 1/2-in. bolts on 2-in. centers with suitable gaskets and bolt retainers. If two-piece construction is specified, the top inspection plate shall have a clear opening of approximately 14 in. × 24 in., unless otherwise specified. When specified on the purchase order, handles for lifting the cleanout cover plate(s) shall be furnished.

### **5.17 Connections Design**

Tanks may be provided with inlet and outlet connections as shown in Table 1, Column 9 and Column 10, and Figure 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 connections C-1, C-4, C-5, and C-6, at the option of the manufacturer. Additional or fewer connections of other sizes or locations may be provided, if so agreed between the purchaser and the manufacturer. When flanged or other types of connections are specified, the nozzle neck shall be a minimum of standard weight pipe and attached by full-fillet welds, both inside and outside. The bolting pattern for the thief hatch shall conform to Figure 1.

### **5.18 Anti-channel Drain Baffle Design**

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

- a) The periphery of the baffle, in plan 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 4 in. minimum for 90-bbl tanks, and 5 1/4 in. minimum for all other sizes.
- 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 3 in. nominal for 90-bbl tanks and 4 in. nominal for all other sizes.
- 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 by the line connection to the tank shell. The baffle shall not be welded to the tank bottom.

### **5.19 Downcomer Pipe**

A downcomer pipe shall be installed if requested by the purchaser; design of downcomer to be by agreement between purchaser and manufacturer.



