



BSI Standards Publication

Workshop fabricated steel tanks

Part 1: Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and nonflammable water polluting liquids other than for heating and cooling of buildings

National foreword

This British Standard is the UK implementation of EN 12285-1:2018. Together with BS EN 12285-3:2019 it supersedes BS EN 12285-1:2003, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PVE/15, Storage Tanks for the Petroleum Industry.

A list of organizations represented on this committee can be obtained on request to its secretary.

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

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Date	Text affected
31 May 2019	Correction to supersession details in national foreword

English Version

**Workshop fabricated steel tanks - Part 1: Horizontal
cylindrical single skin and double skin tanks for the
underground storage of flammable and nonflammable
water polluting liquids other than for heating and cooling
of buildings**

Réservoirs en acier fabriqués en atelier - Partie 1 :
Réservoirs horizontaux cylindriques à simple ou
double paroi pour le stockage enterré de liquides
inflammables et non inflammables polluant l'eau en
dehors du chauffage et du refroidissement des
bâtiments

Werksgefertigte Tanks aus Stahl - Teil 1: Liegende,
zylindrische, ein- und doppelwandige Tanks zur
unterirdischen Lagerung von brennbaren und nicht
brennbaren wassergefährdenden Flüssigkeiten, die
nicht für das Heizen und Kühlen von Gebäuden
vorgesehen sind

This European Standard was approved by CEN on 15 February 2018.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 12285-1:2018) has been prepared by Technical Committee CEN/TC 265 “Metallic tanks for the storage of liquids”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2019, and conflicting national standards shall be withdrawn at the latest by April 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document, together with prEN 12285-3:2016, supersedes EN 12285-1:2003.

Compared to EN 12285-1:2003, this document has been revised as follows:

- exclusion of tanks covered by the Mandate M/131;
- old Clause 3, Terms and definitions has been combined with old Clause 4, Symbols and abbreviations;
- old Clause 5, Designation and purchaser's specification has been combined with new Clause 7, Classification and designation;
- old Clause 6, Materials, Clause 7, Design, Clause 8, Fabrication and Clause 10, Handling and installation have been replaced by new Clause 4, Product characteristics;
- old Clause 9, Testing has now become Clause 5, Testing, assessment and sampling methods;
- old Clause 11, Marking of the tank and manufacturer's statement has now been combined with new Clause 8, Marking, labelling and packaging.

The informative Annexes A and B give further guidance: A on transport, storage and installation procedures and B on the liquid-material combinations to be chosen. Annex C provides guidance on environmental aspects.

This European Standard *Workshop fabricated steel tanks* consists of 3 parts:

- *Part 1: Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and nonflammable water polluting liquids other than for heating and cooling of buildings;*
- *Part 2: Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids;*
- *Part 3: Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and nonflammable water polluting liquids for heating and cooling of buildings.*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document specifies the product characteristics and test methods for workshop fabricated cylindrical, horizontal steel tanks, single (type S) and double skin (type D) intended to be used for the underground storage of water polluting liquids (both flammable and non-flammable) and installed in industrial processes or in petrol stations at normal ambient temperature conditions ($-20\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$) within the following limits:

- from 800 mm up to 3 000 mm nominal diameter and;
- up to a maximum overall length of 6 times the nominal diameter;
- with an operating pressure (P_o) of maximum 50 kPa (0,5 bar(g)) and minimum – 5 kPa (–50 mbar(g)) and;
- for double skin tanks with a vacuum leak detection system where the kinematic viscosity does not exceed $5 \times 10^{-3} \text{ m}^2/\text{s}$.

Tanks designed to this standard allow for an earth cover of up to 1,5 m. If there are imposed traffic loads or a greater earth cover, calculation is expected to be carried out.

This document is not applicable to tanks used for storage and/or supply of fuel/gas for building heating/cooling systems, and of hot or cold water not intended for human consumption, nor to loads and special measures necessary in areas subject to risk of earthquakes.

Guidance on installation of tanks is presented in Annex A, which does not include special measures that might be necessary in areas subject to flooding.

This document is not applicable for the storage of liquids having dangerous goods classes listed in Table 1 because of the special dangers involved.

Table 1 — List of dangerous goods which are not covered by this standard

UN-classification	Type of dangerous goods
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, metal carbons, hydrofluoric acid, bromide liquids

NOTE 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 6.2).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

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

EN 10204:2004, *Metallic products - Types of inspection documents*

EN 13160-1, *Leak detection systems – Part 1: General Principles*

EN 13160-2, *Leak detection systems – Part 2: Requirements and test/assessment methods for pressure and vacuum systems*

EN 13160-3, *Leak detection systems – Part 3: Requirements and test/assessment methods for liquid systems for tanks*

EN 22768 (all parts), *General tolerances (ISO 2768 series)*

EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified property classes - Coarse thread and fine pitch thread (ISO 898-1)*

EN ISO 12944-7, *Paints and varnishes - Corrosion protection of steel structures by protective paint systems – Part 7: Execution and supervision of paint work (ISO 12944-7)*

EN ISO 13920, *Welding - General tolerances for welded constructions - Dimensions for lengths and angles - Shape and position (ISO 13920)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

tank

workshop fabricated cylindrical containment for the storage of liquids

Note 1 to entry: Tanks are made of steel plates, equipped with dished ends and consist of one or more compartments.

