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GRP tanks and vessels for use above ground - Part 3: Design and workmanship

Oberirdische GFK-Tanks und -Behälter - Teil 3: Auslegung und Herstellung

Réservoirs et récipients en PRV pour applications hors sol - Partie 3 : Conception et fabrication

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Réservoirs et récipients en PRV pour applications hors sol - Partie 3 : Conception et fabrication

Oberirdische GFK-Tanks und -Behälter - Teil 3: Auslegung und Herstellung

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 210.

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

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European foreword

This document (prEN 13121-3:2022) has been prepared by Technical Committee CEN/TC 210 “GRP tanks and vessels”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 13121-3:2016.

The following changes were made in this new edition of EN 13121-3:

— the standard was totally revised so as to make it comply with EN 1990; and

— sections covering "Flat panels" and "Loading from local loads" removed from the standard.

EN 13121, *GRP tanks and vessels for use above ground*, is currently composed of the following parts:

— *Part 1: Raw materials — Specification conditions and acceptance conditions*;

— *Part 2: Composite materials — Chemical resistance*;

— *Part 3: Design and workmanship*;

— *Part 4: Delivery, installation and maintenance*;

— *Part 5: Example of calculation* (CEN/TR 13121-5).

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

Introduction

The five parts of EN 13121 together define the responsibilities of the tank or vessel manufacturer and the materials to be used in their manufacture.

EN 13121-1 specifies the requirements and acceptance conditions for the raw materials - resins, curing agents, thermoplastics linings, reinforcing materials and additives. These requirements are necessary in order to establish the chemical resistance properties determined in EN 13121-2 and the mechanical, thermal and design properties determined in this part of EN 13121. Together with the workmanship principles determined in this Part 3, requirements and acceptance conditions for raw materials ensure that the tank or vessel will be able to meet its design requirements. EN 13121-4 specifies recommendations for delivery, handling, installation and maintenance of GRP tanks and vessels

The design and manufacture of GRP tanks and vessels involve a number of different materials such as resins, thermoplastics and reinforcing fibres and a number of different manufacturing methods. It is implicit that vessels and tanks covered by this document are made only by manufacturers who are competent and suitably equipped to comply with all the requirements of this document, using materials manufactured by competent and experienced material manufacturers.

Metallic vessels, and those manufactured from other isotropic, homogeneous materials, are conveniently designed by calculating permissible loads based on measured tensile and ductility properties. GRP, on the other hand, is a laminar material, manufactured through the successive application of individual layers of reinforcement. As a result there are many possible combinations of reinforcement type that will meet the structural requirement of any one-design case. This allows the designer to select the laminate construction best suited to the available manufacturing facilities and hence be most cost effective.

In considering a layered GRP structure it is assumed that it is the glass reinforcement that provides the stiffness and strength required to resist mechanical loadings. Also, since the quantity of glass reinforcement is most readily assessed by weight, the weight of glass per unit area (m) is used instead of thickness in determining mechanical properties, thus the concepts of load and modulus are replaced by unit strength (u) and unit modulus (X), these being defined in Table 1.

It is possible that future advances in resin technology would allow tanks and vessels to be considered for operating temperatures above 120 °C. Should such a situation arise and a manufacturer wish to take advantage of such developments then all other requirements of this document will be maintained and such tanks and vessels will only be designed in accordance with the advanced design method given in 7.9.3.

NOTE To convert a unit load, or a unit modulus to a load and a modulus respectively, U and X may be simply divided by t, where t is the thickness per weight of glass per unit area of the lamina, or laminate under consideration.

1 Scope

This document gives requirements for the design, fabrication, inspection, testing and verification of GRP tanks and vessels with or without thermoplastics lining for storage or processing of fluids, factory made or site built, non-pressurized or pressurized up to 10 bar, for use above ground. Further requirements are presented in normative Annex G.

The terms vessels and tanks as used in this document include branches up to the point of connection to pipe work or other equipment by bolting and supports, brackets or other attachments bonded directly to the shell.

This document covers vessels and tanks subject to temperatures between – 40 °C and 120 °C.

