BS 799-5:2010

BSI Standards Publication

Oil burning equipment –

Part 5: Carbon steel oil storage tanks – Specification

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Contents

Summary of pages
This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 30, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 799 is published by BSI and came into effect on 30 April 2010. It was prepared by Technical Committee RHE/13, *Oil burning equipment*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 799 supersedes BS 799-5:1987, which is withdrawn.

Information about this document

This is a full revision of the standard, and introduces the following principal changes.

a) The maximum capacity of primary storage tanks of types I, II and III is now 4 500 L.

b) Methods for leak testing and pressure testing of tanks have been brought up to date in line with current practice.

Product certification/inspection/testing. Users of this British Standard are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this British Standard. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

Assessed capability. Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body.

Hazard warnings

WARNING. This British Standard calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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1 Scope

This part of BS 799 specifies requirements for the construction and testing of static carbon steel tanks for the storage of liquid fuel of classes A2, C1, C2, D, E, F, G and H conforming to BS 2869:2006 and FAME (fatty acid methyl esters) conforming to BS EN 14213, for use in conjunction with oil burning equipment. The standard is applicable to tanks of the following types intended for use above ground, either externally or internally to a building:

a) service tanks;

b) primary storage tanks with a capacity of 90 L or more with a maximum height of 10 m.

This standard is not applicable to tanks that are to be buried.

NOTE Steel tanks for underground storage of flammable and non-flammable water polluting liquids are specified in BS EN 12285-1.

In addition to the definitive requirements, this standard also requires the items detailed in Clause **4** to be documented. For compliance with this standard, both the definitive requirements and the documented items have to be met.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 21, *Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)*

BS 2869:2006, *Fuel oils for agricultural, domestic and industrial engines and boilers – Specification*

BS EN 1011-1, *Welding – Recommendations for welding of metallic materials – Part 1: General guidance for arc welding*

BS EN 10025-2:2004, *Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels*

BS EN 10111:2008, *Continuously hot rolled low carbon steel sheet and strip for cold forming – Technical delivery conditions*

BS EN 14213, *Heating fuels – Fatty acid methyl esters (FAME) – Requirements and test methods*

PD 5500, *Specification for unfired fusion welded pressure vessels*

3 Terms and definitions

For the purposes of this part of BS 799, the following terms and definitions apply.

3.1 brimful capacity
volume of water held by a tank filled through the filling orifice to the point of overflowing

3.2 bund
containment vessel to hold spillage from a primary tank, or tanks, caused by leakage or overfilling

3.3 design pressure
pressure, or equivalent head of water, acting on the bottom, sides and top of a tank at brimful capacity

3.4 dipstick
rigid measuring device that provides a manual method of measuring the level of liquid in a tank

3.5 dip tape
measuring device made of tape that provides a manual method of measuring the level of liquid in a tank

NOTE 1 A dip tape usually has a weight on the end.

NOTE 2 Dip tapes are normally used on tall vertical cylindrical tanks.

3.6 fill connection
flange or socket to which the delivery pipework is connected

3.7 gauge
device to indicate the level of liquid in a tank

3.8 gauge connection
flange or socket for the connection of a gauge

3.9 nominal capacity
<for a tank with a brimful capacity of 20 000 L or less> 95% of the brimful capacity

3.10 nominal capacity
<for a tank with a brimful capacity of more than 20 000 L> 97.5% of the brimful capacity

3.11 outlet connection
flange or socket for the pipe that carries the contents from a tank

3.12 overfill alarm connection
flange or socket in the roof of a tank for connection of a device that generates an audible and/or visual warning to indicate when the tank which is being filled is reaching its permissible fill capacity

3.13 overfill prevention connection
flange or socket in the roof of a tank for connection of a device that automatically shuts off the delivery when the nominal capacity of the tank has been reached

3.14 return connection
flange or socket for the connection of a return pipe

3.15 service tank
tank that isolates the main storage tank or tanks from the burner installation

3.16 sludge removal connection
flange or socket for the connection of a drain used for removal of water and sludge from a tank

3.17 striker plate
reinforced plate welded to the bottom of a tank directly below the dipstick or dip tape connection

3.18 tank
primary container used for the storage of liquids

3.19 valve
device used to control the flow of a liquid

3.20 vent connection
flange or socket in the roof of a tank for connection of a vent pipe to prevent over-pressurization of, or vacuum in, the tank

4 Information to be supplied by the purchaser

The following information shall be supplied by the purchaser at the time of enquiry and/or order:

a) the tank required, i.e. a service tank or a primary storage tank;

b) the type, size and design pressure of the tank required;

c) for type III and types J and K primary tanks, if transverse supports are required (see **6.3.3** and **6.3.11**);

d) for tanks 1 250 mm or less in diameter, rectangular tanks 4 500 L capacity or less and vertical tanks 4.5 m or less in height, whether manholes are required and if so how many (see Clause **7**);

e) whether a tank oil heater is required and, if so, the heating medium to be used (see **5.3**, **6.4** and Clause **9**);

f) for tanks of types I, II, A, B and C, if a steel cradle is required to support the tank (see **6.15**);

g) if external protection of tanks with a rust inhibiting priming paint prior to despatch is *not* required (see **6.13.1**);

h) if a return connection is required (see **5.5** and **6.9**);

i) if an overfill alarm connection is required;

j) if an overfill prevention connection is required;

k) if an outlet pipe is to be fitted to the tank by the tank manufacturer (see **15.1**).

5 Service tanks

5.1 Types

Service tanks shall be of the following types.

- Type S1: cylindrical tanks having a capacity up to and including 200 L.
- Type S2: rectangular tanks having a capacity up to and including 200 L.
- Type S3: horizontal cylindrical tanks having a capacity over 200 L but not exceeding 1 000 L.
- Type S4: rectangular tanks having a capacity over 200 L but not exceeding 1 000 L.
- Type S5: horizontal oval tanks having a capacity not exceeding 1 000 L.

5.2 Construction and plate thickness

5.2.1 Service tanks shall be of welded construction and shall be made of rolled steel sheets which conform to BS EN 10025-2:2004, Grade S275 or, for steel not exceeding 3 mm thickness, which conform either to BS EN 10025-2:2004 Grade S275 or to BS EN 10111:2008, grade DD11. All welding shall be in accordance with BS EN 1011-1. For rectangular tanks and cylindrical vertical tanks, all seams, excluding the seams attaching the roof to the sides of the tank, shall be welded inside and outside. The seams attaching the roof to the sides of the tank shall be welded on the outside only.

5.2.2 For service tanks having a capacity up to and including 200 L (types S1 and S2) the minimum thickness of the steel sheets shall be 1.6 mm.

5.2.3 For cylindrical service tanks (type S1), the maximum height shall not exceed 750 mm and the maximum diameter shall not exceed 600 mm.

5.2.4 Rectangular service tanks (type S4) shall be stayed or stiffened and the thickness of the steel sheets shall be not less than the relevant value given in Figure 1.

5.2.5 For cylindrical service tanks (type S3) the maximum diameter shall be as given in Table 1 and the thickness of the shell and ends shall be not less than the relevant values given in Table 1. For oval service tanks (type S5) the maximum major axis of the shell shall be as given in Table 1 and the thickness of the shell and ends shall be not less than the relevant value given in Table 1.

Table 1 **Maximum diameter or major axis and minimum thicknesses of the shell and ends for service tanks of types S3 and S5**

Capacity	**Minimum thickness**				**Maximum diameter or major axis**
	Shell	**Dished and flanged ends**	**Ends dished only Flat flanged ends Flat unflanged ends (stiffened)**	**Flat unflanged ends (not stiffened)**	
L	mm	mm	mm	mm	m
Up to and including 500	1.6	1.6	2.0	3.0	0.25
Over 500 up to and including 1 000	2.0	2.0	2.5	4.0	1.0

5.3 Tank oil heaters

If the provision of a tank oil heater is specified by the purchaser [see Clause **4**e)] the tank shall be fitted with a heater conforming to Clause **9**.

5.4 Sludge removal connection and outlet connection

The tank shall be fitted with a sludge removal connection and an outlet connection as specified in Clause **11** and Clause **15**, respectively.

5.5 Vent connection and return connection

The tank shall be fitted with a vent connection and, if specified by the purchaser [see Clause **4**h)], a return connection.

5.6 Manholes and inspection openings

Fitting of manholes and inspection openings shall be in accordance with Clause **7** and Clause **8**, respectively.

5.7 Pressure testing

Each tank shall be pressure tested before being painted.

When tested in accordance with Annex A, at the manufacturer's works, or on site in the case of tanks fabricated on site, the tank shall show no visible evidence of leakage.

The manufacturer shall provide the purchaser with a copy of the test certificate for each tank supplied, including a statement of the design pressure of the tank.

