API Standard 650
Fifth Edition
July 1973

WELDED STEEL TANKS FOR OIL STORAGE

OFFICIAL PUBLICATION

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AMERICAN PETROLEUM INSTITUTE

Refining Department
2101 L Street, Northwest
Washington, D.C. 20037

Price $3.00

SUPPLEMENT NO. 3
TO
API STANDARD 650 (FIFTH EDITION)
WELDED STEEL TANKS FOR OIL STORAGE

AMERICAN PETROLEUM INSTITUTE
Division of Refining
1801 K Street, N.W.
Washington, D.C. 20006

Price: $1.00

SUPPLEMENT NO. 3
TO
WELDED STEEL TANKS FOR OIL STORAGE
FIFTH EDITION OF
API STANDARD 650

This supplement revises certain information set forth in the fifth edition of *API Standard 650: Welded Steel Tanks for Oil Storage,* issued in July 1973, *Supplement No. 1 to API Standard 650 (Fifth Edition): Welded Steel Tanks for Oil Storage,* issued in October 1973, and *Supplement No. 2 to API Standard 650 (Fifth Edition): Welded Steel Tanks for Oil Storage,* issued in August 1974.

In Supplement 3, the method by which Standard 650 is revised has been changed. Complete pages (with revisions included) are presented on green stock to facilitate the incorporation of additional material and the replacement of corresponding pages of Supplement 2 (printed on pink stock), Supplement 1 (printed on blue stock), and the fifth edition of Standard 650 (printed on white stock).

Some of the pages included have no technical or editorial changes but were merely reprinted to accommodate additions made to previous pages. Any revision or addition of new material will be indicated by an **R** in the margin.

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 approximating atmospheric. The object of this publication is to provide a purchase specification to facilitate the manufacture and procurement of storage tanks for the petroleum industry.

Provisions for welding and details pertaining thereto, as given herein, were prepared in cooperation with the American Welding Society. These provisions include: definitions of welding and welded joints and fabrication thereof; materials suitable for welding, including electrodes; and inspection requirements for field welding. In all other respects, welding shall be as specified in *Welding Qualifications*, Sect. IX of *ASME Boiler and Pressure Vessel Code*.

If tanks are purchased in accordance with the specifications in this standard, the purchaser is required to specify certain basic requirements. The purchaser may desire to modify, delete, or amplify sections of this standard, but the API monogram shall not be used on tanks that do not fulfill the minimum requirements or that exceed the limitations of this standard. It is strongly recommended that such modifications, deletions, or amplifications be made by supplementing this standard, rather than by rewriting or incorporating sections thereof into another complete standard. R

Design rules given herein are minimum requirements. Any 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. R

This standard is not intended to cover storage tanks which are to be erected in areas subject to regulations more stringent than the specifications contained herein. In such cases, this standard should be followed, on purchases made under this standard, insofar as it does not conflict with local requirements.

Suggested revisions are invited and should be submitted to the director of the Division of Refining, American Petroleum Institute, 1801 K Street, N.W., Washington, D.C. 20006.

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Suggested revisions are invited and should be submitted to the director of the Division of Refining, American Petroleum Institute, 2101 L Street, N.W., Washington, D.C. 20037.

CAUTION

Do not use this Standard unless page inserts which were published as API Standard 650 (Fifth Edition), *Welded Steel Tanks for Oil Storage,* Supplement No. 3, March 1975, have been added.

RELATED API PUBLICATIONS

American Petroleum Institute publications pertaining to welded steel tanks as well as other types of tanks are:

API Standard 12A: Specification for Oil Storage Tanks with Riveted Shells

Covers material, design, fabrication, and erection requirements for vertical cylindrical aboveground steel tanks with riveted shells, in nominal capacities of 240 bbl to 255,000 bbl (in standard sizes) for oil field service. It also contains appurtenance requirements.

API Standard 12B: Specification for Bolted Production Tanks

Covers material, design, and erection requirements for vertical cylindrical aboveground bolted steel production tanks in nominal capacities of 100 bbl to 10,000 bbl (in standard sizes) for oil field service. It also contains appurtenance requirements.

API Standard 12D: Specification for Large Welded Production Tanks

Covers material, design, fabrication, and erection requirements for vertical cylindrical aboveground welded steel production tanks in nominal capacities of 500 bbl to 3,000 bbl (in standard sizes) for oil field service.

API Standard 12E: Specification for Wooden Production Tanks

Covers material, design, fabrication, and erection requirements for vertical cylindrical aboveground closed-top wooden production tanks in nominal capacities of 130 bbl to 1,500 bbl (in standard sizes) for oil field service.

API Standard 12F: Specification for Small Welded Production Tanks

Covers material, design, and construction requirements for vertical cylindrical aboveground shop-welded steel production tanks in nominal capacities of 90 bbl to 440 bbl (in standard sizes up to a maximum diameter of 12 ft) for oil field service.

API Standard 620: Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks

Covers 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.

API Standard 2000: Venting Atmospheric and Low-Pressure Storage Tanks

Covers recommended procedure for testing venting devices on low-pressure aboveground storage tanks used for petroleum and petroleum products. It also contains venting-capacity tables.

API Recommended Practice 2003: Protection Against Ignition Arising Out of Static, Lightning, and Stray Currents

Covers some of the conditions which have resulted in oil fires ignited by 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 ignition from these sources.

