

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

API SPECIFICATION 12D  
TENTH EDITION, NOVEMBER 1, 1994

**American  
Petroleum  
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## FOREWORD

This specification is under the jurisdiction of the API Committee on Standardization of Production Equipment.

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. The object of this publication is to provide 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 non-potable water. If tanks are purchased in accordance with these specifications, the purchaser is expected to specify certain basic requirements.

*This standard shall become effective on the date printed on the cover but may be used voluntarily from the date of distribution.*

# Specification for Field Welded Tanks for Storage of Production Liquids

## 1 SCOPE

### 1.1 GENERAL

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

b. 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 satisfy himself of compliance by the manufacturer and may reject any material that does not comply with this specification. It is urged that the purchaser avail himself of this right and furnish his own inspection independently of any supervisor 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 Material

### 2.1 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 those listed may be used by agreement between the purchaser and the manufacturer. Where higher strength materials are used, the minimum thickness called for in this specification shall not be reduced.

### 2.2 PLATES

a. Plates shall conform to the latest edition of one of the following ASTM Standards\*:

- A 36 *Structural Steel*
- A 283 *Low and Intermediate Tensile Strength Carbon Steel Plates for Pressure Vessels—grade C or D.*
- A 285 *Low and Intermediate Tensile Strength Carbon Steel Plates for Pressure Vessels—grade C.*

b. Shell plates for which minimum thicknesses have been fixed for practical reasons (greater than required by computation) and which 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 on the order at the option of the purchaser.

### 2.3 SHEETS

Sheets shall conform to the latest revision of ASTM A 570, 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.

### 2.4 WELDING ELECTRODES

Manual arc-welding electrodes shall conform to the E 60 and E 70 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 Specification for Mild Steel Arc-Welding Electrodes.*

### 2.5 STRUCTURAL SHAPES

Structural shapes shall be of open-hearth, electric-furnace, or basic oxygen process and shall conform to the latest edition of ASTM A 36.

### 2.6 PIPING

Pipe shall conform to Grade A or B of the latest edition of API Specification 5L; ASTM A 53; or ASTM A-106.

### 2.7 FLANGES

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

### 2.8 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 Specification 5L, Grade B. Alternatively, couplings may comply with the latest edition of ANSI B16.11† for Steel Pipe Couplings.

\*Available from American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pa. 19103.

\*\*Available from American Welding Society (AWS), P.O. Box 351040, Miami, Florida 33135.

†American National Standards Institute (ANSI), 1430 Broadway, New York, N.Y. 10018.

## 2.9 BOLTING

Tank bolting  $\frac{1}{2}$  inch in diameter to and including  $1\frac{1}{2}$  inch in length shall conform to the requirements given in Appendix A. All other bolting shall conform to the latest revision of ASTM A-307, 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 Appendix 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.

## 3 Design

### 3.1 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/cu. ft. @ 60 F) and at the internal pressure specified in column 2 Table 1. 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 specification shall in no case be decreased.

### JOINT DESIGN

#### 3.2 DEFINITIONS

The following definitions shall apply to tank-joint designs.

- a. Double-Welded Butt Joint. A joint between two abutting parts lying in approximately the same plane and 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 accomplishing complete penetration and reinforcement on both sides of joint.
- b. 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.
- c. Double-Welded Lap Joint. A joint between two overlapping members in which the overlapped edges of both members are welded with fillet welds.
- d. Single-Welded Lap Joint. A joint between two overlapping members, in which the overlapped edge of one member is welded with a fillet weld.
- e. Butt Weld. A weld placed in a groove between abutting members. Grooves may be square, V (single or double), or U (single or double).
- f. 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.
- g. Full-Fillet Weld. A fillet weld whose size is equal to the thickness of the thinner member joined.
- h. Tack Weld. A weld made to hold parts of a weldment in proper alignment until the final welds are made.

#### 3.3 SIZE OF WELD

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

Table 1—Tank Dimensions (See Fig. 1)

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Nominal Capacity, bbl.	Design Pressure oz. per sq. in. <sup>1</sup>		Approximate Working Capacity, bbl. (See Note)	Nominal Outside Diameter, ft. in. A	Nominal Height, ft. in. B	Height of Overflow-Line Connection, <sup>2</sup> ft. in. C	Height of Walkway Lugs, ft. in. D	Location of Fill-Line Connection, <sup>2</sup> in. E	Size of Connections, in.
	Press.	Vac.							
H-500	8	$\frac{1}{2}$	479	15 - 6	16 - 0	15 - 6	13 - 7	14	4
750	8	$\frac{1}{2}$	746	15 - 6	24 - 0	23 - 6	21 - 7	14	4
L-500	6	$\frac{1}{2}$	407	21 - 6	8 - 0	7 - 6	5 - 7	14	4
H-1000	6	$\frac{1}{2}$	923	21 - 6	16 - 0	15 - 6	13 - 7	14	4
1500	6	$\frac{1}{2}$	1438	21 - 6	24 - 0	23 - 6	21 - 7	14	4
L-1000	4	$\frac{1}{2}$	784	29 - 9	8 - 0	7 - 6	5 - 7	14	4
2000	4	$\frac{1}{2}$	1774	29 - 9	16 - 0	15 - 6	13 - 7	14	4
3000	4	$\frac{1}{2}$	2764	29 - 9	24 - 0	23 - 6	21 - 7	14	4
5000	3	$\frac{1}{2}$	4916	38 - 8	24 - 0	23 - 6	21 - 7	14	4
10,000	3	$\frac{1}{2}$	9938	55 - 0	24 - 0	23 - 6	21 - 7	14	4
Tolerance			—	—	—	$\pm \frac{1}{8}$ in.	$\pm \frac{1}{8}$ in.	$\pm \frac{1}{8}$ in.	—

Note: The approximate working capacities shown in Col. 3 apply to flat-bottom tanks. Type A (unskirted) 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. diam. tanks, 32 bbl. for the 21-ft. 6-in. diam. 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.

