BRITISH STANDARD

BS EN 976-1 : 1997

Underground tanks of glass-reinforced plastics (GRP) — Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels

Part 1. Requirements and test methods for single wall tanks

The European Standard EN 976-1 : 1997 has the status of a British Standard

ICS 23.020.10

National foreword

This British Standard is the English language version of EN 976-1 : 1997.

The UK participation in its preparation was entrusted to Technical Committee PRI/64, GRP tanks for underground petrol storage, which has the responsibility to:

– aid enquirers to understand the text;
– present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
– monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

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English version

Underground tanks of glass-reinforced plastics (GRP) — Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels — Part 1: Requirements and test methods for single wall tanks

Réservoirs enterrés en plastiques renforcés de verre (PRV) — Réservoirs cylindriques horizontaux pour le stockage sans pression de carburants ou combustibles pétroliers liquides — Partie 1: Prescriptions et méthodes d'essai pour réservoirs à simple paroi

Unterirdische Tanks aus textilglasverstärkten Kunststoffen (GFK) — Liegende, zylindrische Tanks für die drucklose Lagerung von flüssigen Kraftstoffen auf Erdölbasis — Teil 1: Anforderungen und Prüfverfahren für einwandige Tanks

This European Standard was approved by CEN on 1997-06-21. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization

Comité Européen de Normalisation

Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 976-1 : 1997 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 210, GRP tanks and vessels, the secretariat of which is held by DIN.

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 1998, and conflicting national standards shall be withdrawn at the latest by January 1998.

The 4 parts of this European Standard cover the construction and installation requirements of horizontal, cylindrical GRP tanks used for the underground non-pressure storage of petroleum based fuels, e.g. petrol and diesel fuel storage in service stations, heating oil storage for buildings.

The 4 parts are:

Part 1: *Requirements and test methods for single wall tanks*;

Part 2: *Transport, handling, storage and installation of single wall tanks*;

Part 3: *Requirements and test methods for double wall tanks*;

Part 4: *Transport, handling, storage and installation of double wall tanks.*

The standard is written in different parts in order to clearly define the involvement and responsibilities of different parties in the construction of the tank, its installation and the assurance of a good, safe performance during use.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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1 Scope

This Part 1 of European Standard EN 976 specifies the requirements and associated test methods for horizontal, cylindrical single wall tanks made of glass reinforced thermosetting resins (hereafter called tanks), and for their accessories, used for the underground non-pressure storage of liquid petroleum based fuels.

The tanks specified by this European Standard are tanks with one or more compartments and with or without the possibility of leak detection.

This European Standard covers two types of tanks, type A with manway, type B without manway and two classes of tank stiffness, class 1 and class 2. It also covers two grades of tanks, grade 1 for use with all petroleum based fuels and grade 2 limited to use with diesel fuels and heating oils.

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 61 : 1977	*Glass reinforced plastics — Determination of tensile properties*
EN 63 : 1977	*Glass reinforced plastics — Determination of flexural properties — Three point method*
EN 590 : 1993	*Automotive fuels — Diesel — Requirements and methods of test*
EN 637 : 1994	*Plastics piping systems — Glass-reinforced plastics components — Determination of the amounts of constituents using the gravimetric method*
EN 977	*Underground tanks of glass-reinforced plastics (GRP) — Method for one side exposure to fluids*
EN 978	*Underground tanks of glass-reinforced plastics (GRP) — Determination of factor α and factor β*
ISO 844 : 1978	*Cellular plastics — Compression test for rigid materials*
ISO 1922 : 1981	*Cellular plastics — Determination of shear strength of rigid materials*

3 Materials

3.1 General

The tanks are made of thermosetting resins incorporating reinforcement materials and processing agents and possibly fillers and/or additives.

The specific materials selection is based on the finished tank meeting all the requirements of this European Standard.

3.2 Resins

The thermosetting resins used shall be unsaturated polyester and phenylacrylate (vinylester) resins.

3.3 Reinforcement materials

The reinforcement shall be E-type glass with a sizing allowing bonding between glass and resin. The glass may be in the form of cut or uncut rovings, mats or fabrics.