3.1.2

underground tank

tank which is totally or partially imbedded in the ground

3.1.3**compartment**

single fluid storage space within a tank

3.1.4**explosion pressure shockproof tank**

tank which is designed to withstand an internal explosion without leakage

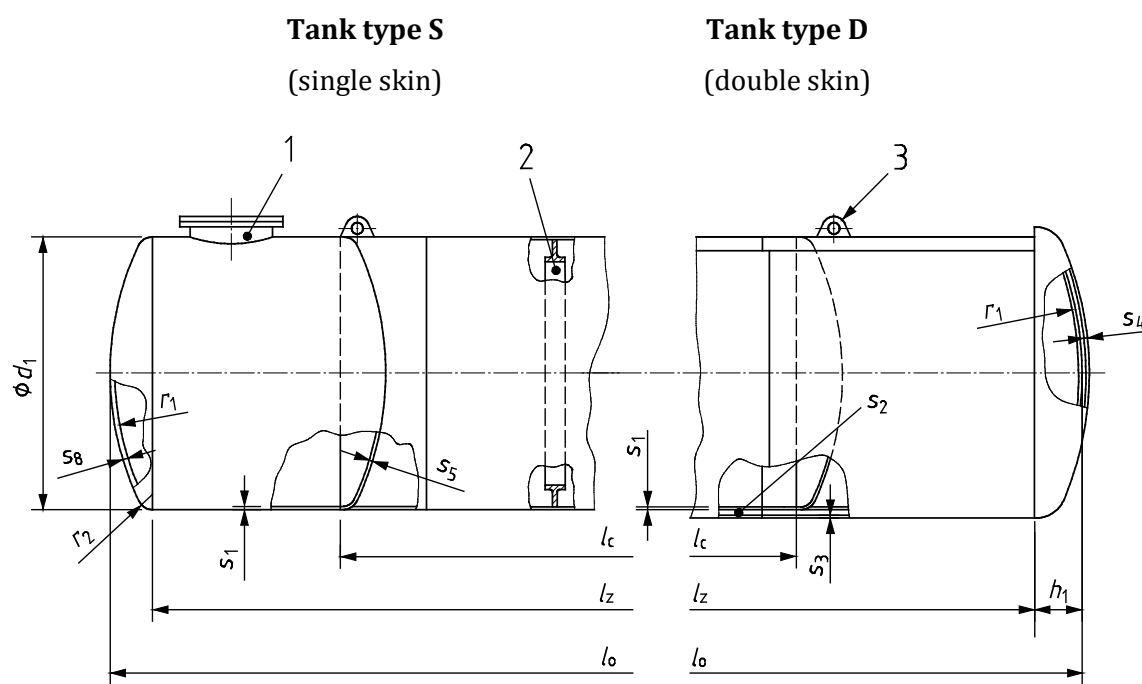
Note 1 to entry: Permanent deformations are permissible.

3.1.5**single skin tank**

impermeable containment consisting of a self contained/ self supported tank of single containment

Note 1 to entry: A single skin tank also constitutes the inner skin of a double skin tank.

Note 2 to entry: See Figure 1.

**Key**

- 1 for manway detail see Figure 3
- 2 for example for stiffening ring see Figure 4
- 3 lifting lug

Figure 1 — Example of tank symbols

3.1.6**double skin tank**

impermeable self contained tank with outer skin welded around the inner tank

Note 1 to entry: See Figure 1.

3.1.7

operating pressure

p_o

pressure bar(g) inside the tank above the liquid during operating conditions

3.1.8

prototype tank test pressure

p_{t1}

pressure bar(g) to which the tank or compartment is subjected for testing

3.1.9

prototype interstitial space test pressure

p_{t2}

pressure bar(g) to which the interstitial space between the skins is subjected for testing

Note 1 to entry: Only applicable for double skin tanks.

3.1.10

tank leak tightness test pressure

p_{t3}

pressure bar(g) to which the tank or compartment is subjected to leak testing

3.1.11

interstitial space leak tight test pressure

p_{t4}

pressure bar(g) to which the interstitial space is subjected to leak testing

3.1.12

nominal volume

storage capacity for which the tank is designed

3.1.13

actual volume

volume which is equal to or greater than the nominal volume

3.2 Symbols and abbreviations

For the purpose of this standard the following symbols apply.

Dimensions in millimetres

a	dimension for welding (See Figure 2)
d_1	external nominal diameter of the tank
d_2	internal diameter of the manway
d_3	diameter of the manway cover and corresponding flange
h_1	length of the straight flange of the dished end
K_p	pitch circle diameter of manway bolts
l_c	length of the compartment of a tank without dished ends

NOTE 1 For a single compartment tank $L_c = L_z$

l_o	overall length of the tank
l_z	length of the tank without dished ends
NOTE 2	For a single compartment tank $L_c = L_z$
p_t	test pressure
p_{t1}	test pressure for prototype test of tank
p_{t2}	test pressure of prototype test of interstitial space
p_{t3}	test pressure of leak tightness test of tank
p_{t4}	test pressure of leak tightness test of interstitial space
r_1	crown radius of dished ends
r_2	knuckle radius of dished ends
s_1	nominal thickness of shell (single walled tank) and inner shell (double walled tank)
s_2	interstitial space
s_3	nominal thickness of outer shell
s_4	nominal thickness of outer dished ends
s_5	nominal thickness of compartment dished ends
s_6	nominal thickness of manway flange and cover
s_7	plate thickness of manway body
s_8	nominal thickness of inner dished ends
γ	incline angle for T-joint welding

4 Product characteristics

4.1 General

The tank material shall be suitable for long term contact with the stored media. Guidelines on material specifications in relation to stored media are provided in Annex B.

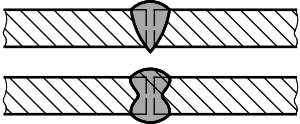
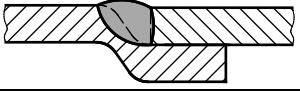
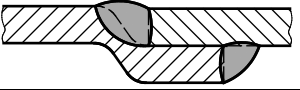
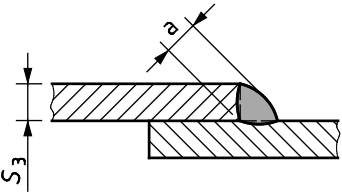
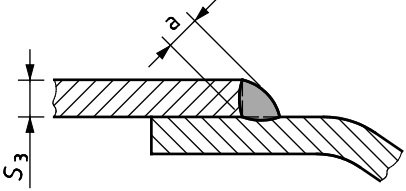
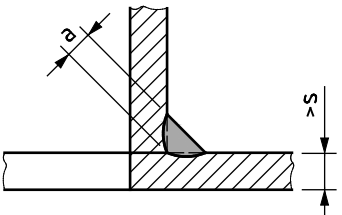
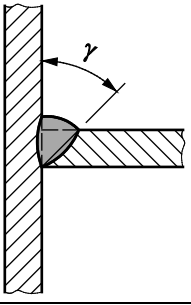
The safe working capacity of the tank should usually not exceed 97 % of the nominal volume at normal operating temperatures.

