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EUROPEAN STANDARD

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Descriptors: Petroleum products storage, storage tanks, underground tanks, thermosetting resins, reinforced plastics, glass reinforced plastics, equipment specifications, access openings, dimensions, specifications, tests, marking

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

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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.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

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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of an identical text or by endorsement, at the latest by January 1998, and conflicting national standards shall be withdrawn at the latest by January 1998.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.

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 |
| prEN 977 | Underground tanks of glass-reinforced plastics (GRP) - Method for one side exposure to fluids |
| prEN 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

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A rib core is a material (such as foam, cardboard or moulded plastic) applied onto 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/m² over a length at each side of at least 16 times the thickness of the thickest of the jointed parts. This finishing layer shall fulfill 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/m² over a length at each side of at least 16 times the thickness of the thicker of the jointed parts. This finishing layer shall fulfill 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.

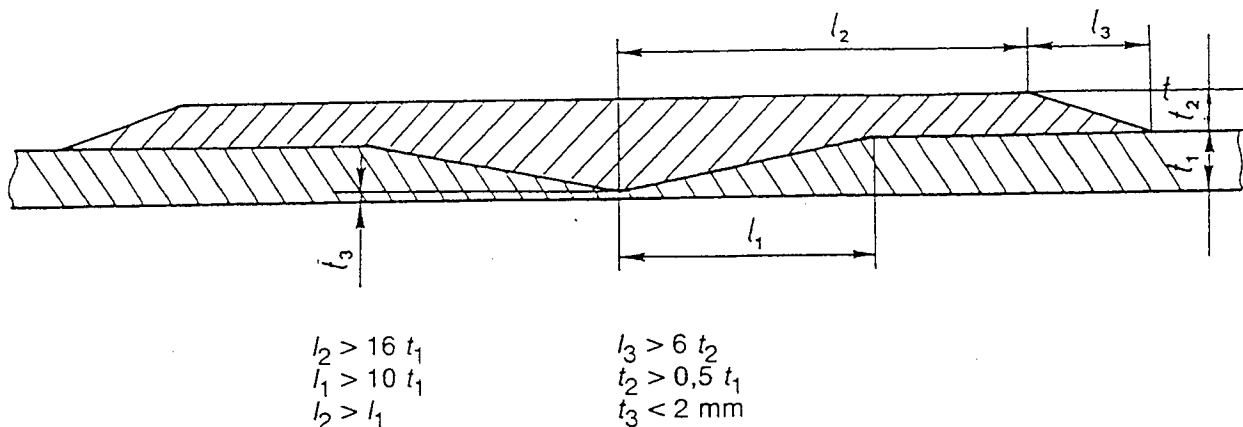


Figure 1 : Possible execution of a butt joint

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

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

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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 m³ 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.