<sup>1</sup>See Par. 3.17 for frangible deck limitations.

<sup>2</sup>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 Col. 6, Table 1, and dimension E of the fill-line connection shall be 6 in.,  $\pm \frac{1}{8}$  in.



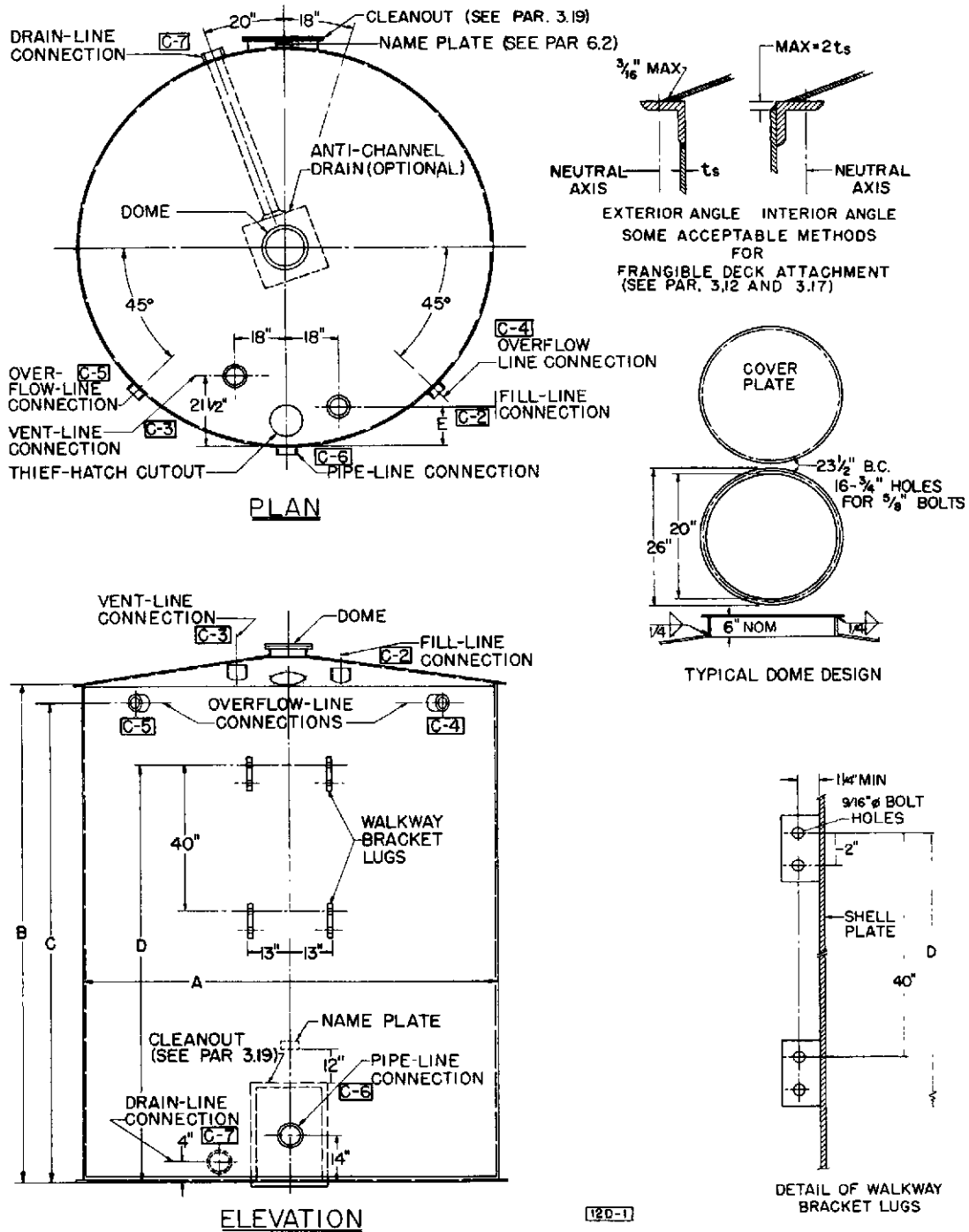


Figure 1—Tank Dimensions (See Table 1)

- 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. For unequal leg fillet welds, the leg lengths of the largest right-triangle which can be inscribed within the fillet-weld cross-section.

### 3.4 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. except as otherwise noted.
- c. Single-welded lap joints shall not be permissible on shell plates.