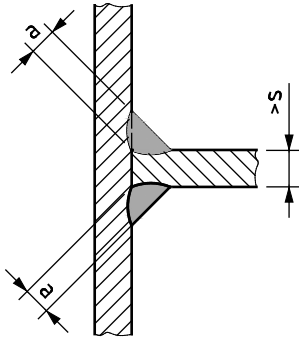
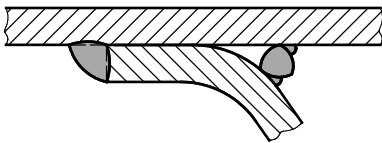
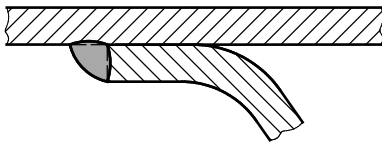
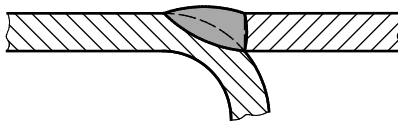
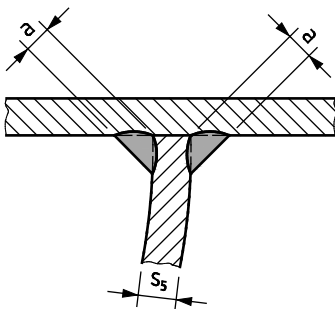
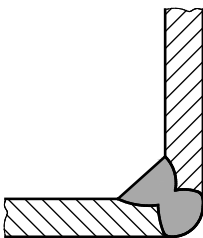
4.2 Welding

4.2.1 Types of joints

The welding related to the different types of joints is given in Table 2. The types of welded joints shall be in accordance with Table 2.

Table 2 — Types of welded joints

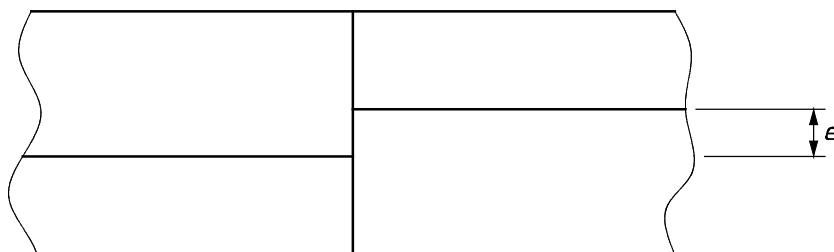
Number	Types of joints	Applicable welding class of tanks and liquid (liquid touched wall)
1	Square butt joint 	Plate misalignment shall not exceed $0,3 s_1$ respectively $0,3 s_3$ or 2 mm For all classes
2a	Joggled butt joint 	For class A and hydrocarbon liquids For double and single skin tanks Not permissible with inner coating
2b	Joggled butt joint 	For class A, B and C
3a	Overlap joint 	For class A, B and C For outer skin $a = 0,7 s_3$
3b	Overlap joint 	For class A, B and C For outer skin on outer dished end $a = 0,7 s_3$
4	Fillet weld in T-joint 	For class A, B and C For nozzles in the outer skin $a = 0,7 s_{min}$ s_{min} : thickness of the thinner plate
5	Fillet weld (full penetration) in T-joint 	For class A, B and C For manways, nozzles and inspection covers $\gamma = 45^\circ$

6	Double fillet weld in T-joint 	For class A, B and C For manways, nozzles and stiffening rings $a = 0,7 s_{\min}$ $s_{\min}$ = thickness of the thinner plate
7a	Fillet weld in overlap joint 	For class A, B and C For compartment dished ends with knuckle radius
7b	Fillet weld in overlap joint 	For class A, B and C For compartment dished ends with knuckle radius Not permissible with inner coating
8	Butt joint 	For class A and B For compartment dished ends with knuckle radius Not permissible with inner coating
9	Double fillet weld in T-joint 	For class A and B For compartment dished ends without knuckle radius $a = 0,7 s_5$
10	Corner and fillet weld 	For class A and B For set-on manways and nozzles

4.2.2 Shell plate arrangement

Cross seams shall not be used. Longitudinal welds shall not be used in the bottom half of the tank.

Shell plate joints shall be offset, having a minimum distance e of five times the wall thickness but not less than 25 mm as shown in Figure 2.



Key

e minimum distance

Figure 2 — Shell-plate arrangement for inner and outer skin

4.2.3 Consumables

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

4.2.4 Interstitial space

The interstitial space gap should be as small as practically possible but suitable for the leak detection system to function.

There shall be at least two sockets for the leak detection system and these shall be located at the highest practical point of the cylindrical part of the interstitial space.

The interstitial space shall be connected to a leak detection system in order to monitor the integrity of the tank permanently; the leak detection systems shall fulfil the requirements of EN 13160-1, and EN 13160-2 or EN 13160-3.

4.3 Load bearing capacity

When tested in accordance with 5.2, the maximum out of roundness of the completed tank after manufacture shall not exceed 1,5 % of the diameter.

The tolerance on the overall length of the tank shall be ± 1 % of the real length stated by the manufacturer.

4.4 Additional requirements

4.4.1 Manways and inspection covers

With the exception of cases where inspection covers are not allowed, the tanks shall be equipped with at least one inspection cover per compartment. In cases where inspection covers are not allowed, the tanks shall have one manway of at least $d_2 = 600$ mm. No part of a compartment shall be more than 10 m from a manway. Single skin tanks shall always have a manway.

Manways, inspection covers, nozzles and/or flanges shall be of set-through or set-on-type and flanges shall be welded in accordance with Table 2.

For the dimensions of the manways and their components see Table 3.

Gaskets shall be provided and shall be suitable for their purpose.

Table 3 — Dimensions of manway components

Inside diameter	Plate thickness of manway body	Diameter of manway cover and corresponding flange	Pitch circle diameter	Bolt hole diameter	Flange thickness and cover thickness		Bolts		
d_2 mm	s_7 mm	d_3 mm	K_p mm	mm	s_6 mm	Class A	Class B and C	Thread size	Number
600 ^a	6	720	680	18	12	16	M16		32
800	7	920	880		12	20			44
1000 ^b	7	1 120	1 080		—	20			48
^a If a manway is required and no specification is given by the purchaser this diameter shall be used.									
^b For tanks of class C inside diameters of the manway (d_2) exceeding 800 mm is not permitted.									

Instead of the manway covers shown in the Figure 3 and dimensioned in Table 3, pressed parts of manways (covers and/or nozzles) 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 pressed manway cover shall withstand the test pressure p_{t1} .

The gasket shall be in one piece.

For inspection covers 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 shall not be larger than 300 mm and not smaller than 120 mm, and the thickness of the inspection cover shall be equal to the minimum thickness of the inner tank.

4.4.2 Structural bolts

Structural bolts used shall be in accordance with EN ISO 898-1, with a property class being at least 6.8.