Other types of surface reinforcement materials (C or E glass or suitable synthetic materials) may be used, in particular for the in- and outside layers of the tank. Surfacing mats shall be E-type glass, C glass or synthetic materials.

3.4 Processing agents

Processing agents, for example catalysts, accelerators, inhibitors, monomers, hardeners and thixotropic agents, are added to the resin as needed.

3.5 Fillers

Fillers are inert materials mainly intended to add bulk.

Fillers can be used in the structural wall but shall not be used in the internal and external layers. Their maximum particle size shall not exceed the lesser of the two values, 1 mm or 1/5 of the total wall thickness.

The use of fillers shall not prevent visual inspection.

3.6 Additives

Additives are materials such as fire retarding agents, pigments, etc.

Additives shall be inert with respect to the environment, the other materials and the tank contents.

The use of additives shall not prevent visual inspection.

3.7 Structural core

A structural core is a build-up of materials, e.g. foam or honeycomb, to obtain the necessary stiffness of a sandwich construction. The structural core shall allow proper adhesion to the inner and outer GRP laminate.

3.8 Rib core

A rib core is a material (such as foam, cardboard or moulded plastic) applied on to the cylinder wall and over which a stiffening rib is laminated. The rib core is not required to have a structural contribution in itself and bond of the rib material to the core is also not required.

4 Tank construction

4.1 General

The tank consists of a cylinder wall (e.g. solid wall with or without ribs, sandwich construction), tank ends, manways, fittings and other accessories.

The parts of the tank wall directly beneath openings (see **4.5** and **4.6**) shall be provided with a protection plate.

4.2 Cylinder wall and tank end build-up

4.2.1 *Internal layer*

The internal surface shall be smooth and resistant to the stored liquid.

The internal layer shall be fabricated from chopped glass fibres and resin. The internal layer shall be finished with a resin surface layer of minimum 0,2 mm thick; any reinforcement provided shall be a surfacing mat. When the thickness of the resin surface layer is more than 0,3 mm, surfacing mat reinforcement shall be provided.

4.2.2 *Structural wall*

The structural wall shall be constructed from resin and E-type glass. Fillers and additives may be used. The structural wall may also include stiffening elements such as ribs or a sandwich structure.

4.2.3 *External layer*

The external layer shall be resistant to soils, ground water and to any spilled liquid.

The external layer shall be fabricated from chopped glass fibres and resin. The external layer shall be finished with a resin surface layer of minimum 0,2 mm thick; any reinforcement provided shall be a surfacing mat. When the thickness of the resin surface layer is more than 0,3 mm, surfacing mat reinforcement shall be provided.

4.3 Jointing of cylinder walls and/or tank ends

4.3.1 *General*

Joints shall have a load bearing capacity and a resistance to chemicals at least as good as the jointed parts. Cut edges shall be treated to preserve the mechanical and chemical properties.

4.3.2 *Socket joints*

If the jointed parts are constructed with the same resin throughout the full wall and if the assembly is finished on the outside with a laminate of calculated thickness and with a total length to each side of at least 16 times the thickness of the thickest of the jointed parts, there is no special requirement for the inside finish of the joint.

If one of these conditions is not fulfilled, the inside of the joint shall be finished with a layer containing the equivalent of two mats of 450 g/m^2 over a length at each side of at least 16 times the thickness of the thickest of the jointed parts. This finishing layer shall fulfil the requirements of **4.2.1**.

4.3.3 *Butt joints*

If the jointed parts are constructed with the same resin throughout the full wall and if the distance between the stiffening ribs embracing the joint is at most equal to 900 mm, there is no special requirement for the inside finish of the joint.

