

In de fabriek vervaardigde metalen tanks. Horizontale enkel- en dubbelwandige tanks voor de ondergrondse opslag van brandbare en niet-brandbare watervervuilende vloeistoffen

Metallic workshop fabricated tanks. Horizontal single skin and double skin tanks for underground storage of flammable and non-flammable water polluting liquids

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Commentaar voor 15 juni 1996

De European Committee for Standardization (CEN), waarin de nationale normalisatie-instituten van 18 Europese landen samenwerken, heeft gepubliceerd het Europese normontwerp:

prEN 12285 Metallic workshop fabricated tanks. Horizontal single skin and double skin tanks for underground storage of flammable and non-flammable water polluting liquids

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Prijsklasse 54

Voorbeeld
Preview

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Descriptors :

English version

Metallic workshop fabricated tanks - Horizontal
single skin and double skin tanks for the
underground storage of flammable and non-flammable
water polluting liquids

Réservoirs métalliques fabriqués en
atelier - Réservoirs horizontaux à
simple et double paroi pour le stockage
enterré de liquides inflammables et non
inflammables polluant l'eau

Werksgefertigte Tanks aus metallischen
Werkstoffen - Liegende ein- und
doppelwandige Tanks zur unterirdischen
Lagerung von brennbaren und
nichtbrennbaren wassergefährdenden
Flüssigkeiten

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Contents

	Page
Foreword	3
1 Scope	3
2 Normative references	3
3 Definitions and symbols	4
4 Designation and purchaser's specification	6
5 Materials	6
6 Design	7
7 Fabrication	13
8 Testing	17
9 Handling and installation	18
10 Evaluation of conformity	18
11 Marking and certification of the tank	18
Annex A (normative) System of evaluation of conformity	20
Annex B (informative) Transport, storage and installation procedure	23
Annex C (informative) Evaluation of liquid material combinations for storage tanks according to this standard	25

Foreword

This draft European Standard has been drawn up by Technical Committee CEN/TC 221 "Metallic shop fabricated tanks", the secretariat of which is held by DIN.

This document is submitted to CEN-enquiry.

1 Scope

This standard specifies the requirements for metallic shop fabricated cylindrical, horizontal tanks, single and double skin for underground storage of water polluting liquids (both flammable and non-flammable) within the following limits:

- from 800 mm up to 3000 mm nominal diameter and,
- up to a maximum overall length of 6 times the nominal diameter and,
- for liquids with a maximum density of up to 1,9 kg/l and,
- with an operating pressure (P_o) of maximum 1,5 bar (abs.) and,
- where double skin tanks with a vacuum leak detection system are used the viscosity of the stored media shall not exceed $5 \times 10^{-3} \text{ m}^2/\text{s}$.

This standard is not applicable to the liquid classes listed in table 1 because of special dangers involved.

Table 1: List of dangerous goods not to be considered by this standard

UN-classification	Dangerous Good
Class 1	Explosives
Class 4.2	Substances liable to spontaneous combustion
Class 4.3	Substances which in contact with water emit flammable gases
Class 5.2	Organic peroxides
Class 6.2	Infectious substances
Class 7	Radioactive substances, hydrocyanic or hydrocyanic solvent liquids, metalcarbonyls, hydrofluoric acid, bromide liquids

The classifications referred to are those adopted by the United Nations Committee of Experts on the Transport of Dangerous Goods (not to be interpreted as tank classes described in 3.1.4).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 287-1	Approval testing of welders – Fusion welding – Part 1: Steels
EN 288-1	Specification and qualification of welding procedures for metallic materials – Part 1: General rules for fusion welding
EN 10025	Hot rolled products of non-alloy structural steels – Technical delivery conditions
EN 10028-2	Flat products made of steels for pressure purposes – Part 2: Non-alloy and alloy steels with specified elevated temperature properties
prEN 10055	Hot rolled steel equal flange tees with radiused root and toes – Dimensions and tolerances on shape and dimensions