### 3.5 SIZE

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

## BOTTOM DESIGN

### 3.6 TYPE

The tank bottom shall be flat or of the type A cone design, as specified on the purchase order. Type A cone bottoms shall conform to Fig. 2.

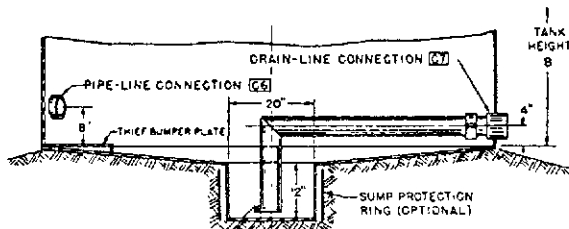


Figure 2—Type A (Unskirted) Cone Bottom

### 3.7 THICKNESS

The thickness of bottom plates shall be  $\frac{1}{4}$  in. (10.20 lb. per sq. ft.) nominal, except the sump of the type A cone bottom which shall be  $\frac{3}{8}$  in. (15.30 lb. per sq. ft.) nominal.

### 3.8 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.

Butt welds shall have complete penetration.

## 3.9 SHELL ATTACHMENTS

The tank bottom shall be attached to the tank shell by full-fillet welds, both inside and outside.

## SHELL DESIGN

### 3.10 THICKNESS

The thickness of shell plates shall be either  $\frac{3}{16}$  in. (7.65 lb. per sq. ft.) nominal, or  $\frac{1}{4}$  in. (10.20 lb. per sq. ft.) nominal, as specified on the purchase order. The thickness of the first 8'0" of shell plates for 10,000 bbl tanks shall be not less than  $\frac{1}{4}$  in. nominal (10.20 lb. per sq. ft.). The width of shell plates shall be determined by the manufacturer, but preferably should be not less than 60 inches.

### 3.11 SHELL JOINTS

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

### 3.12 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.

## DECK DESIGN

### 3.13 TYPE

The deck shall be of the cone type, with a slope of 1 inch in 12 inches, and shall be furnished with a center dome and center deck support.

- a. For decks 15 ft. 6 in. in diameter, added structural supports in the form of rafters shall be provided if the thickness of the deck is less than  $\frac{1}{4}$  in. nominal.
- b. For decks larger than 15 ft. 6 in. in diameter, added structural supports in the form of rafters shall be provided.

### 3.14 THICKNESS

The thickness of deck plates shall be either  $\frac{3}{16}$  in. (7.65 lb. per sq. ft.) nominal, or  $\frac{1}{4}$  in. (10.20 lb. per sq. ft.) nominal, as specified on the purchase order, except the thickness of the dome components shall be at least  $\frac{6}{16}$  in.

### 3.15 DECK JOINTS

Deck 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 as tack welded. Butt joints shall have complete penetration.

### 3.16 SHELL ATTACHMENT

The tank deck shall be attached to the tank shell by full fillet welds, both inside and outside, except as provided in 3.17.

### 3.17 SHELL ATTACHMENT FOR FRANGIBLE DECKS

When so specified by the purchaser, the tank may be provided with a frangible deck, in which case the Design Pressure shall not exceed the weight of the deck, including rafters if external. The deck 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 deck.

### 3.18 DECK SUPPORT

Deck supports shall be designed to support a live load of 20 lb. per sq. ft., in addition to the dead load. Allowable design stresses shall be as follows:

Rolled structural shapes:

Tension, psi, max .....20,000

Bending, psi, max .....20,000

Compression, psi, max .....20,000

$$1 + L^2/20,000 r^2$$

L/r ratio, max .....200

Formed sections\*:

Basic design stress, psi, max.....18,000

Column footings:

Soil-bearing load, psf,

max. (based on max. water load

plus super-imposed roof load.) .....4,000

### 3.19 CLEANOUT

Tanks shall be furnished with an extended-neck cleanout having a minimum opening of 24-in. wide and 36-in. high. 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-piece, as specified on the purchase order. When specified on the purchase order, handles for lifting the cleanout cover plate(s) shall be furnished.

### 3.20 CONNECTIONS

Tanks shall be provided with inlet and outlet connections as shown in Table 1 and Fig. 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-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 upon 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 thief hatches shall conform to one of those shown in Fig. 3. Thief hatches, when used, should be 8-in. x 22-in. obround for pressures up to and including 4 oz. and 8-in. round for pressures greater than 4 oz. The purchaser shall provide full details of external piping loads or vibration expected to be imposed on connections in the liquid section of the shell. The manufacturer shall provide additional reinforcement of these openings where required.

### 3.21 DOME

The dome shall be fabricated from  $\frac{1}{4}$  in. material and shall be installed as shown in Fig. 1. The cover shall be provided with an oil resistant gasket of  $\frac{3}{16}$  in. minimum thickness.

### 3.22 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. Where cone bottoms are furnished, the center support shall not interfere with the function of the sump.

### 3.23 ANTI-CHANNEL DRAIN BAFFLE

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

- The periphery of the baffle, in plan view, shall be 64 inches.
- The height of the baffle from the inside surface of the tank bottom to the top of the baffle shall be  $5\frac{1}{4}$  in. minimum.
- The baffle shall be equipped with spacers so that the bottom edge of the baffle is 1 in. above the tank bottom.
- A drain line shall be provided from the baffle to the tank shell. The line size shall be 4 in. nominal.
- 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.