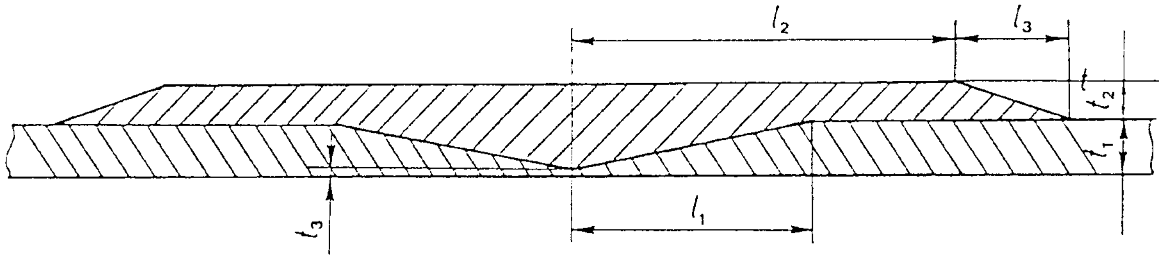
The outside of the joint shall be covered with a laminate with a total length to each side of at least 16 times its thickness and of a thickness at least equal to the thickness of the thicker of the jointed parts.

If one of the conditions of the first paragraph is not fulfilled, two solutions are possible.

1) The inside of the joint shall be finished with a layer containing the equivalent of two mats of 450 g/m^2 over a length at each side of at least 16 times the thickness of the thicker of the jointed parts. This finishing layer shall fulfil the requirements of **4.2.1**.

2) The joint shall be constructed according to figure 1, whereby the V shaped joint opening shall be laminated using a resin with chemical characteristics at least equal to the chemical characteristics of the internal layer.

Both solutions are acceptable for accessible tanks. For non-accessible tanks only the second possibility is applicable.



$l_2 > 16\ t_1$ $l_3 > 6\ t_2$
$l_1 > 10\ t_1$ $t_2 > 0{,}5\ t_1$
$l_2 > l_1$ $t_3 < 2$ mm

Figure 1. Possible execution of a butt joint

4.4 Tank ends

The knuckle radius shall not be smaller than 10 % of the diameter of the tank. No radius of curvature shall be larger than the diameter of the tank.

Partitions between tank compartments shall satisfy the requirements for tank ends.

4.5 Manways

With regard to the presence of a manway, this European Standard considers two types:

type A: tanks with manway;

type B: tanks without manway.

When required, type A tanks shall allow the installation of a flexible inner liner and the tank construction shall not impede the functioning of this liner.

A tank with a capacity of more than 5 m^3 shall be type A and thus have at least one manway. Tanks that are divided in compartments shall have at least one manway that gives access to each compartment.

The manway laminate shall have a build-up which satisfies the requirements of **4.2**. It shall be at least 8 mm thick.

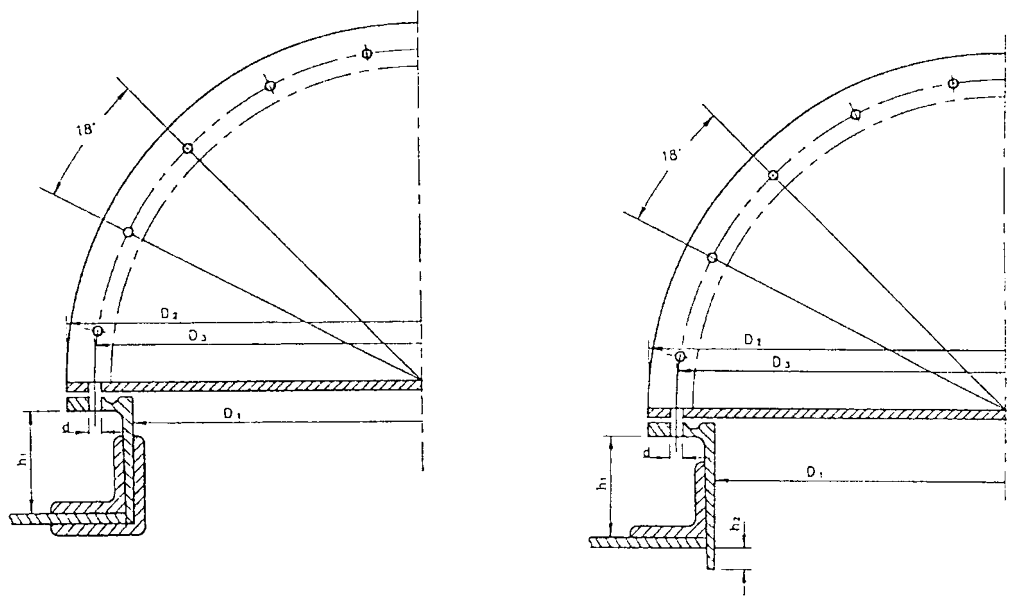
The manway barrel shall be cylindrical (600 mm min. internal diameter). An example of a possible construction and arrangements of the manway covers and their flanges is given in figure 2.