- prEN 10088-1 Stainless steels – Part 1: List of stainless steels
- EN 10204:1991 Metallic products – Types of inspection documents
- EN 20898-1 Mechanical properties of fasteners – Part 1: Bolts, screws and studs (ISO 898-1:1988)
- EN 24063 Welding, brazing, soldering and braze welding of metals – Nomenclature of processes and reference numbers for symbolic representation on drawings (ISO 4063:1990)
- EN 45012 General criteria for certification bodies operating quality system certification
- EN ISO 9002 Quality systems – Model for quality assurance in production, installation and servicing
- ISO 228-1 Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation
- ISO 857 Welding, brazing and soldering processes – Vocabulary
- ISO/DIS 12944-4 Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 4: Types of surface and surface preparation

3 Definitions and symbols

3.1 Definitions

For the purpose of this standard the following definitions apply:

3.1.1 Tank

Metallic workshop fabricated tanks are cylindrical containments for the storage of liquids. They are made of steel, equipped with dished ends and consist of one or more compartments.

In this standard the definitions are related to cylindrical tanks only.

3.1.2 Compartment

A compartment is a single storage fluid space within a tank.

3.1.3 Underground tanks

Underground tanks are those tanks which are totally or partially imbedded in the ground.

3.1.4 Tank classes

Tank classes are defined in table 2.

Table 2: Tank classes

Tank class	Description
Class A	For liquids with density up to 1,1 kg/l
Class B	For liquids with density up to 1,9 kg/l
Class C	For liquids with density up to 1,9 kg/l, explosion pressure shockproof under atmospheric conditions including the use of pressure vent valves (± 30 mbar)

3.1.5 Explosion pressure shockproof tank

Explosion pressure shockproof tanks are designed to withstand an internal explosion without rupture; permanent deformation is permissible. In case of an atmospheric pressure of 1 bar the maximum explosion pressure is measured at 10 bar (abs.).

3.1.6 Tank types

For the purpose of this standard two tank types are distinguished:

Type S: Single skin,
Type D: Double skin.

3.1.7 Operating pressure (P_o)

The operating pressure is the pressure inside the tank above the liquid during operating conditions.

3.1.8 Test pressure (P_{t1})

The test pressure is the pressure to which the tank or compartment is subjected for testing.

3.1.9 Interstitial test pressure (P_{t2})

The interstitial test pressure is the pressure to which the interstitial space between the skins is subjected for testing. It is only applicable for double skin tanks.

3.1.10 Nominal volume

The nominal volume is the volume stated on customer's order.

3.1.11 Actual volume

The actual volume shall be equal to or greater than the nominal volume.

NOTE: The safe working capacity of the tank should normally not exceed 97 % of the nominal volume.

3.2 Symbols

For the purpose of this standard the following symbols apply:

Dimensions in mm

d_1	External nominal diameter of the tank
d_2	Inside diameter of manhole
d_3	Diameter of cover
k	Pitch circle diameter
l	Length of the tank without dished ends
l_c	Length of the compartment of a tank without dished ends
l_o	Overall length of the tank
r_1	Crown radius of dished ends
r_2	Knuckle radius of dished ends
s_1	Nominal thickness of inner skin and inner dished ends
s_2	Nominal thickness of outer skin
s_3	Nominal thickness of outer dished ends
s_4	Nominal thickness of compartment dished ends
s_5	Nominal thickness of flange and cover
s_6	Plate thickness of manhole body