### 3.24 DOWNCOMER PIPE

A downcomer pipe shall be installed, if requested by the

\*Formed sections shall be fabricated from sheet or strip not less than  $\frac{3}{16}$  in. in thickness.

purchaser: design of downcomer to be by agreement between purchaser and manufacturer.

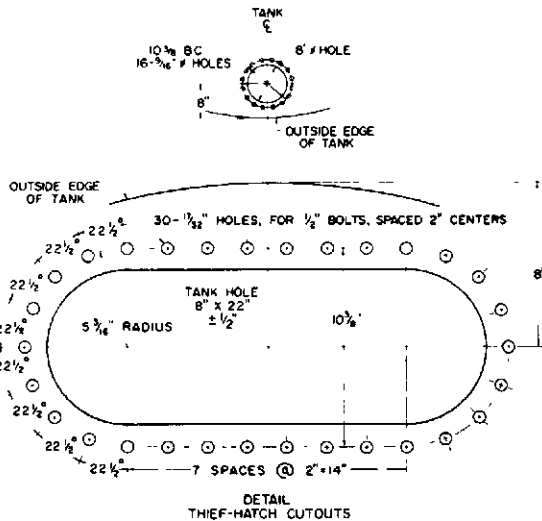


Figure 3—Thief-Hatch Cutouts

## 4 Venting Requirements

### 4.1 NORMAL VENTING

Connection C-3 (Fig. 1) is provided for normal inbreathing and outbreathing due to temperature changes and to liquid movement into and out of the tank. This connection should be fitted with pressure-vacuum valve properly sized in accordance with API Standard 2000. The pressure setting should be from 2 to 4 ounces/sq. in. less than the opening pressure of devices used for emergency venting. Appendix B is provided as a guide to aid in the selection of venting devices, where required.

### 4.2 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 they are installed. The maximum internal pressure under relieving conditions should not exceed that tabulated in Column 6 of Table C-1. Pressure relieving devices may take the form of larger or additional vent valves, larger or additional thief hatches or deck dome covers (see Fig. 1 and 3.21) installed with loose fitting long bolts and suitable gasket so that the dome cover will lift at the required pressure.

#### Notes:

1. Tanks having frangible decks complying with 3.17 need not be fitted with

additional pressure relieving devices for emergency venting.

2. When installing tanks having frangible decks, no piping should be connected to the deck which would restrict movement of the deck.

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

## 5 Construction, Testing, and Painting

### 5.1 CONSTRUCTION

Construction shall be completed in the field in accordance with the applicable paragraphs of this specification, using the best modern practices. Where agreed upon between the purchaser and the manufacturer, tanks may be completely fabricated in the manufacturer's shop prior to delivery to field location.

### 5.2 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<sup>1</sup> is recommended.

### 5.3 TESTING

Bottoms of field erected tanks shall be tested by applying 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 with water for a period of not less than 12 hours, and testing the deck 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  $1\frac{1}{2}$  times the design pressure of the tank (See 3.1 and 3.17).

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

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

**Note:** Vacuum testing may be conveniently performed by means of a testing box, 6 in. wide by 30 in. long, with a glass window in the top, the open bottom being sealed against the tank surface by a sponge rubber gasket. Suitable connections, valves, and gauges must be provided. About 30 in. of the seam under test should be brushed with a soap-suds solution or linseed oil. In freezing weather, a non-freezing solution may be necessary. Place the vacuum box over the coated section of seam, and apply a vacuum to the box. The gauge should register a partial vacuum of at least 2 lb. per sq. in. Porosity in the seam is indicated by bubbles or foam produced by any air sucked through the welded seam. A vacuum can be drawn on the box by any convenient method, such as connection to a gasoline or diesel motor intake manifold, or to an air ejector or special vacuum pump.

### 5.4 EXTERNAL PAINTING

<sup>1</sup>The American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10047.

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.

## 5.5 INTERNAL COATING

Where internal coating is required, procedures and methods outlined in NACE Standard RP-03-72, *Method for Lining Lease Production Tanks with Coal Tar Epoxy*<sup>1</sup>, are recommended, as a minimum requirement. Other coatings and methods may be used by agreement between purchaser and manufacturer.

## 5.6 CLEANING UP

Upon completion of erection, the manufacturer or erector shall remove or dispose of all rubbish and other unsightly material caused by his operations and shall leave the premises in as good condition as he found them.

## 6 Marking\*

**6.1** Tanks manufactured in conformance with this specification shall be identified by a name plate bearing the information shown in Fig. 4.

**6.2** The name plate shall be stamped, etched or embossed on corrosion-resistant material and permanently attached to a bracket or backing plate of ferrous material. Alternatively,

<sup>1</sup>National Association of Corrosion Engineers, P.O. Box 218340, Houston, Texas 77218.

\*Users of this specification should note that there is no longer a requirement for marking a product with the API monogram. The American Petroleum Institute continues to license use of the monogram on products covered by this specification but it is administered by the staff of the Institute separately from the specification. The policy describing licensing and use of the monogram is contained in Appendix F, herein. No other use of the monogram is permitted.

name plate information may be die stamped on a steel plate. The bracket, backing plate or name plate shall be seal-welded to the tank shell in the location shown in Fig. 1.