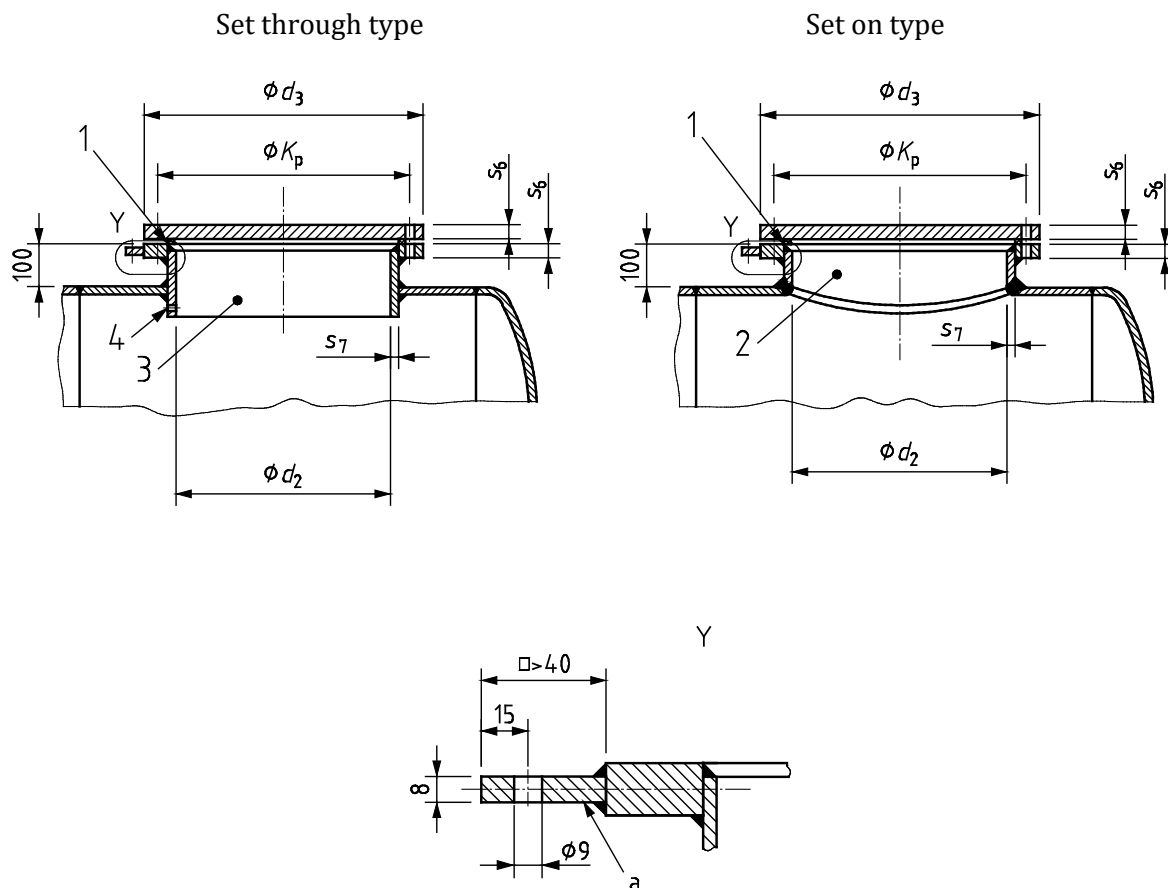
4.4.3 Tank fittings, pipes and nozzles

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

All tank fittings, pipes and nozzles, shall be situated on the manway cover or above the maximum fill level of 97 % of the tank capacity, (that is, the safe working volume).

For tanks of class C only the set-through manways shall be used. For set-through manways a vent of a minimum of 10 mm diameter or equivalent opening shall be provided in the manway at the highest practical point in accordance with Figure 3, item 4.

With the exception of nozzles for leak detection systems, there shall be no penetration of the outer skin. Fittings and all other openings shall have a minimum distance of 50 mm to welded seams.

**Key**

- 1 Gasket
- 2 Set-on nozzle
- 3 Set-through nozzle
- 4 Vent or pressure relief device
- a Connection for earthing and use for cathodic corrosion protection if required

Figure 3 — Examples for manways**4.4.4 Lifting lugs**

Each tank shall be provided with lifting lugs. The number of lifting lugs shall be at least 1 for a tank up to 20 m³ nominal volume and not less than 2 above 20 m³. The lug(s) shall be positioned to enable the tank to be lifted in a horizontal position.

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

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

The lugs shall be fabricated and located to prevent a deformation of the tank that could damage the coating during the lifting.

4.5 Mechanical resistance and stability

4.5.1 Materials for shell, dished ends and manways

The mechanical properties of the steel grade used shall be at least those of S 235 JR according to EN 10025-2:2004, Table 7.

Material inspection documentation of shell plates and dished ends shall be as follows:

- for carbon steel in accordance with EN 10025-2, the inspection documents shall be in accordance with EN 10204:2004, 2.2;
- for all other steel qualities in accordance with EN 10204:2004, 3.1.

4.5.2 Wall thickness

4.5.2.1 Nominal wall thicknesses

The nominal wall thickness of the inner tank shell, outer tank shell and dished ends expressed in millimetres shall be at least as given in Table 4.

The tolerances shall be as given in the EN 22768 series and EN ISO 13920.

Table 4 — Wall thickness of inner tank shell, outer tank shell and dished ends

Dimensions in millimetres

Tank classes	Class A		Class B		Class C	
Nominal diameter of the inner tank	Nominal shell thickness					
d_1	s_1	s_3	s_1	s_3	s_1	s_3
	inner skin	outer skin	inner skin	outer skin	inner skin	outer skin
800 up to 1 600	5	3	5	3	5	3
1 601 up to 2 000	6	3	6	3	6	3
2 001 up to 2 500	6	4	7	4	7	4
2 501 up to 3 000	7	4	9	4	9	4
Nominal diameter of the tank	Nominal wall thickness of dished ends					
d_1	s_8	s_4	s_8	s_4	s_8	s_4
	inner skin	outer skin	inner skin	outer skin	inner skin	outer skin
800 up to 1 600	5	3	5	3	5	3
1 601 up to 2 000	6	3	6	3	6	3
2 001 up to 2 500	6	5	7	5	7	5
2 501 up to 3 000	7	5	9	5	9	5
Nominal diameter of the tank	Nominal wall thickness of compartment dished ends					
d_1	s_5		s_5		s_5	
800 up to 1 600	5		5		10	
1 601 up to 2 000	6		6		14	
2 001 up to 2 500	6		7		16	
2 501 up to 3 000	7		9		18	

4.5.2.2 Dished ends

The following dimensions shall apply:

$$r_1 \leq d_1 \quad (1)$$

$$r_2 \geq d_1 / 30 \quad (2)$$

The minimum wall thicknesses of dished ends after forming shall be at least 92 % of the nominal wall thickness according to Table 4.