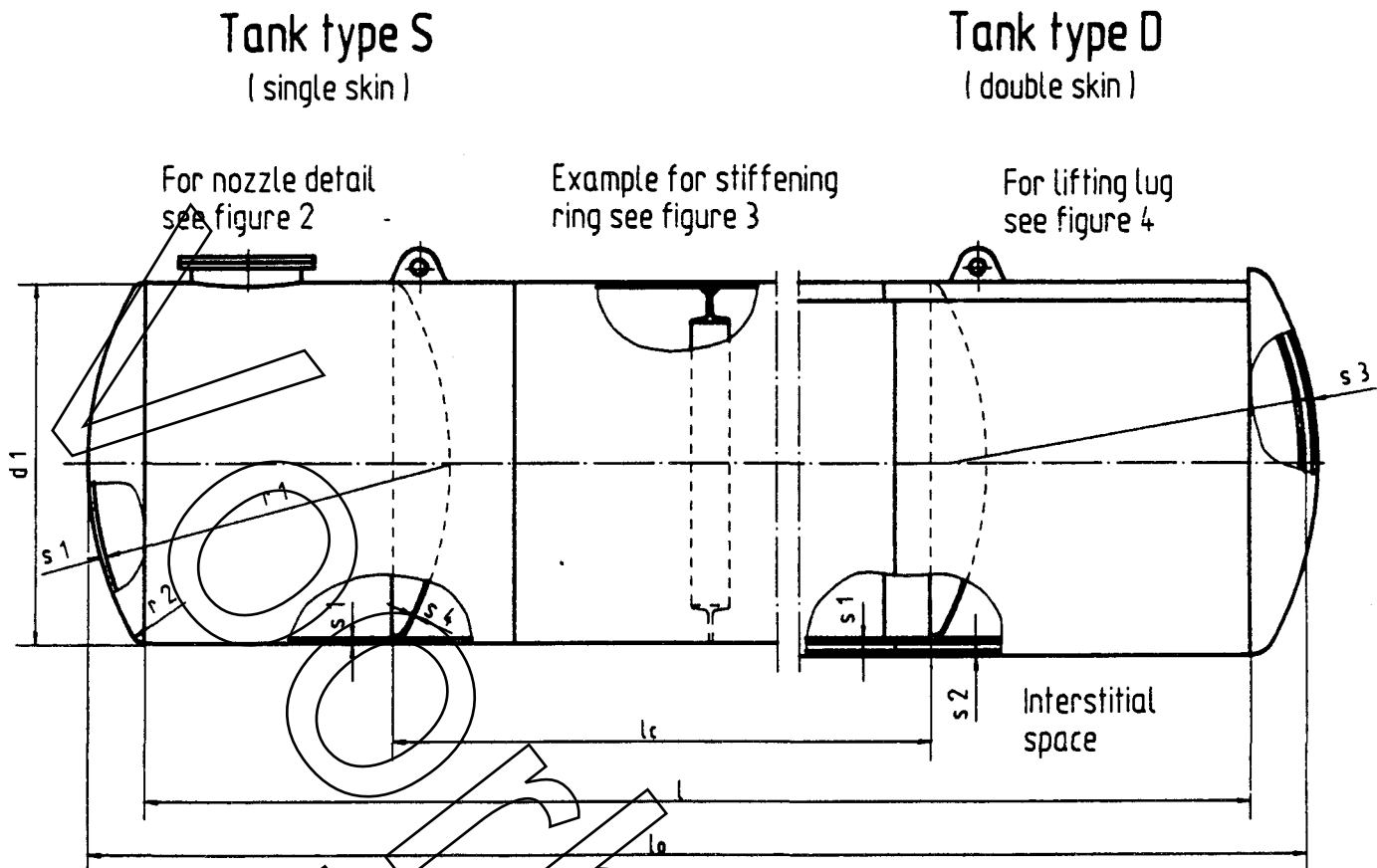


Figure 1: Example of tank symbols

4 Designation and purchaser's specification

Designation of a tank according to this standard with a nominal volume of 50 m³ and a nominal diameter $d_1 = 2500$ mm, tank class A and type D

Tank EN.../50/2500/A/D

In addition to the above details the purchaser shall also provide the following information:

- number of compartments and their volumes,
- material specification,
- external coating.

5 Materials

5.1 General

The manufacturer selects the material in accordance with the customer's instructions either on steel-material itself or by nomination of intended liquids to be stored in accordance with annex C.

5.2 Materials for shell, dished ends and manholes

Carbon steel according to EN 10025 or austenitic stainless steel according to prEN 10088-1 may be used if the mechanical properties are at least equal to those of S 235 JR (EN 10025). In addition to that P 235 GH and P 265 GH as described in EN 10028-2 may be used.

Guidelines on material specifications in relation to storage media are given in annex C.

5.3 Materials for tank fittings

Materials used for the fabrication of tank fittings if welded to the tank shall be compatible with the tank material.

5.4 Consumables

All welding rods/wires and other consumables shall be compatible with the basic material.

5.5 Material inspection documentation

Inspection of shell plates and dished ends shall be in accordance with the requirements of 2.2 of EN 10204:1991 for carbon steel tanks and the requirements of 3.1.B of EN 10204:1991 for stainless steel tanks.

6 Design

6.1 Forms of construction

Tanks shall be manufactured by using shell plates and dished ends. The external surfaces of completed tank shall be protected as specified under 7.5.

6.2 Single skin tanks

Single skin tanks shall form an impermeable containment; they constitute the inner tank of a double skin tank (see table 3).

6.3 Double skin tanks

For double skin tanks, a secondary skin is welded around the inner tank, which forms an impermeable self contained tank. The secondary skin shall cover at least 97 % of the nominal volume of the inner tank.

The interstitial space may be connected to a leak detection system in order to permanently monitor the integrity of the tank.

6.4 Dished ends

For dished ends the dimensions shall be as follows:

$$r_1 = d_1 \quad r_2 \geq d_1/30;$$

to separate compartments dished ends shall be used.

6.5 Compartments

The nominal wall thicknesses of dished ends separating the compartments (compartment dished ends) are given in table 3. For classes A and B a different form of dished ends separating the compartments is possible, where $r_1 = d_1$, but without knuckle radius r_2 and without straight flange.

A compartment dished end with a knuckle radius and a straight flange is equivalent to a reinforcement ring at the same position.

6.6 Dimensions

6.6.1 Material thickness

The nominal wall thickness of the inner tank shell, outer tank shell and dished ends shall be specified by the manufacturer in round millimetres, and shall be at least as given in table 3.

Table 3: Test pressure P_{t1} and P_{t2} , nominal wall thickness for inner and outer skin of tanks, dished ends and compartment dished ends

Tank classes	Class A		Class B		Class C	
Test pressure inner tank and compartment P_{t1} in bar	0,75		2		2	
Test pressure between skins P_{t2} in bar*	0,6		0,6		0,6	
Nominal diameter of the tank d_1 in mm	Nominal shell thickness in mm					
	s_1 inner skin	s_2 outer skin	s_1 inner skin	s_2 outer skin	s_1 inner skin	s_2 outer skin
800 – 1600	5	3	5	3	5	3
1601 – 2000	6	3	6	3	6	3
2001 – 2500	6	4	7	4	7	4
2501 – 3000	7	4	9	4	9	4
Nominal diameter of the tank d_1 in mm	Nominal wall thickness of dished ends in mm					
	s_1 inner skin	s_3 outer skin	s_1 inner skin	s_3 outer skin	s_1 inner skin	s_3 outer skin
800 – 1600	5	3	5	3	5	3
1601 – 2000	6	3	6	3	6	3
2001 – 2500	6	5	7	5	7	5
2501 – 3000	7	5	9	5	9	5
Nominal diameter of the tank d_1 in mm	Nominal wall thickness of compartment dished ends in mm					
	s_4		s_4		s_4	
800 – 1600	5		5		11	
1601 – 2000	6		6		14	
2001 – 2500	6		7		16	
2501 – 3000	7		9		19	
* P_{t2} shall not exceed 0,6 bar at the bottom of the double skin.						

6.6.2 Secondary skin

6.6.2.1 Diameter enclosure

The secondary skin shall enclose at least 300 degrees of the circumference of the tank, leaving not more than 60 degrees on the top uncovered.

In case where the manhole diameter exceeds $d_1/2$, the manhole shall be provided with a secondary skin.

6.6.2.2 Interstitial space

The interstitial space gap should be as small as practically possible.

6.7 Tolerances

6.7.1 The overall length of the inner tank

The tolerance on the overall length of the tank may be $\pm 1\%$ of the real length stated by the manufacturer.

6.7.2 Wall thickness

The minimum thicknesses of dished ends after forming and for shell plates shall be in accordance with table 4.

Table 4: Maximum reduction of nominal wall thickness

Nominal wall thickness mm		Maximum reduction of nominal wall thickness mm
> 3,00 ≤ 4,00	0,27	
> 4,00 ≤ 5,00	0,29	
> 5,00 ≤ 6,00	0,31	
> 6,00 ≤ 8,00	0,35	
> 8,00 ≤ 10,00	0,40	
> 10,00 ≤ 12,50	0,43	
> 12,50 ≤ 15,00	0,46	
> 15,00	0,50	

6.7.3 Circumference of dished ends

For the dished ends, the tolerances shall be $-0/+6$ mm for $d_1 \leq 2000$ mm, and $-0/+10$ mm for $d_1 > 2000$ mm based on the calculated circumference of d_1 .

6.8 Shell plate arrangement

Cross seams are not allowed. Longitudinal welds are not allowed in the bottom half of the tank.

6.9 Manholes and inspection covers

Unless otherwise specified by the purchaser, the tanks shall be equipped with one inspection cover. In cases where inspection covers are not allowed, the tanks shall have one manhole of at least $d_2 = 600$ mm. Single skin tanks shall always have a manhole.

The manufacturer shall decide whether manholes (inspection covers, nozzles) shall be of set-through or set-on-type. Nozzles and flanges shall either be welded inside and outside, or by full penetration.

For the dimensions of the manholes and its components see table 5.

Table 5: Dimensions of manhole components

Inside diameter d_2 mm	Plate thickness of manhole body s_5 mm	Diameter of cover d_3 mm	Pitch circle diameter k mm	Bolt hole diameter mm	Flange thickness and cover thickness s_5 mm		Bolts	
					Class B and C	Class A	Thread size	Number
600 ¹⁾	6	720	690	18	18	12	M 16	32
800	7	920	880		20	12		44
1000	7	1120	1080		20	--		48

¹⁾ If a manhole is required and no specification is given by the purchaser this diameter shall be used.

Instead of the manhole covers shown in the figure 2 and dimensioned in table 5, ribbed or embossed covers may be used in class A tanks with a plate thickness at least equal to the thickness of the inner tank s_1 . A ribbed or embossed cover shall withstand the test pressure P_{t1} .

Inspection covers are allowable only for tanks of class A with $d_1 \leq 1250$ mm and tanks of classes B and C with $d_1 \leq 1000$ mm. The diameter of the inspection cover d_2 shall not be larger than 300 mm and not smaller than 120 mm, and the thickness shall be equal to the minimum thickness of the inner tank.

For tanks of class C inside diameters of the manhole (d_2) exceeding 800 mm are not permitted.

6.10 Structural bolts

Structural bolts used shall be in accordance with EN 20898-1, with a property class being at least 4.6. The material chosen shall be compatible with the tank material.

6.11 Tank fittings, pipes and nozzles

All tank fittings, pipes and nozzles, should be situated on the manhole cover or in the single skin top of the tank. For tanks of class C only the set-through type shall be used. A penetration of the double skin is not allowed (exception: nozzles for leak detection system). Fittings and all other openings should have a minimum distance of 50 mm to welded seams.