5.8 Marking

The following information shall be permanently and clearly marked on the tank:

a) the number and date of this British Standard (i.e. BS 799-5:2010) [1)];

b) nominal capacity (in litres);

c) manufacturer's name or trade mark;

d) manufacturer's reference number;

e) type of tank (e.g. type S1);

f) design pressure;

g) test pressure and date of testing.

6 Primary storage tanks

6.1 Types of tanks

6.1.1 Primary storage tanks shall be single skinned.

NOTE Double skinned tanks are specified in BS EN 12285-2.

6.1.2 Primary storage tanks shall be of the following types.

a) Tanks having a capacity of not more than 4 500 L and a design pressure equivalent to a height of 0.5 m above the roof of the tank:

Type I: horizontal cylindrical tanks;

Type II: horizontal oval tanks (with the major axis horizontal);

Type III: rectangular tanks.

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1) Marking BS 799-5:2010 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

b) Tanks having a capacity exceeding 4500 L and not exceeding 10 m in height:

Type A: horizontal cylindrical tanks having a capacity of not more than 60000 L, with dished or flat ends, and a design pressure equivalent to a height of 0.5 m above the roof of the tank;

Type B: horizontal cylindrical tanks having a capacity of not more than 60000 L, with dished ends, and a design pressure equivalent to a height of 4.5 m above the roof of the tank;

Type C: horizontal cylindrical tanks having a capacity of not more than 60000 L, with dished ends, and a design pressure equivalent to a height of more than 4.5 m above the roof of the tank;

Type D: vertical cylindrical tanks having a capacity of not more than 65000 L, with dished ends, and a design pressure equivalent to a height of 0.5 m above the roof of the tank;

Type E: vertical cylindrical tanks having a capacity of not more than 145000 L, with dished ends, and a design pressure equivalent to a height of 7.5 m above the roof of the tank;

Type F: vertical cylindrical tanks having a capacity of not more than 65000 L, with dished ends, and a design pressure equivalent to a height of more than 7.5 m above the roof of the tank;

Type G: vertical cylindrical tanks having a capacity of not more than 145000 L, with flat bottom end plates, and a design pressure equivalent to a height of 0.5 m above the roof of the tank;

Type J: rectangular tanks having a capacity of not more than 150000 L, and a design pressure equivalent to a height of 0.5 m above the roof of the tank;

Type K: rectangular tanks having a capacity of not more than 150000 L, and a design pressure equivalent to a height of 7.5 m above the roof of the tank.

6.2 Construction

6.2.1 Types I, II and III

Primary storage tanks of types I, II and III shall be of welded construction and made of rolled carbon steel sheets or plates conforming to BS EN 10111:2008, grade D11. Galvanized steel shall not be used. All welding shall be in accordance with BS EN 1011-1.

6.2.2 Types A to K

Primary storage tanks of types A to K shall be of welded construction and made of rolled carbon steel plates conforming to BS EN 10025-2:2004, grade S275. Galvanized steel shall not be used. All welding shall be in accordance with BS EN 1011-1.

6.3 Dimensions, plate thickness and welding

6.3.1 Type I

For type I tanks the maximum diameter of the shell and the minimum plate thickness of the shell and ends shall be as given in Table 2.

6.3.2 Type II

For type II tanks the minimum plate thickness of the shell and ends shall be as given in Table 2.

Table 2 **Maximum diameter and minimum plate thicknesses of the shell and ends of primary storage tanks of types I and II**

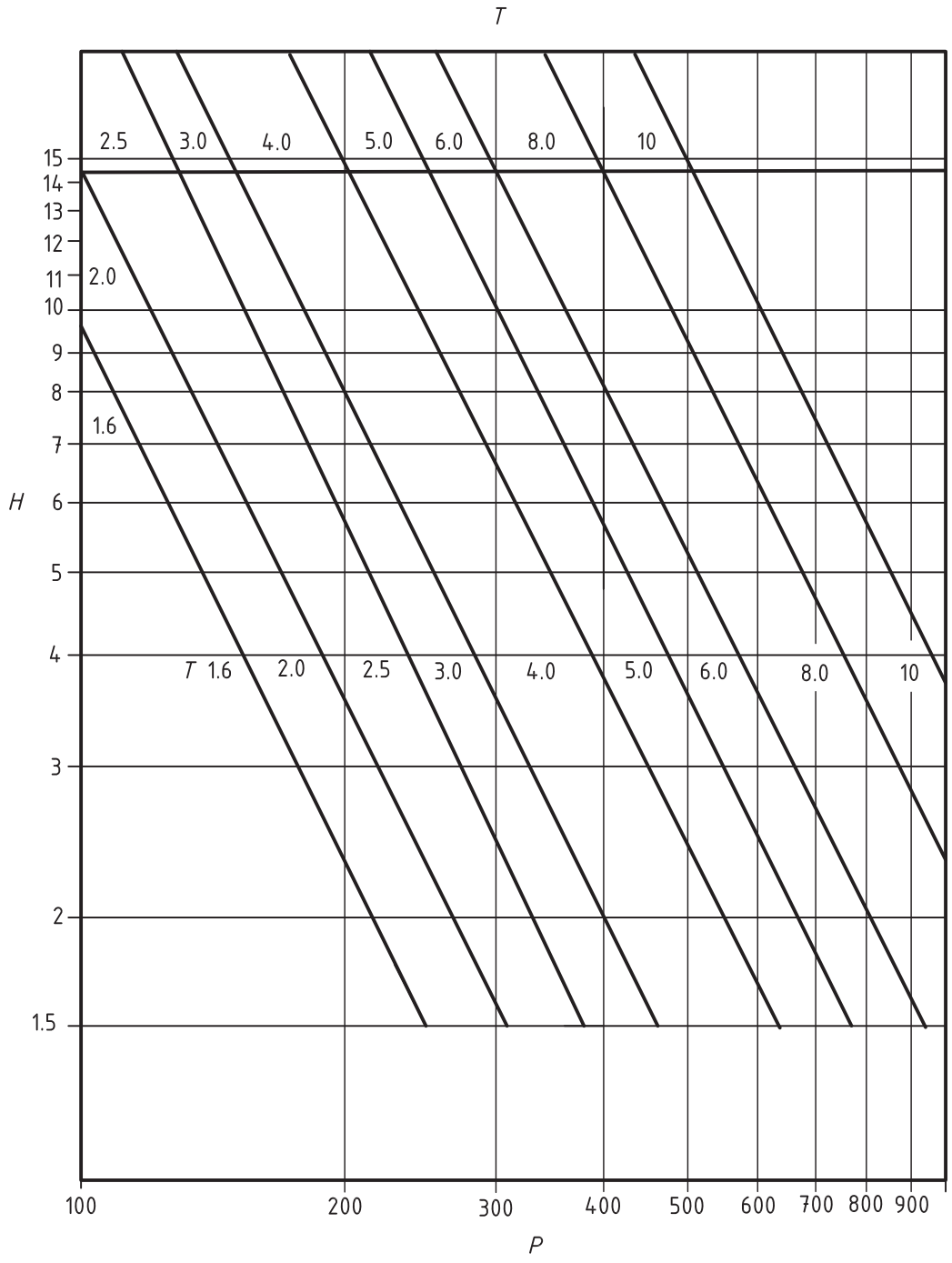
Capacity	**Minimum thickness of plate**				**Maximum diameter for tanks of type I**
	Shell	**Dished and flanged ends**	**Ends dished only Flat flanged ends Flat unflanged ends (stiffened)**	**Flat unflanged ends (not stiffened)**	
L	mm	mm	mm	mm	m
Up to and including 500	1.6	1.6	2.0	4.0	0.75
Over 500 up to and including 1400	2.0	2.0	2.5	4.0	1.0
Over 1400 up to and including 2300	2.5	2.5	4.0	5.0	1.2
Over 2300 up to and including 4500	4.0	4.0	5.0	8.0	1.4

6.3.3 Type III

For type III tanks the thickness of the sheet and the pitch of the staying or stiffening shall be as shown in Figure 1.

The internal stays or stiffening shall be arranged to allow complete draining. If specified by the purchaser [see Clause **4**c)] the tank shall be fitted with two or more transverse supports spaced at intervals not less than as shown in Figure 2.