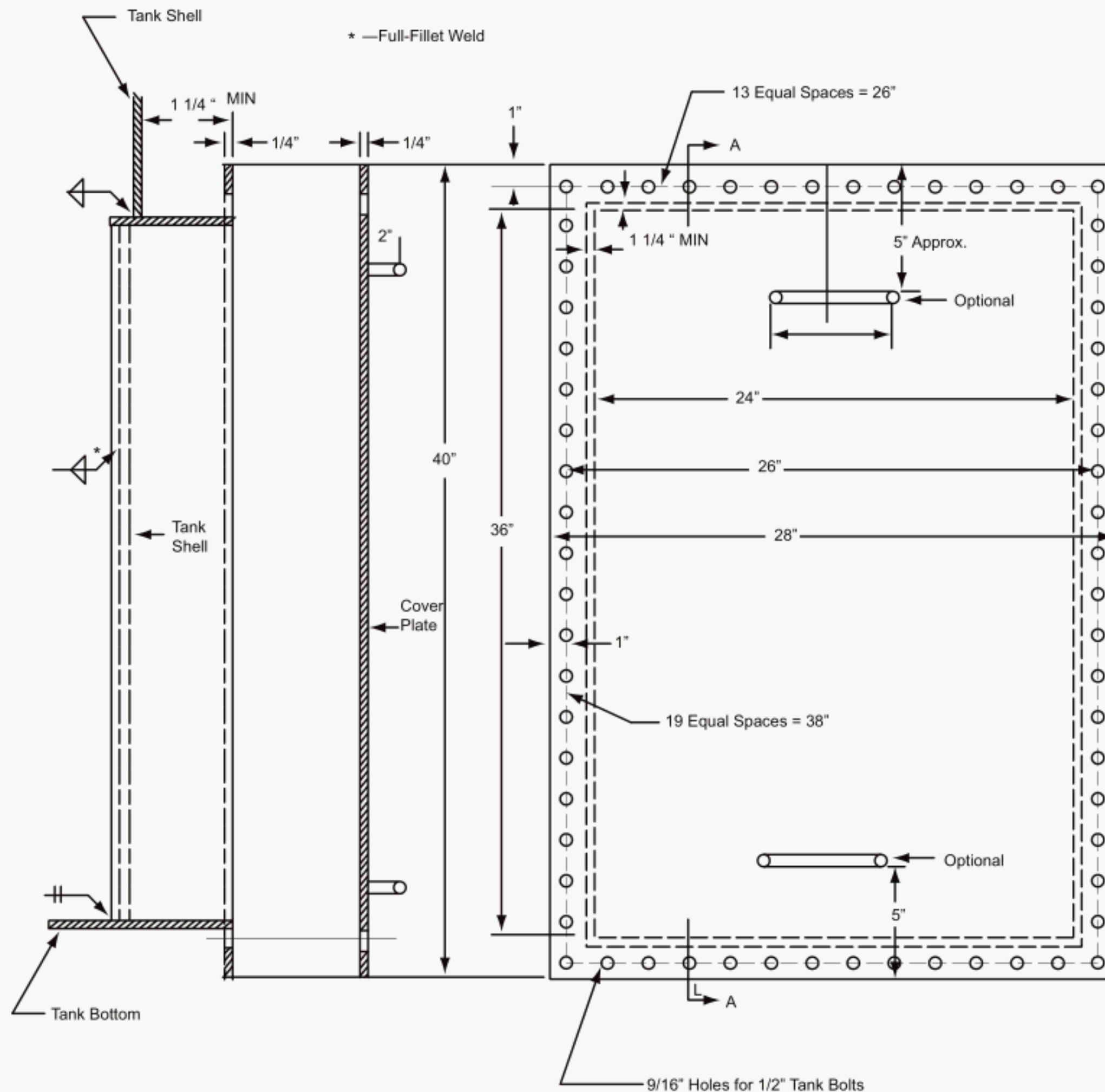


Figure 4—24-in. × 36-in. Extended-neck Cleanout (See 5.16)

## 6 Venting Requirements

### 6.1 Normal Venting

Connections C-1 and C-3 are provided for normal inbreathing and outbreathing due to temperature changes and to liquid movement into and out of the tank. These connections should be fitted with pressure-vacuum valves properly sized in accordance with API 2000. The pressure setting should be from 2 oz/in.<sup>2</sup> to 4 oz/in.<sup>2</sup> less than the opening pressure of devices used for emergency venting. Annex B is provided as a guide to aid in the selection of venting devices, where required.

### 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 which will provide capacity in addition to normal venting to meet the requirements tabulated in Table C.1. 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 Table C.1, Column 6. Pressure relieving devices may take the form of larger or additional vent valves or additional thief hatches.

NOTE With drainage as used in Table C.1, Column 5 means that flammable or combustible liquids will not be retained near the tank by dykes or firewalls.

## **7 Fabrication, Testing, and Painting**

### **7.1 Fabrication**

Fabrication shall be completed in the shop of the manufacturer in accordance with the best modern practices.

### **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 and Pressure Vessel Code* is recommended.

### **7.3 Testing**

Tanks shall be tested in the shop of the manufacturer by the following method.

- a) Brace bottom by securely attaching external stiffening member if required to eliminate permanent deformation during test.
- b) Close all openings with plugs or covers as needed. Bolts and gaskets of the size and type required for final installation are to be used during test.
- c) The tank will be tested with air to 1 1/2 times the maximum design pressure of the tank (see 5.1).

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

- d) For the detection of leaks, apply soap suds, linseed oil, or other suitable material to all shell, bottom, roof, and attachment welds. Carefully examine for leaks.
- e) All defects found in welds by leak test shall be repaired by the manufacturer, and the tank retested.
- f) After release of air pressure, bottom stiffening, if used, shall be removed and scars repaired.

### **7.4 External Painting**

Before shipment, tanks shall be cleaned of rust, grease, scale, and weld spatter, and coated with a good grade of commercial metal primer, unless specified to be unpainted by the purchaser. Finish coats or other protective coatings shall be applied if so agreed upon between the purchaser and the manufacturer.

### **7.5 Internal Coating**

When internal coating is required, procedures, and methods outlined in NACE RP 0372, *Method for Lining Lease Production Tanks with Coal Tar Epoxy* are recommended as a minimum requirement. Other coatings and methods may be used by agreement between purchaser and manufacturer.



## 8 Marking

Tanks manufactured in conformance with this specification shall be identified by a nameplate bearing the information shown in Figure 5.

Manufactured in Accordance with API Specification 12F	
Manufacturer	_____
Serial Number	_____
Year Built	_____
Nominal Diameter	_____
Nominal Height	_____
Bottom Thickness	_____ Type _____
Shell Thickness	_____
Deck Thickness	_____
Design Pressure	_____ oz
Nominal Capacity	_____ bbl

**Figure 5—Nameplate Format**

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. The bracket, backing plate, or nameplate shall be seal-welded to the tank shell in the location shown in Figure 1.

## 9 Inspection and Rejection

### 9.1 Inspection Notice

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

### 9.2 Inspection by Purchaser

The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which will 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. 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 as not to interfere unnecessarily with the manufacturer's operations.

