Welded Steel Tanks for Oil Storage

API STANDARD 650
TENTH EDITION, NOVEMBER 1998

ADDENDUM 1, JANUARY 2000
ADDENDUM 2, NOVEMBER 2001
ADDENDUM 3, SEPTEMBER 2003
ADDENDUM 4, DECEMBER 2005

API
American Petroleum Institute

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Downstream Segment

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FOREWORD

This standard is based on the accumulated knowledge and experience of purchasers and manufacturers of welded steel oil storage tanks of various sizes and capacities for internal pressures not more than $2^1/_2$ pounds per square inch gauge. This standard is meant to be a purchase specification to facilitate the manufacture and procurement of storage tanks for the petroleum industry.

If the tanks are purchased in accordance with this standard, the purchaser is required to specify certain basic requirements. The purchaser may want to modify, delete, or amplify sections of this standard, but reference to this standard shall not be made on the nameplates of or on the manufacturer's certification for tanks that do not fulfill the minimum requirements of this standard or that exceed its limitations. It is strongly recommended that any modifications, deletions, or amplifications be made by supplementing this standard rather than by rewriting or incorporating sections of it into another complete standard.

The design rules given in this standard are minimum requirements. More stringent design rules specified by the purchaser or furnished by the manufacturer are acceptable when mutually agreed upon by the purchaser and the manufacturer. This standard is not to be interpreted as approving, recommending, or endorsing any specific design or as limiting the method of design or construction. 00

This standard is not intended to cover storage tanks that are to be erected in areas subject to regulations more stringent than the specifications in this standard. When this standard is specified for such tanks, it should be followed insofar as it does not conflict with local requirements.

After revisions to this standard have been issued, they may be applied to tanks that are to be completed after the date of issue. The tank nameplate shall state the date of the edition of the standard and any revision to that edition to which the tank has been designed and constructed.

Each edition, revision, or addenda to this API standard may be used beginning with the date of issuance shown on the cover page for that edition, revision, or addenda. Each edition, revision, or addenda to this API standard becomes effective six months after the date of issuance for equipment that is certified as being rerated, reconstructed, relocated, repaired, modified (altered), inspected, and tested per this standard. During the six-month time between the date of issuance of the edition, revision, or addenda and the effective date, the purchaser and manufacturer shall specify to which edition, revision, or addenda the equipment is to be rerated, reconstructed, relocated, repaired, modified (altered), inspected, and tested.

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[Paragraph deleted.] 03

Suggested revisions are invited and should be submitted to the American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005, standards@api.org.

IMPORTANT INFORMATION CONCERNING USE OF ASBESTOS OR ALTERNATIVE MATERIALS

Asbestos is specified or referenced for certain components of the equipment described in some API standards. It has been of extreme usefulness in minimizing fire hazards associated with petroleum processing. It has also been a universal sealing material, compatible with most refining fluid services.

Certain serious adverse health effects are associated with asbestos, among them the serious and often fatal diseases of lung cancer, asbestosis, and mesothelioma (a cancer of the chest and abdominal linings). The degree of exposure to asbestos varies with the product and the work practices involved.

Consult the most recent edition of the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, Occupational Safety and Health Standard for Asbestos, Tremolite, Anthophyllite, and Actinolite, 29 *Code of Federal Regulations* Section 1910.1001; the U.S. Environmental Protection Agency, National Emission Standard for Asbestos, 40 *Code of Federal Regulations* Sections 61.140 through 61.156; and the U.S. Environmental Protection Agency (EPA) rule on labeling requirements and phased banning of asbestos products (Sections 763.160-179).

There are currently in use and under development a number of substitute materials to replace asbestos in certain applications. Manufacturers and users are encouraged to develop and use effective substitute materials that can meet the specifications for, and operating requirements of, the equipment to which they would apply.

SAFETY AND HEALTH INFORMATION WITH RESPECT TO PARTICULAR PRODUCTS OR MATERIALS CAN BE OBTAINED FROM THE EMPLOYER, THE MANUFACTURER OR SUPPLIER OF THAT PRODUCT OR MATERIAL, OR THE MATERIAL SAFETY DATA SHEET.