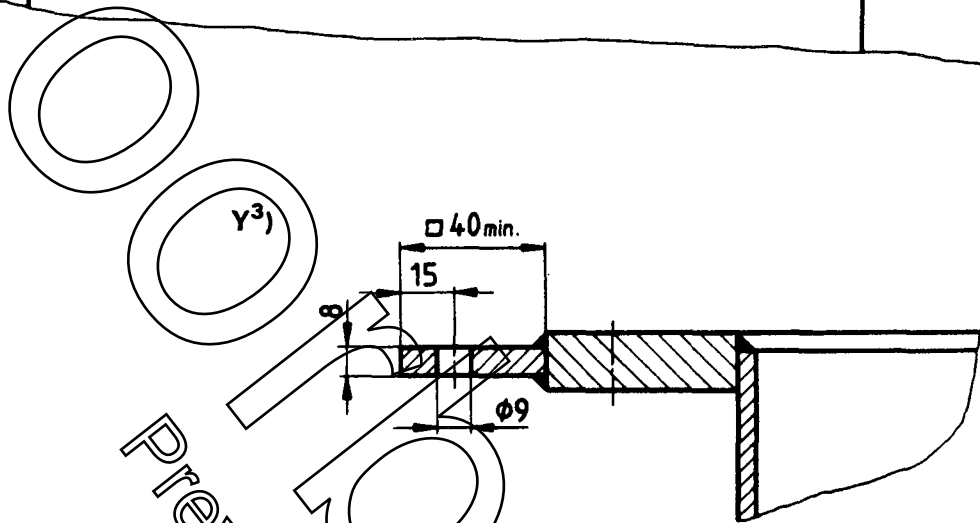
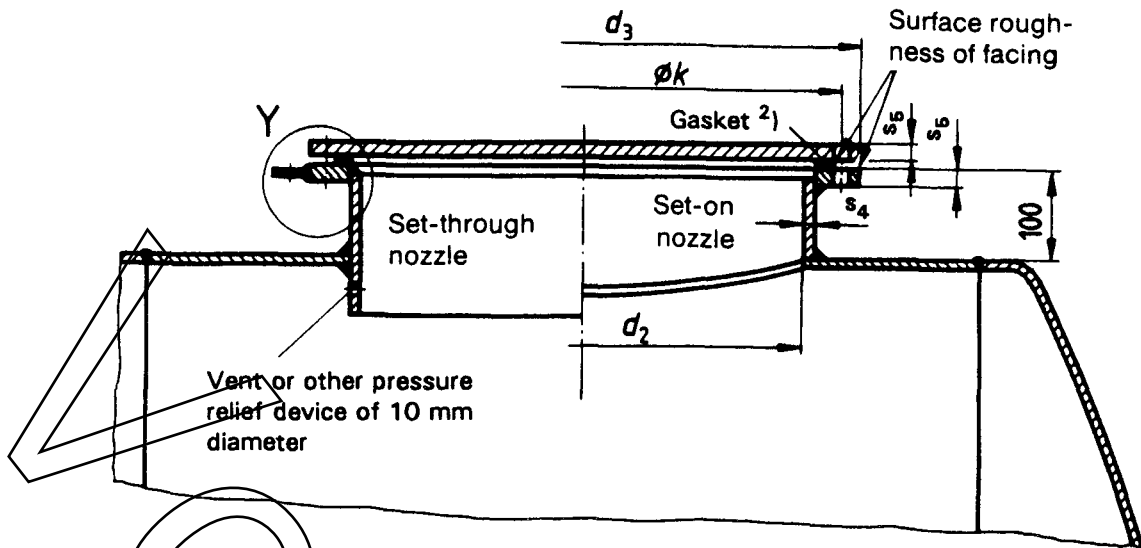


Figure 2 Examples for manhole and earthing connections

6.12 Stiffening rings

The following methods of construction may be used:



T 80 x 80 according to prEN 10055, or  100 x 30.