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 .

4.5.3 Stiffening resistance

The stiffening resistance is only applicable for tank compartments of lengths (l_c or l_z) above 7 800 mm. Where internal coating is asked for, continuous welding shall be used on stiffening rings.

Stiffening rings shall not be located within 50 mm of a plate joint.

The backing ring shall be welded on a compartment head.

Where the stiffening resistance is ensured by the use of stiffening rings, the number of rings shall conform to Table 5 and be equally spaced.

Table 5 — Number of stiffening rings related to length of compartment (l_c)

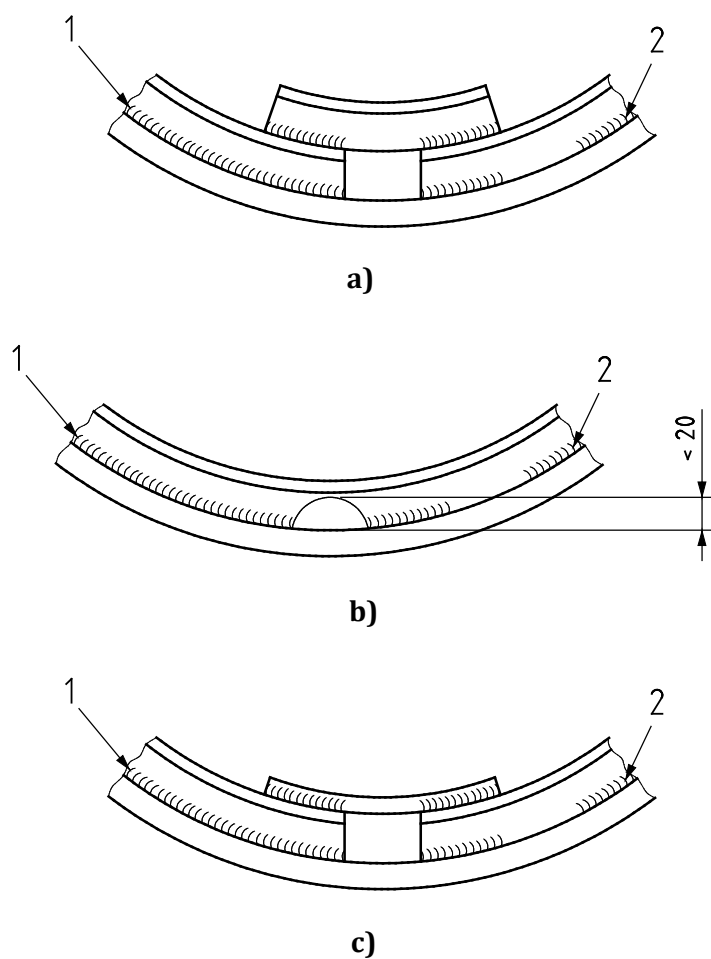
l_c in mm	Number of stiffening rings
$7\,800 < l_c \leq 11\,700$	1
$11\,700 < l_c \leq 15\,600$	2
$15\,600 < l_c$	3

Openings as shown in Figure 4 should be located at the top and bottom of the stiffening rings to allow unobstructed flow of liquids, vapour or gases.

For class A tanks, each stiffening ring may be intermittently welded from both sides of the stiffening rings around the complete circumference with 150 mm welded and then 150 mm not welded.

Alternatively stiffness resistance can be ensured, by increasing the nominal thickness of the inner shell only s_1 in Table 4 using the following calculation method:

$$s_1 = \frac{0,4 l_c + 1,4 d_1}{1\,000} \text{ (rounded up to full mm)} \quad (3)$$



Key

- 1 welding for tank class B and C and for tank class A
- 2 alternatively welding for tank class A; only applicable without internal coating

Figure 4 — Examples of design details of stiffening rings

4.5.4 Design of Stiffening Rings

Where used stiffening rings should be designed to provide a minimum Second Moment of Area (I_x) of $8 \times 10^5 \text{ mm}^4$.

Examples of typical designs are shown in Figure 5.

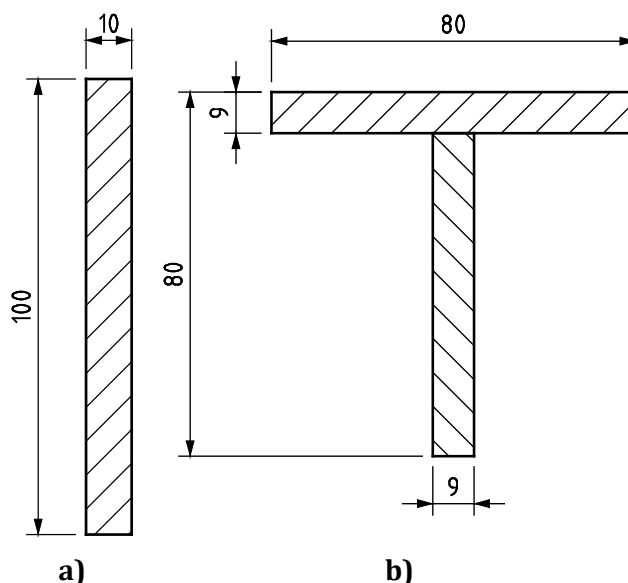


Figure 5 — Examples of typical designs of stiffening rings

4.6 Internal pressure

Resistance to internal pressure shall be ensured by the minimum wall thickness in Table 4.

When tested in accordance with 5.3 and Table 7, there shall be no leakage from

- single skin tanks;
- inner tanks of double skin tanks;
- compartments of double skin tanks;
- the interstitial space.

4.7 Tightness (gas and liquid)

When tested in accordance with 5.4 no leakage shall be detected.

4.8 Release of dangerous substances

National regulations on dangerous substances can require verification and declaration on release and sometimes content when construction products covered by this standard are placed on those markets. In the absence of European harmonized test methods verification and declaration on release/content should be done taking into account national provisions in place of use.

