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GRP tanks and vessels for use above ground

Part 5: Example calculation of a GRP-vessel

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National foreword

This Published Document is the UK implementation of CEN/TR 13121-5:2017.

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

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GRP tanks and vessels for use above ground - Part 5: Example calculation of a GRP-vessel

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European foreword

This document (CEN/TR 13121-5:2017) has been prepared by Technical Committee CEN/TC 210 “GRP tanks and vessels”, the secretariat of which is held by SFS.

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Introduction

EN 13121 consists of the following parts:

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

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

— EN 13121-3, *GRP tanks and vessels for use above ground — Part 3: Design and workmanship*

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

— CEN/TR 13121-5, *GRP tanks and vessels for use above ground — Part 5: Example calculation of a GRP-tank (this report)*

These five parts 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 EN 13121-3. Together with the workmanship principles determined in 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 of this standard specifies recommendations for delivery, handling, installation and maintenance of GRP tanks and vessels. This part of EN 13121 gives guidance in use of the standard. CEN/TC 210 has found it necessary to publish an example calculation of a vessel according to EN 13121-3 due to the standards complexity, and for the understanding of how the standard complies with EN 1990:s principles and requirements for safety, serviceability and durability of structures.

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 standard are made only by manufacturers who are competent and suitably equipped to comply with all the requirements of this standard, 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.

1 Scope

This Technical Report gives guidance for the design of a vessel using the standard EN 13121-3 GRP tanks and vessels for use above ground. The calculation is done according to the advanced design method given in EN 13121-3:2016, 7.9.3 with approved laminates and laminate properties.

2 General

Vessels or vessel structures may contain such structural elements or solutions for which this standard does not provide sufficient guidance. In that case, other methods shall be used in order to obtain a safe structure.

This example calculation is based on a pressurized GRP vessel with an internal diameter of D 3000 mm. The cylindrical parts of the vessel are filament wound. Its bottom and roof are torispherical dished ends that are hand laid up using mixed laminates. Protection against medium attack is obtained by a chemical resistance layer (CRL).

The tank is located outdoors in a seismic area.

IMPORTANT – This example doesn't cover all necessary verifications for the calculation of the GRP tank. Additional verifications have to be performed for the roof, the upper cylinder, etc.

3 Dimensions of the tank

Sketch of the tank dimensions: