

Changes shown by ➤

SCOPE

- I 1.1 This practice covers the design, fabrication, erection, inspection and testing of welded steel storage tanks to **API Standard 650** for above ground atmospheric storage. The requirements given herein supplement and modify those of **API Standard 650**.
If tanks are designed to other standards, the Owner's Engineer shall specify which paragraphs in this practice shall be applied.
- I 1.2 **An asterisk (*)** indicates that a decision by the Purchaser is required or that additional information is furnished by the Purchaser.
- R ➤ 1.3 **Tanks** within the scope of **API-650 Appendix A or Appendix J** may be entirely designed, fabricated, erected, and inspected **per API-650 except**:
 - a. All horizontal shell joints shall be complete penetration and complete fusion welds.
 - * b. Proposals to use pneumatic testing per API-650 Appendix J shall be submitted to the Purchaser for approval by the Owner's Engineer.
 - c. The gap between the bottom shell ring and the lap bottom plates at the radial weld location shall be a maximum of 1/8 in. (3 mm).

SUMMARY OF ADDITIONAL REQUIREMENTS

- I ➤ 2.1 **Table 1** lists the practices, codes and standard which shall be used with this practice.
- I ➤ * 2.2 **Table 2** lists the practices and standards which shall be used with this practice as specified by the Purchaser.

TABLE 1

PRACTICES			
IP 9-7-1	Accessories for Atmospheric Storage Tanks	IP 20-1-1	Inspection of Equipment and Materials
IP 18-7-1	Welding Procedures	IP 20-1-3	Quality Programs
IP 18-10-1	Additional Requirements for Materials		
CODES AND STANDARD			
ASME Codes		API Standard	
Section VIII Pressure Vessels, Division 1		650	Welded Steel Tanks for Oil Storage
Section IX Welding and Brazing Qualifications		RP-2003	Recommended Practice for Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents

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TABLE 2

PRACTICES			
IP 3-5-1	Fill and Discharge Lines, and Auxiliary Piping for Storage Tanks and Vessels	IP 9-7-4	Internal Floating Roofs for Atmospheric Storage Tanks
IP 3-16-1	Flanged Joints, Gaskets, and Bolting	IP 18-4-1	Postweld Heat Treatment of Equipment Handling Alkaline Solutions
IP 4-1-3	Design Loads for Structures	IP 18-12-1	Positive Material Identification
IP 4-8-1	Tank Foundations	IP 19-1-1	Paint and Protective Coatings

TABLE 2 (Cont)

STANDARDS	
ASTM Standards	ASTM Standards (Cont)
A53 Pipe, Steel, Black and Hot-Dipped Zinc-Coated and Seamless	C399 Use of Chemical-Resistant Resin Mortars
A106 Seamless Carbon Steel Pipe for High-Temperature Service	E162 Surface Flammability of Materials Using a Radiant Heat Energy Source
A333 Seamless and Welded Steel Pipe for Low-Temperature Service	API Standards
A573 Structural Carbon Steel Plates of Improved Toughness	5L Line Pipe
B29 Pig Lead	2000 Venting Atmospheric and Low-Pressure Storage Tanks
C279 Chemical Resistant Masonry Units	CSA Standard
C386 Use of Chemical Resistant Sulfur Mortar	G40.21 Structural Quality Steel General Instruction No. 1
C397 Use of Chemical-Setting Chemical-Resistant Silicate and Silica Mortars	NACE Standard
	RP0294-94 Standard Recommended Practice Design, Fabrication, and Inspection of Tanks for the Storage of Concentrated Sulfuric Acid and Oleum at Ambient Temperature

- R 2.3 **Where local regulations require** atmospheric storage tanks to be **designed to API-650**, the more stringent requirements of API-650 or this practice shall be used.

DEFINITIONS

- I 3.1 **Low strength tank steels.** Steels having a specified minimum yield strength equal to or less than 43,000 psi (296 MPa) and a specified maximum tensile strength equal to or less than 85,000 psi (586 MPa).
- I 3.2 **High strength tank steels.** Steels having a specified minimum yield strength greater than 43,000 psi (296 MPa) and a specified maximum tensile strength equal to or less than 100,000 psi (689 MPa).
- I 3.3 **“Fully stiffened” pontoons.** Floating roof pontoons having top and bottom plates reinforced such that the entire pontoon cross section is effective in carrying transmitted loads from the center deck.
- I 3.4 **“Partially stiffened” pontoons.** Floating roof pontoons having top and bottom plates reinforced such that only part of the pontoon cross section is effective in carrying transmitted loads from the center deck.
- I 3.5 **Production impact test plates** are as defined by **ASME Code Section VIII, Par. UG 84**, except that they are to be made of the actual materials to be used for the item to be fabricated or manufactured. The welding procedure for any given test plates shall be identical to that used or to be used for the corresponding construction weld. The purpose of these plates is to provide the required impact test specimens for the weld metal and heat affected zones in the finished item.
- I 3.6 **The term Inspector**, as used in this practice, refers to the Owner's representative.
- I 3.7 **Critical Exposure Temperature** for atmospheric storage tanks is defined as the lower of:
- The lowest one-day mean atmospheric temperature plus 15°F (8°C).
 - The hydrostatic test temperature.