API Recommended Practice 2015: Cleaning Petroleum Storage Tanks

Covers 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 *Bulletin 2016: Cleaning Tanks Used for Gasoline or Similar Low-Flash Products.*

API Standard 2550 (ASTM D 1220-65): Measurement and Calibration of Upright Cylindrical Tanks

Covers procedures for calibrating upright cylindrical tanks larger than a barrel or drum, including procedures for making necessary measurements to determine total and incremental tank volumes and the recommended procedure for computing volumes.

API Standard 2555 (ASTM D 1406-65): Liquid Calibration of Tanks

Covers 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

Covers inspection of atmospheric storage tanks which have been designed for operation at pressures from atmospheric through 0.5 psig and inspection of low-pressure storage tanks which have been designed for operation at pressures above 0.5 psig but not exceeding 15 psig.

SUGGESTIONS FOR ORDERING TANKS

The purchaser should state on his inquiry or purchase order the following:

- Specification
- Number of tanks
- Nominal capacity, in barrels
- Specific gravity of contents
- Appurtenances (type, size, and location)
- Painting requirements
- Time of completion
- Erection location and facilities
- Tank grade details
- Special provisions (permits, fees, etc.)
- Wind velocity

The purchaser may exercise an option with respect to the following requirements:

- Diameter, in feet
- Height, in feet
- Plate specifications (bottom, shell, and roof)
- Mill test reports
- Shop inspection
- Field inspection
- Bottom test
- Shell test
- Roof test
- Welding procedure qualification
- Sectioning method
- Closure of openings
- Segment ownership
- Radiographic method
- Film ownership
- Bolting
- Bottom plates:
  - Thickness
  - Size and arrangement
  - Joint design and welding procedure
- Shell plates:
  - Thickness
  - Width and number of courses
  - Alignment
  - Horizontal joint penetration and fusion
  - Top-angle orientation
  - Wind girders
- Roof plates:
  - Thickness
  - Slope
- Roof supports
- Roof live load and its distribution
- Appurtenances:
  - Shell manhole design
  - Shell nozzle design
  - Cleanout fitting support
  - Drawoff sump design
  - Roof nozzle flange design
- Stairways, platforms, and walkways
- Freight and hauling

Note: See, also, Appendix L, "Storage Tank Specification Data Sheet."

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API specifications [standards] are published as an aid to procurement of standardized equipment and materials. These specifications are not intended to inhibit purchasers and producers from purchasing or producing products made to specifications other than API, and nothing in any API specification is intended to in any way inhibit the purchase of products from companies not authorized to use the API monogram.*

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2. MATERIAL

3. DESIGN

WELDED STEEL TANKS FOR OIL STORAGE

1. SCOPE

1.1 GENERAL

a. This specification 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 pressures, except that a small internal pressure is permitted when the additional requirements of Appendix F are met.

b. This specification is designed to provide the oil industry with tanks of adequate safety and reasonable economy for use in the storage of petroleum and its products and those other liquid products commonly handled and stored by the various branches of the industry. It does not present, nor is it contemplated to establish, a fixed series of allowable tank sizes; but rather it is intended to permit the selection by the purchaser of whatever size of tank may be required to best meet his particular needs. This specification is for the convenience of purchasers and manufacturers in ordering, fabricating, and erecting tanks and is not intended to prohibit purchasers and manufacturers from purchasing and fabricating tanks meeting specifications other than those contained herein; nor is it intended in any way to prohibit purchasers from purchasing tanks from companies not authorized to use the API monogram.

c. Appendix A to this specification presents for ready reference design data relating to tanks which may be built according to specifications contained herein. The data presented in Appendix A are for convenience and are not required in order to comply with this specification.

d. Stressed components in this specification (shell plates, reinforcing pads, etc.) excluding flanges shall be limited to a maximum of ½-in. nominal thickness unless the provisions of Appendix D or G are followed. R

Appendix D to this specification presents an alternative design basis for tanks with improved design, materials, and inspection. Appendix G provides a special design basis for high-strength steels with improved notch toughness. Appendix K presents an alternative procedure for calculating the thickness of the plate courses in tank shells.

e. Appendixes C and H to this specification present rules for special types of roofs for storage tanks. Appendix C provides requirements for pan-type, pontoon-type, and double-deck-type floating roofs. Appendix H provides requirements for a floating roof in a tank having a fixed roof at the top of the tank shell.

f. Appendix J to this specification presents rules covering the complete shop assembly of tanks not exceeding 20 ft. in diameter.

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 he 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 supervisory inspection furnished by the manufacturer, and that the purchaser's inspector follow closely all of the details of field construction and testing herein specified which affect the integrity and safety of the completed structure.

2. MATERIALS

2.1 PLATES

a. Plates purchased shall conform to the latest edition of one of the following specifications, subject to the modifications and limitations indicated in this standard. Material produced to specifications other than those listed in this paragraph may be employed provided the material is certified to meet all the requirements of a material specification listed herein and its use is approved by the purchaser.

R *ASTM* * *Standards*

A 36: Structural Steel †

A 283: Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality —grades C and D only

A 285: Low and Intermediate Tensile Strength Carbon Steel Plates for Pressure Vessels—grade C only

CSA ‡ *Standard*

G40.21: Structural Quality Steel—grade 44W only R
(Elements added for grain refining or strengthening shall be restricted in accordance with Table G-2.)

* American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

† None of the specifications for the appurtenant materials listed in Table 1 of ASTM A 36 are to be deemed acceptable for tanks constructed under these rules unless expressly so provided in this standard.

‡ Canadian Standards Association specifications may be obtained from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.