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Refrigerated Storage Tanks

GP 09-06-01

Scope

- 1) [I] This Global Practice (GP) covers the design, fabrication, erection, inspection, and testing of welded aboveground storage tanks and spheres furnished to API STD 620, Appendix Q or R, and operated at metal temperatures between -325°F and +40°F (-198°C and +5°C) and at pressures not exceeding 15 psig (103 kPa), except as modified and supplemented by this Practice.
- 2) [I] This Practice also covers accessories and auxiliary structures furnished with refrigerated storage tank installations.
- 3) [I] This Practice does not cover double containment and full containment tanks per British Standard BS7777, Flat-bottomed, Vertical, Cylindrical Storage Tanks for Low Temperature Service, Part 2.
- 4) [I] An asterisk (*) indicates that a decision by Purchaser is required or that additional information is furnished by Purchaser.

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1. Required References

[I] This Section lists Practices and Standards that are generically referenced and assumed to be a part of this document. Unless otherwise specified herein, use the latest edition.

1.1. Global Practices–ExxonMobil Engineering Practices

GP 03-02-03	Firewater Systems
GP 18-07-01	Welding Procedures
GP 18-10-01	Additional Requirements for Materials
GP 18-12-01	Positive Material Identification
GP 20-01-01	Inspection of Equipment and Materials
GP 20-01-03	Downstream Quality Programs

1.2. API–American Petroleum Institute

API STD 620	Design and Construction of Large, Welded, Low-Pressure Storage Tanks
API STD 2000	Venting Atmospheric and Low-Pressure Storage Tanks Nonrefrigerated and Refrigerated

1.3. ASME–American Society of Mechanical Engineers

Unless specific references to the ASME Code are listed, an IHS link to the Introduction is provided to facilitate accessing the relevant parts of the Code.

ASME B16.5	Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.47	Large Diameter Steel Flanges NPS 26 Through NPS 60
ASME B31.3	Process Piping
ASME SEC VIII D1	BPVC Section VIII - Rules for Construction of Pressure Vessels - Division 1
ASME SEC VIII D2	BPVC Section VIII - Rules for Construction of Pressure Vessels - Division 2 Alternative Rules

1.4. ASSE–American Society of Safety Engineers

ASSE/SAFE A1264.1	Safety Requirements for Workplace Floor and Wall Openings, Stairs, and Railings Systems
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1.5. ASTM–American Society for Testing and Materials

ASTM A 20/A 20M	Standard Specification for General Requirements for Steel Plates for Pressure Vessels
ASTM A 370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products

2. Additional Requirements

* [I] The following Practices and Standards shall be used with this Practice as specified by Purchaser.

2.1. Global Practices–ExxonMobil Engineering Practices

GP 03-08-01	Expansion Joints
GP 03-15-01	Pressure Relief Valves
GP 03-16-01	Flanged Joints, Gaskets, and Bolting
GP 04-01-03	Design Loads for Structures
GP 04-08-01	Tank Foundations
GP 14-01-01	External Insulation
GP 16-03-01	Wiring Methods and Material Selection
GP 16-04-01	Grounding and Overvoltage Protection
GP 16-13-01	Field Installation and Testing of Electrical Equipment
GP 17-05-01	Human Factors in Plant Design
GP 19-01-01	Paint and Protective Coatings

2.2. ASME–American Society of Mechanical Engineers

ASME B1.15	Unified Inch Screw Threads (UNJ Thread Form)
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2.3. ASTM–American Society for Testing and Materials

ASTM A 123/A 123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 131/A 131M	Standard Specification for Structural Steel for Ships

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ASTM A 153/A 153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 320/A 320M	Standard Specification for Alloy/Steel Bolting Materials for Low-Temperature Service
ASTM A 353/A 353M	Standard Specification for Pressure Vessel Plates, Alloy Steel, 9 Percent Nickel, Double-Normalized and Tempered
ASTM A 516/A 516M	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 537/A 537M	Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
ASTM A 553/A 553M	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel
ASTM A 573/A 573M	Standard Specification for Structural Carbon Steel Plates of Improved Toughness

2.4. AWS—American Welding Society

AWS A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.17/A5.17M	Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
AWS A5.18/A5.18M	Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding

2.5. IEEE—Institute of Electrical and Electronic Engineers

IEEE 515	Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications
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2.6. NEMA—National Electrical Manufacturers Association

NEMA C80.1	Rigid Steel Conduit - Zinc Coated (GRC)
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2.7. NFPA—National Fire Prevention Association

NFPA 59A	Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG) (National Fire Codes, vol. 2)
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3. Documentation

- 1) [R] A complete material specification shall be submitted with the proposal.
- 2) [R] Fabrication drawings shall identify welding materials and procedures for each type of weld.
- 3) [R] Welding and weld repair procedures shall be submitted to Purchaser for review prior to fabrication.
- 4) [R] A record of tank shell and bottom settlement measurements shall be furnished. Procedures for settlement measurements shall be submitted to Purchaser for review.
- 5) * [O] Six copies of a gauge table showing calculated capacity shall be furnished. Unless otherwise specified, capacity shall be shown in 42 (U.S.) gallon barrels for $\frac{1}{8}$ in. increments of liquid level [m^3 for 10 mm increments plus auxiliary table showing m^3 for 1 mm increments].