Figure 1 **Relationship between design pressure, pitch of stays or stiffening and plate thickness for rectangular service tanks of type S4 and rectangular primary storage tanks of types III, J and K**



Key

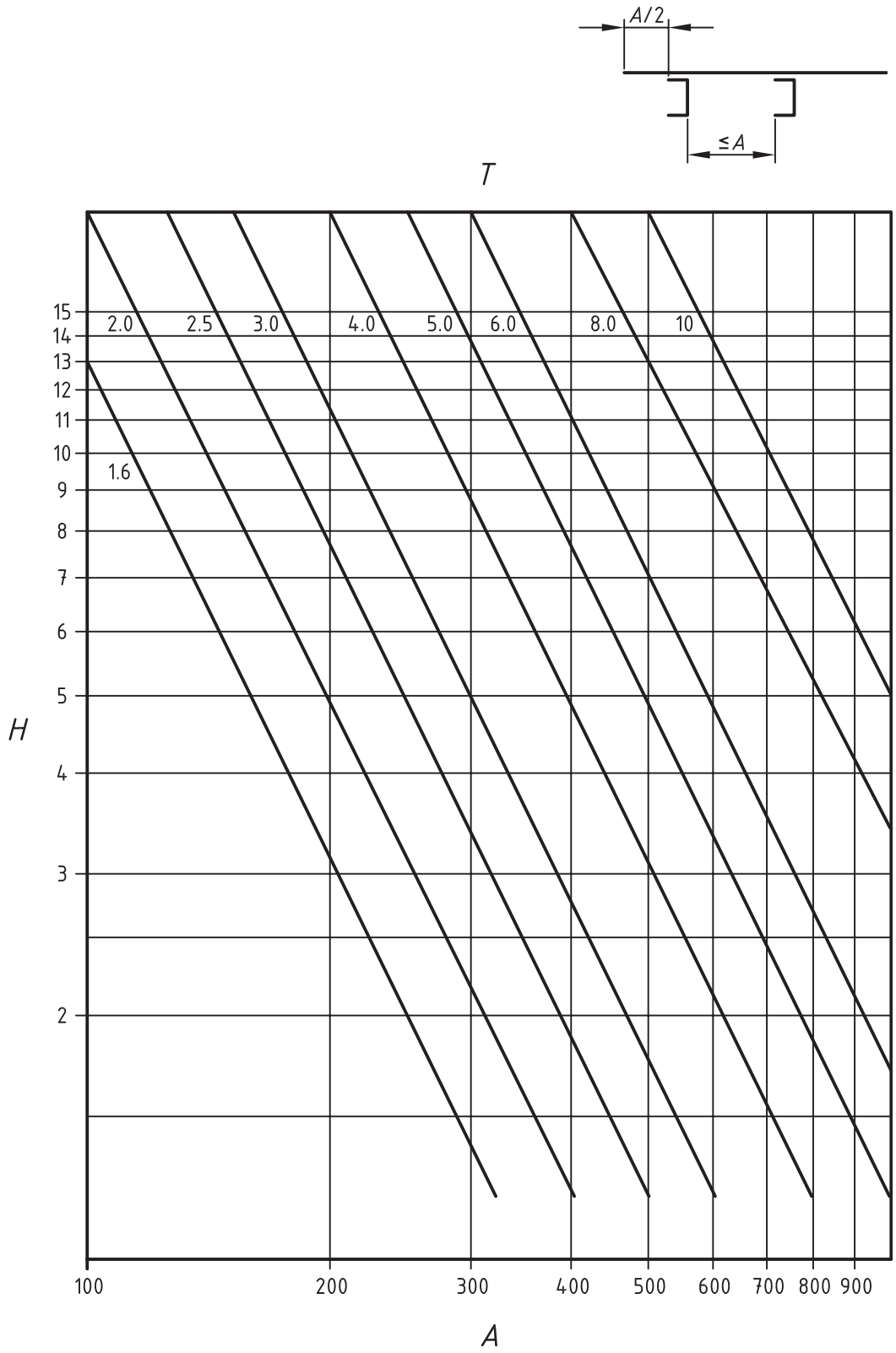
P Pitch of stays or stiffening, in millimetres (mm)

T Plate thickness, in millimetres (mm)

H Total equivalent design head, measured from the base of the tank, in metres of water

$P = 190T/\sqrt{H}$

Figure 2 **Relationship between design pressure, span between supports and plate thickness for rectangular primary storage tanks of types III, J and K**



Key

A Maximum span between supports, in millimetres (mm)

T Plate thickness, in millimetres (mm)

H Total equivalent design head, measured from the base of the tank, in metres of water

$A = 225T/\sqrt{H}$

6.3.4 Type A

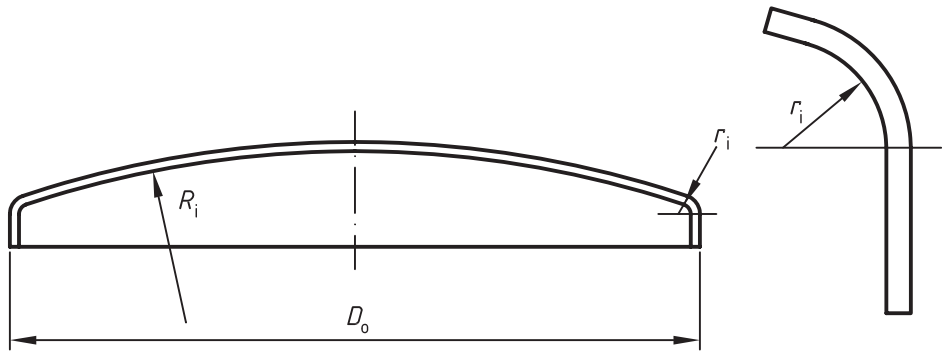
For type A tanks, dished and flanged end plates shall be concave to the oil pressure and shall have dimensions as shown in Figure 3.

The thickness of the shell and end plates shall be not less than the values given in Table 3.

Where the end plates are made of more than one plate, the butt joints shall be fully welded from both sides of the plate.

All seams shall be fully welded inside and outside.

Figure 3 **Shallow dished and flanged end**



Nominal proportions:

$R_i = 1.5D_o$

$r_i \geqslant 38$ mm

$D_o \leqslant 2\,700$ mm

Table 3 **Minimum plate thicknesses for primary storage tanks of type A**

Internal diameter	**Thickness**		
	Shell	**Dished ends**	**Flat ends (unstiffened)**
m	mm	mm	mm
Up to and including 1	4.0	4.0	5.0
Over 1 up to and including 1.6	5.0	5.0	8.0
Over 1.6 up to and including 2.4	6.0	6.0	Dished ends only
Over 2.4 up to and including 2.7	8.0	6.0	Dished ends only

6.3.5 Type B

For type B tanks, end plates shall be dished and flanged, and butt welded or lap welded to the shell. The ends shall be concave to the oil pressure and shall have dimensions as shown in Figure 3.

The thickness of the shell and end plates shall be not less than the values given in Table 4.

Where the end plates are made of more than one plate, the butt joints shall be fully welded from both sides of the plate.

All seams shall be fully welded inside and outside.

6.3.6 Type C

For type C tanks, end plates shall be dished and flanged and butt welded or lap welded to the shell. The ends shall be concave to the oil pressure and shall have dimensions as shown in Figure 4.

The construction shall be as specified in PD 5500 and the plate thickness shall be not less than the values given in Table 4.

Where the end plates are made of more than one plate, the butt joints shall be fully welded from both sides of the plate.

All seams shall be fully welded inside and outside.

Figure 4 **Dished and flanged end**

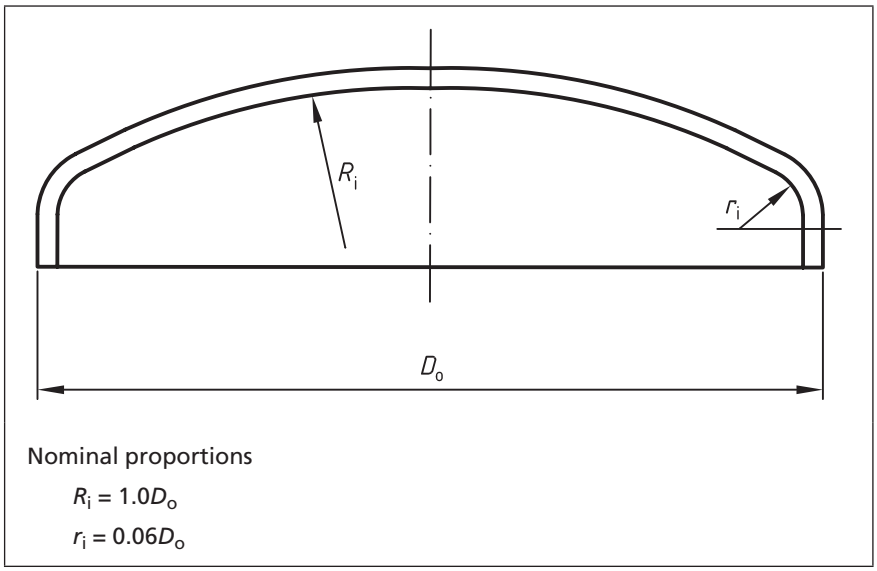


Table 4 **Minimum plate thicknesses for primary storage tanks of types B and C**

Internal diameter	**Thickness**	
	Shell	**Dished ends**
m	mm	mm
Up to and including 1	4.0	4.0
Over 1 up to and including 1.6	5.0	5.0
Over 1.6 up to and including 2.4	6.0	10.0
Over 2.4 up to and including 2.7	8.0	10.0

6.3.7 Type D

For type D tanks, end plates shall be dished and flanged and butt welded or lap welded to the shell.

The dished ends shall be concave to the oil pressure. The top ends shall have dimensions as shown in Figure 3. The bottom ends shall have dimensions as shown in Figure 4.

The thickness of the shell and end plates shall be not less than the values given in Table 5.

Where the end plates are made of more than one plate, the butt joints shall be fully welded from both sides of the plate. All seams, excluding the seams attaching the roof to the sides of the tank, shall be fully welded inside and outside. The seams attaching the roof to the sides of the tank shall be fully welded on the outside only.

Table 5 **Minimum plate thicknesses for primary storage tanks of type D**

	Tank size			Thickness	
	Diameter		Depth	Shell and top dished end	Bottom dished end
	m		m	mm	mm
Up to and including	1.0	or	2.0	4.0	4.0
Over	1.0	or	2.0	5.0	5.0
Up to and including	1.6	or	6.5		
Over	1.6	or	6.5	6.0	6.0
Up to and including	2.7	or	10.0		

The tank shall be fitted with a cylindrical skirt or supporting brackets, to support the tank such that the centre of the end plate will be at least 300 mm clear of the ground when the tank is installed. If the tank has a skirt, inspection openings conforming to Clause **8** shall be fitted in the skirt.

6.3.8 Type E

For type E tanks, end plates shall be dished and flanged, and butt welded or lap welded to the shell.

The dished ends shall be concave to the oil pressure. The top ends shall have dimensions as shown in Figure 3 for tanks up to 2 700 mm diameter and as shown in Figure 4 for tanks with larger diameters.

The bottom ends shall have dimensions as shown in Figure 4.

The thicknesses of the shell and end plates shall be not less than the values given in Table 6.

Where the end plates are made of more than one plate, the butt joints shall be fully welded from both sides of the plate. All seams, excluding the seams attaching the roof to the sides of the tank, shall be fully welded inside and outside. The seams attaching the roof to the sides of the tank shall be fully welded on the outside only.

The tank shall be fitted with a cylindrical skirt or supporting brackets, to support the tank such that the centre of the end plate will be at least 300 mm clear of the ground when the tank is installed. If the tank has a skirt, inspection openings conforming to Clause **8** shall be fitted in the skirt.

6.3.9 Type F

For type F tanks, end plates shall be dished and flanged and butt welded or lap welded to the shell.

The dished ends shall be concave to the oil pressure and shall have dimensions as shown in Figure 4.

The construction shall be as specified in PD 5500 and the plate thickness shall be not less than the values given in Table 6.

Where the end plates are made of more than one plate, the butt joints shall be fully welded from both sides of the plate. All seams, excluding the seams attaching the roof to the sides of the tank, shall be fully welded inside and outside. The seams attaching the roof to the sides of the tank shall be fully welded on the outside only.

The tank shall be fitted with a cylindrical skirt or supporting brackets, to support the tank such that the centre of the end plate will be at least 300 mm clear of the ground when the tank is installed. If the tank has a skirt, inspection openings conforming to Clause **8** shall be fitted in the skirt.

Table 6 **Minimum plate thicknesses for primary storage tanks of types E and F**

	Tank size			**Thickness**		
	Diameter		**Depth**	**Shell**	**Top dished end**	**Bottom dished end (see Figure 4)**
	m		m	mm	mm	mm
Up to and including	1.0	or	2.0	4.0	4.0 (see Figure 3)	4.0
Over	1.0	or	2.0	5.0	5.0 (see Figure 3)	5.0
Up to and including	1.5	or	6.0			
Over	1.5	or	6.0	5.0	6.0 (see Figure 3)	6.0
Up to and including	1.8	or	6.5			
Over	1.8	or	6.5	6.0	8.0 (see Figure 3)	10.0
Up to and including	2.7	or	10.0			
Over	2.7	or	10.0	6.0	10.0 (see Figure 4)	10.0
Up to and including	4.0	or	10.0			

6.3.10 Type G

For type G tanks, the top end plates shall be dished and flanged and butt welded or lap welded to the shell. The top dished ends shall be concave to the oil pressure and shall have dimensions as shown in Figure 3 up for tanks up to 2 700 mm diameter and as shown in Figure 4 for tanks of larger diameters.

The thicknesses of the shell and end plates shall be not less than the values given in Table 7.

Where the end plates are made of more than one plate, the butt joints shall be fully welded from both sides of the plate. All seams, excluding the seams attaching the roof to the sides of the tank, shall be fully welded inside and outside. The seams attaching the roof to the sides of the tank shall be fully welded on the outside only.

Table 7 **Minimum plate thicknesses for primary storage tanks of type G**

	Tank size			Thickness	
	Diameter		Depth	Shell and top dished end	Bottom flat end
	m		m	mm	mm
Up to and including	1.0	or	2.0	4.0 (see Figure 3)	5.0
Over	1.0	or	2.0	5.0 (see Figure 3)	6.0
Up to and including	2.0	or	7.5		
Over	2.0	or	7.5	6.0 (see Figure 4)	8.0
Up to and including	4.0	or	10.0		

6.3.11 Types J and K

For tanks of types J and K, where the plates are made up from more than one piece of steel, the butt joints shall be fully welded from both sides of the plate.

All seams, excluding the seams attaching the roof to the sides of the tank, shall be fully welded inside and outside. The seams attaching the roof to the sides of the tank shall be fully welded on the outside only.

The flat plates shall be stayed or stiffened by one of the following means:

a) stayed with the thickness of the plates and the pitch of the stays as shown in Figure 1;

b) stiffened by carbon steel sections fitted inside and/or outside the tank;

c) both stayed and stiffened by carbon steel sections fitted inside and/or outside the tank.

The stays and/or stiffeners shall be so arranged that they do not:

1) restrict drainage or access to any part of the internal surfaces; or

2) restrict access to and operation of oil level indicators, oil heaters, thermostats, etc.

If specified by the purchaser [see Clause **4**c)] the tank shall be fitted with two or more transverse supports spaced at intervals not less than as shown in Figure 2.

6.4 Tank oil heaters

If the provision of a tank oil heater is specified by the purchaser [see Clause **4**e)] the tank shall be fitted with a heater conforming to Clause **9**.

NOTE Where a heater is fitted, emergency relief venting of the tank is recommended.

6.5 Gauge connection

The tank shall be fitted with a gauge connection.

6.6 Sludge removal connection and outlet connection

The tank shall be fitted with a sludge removal connection and an outlet connection as specified in Clause **11** and Clause **15**, respectively.

6.7 Fill connection

The tank shall be fitted with a filling pipe connection conforming to Clause **12**.

6.8 Vent connection

The tank shall be provided with a vent pipe connection conforming to Clause **13**.

6.9 Return connection

If specified by the purchaser [see Clause **4**h)] the tank shall be fitted with a return connection.

6.10 Outlet connections and pipes

Outlet connections and pipes shall be fitted to the tank as specified in Clause **15.**

6.11 Manholes and inspection openings

The fitting of manholes and inspection openings shall be in accordance with Clause **7** and Clause **8**, respectively.

6.12 Pressure testing

Each tank shall be pressure tested before being painted.

When tested in accordance with Annex A, at the manufacturer's works, or on site in the case of tanks fabricated on site, the tank shall show no visible evidence of leakage.

The manufacturer shall provide the purchaser with a copy of the test certificate for each tank supplied including a statement of the design pressure of the tank.

6.13 Cleaning and painting

6.13.1 Types I, II and III

Each tank fabricated at the manufacturer's works shall be cleaned externally before despatch and, unless otherwise specified by the purchaser [see Clause **4**g)], shall be painted externally with a rust-inhibiting priming paint.

The inside of the tank shall be cleaned and all openings closed to prevent ingress of foreign matter.

Tanks built on site shall be cleaned externally and internally after pressure testing (see **6.12**) and painted externally with a rust-inhibiting priming paint.

6.13.2 Types A to K

Tanks of types A to K fabricated at the manufacturer's works shall, before despatch, be cleaned externally and painted with a rust-inhibiting priming paint; the inside of the tank shall be cleaned and all openings closed to prevent ingress of foreign matter. Tanks fabricated on site shall be cleaned externally and internally after pressure testing (see **6.12**) and painted externally with a rust-inhibiting priming paint.

6.14 Marking

The following information shall be permanently and clearly marked on the tank:

a) the number and date of this British Standard (i.e. BS 799-5:2010[2)]);

b) type of tank (e.g. Type II);

c) capacity (in litres);

d) date of manufacture;

e) manufacturer's name or trade mark;

f) manufacturer's reference number;

g) design pressure;

h) test pressure and date of testing.

6.15 Steel cradles for types I, II, A, B and C tanks

6.15.1 General

If specified by the purchaser [see Clause **4**f)] the tank manufacturer shall supply steel cradles conforming to **6.15.2** or **6.15.3**, as applicable, such that the tank can be supported at a slope of 1 in 50 in the direction of the sludge removal connection.

6.15.2 Cradles for types I and II

The steel cradles shall have the dimensions given in Table 8 or Table 9, as applicable. If the cradles are welded to the tank by the tank manufacturer they shall be positioned as shown in Figure 5 or Figure 6, as applicable. If the cradles are supplied loose with the tank, the tank manufacturer shall supply a copy of Figure 5 or Figure 6 to the purchaser with the tank together with instructions to position the tank on the cradles as shown in the figure and to put a waterproof membrane to completely fill the space between the tank and each cradle.

---

2) Marking BS 799-5:2010 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third party certification of conformity.

Table 8 **Dimensions of steel cradles for tanks of type I (see Figure 5)**

Tank diameter, *D*	**Minimum width of cradles, *B***	**Minimum length of cradles, *C***
m	mm	m
0.75	65	0.66
1.0	75	0.90
1.2	100	1.05
1.4	100	1.25

Figure 5 **Positions of steel cradles for primary storage tanks of type I**

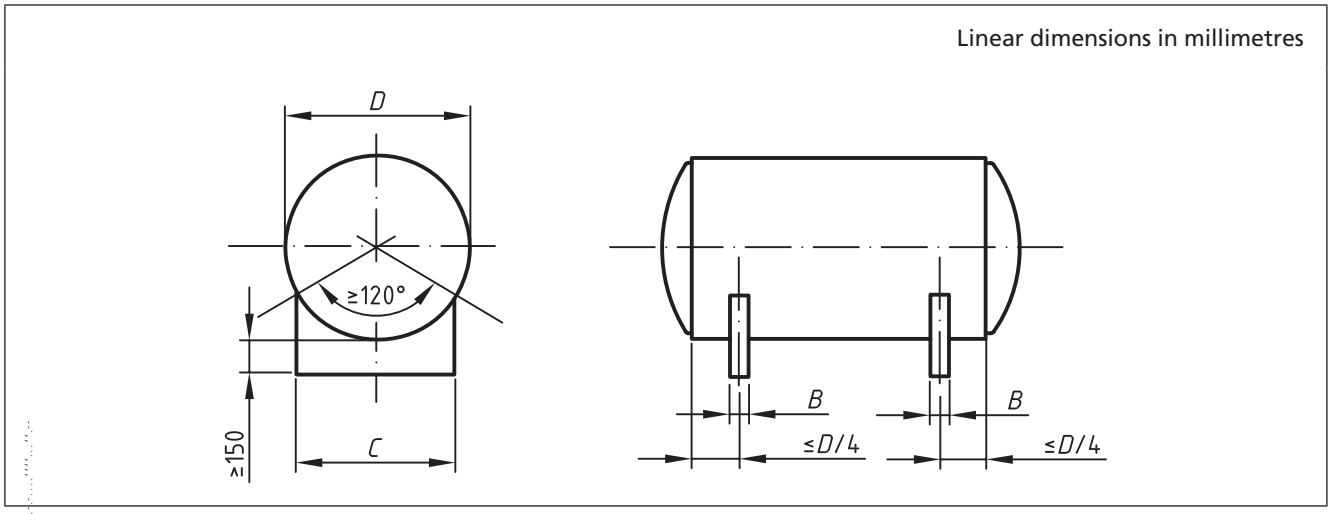
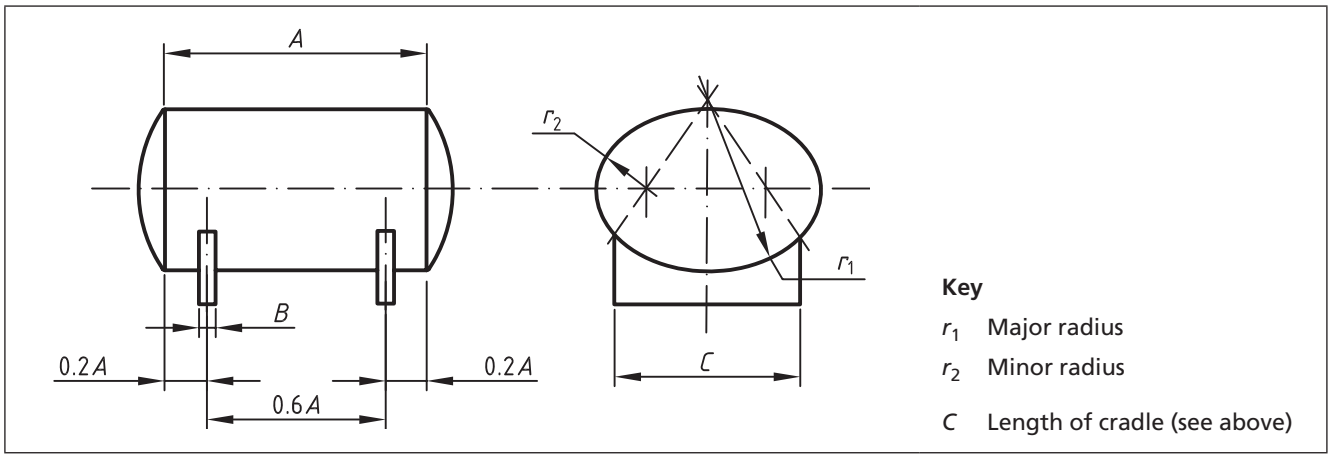


Table 9 **Dimensions of steel cradles for tanks of type II (see Figure 6)**

Tank capacity	**Minimum width of cradles, *B***
L	mm
Up to and including 1 300	50
Over 1 300 up to and including 4 500	65

Figure 6 **Positions of steel cradles for primary storage tanks of type II**



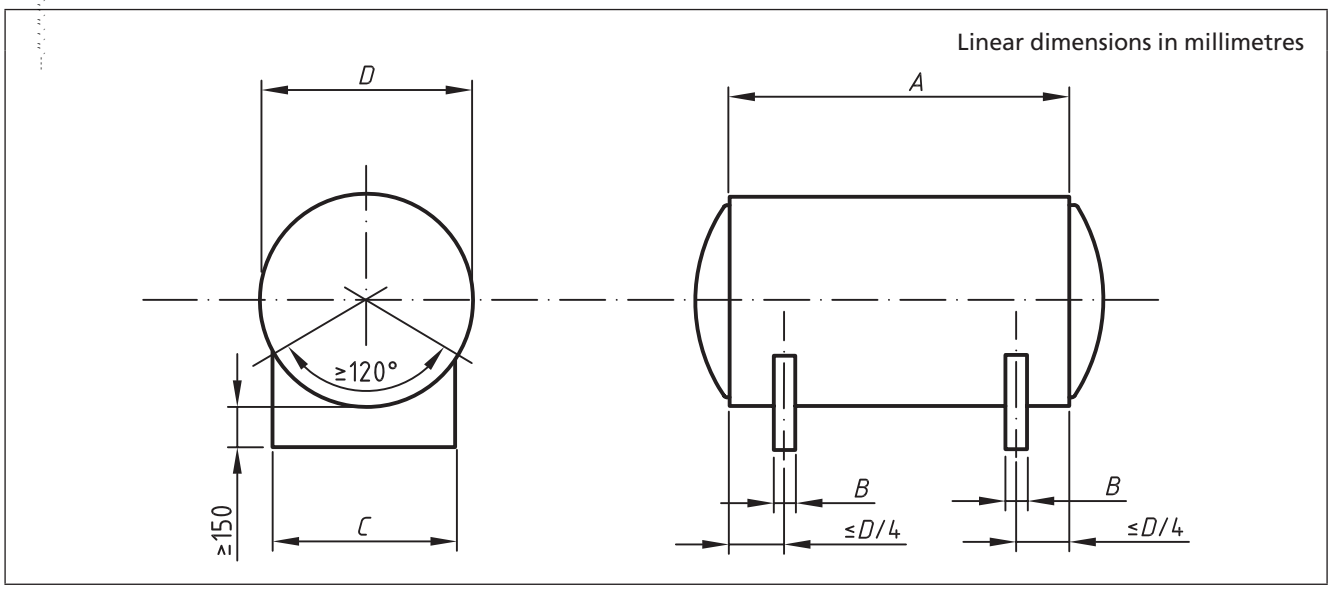
6.15.3 Cradles for types A, B and C

The steel cradles shall have the dimensions given in Table 10. If the cradles are welded to the tank by the tank manufacturer they shall be positioned as shown in Figure 7. If the cradles are supplied loose with the tank, the tank manufacturer shall supply a copy of Figure 7 to the purchaser with the tank together with instructions to position the tank on the cradles as shown in the figure and to put a waterproof membrane to completely fill the space between the tank and each cradle.

Table 10 **Dimensions of steel cradles for tanks of types A, B and C (see Figure 7)**

Tank diameter, *D*	**Length of shell, *A***	**Minimum width of cradles, *B***	**Minimum length of cradles, *C***
m	m	mm	m
1.00	2.50	75	0.90
1.25	2.50	100	1.10
1.50	2.50	100	1.30
1.50	3.00	100	1.30
1.75	3.00	150	1.60
2.00	3.00	150	1.80
2.00	3.25	175	1.80
2.25	3.00	200	2.00
2.25	4.25	200	2.00
2.25	5.25	200	2.00
2.50	4.75	225	2.20
2.75	4.50	250	2.40
2.75	6.00	250	2.40
2.75	9.00	250	2.40

Figure 7 **Positions of cradles for primary storage tanks of types A, B and C**



7 Manholes

All cylindrical tanks over 1250 mm diameter and all rectangular tanks over 4500 L capacity shall be fitted with a manhole.

Vertical tanks over 4.5 m in height shall have either an additional manhole near the bottom of the vertical shell or an internal ladder.

Other tanks shall be fitted with a manhole if specified by the purchaser [see Clause **4**d)]

Manholes shall be not less than 600 mm in diameter if circular in shape and not less than 650 mm long and 600 mm wide if oval in shape; the 600 mm dimension shall be parallel to the longitudinal axis of the tank. Manholes of other shapes shall have no access dimension of less than 600 mm.

Manholes shall be stiffened by the provision of a flanged neck ring welded around the opening or alternatively in the case of a rectangular tank by a flat faced compensating ring welded around the opening. Holes for studs and set screws shall not penetrate the tank plate.

Where practicable, manholes shall be located on top of the tank. Each manhole shall be provided with a cover securely fixed by bolts, studs or set screws and shall have a liquid- and vapour-tight joint made with a gasket of oil-resistant material. The maximum pitch of fixing bolts, studs or set screws in manholes for tanks of types A, B, D, E, G, J and K shall be as given in Table 11.

The minimum thickness for covers for manholes shall be not less than the thickness of the body plate for service tanks and for primary storage tanks of types I, II and III and shall be as given in Table 11 for tanks of types A, B, D, E, G, J and K.

The plate thickness and fixing details of manholes for tanks of type C and type F shall be as specified in PD 5500.

NOTE The thicknesses specified in Table 11 have been adopted to provide for a minimum number of fixing bolts, studs or set screws and to enable top and bottom manhole covers on vertical tanks to be interchangeable.

Table 11 **Manholes – Minimum thicknesses of covers and maximum pitch of fixing bolts, studs and set screws**

Type of tank	Cover thickness	Maximum pitch of M16 bolts, studs or set screws
	mm	mm
A, J	10	100
B, D, G, K	10	80
E	12	90

8 Inspection openings

Inspection openings shall be not less than 125 mm in diameter if circular in shape and not less than 125 mm × 125 mm if square and, if below the brimful capacity level of the tank, shall be sealed as specified in Clause **7**.

9 Tank oil heaters

*COMMENTARY ON CLAUSE **9***
The means of heating may be electricity, steam or hot water.

Heaters can be of the following types:

a) immersion type, inserted through the outlet end of the tank;

b) submersion type, inserted through the top of the tank;

c) outflow type, where the heating elements are concentrated around the outlet from the tank;

d) trace heating;

e) recirculation.

9.1 Tank insulation

Any tank fitted with a heater shall be insulated.

9.2 Electric heaters

The electric loading of heaters installed in tanks for the storage of oil of classes C and D shall not exceed 1.6 W/cm^2 of element sheath surface and for oil of classes E, F, G or H shall not exceed 1.24 W/cm^2 of element sheath surface. The surface temperature of the sheath shall be thermostatically controlled so as to not exceed 175 °C. In addition a safety cut-out shall be provided. Heating elements and thermostats shall be of the dry type so that they can be withdrawn without emptying the tank.

NOTE The element sheath or pocket should be supported as necessary along its length by cradles or other supports.

Heaters fitted to tanks which are to be placed in the open air shall be provided with weatherproof terminal covers.

Electric heaters shall be independently earthed.

9.3 Steam and hot water heaters or coils (including high pressure hot water heaters)

Heaters or coils shall be constructed of seamless steel tube either:

a) without joints within the tank; or

b) where unavoidable, with joints within the tank.

Where such joints are unavoidable they shall be fully welded in accordance with BS EN 1011-1.

Heaters shall be supported at intervals along their length by cradles or other supports.

Steam heaters shall be arranged to drain freely so that they are not subject to water hammer.

9.4 Location

All heaters and controlling thermostats shall be so located in relation to the draw-off level that their surfaces do not become exposed (see Clause **15**).

The tank shall be fitted with visual and audible alarms to give warning when the oil level falls below a depth of 300 mm above the heater.

10 Oil level indicators

The tank manufacturer shall supply an oil level indicator of one of the following types:

a) a dipstick or dip tape;

b) a float gauge;

c) a hydrostatic gauge;

d) an electronic gauge;

e) a displacement gauge;

f) a sight tube.

NOTE The main purpose of an oil level indicator is to show the approximate contents of the tank.

If a dipstick or dip tape is supplied the tank shall be fitted with a striker plate.

11 Sludge removal connection

The tank manufacturer shall fit the tank with a sludge removal connection.

12 Filling pipe and delivery hose connections

12.1 Filling pipe connection

The tank shall be fitted with a filling pipe connection.

If the filling pipe connection is at the bottom of the tank it shall be fitted with a non-return valve.

If the filling pipe connection is continued below the surface of the oil and could form a siphon, an anti-siphoning device, such as a 5 mm hole drilled in the drop pipe from the connection, shall be provided above the maximum oil level within the tank.

12.2 Delivery hose connections for road tanker deliveries

Tanks to be filled from a road tanker shall be fitted with a delivery hose connection which shall have a parallel male thread conforming to BS 21. The dimensions of the delivery hose connection shall be not less than the value given in Table 12.

The connecting parallel thread shall be protected by means of a removable non-ferrous screw-on cap which shall be secured to the delivery hose connection by a chain.

Where the delivery hose connection terminates below the brimful capacity of the tank an oil-tight valve shall be fitted to the end of the delivery hose connection.

NOTE The height of the delivery hose connection should be no more than 1.2 m above the base of the tank.

12.3 Delivery hose connections for rail tanker deliveries

Tanks to be filled from a rail tanker shall be fitted with a dry break coupling.

Table 12 **Delivery hose connection sizes for oil classes C, D, E, F, G, H and FAME**

Oil	Total length of delivery hose [A)]	Minimum bore (nominal) of delivery hose [A)]	Delivery hose connection, male pipe thread conforming to BS 21
	m	mm	mm
Classes C, D and FAME	up to 12	32 for tanks up to and including 1 500 L capacity	50
		50 for tanks over 1 500 L capacity	50
	over 12	50 for tanks up to and including 1 500 L capacity	50
		65 for tanks over 1 500 L capacity	65
Class E	up to 12	65	80
	over 12	80	80
Classes F, G and H	—	80	80

[A)] As specified by the specifier of the tank.

13 Vent pipe connection

For tanks over 200 L capacity, the bore of the vent pipe connection shall be not less than 50 mm nominal diameter and at least equal to the bore of the filling pipe connection or outlet connection whichever is the greater, or the sum of the bores of all the filling or outlet pipe connections if there is more than one.

14 Vent pipe

If a vent pipe is fitted by the tank manufacturer, the open end of the vent pipe shall be turned down and fitted with an open mesh wire cage. Gauze shall not be used.

If a vent pipe is fitted by the tank manufacturer, it shall be so arranged so that any fuel discharge is directed into the bund.

*NOTE 1 Vent pipe design should be in accordance with the design pressure of the tank [see Clause **4**b)].*

NOTE 2 The relationship between the layout of the vent pipe and the design pressure of the tank can be calculated using the method given in Annex B together with Figures 1 and 2.

15 Outlet connections and pipes

15.1 General

The tank manufacturer shall fit an outlet connection to the tank. This shall be a bottom outlet connection conforming to **15.2** or a top outlet connection conforming to **15.3**. If specified by the purchaser [see Clause **4**k)] an outlet pipe shall be fitted to the tank by the tank manufacturer.

15.2 Bottom outlet connections

For all oils except classes C and D, the outlet connection shall be so arranged as to leave a minimum of 50 mm of dead space in the bottom of the tank. In the case of a tank fitted with a heater, the outlet connection shall be fitted a minimum of 150 mm above the top of the heater.

If an outlet pipe is fitted to the tank, a valve shall be provided on the outlet pipe as close to the tank as possible.

15.3 Top outlet connections

Top outlets connections shall comprise an internal suction pipe which shall terminate 50 mm above the tank base.

Annex A (normative) Methods for pressure testing of service tanks and primary storage tanks

WARNING. During pressure testing there is a risk that the tank might rupture. It is essential to take precautions to ensure that personnel are protected against injury should rupture of the tank occur.

A.1 Tanks other than types D to G

A.1.1 General

The tank shall be subjected either to a leak test in accordance with **A.1.2** followed by a design pressure test in accordance with **A.1.3**, or to a hydraulic test in accordance with **A.1.4**, using a total head of water, or an equivalent pressure, equal to the required design pressure of the tank.

A.1.2 Leak test

All but two of the tank connections shall be blanked off. An air line shall be fitted to one connection and a pressure release valve and a pressure gauge or water tube shall be connected to the remaining connection. The pressure release valve shall be set to release at the test pressure (see **A.1.1**). The pressure shall be raised gradually until a pressure of 0.2 bar is reached. All welds shall be checked for leaks using a soap solution. If leaks are detected the air pressure shall be released, the leaks re-welded and the test repeated.

A.1.3 Design pressure test

All but two of the tank connections shall be blanked off. An air line shall be fitted to one connection and a pressure release valve and a pressure gauge or water tube shall be connected to the remaining connection. The pressure release valve shall be set to release at the test pressure (see **A.1.1**). The pressure shall be raised gradually until the test pressure is reached and held for 60 s. If there is no loss of pressure the tank shall be deemed to have passed the test.

A.1.4 Hydraulic tests

A.1.4.1 Test 1

All but one of the top connections on the tank shall be blanked off and a header pipe of a length which will apply the test pressure (see **A.1.1**) when it is full of water shall be connected to the remaining connection. The tank shall be filled with water until the header pipe is full to overflowing. The water level shall be held for 60 s. If the tank leaks, as indicated by a drop in the water level, the tank shall be emptied the leaks re-welded and the test repeated. After the test the tank shall be emptied and thoroughly dried.

A.1.4.2 Test 2

All the openings on the tank except one shall be blanked off. The tank shall be filled with water to brimful capacity. On the remaining

opening a water pressure pump fitted with a pressure gauge shall be fitted. Additional water shall be applied with the pump until the test pressure is reached (see **A.1.1**) and held for 60 s. If there is no loss of pressure the tank shall be deemed to have passed the test. If the tank leaks, as indicated by a drop in the pressure, the tank shall be emptied the leaks re-welded and the test repeated. After the test the tank shall be emptied and thoroughly dried.

A.2 Tanks of types D to G

Vertical storage tanks of types D to G shall either be tested vertically in accordance with **A.1** or alternatively shall be tested horizontally in accordance with **A.1** but at a pressure above the design pressure equivalent to a head of water not less than 0.7 m above the height of the tank.

NOTE The testing of vertical storage tanks of types D to G horizontally should be subject to agreement between the purchaser and the manufacturer. When testing flat bottom vertical tanks horizontally the flat bottoms should be suitably stiffened for the test.

Annex B (informative) Avoidance of overfilling of oil storage tanks

When an oil storage tank is overfilled to the extent that oil flows from the vent pipe (or unloading device), the friction of the oil passing through the pipe causes a pressure to be set up in the tank in addition to that due to the head of oil in the vent pipe. If the vent pipe is too small in diameter or too long, the total pressure due to friction plus the static head may be sufficient to cause serious damage to the tank. The pressure developed at the top of the tank depends upon the height, the bore, the total length and the number of bends in the vent pipe, the viscosity of the oil and the filling rate.

As shown in the examples in this annex, the pressure at the top of the tank due to overfilling can be determined from Figures B.1 to B.4 used in conjunction with Tables B.1 to B.4, respectively, for different values of viscosity and filling rate.

Having determined the pressure at the top of the storage tank, it may be necessary for the specifier of the tank to revise one or more of the following to avoid overfilling of the tank:

a) the type of tank(s) to be used, i.e. cylindrical or rectangular;

b) the design pressure of the tank(s);

c) the vent pipe diameter and length, and unloading device (if any);

d) the location of the tank(s) and the layout of the tank installation.

If changes are decided upon, further reference to the appropriate figure and table should be made to determine the oil pressure that would result.

The pressure developed varies for different classes of oil. Where E, F, G or H grades of fuel oil are to be used, it is better to design the storage installation to suit the maximum viscosity fuel oil available that is suitable for the oil-burning equipment.

EXAMPLE 1
Calculation of the total head developed for a 50 mm bore vent pipe of 7.5 m vertical height, 7.5 m horizontal run and four easy bends.

Total equivalent vent height calculated using Table B.1:

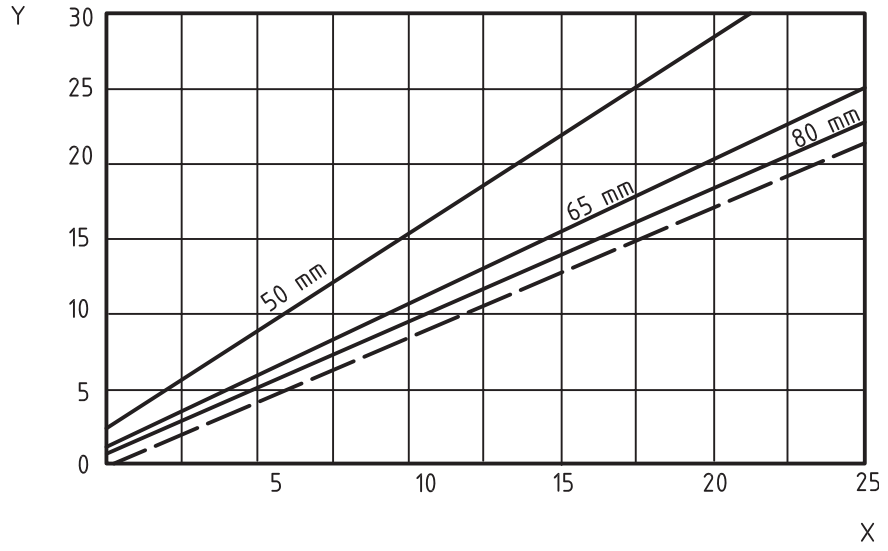
Vertical height: (including entry, exit, return bend)	=	7.5 m
Horizontal run of 7.5 m: (taken pro rata from Table B.1)	=	2.6 m
Four easy bends:	=	1.2 m
Total equivalent vent height:	=	11.3 m

From Figure B.1, a vent of 11.3 m height and 50 mm bore would result in a head of 17.5 m of water at the top of the tank.

Table B.1 **Equivalent height of vent – Allowances for horizontal pipe runs, easy and sharp bends at a filling rate of 500 L/min and at a viscosity of 16 mm^2/s**

Fitting	**Bore of vent**		
	50 mm	65 mm	80 mm
	Equivalent height of vent m		
10 m of horizontal run	3.5	1.5	0.5
Each easy bend	0.3	0.15	0.08
Each sharp bend	0.6	0.3	0.15

Figure B.1 **Graph showing pressure developed when a tank is overfilled with oil of classes C or D at a filling rate of 500 L/min and at a viscosity of 16 mm^2/s[A] (relative density 0.84)**



Key

X Height of vent above top of tank, in metres (m)

Y Head developed at top of tank, in metres of water

Solid lines: Pressure at top of tank with the vent overflowing

Dashed line: Static pressure only

NOTE Pressures given include: (static head due to vertical column of oil) + (entry and exit losses) + (friction loss in pipe) + (friction loss in return bend at top of vent).

[A] 1 mm^2/s = 1cSt.

EXAMPLE 2
Calculation of the total head developed for a 65 mm bore vent pipe of 7.5 m vertical height, 7.5 m horizontal run and four easy bends.

Total equivalent vent height calculated using Table B.2:

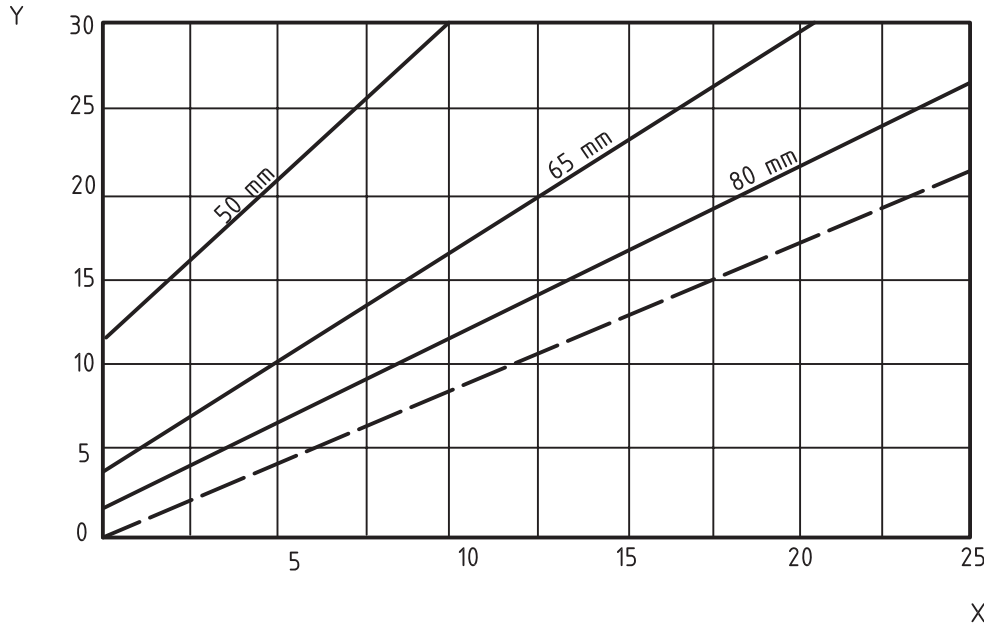
Vertical height: (including entry, exit, return bend)	=	7.5 m
Horizontal run of 7.5 m (calculated pro rata from Table B.2)	=	2.6 m
Four easy bends	=	2.0 m
Total equivalent vent height	=	12.1 m

From Figure B.2 a vent of 12.1 m height and 65 mm bore would result in a head of 19.2 m of water at the top of the tank.