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1 Scope

1.1 GENERAL

1.1.1 This standard covers material, design, fabrication, erection, and testing requirements for vertical, cylindrical, aboveground, closed- and open-top, welded steel storage tanks in various sizes and capacities for internal pressures approximating atmospheric pressure (internal pressures not exceeding the weight of the roof plates), but a higher internal pressure is permitted when additional requirements are met (see 1.1.10). This standard applies only to tanks whose entire bottom is uniformly supported and to tanks in nonrefrigerated service that have a maximum design temperature of 93°C (200°F) (see 1.1.17) or less. 05

1.1.2 This standard is designed to provide the petroleum industry with tanks of adequate safety and reasonable economy for use in the storage of petroleum, petroleum products, and other liquid products commonly handled and stored by the various branches of the industry. This standard does not present or establish a fixed series of allowable tank sizes; instead, it is intended to permit the purchaser to select whatever size tank may best meet his needs. This standard is intended to help purchasers and manufacturers in ordering, fabricating, and erecting tanks; it is not intended to prohibit purchasers and manufacturers from purchasing or fabricating tanks that meet specifications other than those contained in this standard.

Note: A bullet (•) at the beginning of a paragraph indicates that there is an expressed decision or action required of the purchaser. The purchaser's responsibility is not limited to these decisions or actions alone. When such decisions and actions are taken, they are to be specified in documents such as requisitions, change orders, data sheets, and drawings. 98

● **1.1.3** This standard has requirements given in two alternate systems of units. The requirements are similar but not identical. These minor differences are due to issues such as numerical rounding and material supply. When applying the requirements of this standard to a given tank, the manufacturer shall either comply with all of the requirements given in SI units or shall comply with all of the requirements given in US Customary units. The selection of which set of requirements (SI or US Customary) shall apply to a given tank shall be by mutual agreement between the manufacturer and purchaser. 03

1.1.4 The appendices of this standard provide a number of design options requiring decisions by the purchaser, standard requirements, recommendations, and information that supplements the basic standard. An appendix becomes a requirement only when the purchaser specifies an option covered by that appendix. See Table 1-1 for the status of each appendix. 98

1.1.5 Appendix A provides alternative simplified design requirements for tanks where the stressed components, such as shell plates and reinforcing plates, are limited to a maximum nominal thickness of 12.5 mm ($^1/_2$ in.), including any corrosion allowance, and whose design metal temperature exceeds the minimums stated in the appendix. 98

1.1.6 Appendix B provides recommendations for the design and construction of foundations for flat-bottom oil storage tanks.

1.1.7 Appendix C provides minimum requirements for pan-type, pontoon-type, and double-deck-type external floating roofs.

1.1.8 Appendix D provides requirements for submission of technical inquiries on this standard. 00

● **1.1.9** Appendix E provides minimum requirements for tanks subject to seismic loading. An alternative or supplemental design may be mutually agreed upon by the manufacturer and purchaser.

1.1.10 Appendix F provides requirements for the design of tanks subject to a small internal pressure.

1.1.11 Appendix G provides requirements for an optional aluminum dome roof.

1.1.12 Appendix H provides minimum requirements that apply to an internal floating roof in a tank with a fixed roof at the top of the tank shell. 98

● **1.1.13** Appendix I provides acceptable construction details that may be specified by the purchaser for design and construction of tank and foundation systems that provide leak detection and subgrade protection in the event of tank bottom leakage, and provides for tanks supported by grillage.

1.1.14 Appendix J provides requirements covering the complete shop assembly of tanks that do not exceed 6 m (20 ft) in diameter.

1.1.15 Appendix K provides a sample application of the variable-design-point method to determine shell-plate thicknesses.

1.1.16 Appendix L provides data sheets listing required information to be used by the purchaser in ordering a storage tank and by the manufacturer upon completion of construction of the tank.

1.1.17 Appendix M provides requirements for tanks with a maximum design temperature exceeding 93°C (200°F) but not exceeding 260°C (500°F). 05