The term Critical Exposure Temperature shall be used in **place of the term “minimum design metal temperature” per API-650**.

MATERIALS

- R 4.1 **Annular plates per Par. 5.1** shall be of the same material group per **API-650** as the lowest shell course.
- S 4.2 **For tanks with shell thickness greater than 1/2 in. (13 mm), and critical exposure temperature less than 32°F (0°C)**, the lowest two shell courses and annular plates shall be constructed from fully killed carbon steels manufactured to fine grain practice and normalized or quenched and tempered.
- S ♦ * 4.3 **Tank materials of construction, including welding consumables**, shall meet the impact requirements given in API 650 for the applicable combination of type of steel, thickness, and Critical Exposure Temperature. For materials with minimum yield strength greater than 55,000 psi (379 MPa), transverse impacts with values per API-650, are required in addition to the longitudinal impacts.
- R ♦ 4.4 **The use of CSA Grade G40.21 plate** with a V content < 0.10 weight percent, Nb content of < 0.02 weight percent and carbon equivalent (CE) per **IP 18-10-1** is acceptable provided a minimum preheat of 150°F (65°C) is maintained during welding and root pass and final pass of all welds are magnetic particle inspected. The preheat shall be maintained during the root pass inspection and until the weld is complete. The final weld pass to be magnetic particle inspected 48 hours after completion of the weld.

BOTTOM DESIGN

R * 5.1 **Tank Bottom Design Category required** for the predicted settlement is:

Category of Bottom Specified (1)	PREDICTED SETTLEMENT (2)	ANNULAR PLATE WIDTH AND BOTTOM PLATE WELDING REQUIREMENTS	
	Maximum at Shell	Tank Diameter (3) Over 50 ft to 150 ft	Tank Diameter Over 150 ft
1	≤ 2 in.	Per API-650	Annular plates shall provide a minimum radial width of 2 ft between the inside of the shell and any lap welded joint in the bottom. Bottom plates two pass welded with 70% joint efficiency.
2	≤ 6 in.	Annular plates shall provide a minimum radial width of 2 ft between the inside of the shell and any lap welded joint in the bottom. Bottom plates two pass welded with 70% joint efficiency.	Annular plates shall provide a minimum radial width of 3 ft between the inside of the shell and any lap welded joint in the bottom. Bottom plates two pass welded with 70% joint efficiency.
3	≤ 12 in. (4)	Annular plates shall provide a minimum radial width of 3 ft between the inside of the shell and any lap welded joint in the bottom. Bottom plates two pass welded with 70% joint efficiency.	Annular plates shall provide a minimum radial width of 6 ft between the inside of the shell and any lap welded joint in the bottom. Bottom plates two pass (min.) welded with 80% joint efficiency.

Notes:

- (1) Category 2 bottoms shall be used for tankage built in permafrost areas.
- (2) PREDICTED SETTLEMENT includes initial water loading of the tank.
- (3) No special requirements for tanks 50 ft and under in diameter.
- (4) **If this settlement is exceeded, some form of site improvement is required prior to tank erection. Soil improvement will be done by Purchaser or vendor, as specified.**

General Notes:
ACCEPTABLE METRIC EQUIVALENT DIMENSION

in.	2	6	12	2 ft	3 ft	6 ft	50 ft	150 ft
mm	50	150	300	600	900	1800	15 m	46 m

SHELL DESIGN

- O * 6.1 **For fixed roof tanks**, the **height specified** shall be from the bottom of the shell to the top of the top angle. **Where an internal roof or floating cover will be used**, the determination of the maximum fill height shall consider the portion of shell height above the maximum liquid level required to accommodate the floating roof or cover and associated attachments.
- O * 6.2 **For floating roof tanks**, the **height specified** shall be from the bottom of the shell to the maximum filling height. Shell extension of a sufficient height shall be provided (as required) to accommodate the roof above this specified height, and shall be designed such that no damage will occur to the roof seal if the tank is overfilled.
- O,R 6.3 Where tank capacity is specified, this shall be taken as the usable tank volume. For tanks with floating roofs or internal floating covers, usable volume shall be determined with the roof at its maximum recommended operating level.
- R 6.4 The maximum allowable stresses shall be per the applicable design code acceptable to the authorities where the tank is to be located.

SHELL PLATE THICKNESS

- R * 6.5 **Unless otherwise specified, the following shall govern:**
- a. **Specific Gravity, G:** Use 1.0 if actual $G \leq 1.0$; Use actual value if $G > 1.0$ (for calculations in metric units, use relative density at 15°C).
 - * b. **Corrosion Allowance, CA:** As specified, but not less than 1/16 in. (1.5 mm).
 - c. The minimum shell thickness for tanks greater than 250 ft (76 m) diameter shall not be less than 7/16 in. (11 mm).