4. Definitions

- 1) [I] The term "Critical Exposure Temperature" shall be used in place of the term "design metal temperature" which is defined in API STD 620, Appendix Q and Appendix R.
- 2) [I] The terms "Primary" and "Secondary" are as defined in API STD 620, Appendix Q and Appendix R. Primary components shall also include the following components in an outer (secondary) shell or floor:
 - a) Shell plate and reinforcing plate at product nozzle penetrations.
 - b) Floorplate in the area of product bottom piping.

5. Materials

- 1) [R] Materials shall conform to the following ASTM Standards: A131 Grade CS, A353/A353M, ASTM A516/A516M, A537/A537M Class 1, A553/A553M Grade A, A573 Grades 65 or 70.
- 2) * [S] Materials for all primary components and materials welded directly to primary components shall meet the impact requirements of Table 1 for the specified Critical Exposure Temperature and the following:
 - a) The requirements of API STD 620 including Appendix Q or Appendix R, as applicable.
 - b) Impact test requirements for ASTM A 353/A 353M and ASTM A 553/A 553M materials shall be as specified in API STD 620 Appendix Q. All piping falling within this scope shall be classified as nozzles for the purposes of establishing material impact test requirements.
 - c) All impact testing shall be conducted per ASTM A 370 using the Charpy V (Type A) specimen.
 - d) Impact determinations shall be made for each plate as rolled. Specimens shall be selected as follows:
 - i) Impact specimens shall be taken per ASTM A 20/A 20M, with the base of the notch perpendicular to the plate surface.

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- ii) Impact specimens shall have their long dimension parallel to the final direction of rolling (longitudinal specimens) for all applications except spheres, or hemispherical heads fabricated from segments.
 - iii) Impact specimens for spheres, or hemispherical heads fabricated from segments, shall have their long dimension perpendicular to the final direction of rolling (transverse specimens). For spun or pressed (one-piece) hemispherical heads or components, longitudinal impact specimens shall be used.
- 3) [R] Bottom nozzle insert plates and annular plates shall be of the same material specification and grade as the lowest shell course.
- 4) [R] Materials for permanent structural attachments, welded to the shell, shall be of the same nominal composition as the tank shell materials.
- 5) * [S] Materials other than those listed in API STD 620 may be used with the approval of Owner's Engineer. If an alternative material is submitted for approval, the following information shall be furnished with Vendor's:
 - a) Complete proposal: chemical and mechanical specification limits, manufacturing process and heat treatment.
 - b) Minimum guaranteed Charpy V-notch impact values of base material, weld material and heat-affect zone at minimum design temperature.
 - c) Welding consumables and procedures proposed and the resultant mechanical properties of the weldments.
- 6) * [S] For primary components of ferritic materials, the following requirements shall be met:
 - a) All steels shall be fully killed.
 - b) All steels shall be supplied from the mill in the normalized or quenched and tempered condition, as applicable.
 - c) The actual yield strength divided by the actual ultimate tensile strength shall not exceed 0.85.

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Table 1: Charpy-V Impact Requirements For Full Size Specimens ⁽¹⁾⁽²⁾⁽³⁾

Class	Type of Steel	Thickness, in.	Critical Exposure Temperature, °F			
			Below –55	From –55 Through –20	From –20 Through 31	From 32 Through 40
II	Fully Killed and Medium Carbon and Low Alloy					
a.	Material with a specified minimum yield strength < 35000 psi and a specified maximum tensile strength ≤ 75000 psi.	$t \leq \frac{5}{8}$	30/25	25/20	25/20	None
		$\frac{5}{8} < t \leq 1\frac{1}{2}$	30/25	25/20	25/20	25/20
		$1\frac{1}{2} < t \leq 2$	30/25	30/25	30/25	30/25
		$t > 2$	35/28	35/28	35/28	35/28
b.	Material with a specified minimum yield strength ≤ 55000 psi and a specified maximum tensile strength ≤ 90000 psi.	$t \leq \frac{5}{8}$	30/25	30/25	30/25	None
		$\frac{5}{8} < t \leq 1\frac{1}{2}$	35/28	35/28	35/28	35/28
		$t > 1\frac{1}{2}$	40/32	40/32	40/32	40/32
c.	Material with a specified minimum yield strength ≤ 65000 psi and a specified maximum tensile strength ≤ 100,000 psi.	$t \leq \frac{1}{2}$	35/28	35/28	35/28	None
		$\frac{1}{2} < t \leq 1$	40/32	40/32	40/32	40/32
		$t > 1$	45/36	45/36	45/36	45/36
IV	3½% Nickel	All	20/16	20/16	None	None
V	9% Nickel, 5% Nickel	All	25/20	25/20	None	None

Notes:

- (1) When subsize specimens are necessary, the required impact values shall be those given in Table 1 multiplied by the reduction factor given below for the corresponding specimen size. Interpolation is permitted to utilize maximum possible specimen width.

Specimen Size	Impact Requirement Reduction Factor
10 x 7.5 mm	0.83
10 x 5 mm	0.67
10 x 2.5 mm	0.33

- (2) In the notation such as 25/20, the first number is the average energy in ft-lb of three specimens while the second number is the minimum for one specimen when full-size specimens are used, i.e., a 10 mm x 10 mm cross-section.
- (3) Longitudinal Type A specimens.
- (4) For 5% through 9% nickel steels and where the electrodes are of lower minimum specified tensile or yield strength than the base material, the electrodes shall be tested for conformance to their required yield and tensile strengths.