### 9.3 Rejection

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

## **9.4 Compliance**

The manufacturer shall be responsible for complying with all provisions of this specification. The purchaser may make any investigation necessary to be assured of compliance by the manufacturer and may reject any material that does not comply with this specification.

## **Annex A** **(normative)**

### **Specification for Tank Bolting**

#### **A.1 Scope**

The annex covers tank bolting  $\frac{1}{2}$  in. in diameter to and including  $1\frac{1}{2}$  in. in length. Bolts and nuts shall be either black-finish or galvanized, as specified on the purchase order.

#### **A.2 Physical Properties**

The breaking load of the bolts, tested in full size, shall not be less than 11,350 lb.

NOTE The breaking load of 11,350 lb is equivalent to a tensile strength of 80,000 lb/in.<sup>2</sup> based on the stress area (mean thread area) or approximately 91,000 lb/in.<sup>2</sup> based on the root thread area.

#### **A.3 Tension Test**

Tension tests of bolts shall be taken on the finished bolt with the load applied between the head and a nut or suitable fixture, either of which will have sufficient thread engagement to develop the full strength of the bolt. The nut or fixture shall be assembled on the bolt leaving at least three full bolt threads exposed within the grip. If failure occurs by threads stripping before reaching the minimum required tensile load, the individual test shall be discarded.

#### **A.4 Stripping Test**

The nuts for bolts shall be capable of developing the load specified in A.2 without stripping.

#### **A.5 Head Test**

During the tension test specified in A.3, failure shall occur in the threaded section and not at the junction of the head and shank.

#### **A.6 Number of Tests**

The requirements of these specifications are those met in continuous production for stock during which the manufacturer has made such sample inspections as to insure normally that the material is controlled within the specified limits. For this reason, additional tests by the manufacturer of the individual shipments of material are not contemplated. If specified on order, one tension test shall be made from each lot. A lot shall consist of 5,000 pieces or fraction thereof.

#### **A.7 Retests**

Should the sample from the lot fail to meet the requirements of a specified test, two additional samples shall be tested; in which case, both samples shall meet the test.

#### **A.8 Thread Requirements**

Threads of unplated product shall be coarse-thread series as specified for screw threads (ANSI B1.1 of latest issue) having a Class 2A tolerance for bolts and Class 2B tolerance for nuts. Bolts to be galvanized shall have Class 2A threads before hot dip or mechanical galvanizing. After galvanizing, the maximum limit of pitch and major diameter may exceed the Class 2A limit by 0.021 in.

## **A.9 Bolt Requirements**

Bolts shall be regular square, unless otherwise agreed upon between the purchaser and the manufacturer, in which case they may be regular hex. All bolts shall comply with the applicable section of the latest edition of ANSI B18.2.1, *Square and Hex Bolts and Screws*.

## **A.10 Nut Requirements**

Nuts shall be regular square, unless otherwise agreed upon between the purchaser and the manufacturer, in which case they may be regular hex. All bolts shall comply with the applicable section of the latest edition of ANSI B18.2.2, *Square and Hex Nuts*.

## **A.11 Galvanizing**

Unless otherwise specified, galvanized bolts and nuts shall be hot-dip galvanized in accordance with the requirements of ASTM A153. The weight of coating shall be that specified for Class C materials in ASTM A153 and the nuts shall be tapped after galvanizing. When specified by the purchaser to be mechanically galvanized, bolts and nuts shall be mechanically zinc-coated, and the coating shall conform to the requirements for Class 50 of ASTM B454 or to the coating thickness, adherence, and quality requirements for Class C of ASTM A153. Mechanically zinc-coated nuts for assembly with mechanically zinc-coated bolts shall be tapped oversize prior to coating and need not be retapped afterwards.

## **A.12 Marking**

Bolt heads shall be marked (by raised or depressed mark at the option of the manufacturer) to identify the manufacturer. The manufacturer may use additional marking for internal use.