The flexibility of any gasket shall be such as to ensure sealing.

The laminate between the manway barrel and the tank shall offer adequate mechanical and chemical resistance.

Nuts and bolts shall be of non-corrodible materials (e.g. hot dip galvanized, stainless steel) and be easily replaceable.

Beneath the manway on the tank bottom, the internal wall of the tank shall be provided with a protection plate with a diameter at least equal to that of the manway. When a GRP plate is used it shall be at least 6 mm thick; when a steel plate is used, it shall be resistant to the stored liquid or protected from it and have a minimum thickness of 3 mm.



a) Flush-fitting b) With insert

		Dimensions in mm
Nominal manhole diameter		600
Inside diameter	D_{1min}	600
Manhole cover diameter	D_{2min}	780
Bolt pitch circle diameter	D_3	725
Diameter of hole	d	$14 \pm 0,5$
Height to flange	h_{1min}	150
Neck length below tank wall	h_{2max}	50
	h_1 or $(h_1 + h_2)_{max}$	250
Bolts: number		20
dimensions		M12

Figure 2. Example of construction of circular manways

4.6 Connected pipes and their fittings

The following fittings are minimally required per compartment:

	Minimum DN	Recommended DN for larger tanks (> 15 m^3)
Fill pipe	50	100
Dispensing pipe	25	50
Venting pipe	50	100
Gauging pipe	50	50

In an open system (i.e. without vapour balancing), the diameter of the venting pipe should at least be equal to that of the fill pipe and at least be double of that of the dispensing pipe.

The tank shall be capable of accepting an overfill protection device and a vapour recovery system.

The fill pipe shall reach at least 20 mm deeper than the dispensing pipe.

The venting pipe shall protrude 30 to 40 mm into the tank.

The fittings shall be attached to the tank top either on the manway lid or on the tank wall. All pipes inside the tank shall clear the tank bottom by at least 3 % of the inside tank diameter with a minimum of 50 mm.

Beneath each fitting on the tank bottom, the internal wall of the tank shall be provided with a protection plate with a diameter at least equal to the fitting diameter.

All fittings and pipes shall be resistant to the stored liquid and/or to the soil.

The distance between the gauging pipe and the tank bottom shall not be greater than 200 mm.

4.7 Lifting devices

The tank shall be provided with a lifting device designed to allow safe vertical lifting of the tank. Lifting devices (lugs, webbings) shall be designed to take the appropriate loads. When lugs are used they shall have a 25 mm to 50 mm inside diameter.

4.8 Anchoring devices

Each tank shall be capable of being anchored by suitable cables (not in contact with the tank), webbing or straps.

The manufacturer shall specify and mark on the tank the anchoring positions, which shall be spaced no further apart than one tank diameter.

4.9 Static charge dissipation

The tank shall be provided with an earthed conductive object in contact with the liquid.

NOTE. Tanks made entirely of insulating material buried underground are electrically similar to tanks with insulating inner coating. During cleaning operations precautions, such as carefully earthing the person entering the tank, should be taken for fluids with a flash point below 55 °C.

The manufacturer shall advise the user that the filling velocity shall not exceed:

7 m/s for a DN 50 fill pipe;
5,2 m/s for a DN 100 fill pipe.

5 Requirements

5.1 Appearance

The internal surface and all mating surfaces of joints shall be smooth. Both internal and external surfaces shall be free from irregularities which would impair the ability of the tank or joint to satisfy the other requirements of this European Standard. The surface shall not be tacky.

5.2 Dimensions

The thickness of the cylinder wall and of the tank end shall not be less than the reference value obtained at type testing.