Excluded from this part of EN 13121 are:

— tanks and vessels for the transport of fluids;

— underground storage tanks;

— spherical vessels;

— vessels and tanks of irregular shape;

— tanks and vessels with double containment where the double wall is considered structural;

— tanks and vessels which are subject to the risk of explosion, or failure of which may cause an emission of radioactivity;

— specification for fibre reinforced cisterns of one piece and sectional construction for the storage, above ground, of cold water (see EN 13280).

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 59:2016, *Glass reinforced plastics — Determination of indentation hardness by means of a Barcol hardness tester*

EN 1990:2021, *Eurocode — Basis of structural design*

EN 1991-1-3:2010, *Eurocode 1 — Actions on structures — Part 1-3: General actions - Snow loads*

EN 1991-1-4:2010, *Eurocode 1: Actions on structures — Part 1-4: General actions - Wind actions*

EN 1991-4:2010, *Eurocode 1 — Actions on structures — Part 4: Silos and tanks*

EN 1993-1-1:2010, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

EN 1993-1-6:2017, *Eurocode 3 — Design of steel structures — Part 1-6: Strength and Stability of Shell Structures*

EN 1998-1:2010, *Eurocode 8: Design of structures for earthquake resistance — Part 1: General rules, seismic actions and rules for buildings*

EN 10025-2:2019, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 13067:2020, *Plastics welding personnel — Qualification testing of welders — Thermoplastics welded assemblies*

EN 13121-1:2021, *GRP tanks and vessels for use above ground — Part 1: Raw materials — Specification conditions and acceptance conditions*

EN 13121-2:2003, *GRP tanks and vessels for use above ground — Part 2: Composite materials — Chemical resistance*

EN 13121-4:2005, *GRP tanks and vessels for use above ground — Part 4: Delivery, installation and maintenance*

EN 13445-3:2021, *Unfired pressure vessels — Part 3: Design*

EN ISO 75-2:2013, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite (ISO 75-2)*

EN ISO 291:2008, *Plastics — Standard atmospheres for conditioning and testing (ISO 291)*

EN ISO 527-4:2021, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotopic fibre-reinforced plastic composites (ISO 527-4)*

EN ISO 1172:1998, *Textile-glass-reinforced plastics — Prepregs, moulding compounds and laminates — Determination of the textile-glass and mineral-filler content — Calcination methods (ISO 1172)*

EN ISO 2592:2017, *Petroleum and related products — Determination of flash and fire points — Cleveland open cup method (ISO 2592)*

EN ISO 3915:2022, *Plastics — Measurement of resistivity of conductive plastics (ISO 3915)*

EN ISO 7500-1:2018, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system (ISO 7500-1)*

EN ISO 9513:2012, *Metallic materials — Calibration of extensometer systems used in uniaxial testing (ISO 9513)*

EN ISO 11357-2:2020, *Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature and glass transition step height (ISO 11357-2)*

EN ISO 14125:2011, *Fibre-reinforced plastic composites — Determination of flexural properties (ISO 14125)*

EN ISO 14692-3:2018, *Petroleum and natural gas industries — Glass-reinforced plastics (GRP) piping — Part 3: System design (ISO 14692-3)*

ISO 48-2:2018, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ASTM D4541:2017, *Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org

3.1
manufacturer
organization that designs, manufactures and tests the vessel or tank in accordance with this document

3.2
purchaser
organization or individual that buys the finished vessel or tank and specifies the process requirements

3.3
authorized inspecting authority
body or organization that maybe required to check that the design, materials and construction comply with this document

Note 1 to entry: For this document, when PS ≤ 0,5 bar.

3.4
vessel
closed container subject to applied pressure or vacuum, with or without hydrostatic head, including branches up to the first flanged connection

3.5
notified body
certificated organization listed by the European commission of pressure equipment

Note 1 to entry: For this document, when PS > 0,5 bar.

3.6
internal inspection authority
inspector from the manufacturer which is independent from the workshop

3.7
tank
container for the storage of fluids subject only to the fluid hydrostatic head and freely vented to atmosphere, including branches up to the first flanged connection

3.8
laminate
resin reinforced with glass fibre

3.9
gel coat
thin layer of resin on the surface of a laminate that may or not be reinforced with a glass or a synthetic fibre tissue

3.10
cure
chemical reaction resulting in the polymerized laminate