## 7 Inspection and Rejection

### 7.1 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.

### 7.2 INSPECTION

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.

### 7.3 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 specifications.


  12D	MANUFACTURER _____
	SERIAL NUMBER _____
	YEAR BUILT _____
	NOMINAL DIAMETER _____
	NOMINAL HEIGHT _____
	NOMINAL CAPACITY _____ BBL
	BOTTOM THICKNESS _____ TYPE _____
	SHELL THICKNESS _____
	DECK THICKNESS _____
	DESIGN PRESSURE _____ OZ
ERECTED BY _____	

Figure 4—Suggested Name Plate Format

## APPENDIX A—SPECIFICATION FOR TANK BOLTING

### A.1 Scope

This Appendix covers tank bolting  $\frac{1}{2}$  inch in diameter to and including  $1\frac{1}{2}$  inch 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. per sq. in. based on the stress area (mean thread area) or approximately 91,000 lb. per sq. in. 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 5000 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

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 inches.

### A.9

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

Nuts shall be regular square, unless otherwise agreed upon between the purchaser and the manufacturer, in which case they may be regular hex. All nuts 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 Specification A 153. The weight of coating shall be that specified for Class C materials in Specification A 153 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 Specification B 454 or to the coating thickness, adherence, and quality requirements for Class C of Specification A 153. 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 his own use.

## APPENDIX B—RECOMMENDED PRACTICE FOR NORMAL VENTING

Table B-1—Venting Capacity Requirements (See 4.1)

(1)	(2)		(3)		(4)	(5)	(6)	(7)
Nominal Tank Capacity, bbl	Tank Size		Design Pressure <sup>1</sup> oz. per sq. in.		Surface Area, sq. ft.	Thermal Venting		
						Pressure (Outbreathing)		
	Diameter ft.-in.	Height ft.	Press.	Vac.		Vacuum (Inbreathing) All Stocks	Flash Point 100 F or Above	Flash Point Below 100 F
H-500	15-6	16	8	1/2	780	500	300	500
750	15-6	24	8	1/2	1,170	750	450	750
L-500	21-6	8	6	1/2	540	500	300	500
H-1000	21-6	16	6	1/2	1,080	1,000	600	1,000
1500	21-6	24	6	1/2	1,620	1,500	450	1,500
L-1000	29-9	8	4	1/2	750	1,000	600	1,000
2000	29-9	16	4	1/2	1,500	2,000	1,200	2,000
3000	29-9	24	4	1/2	2,250	3,000	1,800	3,000
5000	38-8	24	3	1/2	2,840	5,000	3,000	5,000
10,000	55-0	24	3	1/2	4,170	10,000	6,000	10,000

## Notes:

## 1. Filling and Emptying Venting.

a. *Outbreathing at maximum filling rate:* For flash points less than 100 F, provide 1200 standard cubic feet per hour (SCFH) for each 100 bbl per hour. For flash points of 100 F or more, provide 600 SCFH for each 100 bbl per hour.

b. *Inbreathing at maximum emptying rate:* For all liquids, provide 600 SCFA for each 100 bbl per hour.

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

<sup>1</sup>See 3.17 for frangible deck limitations.

## APPENDIX C—RECOMMENDED RELIEVING CAPACITIES

Table C-1—Emergency Venting Requirements (See 4.2)

(1)	(2)	(3)		(4)	(5)		(6)
Nominal Capacity, bbl	Diameter x Height, ft.-in.	Design Pressure, <sup>1</sup> Ounces		Exposed Area, sq. ft.	Emergency Venting Required SCFH		Max. Press <sup>1</sup> During Emergency Venting, Ounces
		Pressure	Vacuum		With Drainage*	Without Drainage	
H-500	15-6 x 16-0	8	1/2	780	227,600	455,200	12
750	15-6 x 24-0	8	1/2	1,170	271,800	543,600	12
L-500	21-6 x 8-0	6	1/2	543	184,600	369,200	9
1000	21-6 x 16-0	6	1/2	1,090	267,200	534,400	9
1500	21-6 x 24-0	6	1/2	1,630	308,380	617,760	9
L-1000	29-9 x 8-0	4	1/2	750	222,500	445,000	6
2000	29-9 x 16-0	4	1/2	1,500	300,250	600,500	6
3000	29-9 x 24-0	4	1/2	2,260	344,650	689,300	6
5000	38-8 x 24-0	3	1/2	2,840	371,000	742,000	4 1/2
10000	55-0 x 24-0	3	1/2	4,170	371,000	742,000	4 1/2

Note: Normal vents (See 4.1 and Appendix B) may satisfy all or part of these requirements.

\*In applying recommended emergency venting required *with drainage*, careful attention should be given to the provisions of 2.3.2 and 2.5.7, NFPA No. 30, available from National Fire Protection Association, Inc., Batterymarch Park, Quincy, MA 02269.

<sup>1</sup>See 3.17 for frangible deck limitations.