The internal cylinder diameter (average of 2 perpendicular measurements) shall be within the tolerances stated in documents by the manufacturer; the tolerance shall be at most ± 1 %.

The cylinder length over diameter ratio *L/D* shall be at most 6 and at least 1.

The cylinder taper shall not exceed 0,1 % per side.

5.3 Leaktightness

When tested in accordance with **6.3**, the tank shall not leak.

5.4 Bending and torsion moments on fittings

When tested in accordance with **6.4**, the tank shall show no visual deterioration and shall not leak when submitted to a leaktightness test according to **6.3**.

5.5 Internal impact resistance

When tested in accordance with **6.5**, no cracking of the internal surface or a surface change visible with the unaided eye shall occur.

5.6 External impact resistance

When tested in accordance with **6.6**, the tank shall show no visual deterioration.

5.7 Lifting system loading

When tested in accordance with **6.7**, breaking shall not occur.

5.8 Structural stability

5.8.1 *General*

With regard to structural stability the tanks are divided into two classes, class 1 and class 2.

For the negative pressure tests defined hereafter, there shall be no visual deterioration internally or externally following the test.

5.8.2 ***Class 1***

5.8.2.1 *General stability*

When tested in accordance with **6.8**, the tank shall withstand a negative pressure level, in kPa, given by the equation:

$$p = \frac{55}{\beta \times \sqrt{\alpha}} \quad \text{with a minimum of 65 kPa (35 kPa absolute pressure)}$$

where:

α is the factor as determined in **6.9.6** (the structural factor α_s in the case of rib reinforced tanks);

β is the factor as determined in **6.9.6** (the structural factor β_s in the case of rib reinforced tanks).

For each wall construction and for each diameter, the tank tested shall have a ratio $L/D \geq 5$, L being the cylinder length and D the internal cylinder diameter.

5.8.2.2 *Local stability*

In order to check local stability the manufacturer shall fabricate a special test tank which, for each wall construction and for each diameter, shall fulfil the requirement $L \geq D$, L being the cylinder length, and shall, in the case of rib reinforced tanks, contain at least two ribs at the designed spacing.

When tested according to **6.8**, this test tank shall withstand a negative pressure level, in kilopascals, given by the equation:

$$p = \frac{1{,}2(H + D)10}{\beta \times \sqrt{\alpha}}$$

where:

H is the maximum cover depth, in metres (H = 2 m);

D is the internal cylinder diameter, in metres;

α is the factor as determined in **6.9.6** (the factor of the laminate between the ribs α_t in case of rib reinforced tanks);

β is the factor as determined in **6.9.6** (the factor of the laminate between the ribs β_t in case of rib reinforced tanks).

5.8.2.3 *Dimensional requirement for rib reinforced tanks*

A rib reinforced tank shall fulfil the requirement

$$\frac{D}{t}\left(\frac{E_N}{E}\right)^{0{,}5} \leq 0{,}35$$

where:

D is the internal cylinder diameter, in metres;

t is the lowest value of the laminate thickness in any section of the cylinder, in millimetres;

E_N is a reference circumferential flexural modulus of elasticity, in newtons per square millimetre (E_N = 12 000 N/mm^2);

E is the circumferential flexural modulus of elasticity of the cylinder laminate as determined in **6.9.5** by external loading, in newtons per square millimetre.

5.8.3 ***Class 2***

5.8.3.1 *General stability*

When tested in accordance with **6.8**, the tank shall withstand a negative pressure level, in kilopascals, given by the equation:

$$p = \frac{25}{\beta \times \sqrt{\alpha}} \quad \text{with a minimum of 35 kPa (65 kPa absolute pressure)}$$

where α and β are defined as in **5.8.2.1**.

For each wall construction and for each diameter, the tank tested shall have a ratio $L/D \geq 5$, L being the cylinder length and D the internal cylinder diameter.

5.8.3.2 *Local stability*

See **5.8.2.2**.

5.9 Laminate requirements

5.9.1 ***Chemical resistance***

With regard to chemical resistance the tanks are divided into two grades, grade 1 and grade 2, the difference being determined by the test liquid used during chemical exposure.

