



BSI Standards Publication

GRP tanks and vessels for use above ground

Part 5: Example calculation of a GRP-vessel

National foreword

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

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Contents	Page
European foreword.....	5
Introduction	6
1 Scope.....	7
2 General.....	7
3 Dimensions of the tank	7
4 Building materials	9
5 Loadings (9)	9
6 Limit strain for laminate (8.2.2)	11
7 Influence factors (7.9.5.2)	11
8 Partial safety factors (Table 12)	12
9 Combination factors (Table 11).....	12
10 Analysis of the cylinder.....	12
10.1 Influence factor A_5	12
10.2 Characteristic strength values.....	13
10.3 Moduli of elasticity	13
10.4 Analysis of the cylinder in axial direction.....	13
10.4.1 Proof of strength (Ultimate limit state)	14
10.4.2 Proof of strain (Serviceability limit state)	17
10.4.3 Stability proof (Ultimate limit state).....	19
10.5 Analysis of the cylinder in tangential direction.....	21
10.5.1 Strength analysis (Ultimate limit state).....	21
10.5.2 Proof of strain (Serviceability limit state)	23
10.5.3 Stability proof for the cylindrical shell tangential (Ultimate limit state)	23
10.5.4 Critical buckling pressure for rings (Ultimate limit state)	24
10.6 Earthquake design of the cylinder	26
10.6.1 Analysis of the cylinder in axial direction.....	26
10.6.2 Analysis of the cylinder in tangential direction	29
11 Opening in the cylinder.....	30
11.1 Analysis in circumferential direction	31
11.1.1 Proof of strength.....	31
11.1.2 Proof of strain.....	31
11.2 Analysis in axial direction.....	32
11.2.1 Proof of strength.....	32
11.2.2 Proof of strain.....	32
12 Analysis of the skirt.....	33
12.1 Internal forces of the skirt.....	33
12.2 Proof of strength (Ultimate limit state)	34
12.2.1 Design value of actions.....	34
12.2.2 Design value of corresponding resistance	34
12.2.3 Verification.....	35
12.3 Proof of strain (Serviceability limit state)	35
12.3.1 Design value of actions.....	35

12.3.2	Limit design value of serviceability criterion.....	35
12.3.3	Verification	35
12.4	Stability proof (Ultimate limit state)	35
12.4.1	Design value of actions	35
12.4.2	Design value of corresponding resistance.....	36
12.4.3	Verification	36
12.5	Earthquake design of the skirt.....	36
12.5.1	Internal forces Earthquake	36
12.5.2	Proof of strength (Ultimate limit state).....	37
12.5.3	Proof of strain (Serviceability limit state).....	37
12.5.4	Stability proof (Ultimate limit state)	38
13	Overlay laminate connection skirt - vessel	39
13.1	Proof of strength (Ultimate limit state).....	39
13.1.1	Design value of actions	39
13.1.2	Design value of corresponding resistance.....	40
13.1.3	Verification	40
13.2	Proof of strain (Serviceability limit state).....	40
13.2.1	Design value of actions	40
13.2.2	Limit design value of serviceability criterion.....	40
13.2.3	Verification	40
13.3	Seismic design of the skirt overlay	41
13.3.1	Proof of strength (Ultimate limit state).....	41
13.3.2	Proof of strain (Serviceability limit state).....	41
14	Analysis of the bottom	42
14.1	Influence factor A_5	42
14.2	Characteristic strength values	42
14.3	Moduli of elasticity	42
14.4	Actions, which cause internal forces for the bottom	42
14.5	Strength analysis (Ultimate limit state)	42
14.5.1	Design value of actions	42
14.5.2	Proof of strain (Serviceability limit state).....	44
14.5.3	Stability proof of the bottom (Ultimate limit state)	45
15	Lower part of the cylinder (Region 1).....	46
15.1	Strength analysis (Ultimate limit state)	46
15.1.1	Design value of corresponding resistance.....	47
15.1.2	Verification	47
15.2	Proof of strain (Serviceability limit state).....	47
15.2.1	Design value of actions	47
15.2.2	Limit design value of serviceability criterion.....	47
15.2.3	Verification	47
15.3	Earthquake design of region 1 (Ultimate limit state).....	48
15.3.1	Strength analysis (Ultimate limit state)	48
15.3.2	Proof of strain (Serviceability limit state).....	48
16	Upper part of the skirt (Region 2)	49
16.1	Strength analysis (Ultimate limit state)	49
16.1.1	Design value of corresponding resistance.....	50
16.1.2	Verification	50
16.2	Proof of strain (Serviceability limit state).....	50
16.2.1	Design value of actions	50
16.2.2	Limit design value of serviceability criterion.....	50
16.2.3	Verification	50

16.3	Seismic design of region 2 (Ultimate limit state)	51
16.3.1	Strength analysis (Ultimate limit state)	51
16.3.2	Design value of corresponding resistance	51
16.3.3	Verification	51
16.4	Proof of strain (Serviceability limit state)	51
16.4.1	Design value of actions	51
16.4.2	Limit design value of serviceability criterion	51
16.4.3	Verification	52
17	Flange design	52
18	Anchorage	57
18.1	Anchorage for wind loads (Permanent / Transient situation)	57
18.1.1	Uplifting anchor force	57
18.1.2	Anchor shear force	57
18.2	Anchorage for seismic loads (Seismic design situation)	57
18.2.1	Uplifting anchor force	57
18.2.2	Anchor shear force	58

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: