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**BRITISH STANDARD 2654 : Part 1 : 1965**

UDC 665.5 : 621.642.3-111.1 : 669.14 : 621.791.053.6

**WITHDRAWN**

**VERTICAL MILD STEEL  
WELDED STORAGE TANKS  
WITH BUTT-WELDED SHELLS  
FOR THE PETROLEUM INDUSTRY**

**Part 1. Design and Fabrication**

**BRITISH STANDARDS INSTITUTION**

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Price 25/- net

**BRITISH STANDARDS INSTITUTION**

INCORPORATED BY ROYAL CHARTER

BRITISH STANDARDS HOUSE, 2 PARK ST., LONDON, W.1

TELEGRAMS: STANDARDS LONDON W1

TELEPHONE: MAYFAIR 9000

THIS BRITISH STANDARD, having been approved by the Petroleum Equipment Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 3rd September, 1965.

First published, February, 1956.

First revision, September, 1965.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 4000, fully indexed and with a note of the contents of each, will be found in the British Standards Yearbook, price 15s. The B.S. Yearbook may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards:

- B.S. 15. Mild steel for general structural purposes.
  - B.S. 275. Dimensions of rivets ( $\frac{1}{2}$  in to  $1\frac{3}{4}$  in diameter).
  - B.S. 639. Covered electrodes for the metal-arc welding of mild steel and medium tensile steel.
  - B.S. 916. Black bolts, screws and nuts.
  - B.S. 1133. Packaging Code.
  - B.S. 1501-6. Steels for use in the chemical, petroleum and allied industries.
  - B.S. 1560. Steel pipe flanges and flanged fittings (nominal sizes  $\frac{1}{2}$  in to 24 in) for the petroleum industry.
  - B.S. 1750. Bolting for the petroleum industry.
  - B.S. 2708. Unified black square and hexagon bolts, screws and nuts (UNC and UNF threads). Normal series.
  - B.S. 2762. Notch ductile steel for general structural purposes.
  - B.S. 3602. Steel pipes and tubes for pressure purposes. Carbon steel: high duties.
  - B.S. 3603. Steel pipes and tubes for pressure purposes. Carbon and alloy steel: low temperature duties.
  - B.S. 3706. Mild steel for general engineering purposes.
- and to the following specifications of the American Petroleum Institute (obtainable through the British Standards Institution):
- API Std. 5-L. Line pipe.
  - API Std. 650. Welded steel tanks for oil storage.

*British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.*

## CO-OPERATING ORGANIZATIONS

The Petroleum Equipment Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government department and scientific and industrial organizations:

- \*British Iron and Steel Federation
- \*Council of British Manufacturers of Petroleum Equipment
- Federation of British Rubber and Allied Manufacturers
- Ministry of Power
- \*Oil Companies' Materials Association

The scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

- Association of British Chemical Manufacturers
- British Chemical Plant Manufacturers' Association
- British Electrical and Allied Manufacturers' Association
- Engineering Equipment Users' Association
- Institute of Welding
- Tank and Industrial Plant Association

The following B.S.I. references relate to the work on this standard:  
Committee reference PEE/12. Draft for comment D63/10900.



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# BRITISH STANDARD SPECIFICATION FOR VERTICAL MILD STEEL WELDED STORAGE TANKS, WITH BUTT-WELDED SHELLS, FOR THE PETROLEUM INDUSTRY

## Part 1. Design and Fabrication

### FOREWORD

This British Standard, prepared under the authority of the Petroleum Equipment Industry Standards Committee, is designed to provide the petroleum industry with tanks of adequate safety, reasonable economy and in a range of suitable capacities.

The principal alteration to the 1956 edition of the standard is that high-pressure fixed roof tanks are now included.

This part of the standard deals with the materials, design and fabrication of tanks; Part 2 deals with site erection, inspection and testing.

### SPECIFICATION

#### SECTION ONE : GENERAL

##### SCOPE

1. This British Standard relates to the materials, design and fabrication of vertical mild steel cylindrical welded tanks for the petroleum industry, for erection above ground, of the following designs:

- (1) Non-pressure fixed roof tanks (up to 160 ft diameter only).
- (2) Low-pressure fixed roof tanks (up to 128 ft diameter only).
- (3) High-pressure fixed roof tanks (up to 64 ft diameter only).
- (4) Open-top tanks (all sizes).

This standard specifies the use only of butt-welded shells and includes reference to mountings, stairways and handrailings.

This standard does not include the design and construction of floating roofs and column-supported roofs, which should comply with the recommendations of API Standard 650\*. For practical considerations relating to the use of floating roofs, see Appendix C. Column-supported roofs are not recommended for pressure tanks, and should not be used under conditions where subsidence may occur.

NOTE. Attention is drawn to Appendix B which tabulates the information to be supplied by the purchaser on alternatives permitted by this British Standard.

##### DESIGN CONDITIONS

2. *a. Non-pressure tanks* shall be suitable for working at atmospheric pressure, but designed for an internal pressure of 3 inches water gauge and a vacuum as specified for shells in Subclause 14f and for roofs in Clause 26 (see also Clause 15).

\* American Petroleum Institute Standard 650, 'Welded steel tanks for oil storage' (obtainable through the British Standards Institution).