## Annex B (informative)

### Recommended Practice for Normal Venting

**Table B-1—Venting Capacity Requirements (See 6.1)**

(1)	(2)		(3)	(4)	(5)	(6)	(7)
Nominal Tank Capacity bbl	Tank Size		Design Pressure oz/in. <sup>2</sup>	Surface Area, ft <sup>2</sup>	Thermal Venting SCFH		
			Pressure, Vacuum		Vacuum (Inbreathing) All Stocks	Pressure (Outbreathing)	
	Diameter ft, in.	Height ft				Flash Point 100°F or Above	Flash Point Below 100°F
90	7, 11	10	16, 1/2	250	90	55	90
100	9, 6	8	16, 1/2	240	100	60	100
150	9, 6	12	16, 1/2	360	150	90	150
200	12, 0	10	16, 1/2	378	200	120	200
210	10, 0	5	16, 1/2	372	210	125	210
250	11, 0	15	16, 1/2	520	250	150	250
300	12, 0	15	16, 1/2	565	300	180	300
400	12, 0	20	16, 1/2	755	400	240	400
500	12, 0	25	16, 1/2	945	500	300	500
500	15, 6	16	8, 1/2	780	500	300	500
750	15, 6	24	8, 1/2	1,170	750	450	750

NOTE 1 Filling and emptying venting.

- *Outbreathing at maximum filling rate:* For flash points less than 100°F, provide 1200 standard cubic feet per hour (SCFH) for each 100 bbl/hr. For flash points of 100°F or more, provide 600 SCFH for each 100 bbl/hr.
- *Inbreathing at maximum emptying rate:* For all liquids, provide 600 SCFH for each 100 bbl/hr.

NOTE 2 The values calculated for filling and emptying venting requirements shall be added to the appropriate thermal venting requirements.





## Annex C (informative)

### Recommended Relieving Capacities

**Table C.1—Emergency Venting Requirements (See 6.2)**

(1)	(2)	(3)	(4)	(5)		(6)
Nominal Capacity bbl	Diameter × Height ft, in.	Design Pressure oz/in. <sup>2</sup>	Exposed Area ft <sup>2</sup>	Emergency Venting Required SCFH		Max. Press. During Emergency Venting oz
		Pressure, Vacuum		With Drainage <sup>a</sup>	Without Drainage	
90	7, 11 × 10, 0	16, 1/2	250	119,500	239,000	48
100	9, 6 × 8, 0	16, 1/2	240	116,500	233,000	48
150	9, 6 × 12, 0	16, 1/2	360	146,000	292,000	48
200	12, 0 × 10, 0	16, 1/2	378	150,700	301,000	24
210	10, 0 × 15, 0	16, 1/2	372	171,100	342,000	48
250	11, 0 × 15, 0	16, 1/2	520	180,000	361,000	24
300	12, 0 × 15, 0	16, 1/2	565	189,350	378,700	24
400	12, 0 × 20, 0	16, 1/2	755	223,350	446,350	24
500	12, 0 × 25, 0	16, 1/2	945	253,000	507,000	24
500	15, 6 × 16, 0	8, 1/2	780	227,600	455,200	12
750	15, 6 × 24, 0	8, 1/2	1,170	271,800	543,600	12
NOTE Normal vents (see 6.1 and Annex B) may satisfy all or part of these requirements.						
<sup>a</sup> In applying recommended emergency venting required <i>with drainage</i> careful attention should be given to the provisions of 2.3.2 and 2.5.7, NFPA No. 30.						

**Table C.2—Calculated Venting Capacity of 8-in. Round Thief Hatch**

(1)	(2)	(3)	(4)
Venting Pressure oz	Venting Capacity SCFH Q	Venting Pressure oz	Venting Capacity SCFH Q
1.5	59,783	18	207,097
3.0	84,547	24	239,135
4.5	103,548	32	386,000
6.0	119,567	40	434,000
12.0	169,094	48	471,000

NOTE Values in the above table are based on the following equation:

$$Q = 1667 C_f A \sqrt{P_t - P_a} \quad (C.1)$$

where

$Q$  is the venting capacity in standard cubic feet of free air per hour (SCFH);

$C_f$  is 0.5 (the flow coefficient);

$A$  is the hatch area in.<sup>2</sup> ( $A = 44$  in.<sup>2</sup> for 8-in. round hatch);

$P_t$  is the absolute pressure inside the tank in inches of water;

$P_a$  is the absolute pressure outside the tank in inches of water.