Table C-2—Calculated Venting Capacities of Thief Hatches

(1)	(2)	(3)	(4)
8 inch Round Hatch A = 44		8 inch x 22 inch Obround Hatch A = 154 sq. in.	
Tank Pressure, ounces	Venting Capacity Q, SCFH	Tank Pressure, ounces	Venting Capacity Q, SCFH
1.5	59,783	1.5	206,892
3.0	84,547	3.0	292,590
4.5	103,548	4.5	358,348
6.0	119,567	6.0	413,785
12.0	169,094	— Not Applicable —	

Note: Values in the above table are based on the following formula:

$$Q = 1667 C_f A \sqrt{P_i - P_o}$$

Where:

$Q$  = Venting capacity in standard cubic feet of free air per hour (SCFH)

$C_f$  = 0.5 (the flow coefficient)

$A$  = hatch area in sq. in.

$P_i$  = absolute pressure inside the tank in inches of water

$P_o$  = absolute pressure outside the tank in inches of water

## APPENDIX D—WALKWAYS, STAIRWAYS AND LADDERS

### General

#### D.1

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 2.

#### D.2

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 employees 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.

### Walkways

#### D.3

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. per sq. ft., or a concentrated load of 1,000 lb. at any place on the span without deflecting more than  $1/360$  of the unsupported span length. The maximum span between tank brackets or ground supports shall be 25 feet. 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 inches 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 build-up 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 inches 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 inches 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 Fig. 3.1. The brackets shall be installed to provide a 26-inch wide access to the tank at the point of attachment.

### Stairways

#### D.9

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  $1/360$  of the unsupported stairway length. Stairway width shall be a minimum of 26 inches. 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  $8\frac{1}{2}$  inches with a nominal tread width of not less than 8 inches. 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 are 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 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 inches nor more than 34 inches 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, attached to brackets or welded securely to the shell 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 inches, measured 13 inches from the exterior arc. Spiral stairways are not recommended for installation on tanks less than 15 feet-6 inches in diameter.

## **Ladders**

### **D.12**

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 inches x 30 inches with standard railings except at the entrance from the ladder.

### **D.13**

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

### **D.14**

Rungs shall be a minimum of  $\frac{3}{4}$  inch diameter spaced a maximum of 12 inches c-c (center to center), with a minimum clear length of 16 inches, and designed to support a minimum load of 200 lb.

### **D.15**

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

## APPENDIX E—SUGGESTIONS FOR ORDERING

In 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 3.1, Col. 1
Size .....	Par. 3.5
Outside diameter .....	Table 3.1, Col. 4
Height of shell .....	Table 3.1, Col. 5
Type of bottom .....	Par. 3.6
Shell plate thickness .....	Par. 3.10
Deck plate thickness .....	Par. 3.14
Delivery date and shipping instructions .....	
Inspection by purchaser .....	Par. 7.2

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

are optional with the purchaser:

Bolting .....	Par. 2.9
Viscous oil option .....	Table 3.1, Footnote
Cleanout cover-plate design .....	Par. 3.19
Anti-channel drain baffle .....	Par. 3.23
Downcomer pipe and design .....	Par. 3.24
Walkways, stairways and ladders .....	Appendix D

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

Additional connections .....	Par. 3.20
Finish coats of paint .....	Par. 5.4
Alternative bolting requirements and/or finish .....	Par. 2.9
Materials .....	Par. 2.1
Internal coating .....	Par. 5.5

## APPENDIX F—USE OF API MONOGRAM

The API monogram  is a registered trademark of the American Petroleum Institute.

Manufacturers desiring to warrant that articles manufactured or sold by them conform with this specification shall obtain the license to use the Official API Monogram.

The original resolutions adopted by the Board of Directors of the American Petroleum Institute on Oct. 20, 1924, embodied the purpose and conditions under which such official monogram may be used.

The following restatement of the resolution was adopted by the Board of Directors on Nov. 14, 1977.

WHEREAS, The Board of Directors of the American Petroleum Institute has caused a review of the Institute's program for licensing the use of the API monogram and

WHEREAS, It now appears desirable to restate and clarify such licensing policy and to confirm and make explicitly clear that it is the licensees, not API, who make the representation and warranty that the equipment or material on which they have affixed the API monogram meets the applicable standards and specifications prescribed by the Institute;

NOW, THEREFORE, BE IT RESOLVED, That the purpose of the voluntary Standardization Program and the Monogram Program of the American Petroleum Institute is to establish a procedure by which purchasers of petroleum equipment and material may identify such equipment and materials as are represented and warranted by the manufacturers thereof to conform to applicable standards and specifications of the American Petroleum Institute; and be it further

RESOLVED, That the previous action under which the following monogram was adopted as the official monogram of the American Petroleum Institute is reaffirmed;



BE IT FURTHER RESOLVED, That the American Petroleum Institute's monogram and standardization programs have been beneficial to the general public as well as the petroleum industry and should be continued and the Secretary is hereby authorized to license the use of the monogram to anyone desiring to do so under such terms and conditions as may be authorized by the Board of Directors of the American Petroleum Institute, provided that the licensee shall agree that the use of the monogram by such licensee shall constitute the licensee's representation and warranty that equipment and materials bearing such monogram complies with the applicable standards and specifications of the

American Petroleum Institute; and that licensee shall affix the monogram in the following manner;