4.9 Durability

An external protective coating, including surface preparation (when recommended by the coating manufacturer), provides added corrosion resistance for the tank. The total minimum thickness of each external protective coating shall be in accordance with Table 6.

Table 6 — Minimum thickness

Coating material		Min. thickness mm
Bitumen	with fabric reinforcement	3
	without reinforcement	5
Epoxy		0,7
Glassfibre (GRP)		2
Polyurethane		0,8
PVC		1,25

Tanks may be coated internally but due consideration should be given to type of welds (4.2.1) and construction, for example stiffening rings (4.5.3).

4.10 Crushing resistance

The resistance to crushing shall exceed the weight of the earth cover of up to 1,5 m depth. The maximum overall length of the tank shall not exceed 6 times the nominal diameter.

5 Testing and sampling methods

5.1 Mechanical resistance and stability

5.1.1 Materials for shell, dished ends and manways

Check that the steel plates used conform to the European Standards given in 4.5.1.

5.1.2 Wall thickness

The manufacturer should measure samples of the steel plates to ensure that they conform to the specified thickness according to Table 3 and Table 4, or 4.5.3 using a calibrated device with a sensitivity of at least 0,1 mm.

5.1.3 Welding

Visually inspect the tank and record the results to verify that the welds conform to Table 2 and that all internal tank shell welding is continuous.

5.1.4 Stiffening resistance

Measure the length of the tank (l_c) and record the results to verify that the appropriate number of stiffening rings are fitted in accordance with 4.5.3. If the stiffening rings are replaced by an increase in the thickness of the shell plate s_1 measure samples of the steel plates to ensure that they conform to the equation in 4.5.3.

5.2 Load-bearing capacity

The load bearing capacity is dependent on the roundness of the tank.

The measurement of the height and width shall be taken at the end of the manufacturing process inside each compartment of the tank in the middle of its cylinder. The greater of the two shall not exceed the smaller by more than 1,5 %.

5.3 Tightness test (gas or liquid)

Single skin and inner tanks/compartments of double skin tanks and the interstitial space shall be tested in accordance with Table 7. No leakage shall be observed during the testing, or permanent deformation afterwards.

Table 7 — Test pressure p_t

Pressure in kPa (bar(g)) ¹				
Test	Test medium	Tank class		
		A	B	C
Type test of tank, p_{t1}	liquid	110 (1,1)	140 (1,4)	1 000 (10)
Type test of interstitial space, p_{t2}	air or liquid	60 (0,6)	60 (0,6)	60 (0,6)
Leak tightness test of tank, p_{t3}	air	30 (0,3)	30 (0,3)	--
	liquid	75 (0,75)	140 (1,4)	200 (2,0)
Leak tightness test of interstitial space, p_{t4}	air	30 (0,3)	30 (0,3)	30 (0,3)
	liquid	60 (0,6)	60 (0,6)	60 (0,6)

5.4 Crushing resistance

Check that the wall thicknesses are in accordance with Table 4, and stiffening rings, if needed in accordance with Table 5 and 4.5.3 in order to conform to the requirements of 4.10.

5.5 Testing of additional requirements

5.5.1 Manways and inspection covers

Visually inspect to confirm that the tank conforms to the requirements of 4.4.1.

5.5.2 Structural bolts

Visually inspect to confirm that the tank conforms to the requirements of 4.4.2.

5.5.3 Tank fittings, pipes and nozzles

Visually inspect to confirm that the fittings, pipes and nozzles conforms to the requirements of 4.4.3.

5.5.4 Lifting lugs

Visually inspect to confirm that the tank conforms to the requirements of 4.4.4.

¹ 1 bar = 0,1 MPa.

5.6 Durability

Before leaving the workshop the external coating of each tank shall be submitted to a high voltage Holiday test (porosity test) in order to prove its integrity in accordance with EN ISO 12944-7. The test voltage is given in Table 8. After testing and repair if necessary, no detection of porosity shall occur.

Table 8 — External coating minimum thickness and test voltage

Coating material		Min. thickness mm	External surface coating tested to the following test voltage V
Bitumen	with fabric reinforcement	3	14 000
	without reinforcement	5	20 000
Epoxy		0,7	6 000
Glass fibre (GRP)		2	15 000
Polyurethane		0,8	6 000
PVC		1,25	10 000

6 Classification

6.1 Tank type

Two tank types are distinguished:

- Type S: Single skin;
- Type D: Double skin.

6.2 Tank classes

The tank classes are defined in Table 9.

Table 9 — 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, and explosion pressure shockproof under atmospheric conditions (see also 3.1.4)

6.3 Designation and purchaser's specification

Example for designation: A tank according to this standard with a nominal volume of 50 m³ and a nominal diameter $d_1 = 2\,500$ mm, tank class B and type D is designated as follows:

Tank EN 12285-1/50/2500/B/D

In addition to the above details the manufacturer shall obtain from the purchaser the following requirements:

- a) number and order of compartments and their volumes;
- b) material specification or liquid to be stored;
- c) type of external coating;
- d) type of internal coating, if applicable;
- e) position of manways.

7 Marking and labelling

7.1 Marking of the tank

Each tank shall be marked using a durable label which shall be corrosion resistant and resistant to the stored product.

The label shall be fixed to the tank on or close to the manway of the tank.

The label shall contain the following information as a minimum:

- name and address of manufacturer;
- year of manufacture;
- serial number of tank;
- designation in accordance with 6.3;
- type of coatings;
- mass of empty tank;
- type of leak detection liquid (when supplied).

In addition each compartment shall be provided with a label indicating the nominal volume in m³ of that compartment.

7.2 Documentation

A document containing at least the information included in 7.1 shall be provided by the manufacturer.

Guidelines for transport, storage and installation are given in Annex A.

8 Environmental aspects

Guidelines on environmental aspects are given in Annex C.

Annex A (informative)

Transport, storage and installation procedure

A.1 Transport

The tank should be placed on the vehicle in such a way to ensure that the surface coating of the tank is not damaged.

The tanks should be carefully fixed on the vehicle to prevent movement while being transported, using webbing or other fixing methods, which will not damage the tank coating.

The tank should be controlled while suspended by the use of guide ropes when placing the tank in position. Where two lifting lugs are used the lifting angle between the guide ropes should not exceed 120°.