## **Annex D** **(normative)**

### **Walkways, Stairways, and Ladders**

#### **D.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.

#### **D.2 Access**

It should be noted that walkways, platforms, and stairways or ladders are intended to provide access to devices on or near the deck within easy reach from the ladder or platform, and not for employee egress onto the deck itself. Where individuals are required to have access to the deck, suitable guard railings should be installed to prevent their falling.

#### **D.3 Walkways**

Walkway shall consist of tread (decking) sections, railing assemblies, and toeboards designed and assembled so that the completed structure will support a uniform load of 50 lb/ft<sup>2</sup>, or a concentrated load of 1,000 lb at any place on the span without deflecting more than  $\frac{1}{360}$  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.

#### **D.4 Treadway**

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.

#### **D.5 Railings**

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

#### **D.6 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.

#### **D.7 Midrail**

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.

#### **D.8 Brackets**

Each tank shall be equipped with two bracket assemblies, securely bolted to the lugs specified in Figure 1. The brackets shall be installed to provide a 26-in. wide access to the tank at the point of attachment.

## **D.9 Stairways**

Stairways, when required for access to 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 1,000 lb at any point on the stairway without deflecting more than  $\frac{1}{360}$  of the unsupported stairway length. Stairway width shall be a minimum of 26 in. Stairways shall be designed and installed to have an angle of 45 degrees with the horizontal, unless otherwise specified by the purchaser. When installed at 45 degrees, 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 degrees shall be acceptable, so long as all other requirements of this specification area met. The rise height and tread width shall be uniform throughout any stairway, including any foundation used as one or more steps.

## **D.10 Railings**

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. nor more than 34 in. measured vertically from the upper surface of the nose of a tread. Protection against falling shall be provided between the stairway runners and the top rail.

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.

## **D.11 Spiral Stairways**

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 the 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 ft, 6 in. in diameter.

## **D.12 Ladders**

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 minimum dimensions of 26 in.  $\times$  30 in. with standard railings except at the entrance from the ladder.

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

Rungs shall be a minimum of  $\frac{3}{4}$ -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.

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 E**

(informative)

### **Suggestions for Ordering Shop Welded Tanks**

In placing orders for tanks to be manufactured in accordance with the stipulations of API 12F, purchasers should specify the following on their purchase order:

Specification	API Spec 12F
Number of tanks	
Nominal capacity	Table 1, Column 1
Size	5.5
Outside diameter	Table 1, Column 4
Height of shell	Table 1, Column 5
Type of bottom	5.6
Shell plate thickness	5.10
Delivery date and shipping instructions	
Inspection by purchaser	9.2

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

Bolting	4.9
Viscous oil options	Table 1, Footnote a
Cleanout cover-plate design	5.16
Anti-channel drain baffle	5.18
Downcomer pipe and design	5.19
Walkways, stairways, and ladders	Annex D

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

Materials	4.1
Alternative bolting materials and/or finish	4.9
Additional connections	5.17
Finish coats of paint	7.4
Internal coating	7.5



## **Annex F** (informative)

### **Use of the API Monogram by Licensees**

#### **F.1 Scope**

The API Monogram Program allows an API Licensee to apply the API Monogram to products. The API Monogram Program delivers significant value to the international oil and gas industry by linking the verification of an organization's quality management system with the demonstrated ability to meet specific product specification requirements. The use of the Monogram on products constitutes a representation and warranty by the Licensee to purchasers of the products that, on the date indicated, the products were produced in accordance with a verified quality management system and in accordance with an API product specification.

When used in conjunction with the requirements of the API License Agreement, API Q1, in its entirety, defines the requirements for those organizations who wish to voluntarily obtain an API License to provide API monogrammed products in accordance with an API product specification.

API Monogram Program Licenses are issued only after an on-site audit has verified that the Licensee conforms to the requirements described in API Q1 in total, and the requirements of an API product specification. Customers/users are requested to report to API all problems with API monogrammed products. The effectiveness of the API Monogram Program can be strengthened by customers/users reporting problems encountered with API monogrammed products. A nonconformance may be reported using the API Nonconformance Reporting System available at <https://ncr.api.org>. API solicits information on new product that is 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.