BE IT FURTHER RESOLVED, That the words "Official Publication" shall be incorporated with said monogram on all such standards and specifications that may hereafter be adopted and published by the American Petroleum Institute, as follows:

OFFICIAL PUBLICATION



REG. U.S. PATENT OFFICE

### F.1 API Monogram

The API monogram——is a registered trademark/servicemark of the American Petroleum Institute. Authorization to use the monogram is granted by the Institute to qualified licensees for use as a warranty that they have obtained a valid license to use the monogram and that each individual item which bears the monogram conformed, in every detail, with the API Specification applicable at the time of manufacture. However, the American Petroleum Institute does not represent, warrant or guarantee that products bearing the API monogram do in fact conform to the applicable API standard or specification. Such authorization does not include use of the monogram on letterheads or in advertising without the express statement of fact describing the scope of licensee's authorization and further does not include use of the monogram, the name AMERICAN PETROLEUM INSTITUTE or the description "API" in any advertising or otherwise to indicate API approval or endorsement of products.

The formulation and publication of API Specifications and the API monogram program is not intended in any way to inhibit the purchase of products from companies not licensed to use the API monogram.

### F.2 Application for Authority to Use Monogram

Manufacturers desiring to warrant that products manufactured by them comply with the requirements of a given API specification may apply for a license to use the monogram with forms provided in an appendix to each specification. Exhibit B is a typical "Statement of Manufacturer's Qualifications" and Exhibit C is a "License Agreement."

The "Agreement" form must be submitted in duplicate for each specification under which monogram rights are desired. One "Statement of Manufacturer's Qualifications" is required for each facility.

A manufacturer desiring to apply the monogram at more than one facility (a facility is any manufacturing location) must submit a separate application for each facility.

Applicants shall have an approved functioning quality program in conformance with API Specification Q1 prior to being issued a license to use the API monogram.

### F.3 Authorization to Use the Monogram

A decision to award or withhold monogram rights will be made by the staff of the Institute. A survey of the applicant's facilities will be made by an approved Institute surveyor prior to a decision to approve or withhold the license. The basis of the survey shall be the appropriate product Specification and all applicable portions of API Specification Q1.

For a manufacturer having more than one facility (plant), each facility will be judged separately and if determined to be eligible for authorization to use the monogram will be granted a separate license for each Specification, or part thereof, under which authorization is granted. The application of the monogram may not be subcontracted.

### F.4 Fee for Use of Monogram

**Initial Authorization Fee.** The applicant will be invoiced an initial authorization fee for the first Specification included in the application, and a separate fee for each additional Specification included in the application. The applicant will also be invoiced for the surveyor's fee.

**Annual Renewal Fee.** In addition to the initial authorization fee, licensees will be assessed an annual renewal fee for each specification under which he is authorized to use the monogram. Applicants issued monogram certificates dated November 1 through December 31 shall not be required to pay a renewal fee for the following year.

The fees assessed are to defray the cost of the Monogram Program.

### F.5 Periodic Surveys

Existing licensees must be periodically surveyed by an approved Institute surveyor to determine whether or not they continue to qualify for authorization to use the monogram. The frequency of the periodic surveys will be at the discretion of the staff of the Institute. The surveyor's fee and expenses for making a periodic survey will be paid by the Institute.

### F.6 Cancellation of Monogram Rights

The right to use the monogram is subject to cancellation for the following causes:

- a. Applying the monogram on any product that does not meet the Specification.
- b. Failure to maintain reference master gauges in accordance with the Specifications.
- c. Failure to meet the requirements of any resurvey.
- d. Failure to pay the annual renewal fee for use of the monogram.
- e. For any other reason satisfactory to the Executive Committee on Standardization of Oilfield Equipment and Materials.

### F.7 Reinstatement of Monogram Rights

Manufacturers whose authorization to use the monogram has been cancelled may request reinstatement at any time. If a request for reinstatement is made within sixty (60) days after cancellation, and if the reason for cancellation has been corrected, no new application is necessary. A resurvey of the manufacturer's facilities will be made by an approved Institute surveyor prior to a decision to reinstate monogram rights. The manufacturer will be invoiced for this resurvey regardless of the Institute's decision on reinstatement. If the resurvey indicates that the manufacturer is qualified, the license will be reissued.

Request for reinstatement made more than sixty (60) days after cancellation shall be treated as a new application unless circumstances dictate an extension of this time period as agreed upon by the API staff.

### F.8 Appeals

An interested party may appeal any API standards action. Appeals shall be directed to the Director, API Production Department and handled by the General Committee of the Production Department with a further right of appeal to the API Management Committee. Competing suppliers or manufacturers of the product or service to which the standard applies or might apply may not be involved in appeals. The General Committee and the Management Committee may convene appeals boards to hear and act on appeals.

### F.9 Marking

The following marking requirements apply to licensed manufacturers using the API monogram on products covered by this specification.

### F.10

Tanks manufactured in conformance with this specification shall be identified by a name plate bearing the information shown in Fig. F.1.

**F.11**

The name plate shall be stamped, etched or embossed on corrosion-resistant material and permanently attached to a bracket or backing plate of ferrous material. Alternatively, name plate information may be die stamped on a steel plate. The bracket, backing plate or name plate shall be seal-welded to the tank shell in the location shown in Fig. 1.