A.2 Storage

When stored on site before installation the tanks should be placed on a level surface, free from protrusions, and on a suitable base to protect the coating (for example, sand, foam, etc.). The position should be chosen to avoid accidental damage from site traffic and the tanks should be restrained from rolling.

A.3 Installation procedure

A.3.1 Planning

Prior to commencement of the installation the site conditions should be determined and recorded, the type of ground will determine the need and type of ground support. Overhead cables and underground service should be plotted.

The installation should be set out, taking care not to undermine any existing structures or damage underground services.

Owing to possible damage during transport, storage and handling, it is essential that the test in 5.6 and Table 8 is repeated on the site by the installer immediately before lowering the tank into the pit.

A.3.2 Ground works

Proper care should be taken to ensure that the excavation does not collapse, the use of sheet piling or other proved methods should be adopted.

De-watering facilities should be provided in cases of high water table.

Owing to possible damage during transport, storage and handling, it is essential that the coating of each tank should be subject to a high voltage test in accordance with Table 8. Where coating is damaged it should be repaired and retested.

The tank should be securely fixed in the installation using a suitable method to prevent any movement of the tank (e.g. anchored to a concrete base).

The tank should be installed on a levelled base.

The methods used to secure the tank in the excavation should not damage the coating of the tank.

A.3.3 Backfill materials

A.3.3.1 General

The backfill used should be non-cohesive granular material which will surround the tank to give adequate support and restrain.

The choice of backfill used can depend upon the native soils and their compatibility with the coating of the tank. For possible combinations see Table A.1.

All backfill material should be washed, graded and free flowing, free from ice, clay, organic materials and free of heavy objects. The minimum bulk density should be 1 500 kg/m³.

Table A.1 — Recommended backfill according to coating used

BACKFILL COATING	Sand	Gravel	Stone crushings
Bitumen	✓✓	×	×
Epoxy	✓✓	✓	×
Glassfibre	✓✓	✓	✓
Polyurethane	✓✓	✓	✓
PVC	✓✓	✓	✓
✓✓ Recommended ✓ Possible × Not recommended (but may be possible according to coating producers' instructions)			

A.3.3.2 Sand

Sand should be well graded and shall have less than 8 % passing a 75 µm screen with the largest particle size less than 3 mm.

A.3.3.3 Gravel

The backfill material should not have more than 3 % passing a 2,4 mm screen. The material shall be well-rounded pea gravel with a mix of particle size not less than 3 mm and not more than 20 mm.

A.3.3.4 Stone crushings

Stone crushings with angular particle size of not less than 3 mm, not more than 16 mm, not more than 3 % should pass a 2,4 mm screen.

A.3.3.5 Concrete

Concrete should not be used.

A.3.4 Installing backfill

Sufficient backfill should be placed on the excavation base before the tank is lowered in the excavation.

Backfill should be carefully placed around the installation.

The installer should compact the backfill to ensure the backfill reaches all parts of the excavation, taking all necessary precautions to avoid deformation of the tank. Sufficient backfill should be placed above the top of the tank.

A.3.5 Access chamber

An access chamber being liquid tight and capable of preventing any spilt liquid being stored from entering the environment should be fitted to the tank.

The access chamber should be designed in such a way to prevent loads from the traffic area above being transmitted to the tank.

Annex B

(informative)

Evaluation of liquid-material-combinations for storage tanks according to this standard

B.1 General

This Annex provides evaluations of chemical loads resulting from liquids stored in tanks as described in this standard, considering specific materials used and specific working conditions.

Owing to the number of possible liquid-material-combinations, the list cannot be final and complete and should always be open for new liquids and new materials to be added.

This annex applies to above- and underground tanks. It should be considered, as far as this standard is concerned, that the groups C and F relate to underground tanks.

B.2 Criteria for evaluation

B.2.1 Conditions for resistance

B.2.1.1 Design for tanks

The tank should be manufactured in accordance with the standard.

The materials defined by EN 10025-2, EN 10028-7 and EN 10088-2, -3, -4, -5 may be used. In addition to that P235GH and P265GH of EN 10028-2 may also be used.

The positive-liquid list provides information about the use of the relevant liquid when storing in tanks whose liquid-touched wall consists of the materials listed in Table B.1:

Table B.1 — Tank materials

Steel specification	Material Code	Standard
S235JR	1.0038	EN 10025-2
S235J2 +N	1.0117+N	EN 10025-2
S275J2 +N	1.0145 +N	EN 10025-2
P235GH	1.0345	EN 10028-2
P265GH	1.0425	EN 10028-2
P295GH	1.0481	EN 10028-2
X2CrNi 1911	1.4306	EN 10028-7
X6CrNiTi 1810	1.4541	EN 10088-2, -3, -4, -5
X6CrNiMoTi 17 122	1.4571	EN 10028-7
X4CrNiMo 17 121	1.4401	EN 10088-2, -3, -4, -5
X2CrNiMo 17 122	1.4404	EN 10028-7
X2CrNiMo 18 143	1.4435	EN 10088-2, -3, -4, -5
X2CrNiMoN 17135	1.4539	EN 10028-7
		EN 10088-2, -3, -4, -5
		EN 10028-7
		EN 10088-2, -3, -4, -5
		EN 10028-7
		EN 10088-2, -3, -4, -5
		EN 10028-7
		EN 10088-2, -3, -4, -5

The austenitic CrNi steel grade 1.4301 can only be used as tank material for storage tanks filled with certain special liquids with shorter storage times. The reason is that this steel grade is sensitive to intergranular corrosion, especially in the area of welding seams. It is necessary to decide in each individual case if this steel grade is suitable as tank material for the storage of certain liquids. Therefore, the steel grade 1.4301 has its own column in the positive-liquid-list.

B.2.1.2 Purity of liquids

The evaluations of resistance of materials are valid for tradable and technically pure liquids only. The evaluations are not valid for waste or mixtures containing an undefined number and concentration of liquid-additions or impurities.

B.2.1.3 Gaskets

It is essential that the dimensional stability and the resistance of the gasket materials to the liquids are guaranteed.

B.2.1.4 Conditions

The safe working of a tank during its lifetime needs to consider the suitability of the liquid-material combination. Therefore, conditions in B.2.2 to B.4.2.3 are defined. The conditions belonging to a material-

liquid combination are specified in Table B.2. The liquid-material combination is suitable when the conditions are fulfilled.