This annex sets forth the API Monogram Program requirements necessary for a supplier to consistently produce products in accordance with API specified requirements. For information on becoming an API Monogram Licensee, please contact API, Certification Programs, 1220 L Street, N. W., Washington, D.C. 20005 or call 202-962-4791 or by email at [certification@api.org](mailto:certification@api.org).

#### **F.2 References**

In addition to the referenced standards listed in Section 2 of this document, this annex references the following standard:

API Specification Q1

For Licensees under the Monogram Program, the latest version of this document shall be used. The requirements identified therein are mandatory.

#### **F.3 API Monogram Program: Licensee Responsibilities**

**F.3.1** For all organizations desiring to acquire and maintain a license to use the API Monogram, conformance with the following shall be required at all times:

- a) the quality management system requirements of API Q1;
- b) the API Monogram Program requirements of API Q1, Annex A;

- c) the requirements contained in the API product specification(s) for which the organization desires to be licensed; and
- d) the requirements contained in the API Monogram Program License Agreement.

**F.3.2** When an API-Licensed organization is providing an API monogrammed product, conformance with API specified requirements, described in API Q1, including Annex A, is required.

**F.3.3** Each Licensee shall control the application of the API Monogram in accordance with the following.

- a) Each Licensee shall develop and maintain an API Monogram Marking Procedure that documents the marking/monogramming requirements specified by the API product specification to be used for application of the API Monogram by the Licensee. The marking procedure shall define the location(s) where the Licensee shall apply the API Monogram and require that the Licensee's License number and date of manufacture be marked on monogrammed products in conjunction with the API Monogram. At a minimum, the date of manufacture shall be two digits representing the month and two digits representing the year (e.g. 05-07 for May 2007) unless otherwise stipulated in the applicable API product specification. Where there are no API product specification marking requirements, the Licensee shall define the location(s) where this information is applied.
- b) 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 nonconforming with API specified requirements. Products that do not conform to API specified requirements shall not bear the API Monogram.
- c) Only an API Licensee may apply the API Monogram and its License to API monogramable products. For certain manufacturing processes or types of products, alternative Monogram marking procedures may be acceptable. The current API requirements for Monogram marking are detailed in the API Policy Document, *Monogram Marking Requirements*, available on the API Monogram Program website at <http://www.api.org/certifications/monogram/>.
- d) The API Monogram shall be applied at the licensed facility.
- e) The authority responsible for applying and removing the API Monogram shall be defined in the Licensee's API *Monogram Marking Procedure*.

**F.3.4** Records required by API product specifications shall be retained for a minimum of five years or for the period of time specified within the product specification if greater than five years. Records specified to demonstrate achievement of the effective operation of the quality system shall be maintained for a minimum of five years.

**F.3.5** Any proposed change to the Licensee's quality program to a degree requiring changes to the quality manual shall be submitted to API for acceptance prior to incorporation into the Licensee's quality program.

**F.3.6** Licensee shall not use the API Monogram on letterheads or in any advertising (including company-sponsored web sites) without an express statement of fact describing the scope of Licensee's authorization (License number). The Licensee should contact API for guidance on the use of the API Monogram other than on products.

## **F.4 Marking Requirements for Products**

These marking requirements apply only to those API Licensees wishing to mark their products with the API Monogram.

**F.4.1** Manufacturers shall mark equipment on the nameplate with the information identified in Section 8 of this specification, as a minimum, including "API Spec 12F."

**F.4.2** As a minimum, equipment should be marked with English (Imperial) units.



**F.4.3** Nameplates shall be made of a corrosion-resistant material and shall be located as indicated in the marking section of this specification. If the location is not identified, then F.3.3 a) of this annex shall apply.

**F.4.4** Nameplates may be attached at the point of manufacture or, at the option of the manufacturer, at the time of field erection.

**F.4.5** The API Monogram shall be marked on the nameplate, in addition to the marking requirements of this specification. The API Monogram License number shall not be used unless it is marked in conjunction with the API Monogram.

## **F.5 API Monogram Program: API Responsibilities**

**F.5.1** The API shall maintain records of reported problems encountered with API monogrammed products. documented cases of nonconformity with API specified requirements may be reason for an audit of the Licensee involved, (also known as audit for “cause”).

Documented cases of specification deficiencies shall be reported, without reference to Licensees, customers or users, to API Subcommittee 18 (Quality) and to the applicable API Standards Subcommittee for corrective actions.





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