Table B.2 **Equivalent height of vent – Allowances for horizontal pipe runs, easy and sharp bends at a filling rate of 1 000 L/min and at a viscosity of 16 mm^2/s**

Fitting	**Bore of vent**		
	50 mm	65 mm	80 mm
	Equivalent height of vent m		
10 m of horizontal run	6.5	3.5	2.0
Each easy bend	0.7	0.5	0.25
Each sharp bend	1.4	0.9	0.5

Figure B.2 **Graph showing pressure developed when a tank is overfilled with oil of classes C or D at a filling rate of 1 000 L/min and at a viscosity of 16 mm^2/s (relative density 0.84)**



Key

X Height of vent above top of tank, in metres (m)

Y Head developed at top of tank, in metres of water

Solid lines: Pressure at top of tank with the vent overflowing

Dashed line: Static pressure only

NOTE Pressures given include: (static head due to vertical column of oil) + (entry and exit losses) + (friction loss in pipe) + (friction loss in return bend at top of vent).

EXAMPLE 3
Calculation of the total head developed for an 80 mm bore vent pipe of 7.5 m vertical height, 7.5 m horizontal run and four easy bends.

Total equivalent vent height calculated using Table B.3:

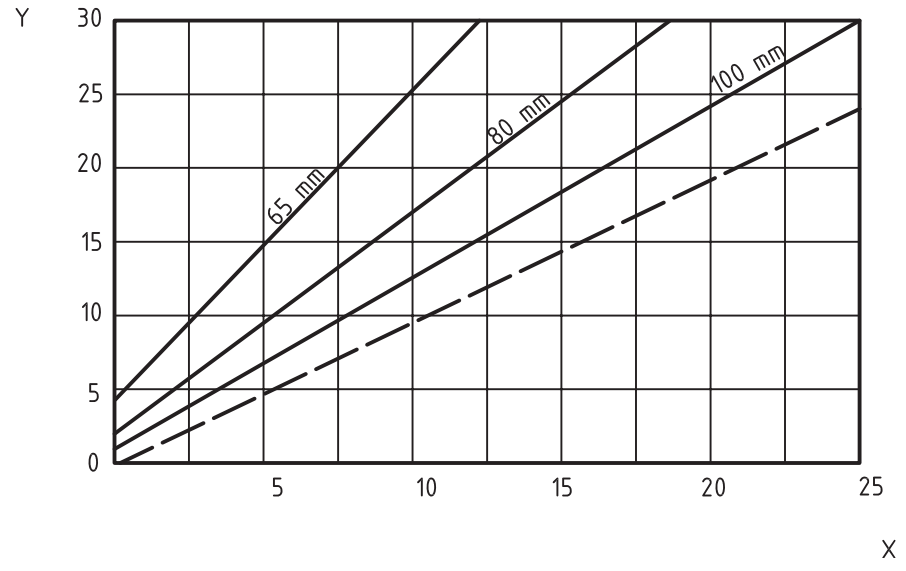
Vertical height: (including entry, exit, return bend)	=	7.5 m
Horizontal run of 7.5 m (calculated pro rata from Table B.3)	=	3.0 m
Four easy bends	=	0.8 m
Total equivalent vent height	=	11.3 m

From Figure B.3 a vent of 11.3 m height and 80 mm bore would result in a head of 19.2 m of water at the top of the tank.

Table B.3 **Equivalent height of vent – Allowances for horizontal pipe runs, easy and sharp bends at a filling rate of 1000 L/min and at a viscosity of 370 mm^2/s**

Fitting	**Bore of vent**		
	65 mm	80 mm	100 mm
	Equivalent height of vent m		
10 m of horizontal run	6.0	4.0	2.0
Each easy bend	0.3	0.2	0.1
Each sharp bend	0.6	0.4	0.2

Figure B.3 **Graph showing pressure developed when a tank is overfilled with oil of classes E, F or G at a filling rate of 1000 L/min and at a viscosity of 370 mm^2/s (relative density 0.935)**



Key

X Height of vent above top of tank, in metres (m)

Y Head developed at top of tank, in metres of water

Solid lines: Pressure at top of tank with the vent overflowing

Dashed line: Static pressure only

NOTE Pressures given include: (static head due to vertical column of oil) + (entry and exit losses) + (friction loss in pipe) + (friction loss in return bend at top of vent).

EXAMPLE 4
Calculation of the total head developed for an 80 mm bore vent pipe of 7.5 m vertical height, 7.5 m horizontal run and four easy bends.

Total equivalent vent height calculated using Table B.4:

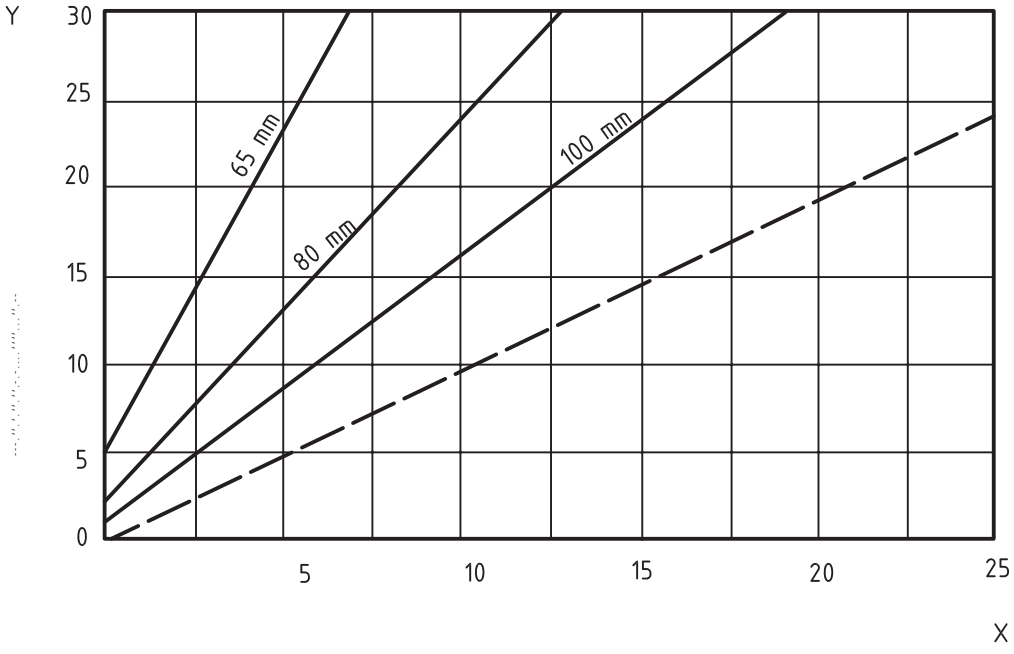
Vertical height (including entry, exit, return bend)	=	7.5 m
Horizontal run of 7.5 m calculated pro rata from Table B.4	=	4.5 m
Four easy bends	=	0.4 m
Total equivalent vent height	=	12.4 m

From Figure B.4 a vent of 12.4 m height and 80 mm bore would result in a head of 30 m of water at the top of the tank.

Table B.4 **Equivalent height of vent – Allowances for horizontal pipe runs, easy and sharp bends at a filling rate of 1 000 L/min and at a viscosity of 860 mm^2/s**

Fitting	**Bore of vent**		
	65 mm	80 mm	100 mm
	Equivalent height of vent m		
10 m of horizontal run	8.0	6.0	4.0
Each easy bend	0.15	0.1	0.07
Each sharp bend	0.3	0.2	0.14

Figure B.4 **Graph showing pressure developed when a tank is overfilled with oil of classes E, F or G at a filling rate of 1 000 L/min and at a viscosity of 860 mm^2/s (relative density 0.946)**



Key
X Height of vent above top of tank, in metres (m)
Y Head developed at top of tank, in metres of water
Solid lines: Pressure at top of tank with the vent overflowing
Dashed line: Static pressure only

NOTE Pressures given include: (static head due to vertical column of oil) + (entry and exit losses) + (friction loss in pipe) + (friction loss in return bend at top of vent).

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For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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