When tested in accordance with **6.9.2**:

– the flexural modulus of the laminate shall be retained at at least 80 %;

– the surface shall show no blisters or cracks when examined with the unaided eye.

5.9.2 ***Composition***

When tested in accordance with **6.9.3**, the test results for each component shall be within ± 10 % of the reference values obtained at type testing.

5.9.3 ***Tensile properties***

When tested in accordance with **6.9.4**, the test results shall be at least 90 % of the reference values obtained at type testing.

5.9.4 ***Flexural properties***

When tested in accordance with **6.9.5**, the test results shall be at least 90 % of the reference values obtained at type testing.

5.9.5 ***Factor*** α **and factor** β **in bending**

When measured in accordance with **6.9.6** factor α and factor β shall meet the following requirements:

$\alpha \geq 0{,}5 \qquad \beta \geq 0{,}6$

5.10 Structural core properties

When a structural core is used, the core material shall be tested in accordance with **6.10** and the test results shall be at least 90 % of the reference values obtained at type testing.

6 Test methods

6.1 General

Conditioning of the test specimens is not required unless otherwise specified by the test method.

Conduct the tests at ambient conditions without any special controls on temperature or relative humidity unless otherwise specified by the test method.

6.2 Dimensions

Measure all dimensional parameters of importance, i.e. diameter, thickness, rib spacing, length.

Measure the dimensions other than thickness to the nearest 1 mm.

Measure thickness to the nearest 0,1 mm with a micrometer, calliper gauge or other suitable instrument.

Verify the requirements of **5.2**.

6.3 Leaktightness

Submit the tank, compartment by compartment, to an air pressure of 20 kPa (0,2 bar).

Check for leaks by covering the entire external surface with soapy water solution (1 l of water with 12 ml of household dishwashing detergent). In freezing conditions, 1 l of automotive windshield washer solution for 1 l of water may be substituted. Soap the entire tank and fittings.

6.4 Bending and torsion moments on fittings

Carry out the test on the tank which has been restrained.

Apply successively a 500 N·m moment of bending and a 500 N·m moment of torsion on piping sections fixed on each of the pipe fittings attached to the tank cylinder or on the manway cover; maintain these moments for 1 min.

Inspect the tank visually. Submit the tank to a leaktightness test in accordance with **6.3**.

6.5 Internal impact resistance

Drop a (0,5 ± 0,005) kg solid steel ball from the upper edge of the manway onto the protection plate of the tank.

6.6 External impact resistance

Drop a (0,5 ± 0,005) kg solid steel ball from a height of (1 ± 0,01) m onto the cylinder wall.

If the cylinder wall contains ribs, carry out the test:

1) by dropping the ball centrally between ribs;
2) by dropping the ball on the crown of a rib.

6.7 Lifting system loading

Submit the lifting system for 6 min to a vertical force equal to 5 times the weight of the tank.

6.8 Negative pressure test

WARNING. Failure (implosion) in a negative pressure test can release large quantities of energy. Adequate precautions shall be taken to protect personnel and facilities.

6.8.1 *Principle*

Verification of the stability of the tank subjected to a negative pressure calculated in accordance with **5.8**.

6.8.2 *Apparatus*

6.8.2.1 *Vacuum pump*, capable of realizing the specified negative pressure level within 30 min.

6.8.2.2 *Manometer*, for negative pressure capable of being read to the nearest 0,5 kPa.

6.8.2.3 *Valves, fittings and piping*, to connect the tank to the vacuum pump.

6.8.3 *Procedure*

Support the tank uniformly.

Close up with temporary means all openings in the tank except for those used for the manometer and the vacuum pump.

Connect the manometer and the vacuum pump.

Operate the vacuum pump so as to reach the required negative pressure level within 15 min to 30 min.

Maintain that vacuum for 1 min.

6.9 Tests on laminate

6.9.1 *Samples*

The necessary samples for the laminate testing shall be cut from the shell and from the end caps.