B.2.2 Criteria for the suitability evaluation of liquid-material-combinations

B.2.2.1 Liquid-material-combinations are considered as suitable when the decrease of the wall thickness caused by corrosion (area-corrosion) does not exceed 0,1 mm per year and local corrosion in form of pitting and stress corrosion cracking is not expected.

B.2.2.2 Liquid-material-combinations are not considered as suitable when one of the listed points is given:

- the decrease of the wall thickness by area-corrosion exceeds 0,1 mm per year,
- liquids will cause stress corrosion at the working temperature,
- other local corrosions, e.g. pitting corrosion, shall be expected under the given conditions,
- the liquid can react with the tank wall in a dangerous way (e.g. catalytic decomposition of the liquid).

B.3 Evaluation of liquids not mentioned in the positive-liquid-list

The storage of liquids, which are not mentioned in the positive-liquid-list, may also be approved if the qualification of the liquid-material-combination according to B.2.2.1, B.2.2.2 and B.4.2 is demonstrated by using the form shown in Appendix 1, laboratory tests or relevant literature.

If required by national regulation, the references by laboratory tests or relevant literature should be confirmed according to the national rules.

NOTE Information usually is sent to the national competent authority.

B.4 Use of the positive-liquid-list

B.4.1 Classification of the tanks according to their working conditions

B.4.1.1 Pressureless tanks

Group A: Pressureless tank without specific precautions against heating up.

Group B: Pressureless tank with a temperature under working conditions measured directly at the tank wall not exceeding 40 °C (e.g. aboveground tank standing in a room or tank with specific precaution against heating up). Maintaining a light coloured coating is considered as suitable precaution against radiated heat.

Group C: Pressureless tank with a temperature under working conditions measured directly at the tank wall not exceeding 30 °C (e.g. underground tank, 0,8 m earth-covered, or tank with an equivalent isolation).

B.4.1.2 Tanks with internal working pressure (less than 50 kPa (0,5 bar))

Group D: Tank with internal working pressure without any precaution against radiated heat.

Group E: Tank with internal working pressure with a temperature under working conditions measured directly at the tank wall not exceeding 40 °C (e.g. aboveground tank standing in a room or tank with specific precaution against heating up). Maintaining a light coloured coating is considered a suitable precaution against radiated heat.

Group F: Tank with internal working pressure with a temperature under working conditions measured directly at the tank wall not exceeding 30 °C (e.g. underground tank, 0,8 m earth-covered, or tank with an equivalent isolation).

B.4.2 Conditions for the use of the liquids

B.4.2.1 Conditions related to liquids

A: Anhydrous

A1: Water content ≤ 10 %

A6: Water content $< 0,1$ %

A7: Water content $< 0,2$ %

B: Free of bromides and chlorides

B1: The hydrocarbon-mixture shall consist only of components which are aliphatically and alicyclic saturated hydrocarbons, monoolefins and aromatic hydrocarbons.

B2: Only bromide-free and chloride-free alcohols with no further functional groups in the molecule (only OH groups in the hydrocarbon basic structure)

C: Free of acids (pH value 6,5 to 8,5)

C1: Free of sulfuric acid

C2: Alkaline (pH value $> 8,5$)

C3: pH value ≤ 7

C5: Content of formic acid ≤ 2 %

C8: Ash content $< 0,1$ %

C9: Ash content < 1 %

D: Chloride content $< 0,5$ %; pH value 5 minimum

E: Free of mixtures; except necessary stabilizers

E1: Free of iron salts

F: Free of fluorides

G: Free of ammonium salts

I: Only with corrosion inhibitors, e.g. amines or ammonia

S: Free of sulfur

S1: Sulfur content $< 0,1$ %

S2: Sulfur content < 1 %

S3: Sulfur content < 3 %

U: Only solvents and their mixtures having a positive compatibility evaluation with the materials used for the shell, the fittings and the seals and the flash point, boiling point and/or vapour pressure values referenced in the name of the substance. It is essential that the conditions stated in conjunction with the corresponding solvents and the materials used are observed.

B.4.2.2 Conditions related to working conditions

H: Liquid temperature at the tank shell 30 °C maximum

- H2: Liquid temperature at the tank shell 30 °C maximum (increased corrosion rate above 25 °C)
- H4: Liquid temperature at the tank shell 40 °C maximum
- H5: Working temperature, particularly during heating, filling and discharging tanks shall not exceed 65 °C.
- H7: Liquid temperature at the tank shell 25 °C maximum
- K1: Inner tank wall completely free of rust
- K3: When changing charges, before filling, the tanks shall be passivated with a suitable passivating agent.
- M: The tanks should be installed in such a manner that the temperature of the liquid does not exceed 30 °C.
- M1: The tanks should be installed in such a manner that the temperature of the liquid does not exceed 15 °C.
- N: The tanks shall be pressured with 50 kPa (0,5 bar) (over-pressure) using nitrogen or some other suitable dry gas. The over-pressure shall be maintained until the tank is completely empty.
- T: It shall be ensured that the tanks are only filled when they are completely dry, and after filling they shall be tightly closed; this is to prevent moisture from penetrating the tank during transportation. If there is the possibility of moisture penetrating the tank, the tank shall be given a surcharge pressure of 50 kPa (0,5 bar) using nitrogen or some other suitable dry gas. This overpressure shall then be maintained until the tank is fully empty.

B.4.2.3 Explanation of the abbreviations in the positive-liquid-list

- + Liquid is allowed to store in the tank
- Liquid is not allowed to store in the tank
- b.p. Boiling point
- conc. Concentration
- cond. Conditions
- fl.p. Flash point
- p(50) Vapour pressure at 50°C
- n.o.s. Unless otherwise named in the positive-liquid-list
- °C Degrees centigrade
- UN-No. Identification number according to the dangerous goods rules
- Vol-% percent by volume

Table B.2 — Positive-liquid-list

Substance designation	No.	UN- no.	Boiling point [°C]	Vapour pressure at 50°C [bar]	Density at 20°C [kg/l]	steel grade																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
						S235JR, S235J2+N, S275J2+N, P235GH, P265GH, P295GH						1.4306, 1.4541						1.4571, 1.4401, 1.4404, 1.4435, 1.4439																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Substance designation	No.	UN- no.	Boiling point [°C]	Vapour pressure at 50°C [bar]	Density at 20°C [kg/l]	steel grade																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Adhesives, containing a flammable liquid, 23°C ≤f.l.p.≤ 60°C	3178	1133	50	≤1,100	≤1,20	+	+	+	+	+	+	U	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+</

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