*b. Low-pressure tanks* shall be designed for an internal pressure of 8 inches water gauge and 2½ inches water gauge vacuum (see Clauses 15 and 26).

*c. High-pressure tanks* shall be designed for an internal pressure of 21½ inches water gauge and 2½ inches water gauge vacuum (see Clauses 15 and 26).

*d. Tanks* may be designed in accordance with this British Standard to withstand other pressure and/or vacuum conditions within the limits quoted in Subclause 2c, provided the allowable stresses given in this standard are not exceeded.

##### TANK AND PLATE SIZES

3. The dimensions of the plates shall be as agreed between purchaser and manufacturer but preferably should be not less than those given below.

Tables 1 to 12, which are included for general guidance, are based on the following plate dimensions which are in common usage.

In Tables 1 to 12, the maximum diameter 200 ft and maximum height 72 ft are indicated. These dimensions may be exceeded providing that the maximum shell plate thickness does not exceed 1½ in.

##### PLATE SIZES

Tank diameter	Length	Width
ft	ft	ft
Up to and including 40	5 π (approx. 15·71)	5 or 6
Over 40	8 π (approx. 25·13)	6 or 8

## PLATE THICKNESS TOLERANCES

4. No plate shall be under the thickness required by this standard at any part. Unless otherwise agreed between purchaser and manufacturer, no plate shall exceed the calculated weight by more than the appropriate rolling weight tolerance as shown in the table below.

## CODING

5. For easy reference to tank sizes and types in cables and correspondence, etc., a coding system for each size of tank is given in next column:

## a. Prefix:

Fixed roof tank, non-pressure	BNP
Fixed roof tank, low-pressure	BLP
Fixed roof tank, high pressure	BHP
Open top tank	BOT
Floating roof tank	BOF

NOTE. The prefix 'B' indicates 'butt-welded shell'.

b. The above prefixes shall be followed by a number consisting of the diameter and height of the tank in feet.

## c. Examples.

Tank with non-pressure roof,  
160 ft diameter and 48 ft high = BNP 160/48.  
Tank with high-pressure roof,  
40 ft diameter and 35 ft high = BHP 40/35.

## SECTION TWO : MATERIALS

## PLATES AND SECTIONS

6. The minimum requirements for the quality of the steel to be used for the bottom and shell plates, the roof plates and the rolled sections shall be as given below. Bessemer steel shall not be used.

## Roof plates:

B.S. 3706\*  
B.S. 15†  
B.S. 1501-101‡

## Rolled sections

B.S. 15†.

Shell, bottom and reinforcing plates. The choice of materials, particularly in regard to their level of notch ductility shall be related to service conditions and shall be the subject of agreement between purchaser and manufacturer.

Recommended minimum requirements are given below:

Working conditions	Plate thickness
For tanks built in temperate§ and warm climates	$\frac{3}{4}$ in and less { B.S. 3706* B.S. 1501-101‡ B.S. 15†
	Over $\frac{3}{4}$ in B.S. 2762   Grade ND.I
For tanks built in very cold§ climates	Less than $\frac{1}{2}$ in { B.S. 3706* B.S. 1501-101‡ B.S. 15†
	$\frac{1}{2}$ in up to and including $\frac{3}{4}$ in { B.S. 2762   Grade ND.I
	Over $\frac{3}{4}$ in B.S. 2762   Grade ND.II

## SCHEDULE OF PERCENTAGE ROLLING WEIGHT TOLERANCES FOR SHELL PLATES

Ordered thickness	Widths								
	Under 48 in	48 in to under 60 in	60 in to under 72 in	72 in to under 84 in	84 in to under 96 in	96 in to under 108 in	108 in to under 120 in	120 in to under 132 in	132 in and over
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
$\frac{3}{16}$ in to under $\frac{1}{4}$ in	10	10	10	10	10	—	—	—	—
$\frac{1}{4}$ in to under $\frac{5}{16}$ in	10	10	10	10	10	12	12	—	—
$\frac{5}{16}$ in to under $\frac{3}{8}$ in	5	5	5	6	7.5	10	11	12	—
$\frac{3}{8}$ in to under $\frac{7}{16}$ in	5	5	5	6	6	8	9	11	15
$\frac{7}{16}$ in to under $\frac{1}{2}$ in	5	5	5	5	6	7.5	8	9	12
$\frac{1}{2}$ in to under $\frac{5}{8}$ in	5	5	5	5	6	6	7.5	9	10
$\frac{5}{8}$ in to under $\frac{3}{4}$ in	5	5	5	5	5	5	7	8	9
$\frac{3}{4}$ in to under 1 in	5	5	5	5	5	5	6	7	8
1 in to 1 $\frac{1}{2}$ in	5	5	5	5	5	5	5	6	7

\* B.S. 3706, 'Mild steel for general engineering purposes'.

† B.S. 15, 'Mild steel for general structural purposes'.

‡ B.S. 1501-6, 'Steels for use in the chemical, petroleum and allied industries'.

§ In this context, the definitions of 'temperate and warm climates' and 'very cold climates' are shown in Fig. 16.

|| B.S. 2762, 'Notch ductile steel for general structural purposes'.