²⁾ Gaskets must be suitable for purpose.

³⁾ Connection for earthing and used for cathodic corrosion protection if required; for a set-through-nozzles a gap of approximately 3 cm² will be provided in the manhole neck at the highest practical point.

The number of stiffening rings depends on tan to tan length (l_c) of each compartment and shall be in accordance with table 6.

Table 6: Number of required stiffening rings in accordance with the length of each compartment

Length of the compartments in mm	Number of rings
$l_c \leq 7800$	--
$7800 < l_c \leq 11700$	1
$11700 < l_c \leq 15600$	2
$15600 < l_c$	3

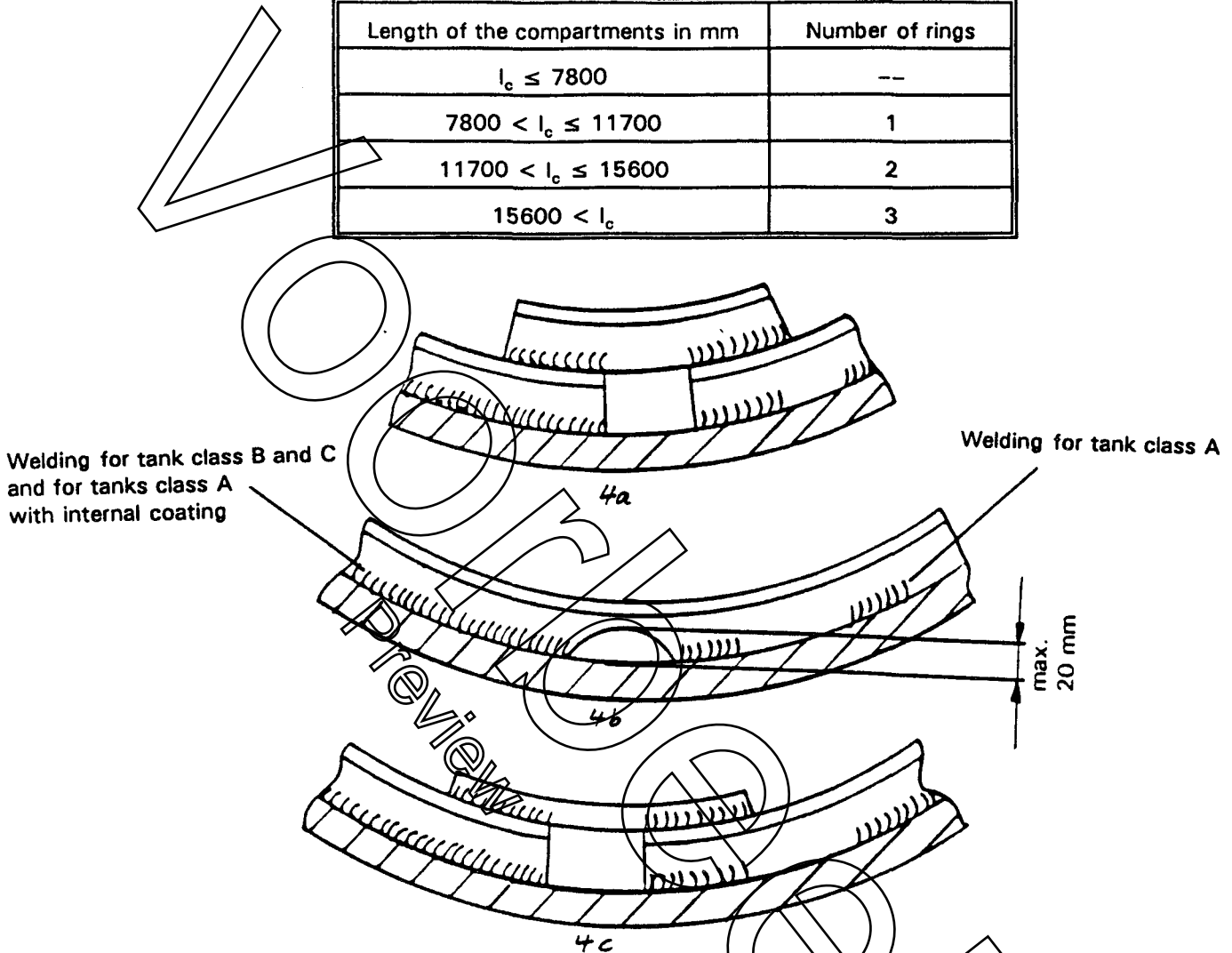


Figure 3: Examples for design details of stiffening rings

Apertures as shown in figure 3 should be located at the top and bottom of the stiffening rings to allow unobstructed flow of liquids, vapour or gases.

Where internal coating is asked for continuous welding should be used on stiffening rings.

Alternatively, instead of using stiffening rings, the wall thickness of inner tanks may be increased. In this case the wall thickness of the inner tank shall be the greater of the following:

- a) nominal wall thickness according to table 3

- b)
$$s_1 = \frac{0,4 l_c + 1,4 d_1}{1000}$$

6.13 Lifting lugs