**F.12 API Monogram**

Tanks conforming to this specification shall be marked with the API monogram by manufacturers authorized to use the monogram. The monogram shall not be applied to tanks which do not conform to this specification, nor by manufacturers who have not been authorized to use the monogram.


  12D	MANUFACTURER_____
	SERIAL NUMBER_____
	YEAR BUILT _____
	NOMINAL DIAMETER_____
	NOMINAL HEIGHT_____
	NOMINAL CAPACITY_____BBL.
	BOTTOM THICKNESS _____TYPE_____
	SHELL THICKNESS_____
	DECK THICKNESS_____
	DESIGN PRESSURE_____OZ.
ERECTED BY_____	

Figure F-1—Suggested Name Plate Format

## CURRENT PUBLICATIONS OF THE AMERICAN PETROLEUM INSTITUTE PERTAINING TO STORAGE TANKS

### API

#### RP 12R1 *Recommended Practice for Setting, Connecting, Maintenance and Operation of Lease Tanks*

A guide for new tank battery installations and a guide for revamping existing batteries if this is necessary for any reason.

#### RP 2003 *Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents*

Described in this publication are some of the conditions which have resulted in oil fires ignited by the electrical sparks and arcs from so-called natural causes, as well as the methods which the petroleum industry currently is applying for the prevention of ignitions from these sources.

#### RP 2015 *Cleaning Petroleum Storage Tanks*

A discussion of safe practices in tank cleaning—including use of suitable mechanical equipment and protective clothing, use of proper cleaning methods, elimination of potential ignition hazards, and provision for means of entrance and exit in an emergency. Combines and updates information contained in *Accident Prevention Manual No. 1: Cleaning Petroleum Storage Tanks—Section A, Crude Oil and Unfinished Products Tanks* and *Bull. 2016: Cleaning Tanks Used for Gasoline or Similar Low-Flash Products*.

#### Spec 12B *Specification for Bolted Tanks for Storage of Production Liquids*

Covers material, design, fabrication, and testing requirements for vertical, cylindrical, above-ground, closed and open top, bolted steel storage tanks in nominal capacities of 100 to 10,000 bbl (in standard sizes). Also includes appurtenance requirements.

#### Spec 12D *Specification for Field Welded Tanks for Storage of Production Liquids*

Covers material, design, fabrication, and testing requirements for vertical cylindrical, above-ground, closed top, field welded steel storage tanks in nominal capacities of 500 to 10,000 bbl (in standard sizes).

#### Spec 12F *Specification for Shop Welded Tanks for Storage of Production Liquids*

Covers material, design, fabrication, and testing requirements for shop-fabricated vertical, cylindrical, aboveground, closed top, shop-welded steel storage tanks in nominal capacities of 90 to 500 bbl (in standard sizes).

#### Std 620 *Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks*

These rules cover the design and construction of large, welded, field-assembled storage tanks used for petroleum intermediates and finished products operated at a gas pressure

of 15 psig and less, down to an internal gas pressure close to atmospheric pressure, which are not now provided for in API Standard 650.

#### Std 650 *Welded Steel Tanks for Oil Storage*

This standard covers material, design, fabrication, erection, and testing requirements for vertical, cylindrical, above-ground, closed- and open-top, welded steel storage tanks, in various sizes and capacities, for internal pressures approximating atmospheric pressures. It also includes an alternate basis for shell design, as well as one for calculating tank shell thickness.

#### Std 2000 *Venting Atmospheric and Low-Pressure Storage Tanks*

This standard applies to the normal and emergency venting requirements for aboveground liquid petroleum storage tanks and aboveground and belowground refrigerated storage tanks designed to operate from 1/2 oz. per sq. in. vacuum through 15 psig pressure. The requirements of the standard do not apply to floating- or lifter-roof tanks.

#### Std 2550 *(ASTM D 1220-65)(75),† Measurement and Calibration of Upright Cylindrical Tanks, 1956 (ANSI Z11.197-1971) (Redesignated Chapter 2.2.2, API Manual of Petroleum Measurement Standards)*

This standard describes the procedures for calibrating upright cylindrical tanks larger than a barrel or drum. It is presented in two parts: Part I outlines procedures for making necessary measurements to determine total and incremental tank volumes. Part II presents the recommended procedure for computing volumes. Sample calculations are included in an appendix.

#### Std 2555 *(ASTM D 1406-65)(75),\* Liquid Calibration of Tanks, 1966 (ANSI Z11.202-1971) (Redesignated Chapter 2.6, API Manual of Petroleum Measurement Standards)*

This standard describes the standard procedure for calibrating tanks, or portions of tanks, larger than a barrel or drum by introducing or withdrawing measured quantities of liquid.

#### *Guide for Inspection of Refinery Equipment, Chapter XIII, Atmospheric and Low-Pressure Storage Tanks*

This chapter covers the inspection of atmospheric storage tanks which have been designed to operate at pressures from atmospheric through 0.5 psig through, but not over, 15 psig. Such details as reasons for inspection, frequency and time of inspection, methods of inspection and of repair, and records are some of the principal items included.

†Joint standards for which API has prime responsibility.

\*Joint standards for which ASTM has prime responsibility.



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