6.9.2 *Chemical resistance*

Measure the flexural modulus in accordance with EN 63 in the circumferential direction by external loading of a test specimen cut from the sample (**6.9.1**). Carry out a chemical exposure in accordance with EN 977 on the internal surface of a test specimen from the same laminate sample applying the following parameters:

Test time: 1000 h

Test temperature: (50 ± 1) °C

Test liquid:	Grade 1 tanks:	Grade 2 tanks:
	41,5 % by volume of toluene	Diesel fuel complying with EN 590
	41,5 % by volume of iso-octane	
	15 % by volume of methanol	
	2 % by volume of isobutanol	

After the chemical exposure, measure the flexural modulus (using the initial thickness for calculation) in accordance with EN 63 in the circumferential direction by external loading of the test specimen.

Compare the flexural modulus values before and after chemical exposure.

6.9.3 ***Composition***

Determine the content of reinforcement materials and of other non-combustible materials of both the cylinder and the end cap laminate in accordance with EN 637.

Compare the results of this determination with the reference value(s) obtained at type testing.

6.9.4 ***Tensile properties***

Determine the tensile properties (strength and modulus) in the lengthwise (axial) direction of the cylinder laminate in accordance with EN 61.

Compare the results of this determination with the reference values obtained at type testing.

6.9.5 ***Flexural properties***

Determine the flexural properties (strength and modulus) in accordance with EN 63 of:

1) the cylinder laminate in both directions and on both sides;

2) the end cap laminate by external loading.

Compare the results with the reference values obtained at type testing.

6.9.6 ***Factor α and factor β***

Determine the factor α extrapolated to a period of 50 years (for rib reinforced tanks both the structural factor α_s and the factor α_t of the laminate between the ribs shall be determined) and the factor β (β_s and β_t for a rib reinforced tank) in accordance with EN 978.

6.10 Structural core properties

Determine the compression properties of the structural core material in accordance with ISO 844 when cellular materials are used or in accordance with any appropriate method when other materials are used.

Determine the shear modulus of the structural core material in accordance with ISO 1922 when cellular materials are used or in accordance with any appropriate method when other materials are used.

Compare the results with the reference values obtained at type testing.

7 Marking

The following information shall be indelibly indicated:

– for type A tanks: both on the manway lid and on the inside of the manway barrel of each compartment;

– for type B tanks: on the crown line near the pipe fittings:

a) reference to this European Standard EN 976-1;

b) type A or type B, in accordance with **4.5**;

c) class 1 or class 2, in accordance with **5.8**;

d) grade 1 or grade 2, in accordance with **5.9.1**;

e) the capacity of the tank, in litres, and the tank diameter, in millimetres;

f) the name of the manufacturer;

g) the production code giving access to information such as date of fabrication, quality control testing, etc.

Annex A (informative)

A-deviations

A-deviation: national deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC member.

This European Standard does not fall under any Directive of the EC. In the relevant CEN/CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

Reference to legal German requirements

– Verordnung über Anlagen zur Lagerung, Abfüllung und Beförderung brennbarer Flüssigkeiten zu Lande (Verordnung über brennbare Flüssigkeiten — VbF) (Artikel 6 der Verordnung zur Ablösung von Verordnungen nach § 24 der Gewerbeordnung/Referenz: GSG vom 27.02.1980, Ausgabe 06.94: § 4 Absatz 1 und 3; Anhang 2 Punkt 100.7.

– TRbF 120 Ortsfeste Tanks aus metallischen und nichtmetallischen Werkstoffen; Allgemeines; Ausgabe 08.94: Geltungsbereich und Abschnitt 2 Absatz 2.

– Bau- und Prüfgrundsätze für unterirdische GF-UP-Behälter und -Behälterteile; Ausgabe 1984: Punkt 2.2.6.

In addition to the requirements in subclause **4.9** of this European Standard valid in Germany:

Tanks for the storage of flammable liquids with flash points below 55 °C shall meet the following requirements.

– All metal parts of the tank as well as the electrically conductive layers of the wall shall be conductively connected with each other. The resistance between the conductive parts and the ground shall not exceed 10^6 Ω.

– The leakage resistance of accessible (man-sized) tank areas shall not exceed 10^8 Ω.

– The surface resistance of the tank walls having no electrically conductive layers shall not exceed 10^9 Ω.

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