Each tank shall be provided with lifting lugs. An example is given in figure 4. The number of lifting lugs shall be at least 1 for a tank up to 20 m³ and not less than 2 above 20 m³. When only one lifting lug is fitted, it shall be positioned to enable the tank to be lifted in horizontal position.

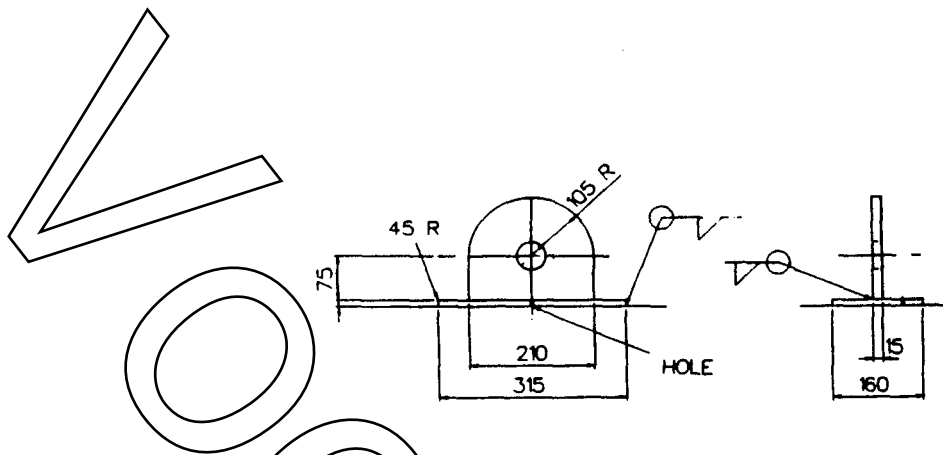


Figure 4: Example of lifting lug

Lifting lugs fully welded to the tanks shall be provided in sufficient size and quantity to enable the empty tank to be lifted.

The lifting lugs shall be provided with a hole of at least 60 mm.

In order to prevent deformation for maintaining integrity of the coating, a reinforcement plate shall be used or the lifting lug is to be made long enough.

7 Fabrication

7.1 Plate preparation

The plate edges shall be visually examined for laminations by the manufacturer. Where such faults are found the plate shall be deemed unsuitable for fabrication of the tank.

7.2 Shell plate forming

All plates shall be formed to the required curvature over the full width or length of the plate as might be applicable. The manufacturer shall ensure that there is continuity of curvature at the longitudinal butt welds.

7.3 Welding type

The forms of welds shall be in accordance with table 7.

7.4 Welding procedures, welders qualifications

Welding procedures shall be in accordance with EN 288-1 and welders qualifications shall be in accordance with EN 287-1.

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