



COMMAX™ - Performance and Testing

This document presents a performance evaluation of the COMMAX™ access chamber designed for use in civil and utility infrastructure projects. The assessment includes vertical and horizontal load testing results, side-wall performance analysis, and a summary of material properties. These evaluations are conducted to ensure the chamber's durability, load-bearing capacity, and long-term reliability. Supporting data, including theoretical load scenarios and test reports, are provided in the appendices.

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1. Reference Standards

Composite access chambers are not covered by a harmonised European standard. For example, the harmonised European standard EN 1917 relates only to manholes and inspection chambers made from unreinforced concrete, steel fibre concrete and/or reinforced concrete. BS 5834-4:2011 specifies requirements and test methods for precast reinforced concrete and recycled polymer units for utility chambers with a maximum designated clear opening of 900mm × 600mm.

In the absence of any specific European standard relating to composite chambers, EJ have carried out vertical and horizontal load testing using guidance from various standards and specifications listed below along with input by independent Civil and Structural Engineering professionals.

- EN 1917- Concrete manholes and inspection chambers, unreinforced, steel fibre and reinforced.
- EN 124:2015- Gully tops and manhole tops for vehicular and pedestrian areas.
- BS 5834-4:2011 - Surface boxes, guards and underground chambers for the purposes of utilities, Part 4: Specification for utility chambers.
- ANSI/SCTE 77 2013, Specification for Underground Enclosure Integrity.
- NF P 98-050-1:2016 Underground works for hosting dry networks- Part 1: Drawpit and connection chambers.
- EN 1991-2:2003 Eurocode 1: Actions on structures. Part 2: Traffic loads on bridges.

2. Vertical Load Testing

A vertical load test was carried out on the chamber as a freestanding unit, without any lateral support or backfill. The chamber was subjected to a maximum load of 900 kN and held for 30 seconds. Appendix A provides details on the test setup, instrumentation, and results.

3. Horizontal Load Testing

Side-wall loading conditions vary depending on the installation environment (e.g., B125 vs. D400 load classes). Even in pedestrian zones, occasional vehicular access may occur. Therefore, chamber designs should account for worst-case loading scenarios, and appropriate testing must be conducted to validate performance under such conditions. To ensure structural integrity under lateral forces such as traffic loads and ground movement, full-scale side-wall load tests were performed. With no harmonised standard available, tests were designed to replicate real in-situ conditions.

The theoretical analysis presented in Appendix B indicates that the side wall of a typical underground chamber will experience a pressure of 42 kN/m² under standard operating conditions. Experimental testing of the COMMAX™ chamber demonstrates performance significantly exceeding this theoretical load. The chamber withstood pressures well beyond the expected service conditions, confirming that its ultimate strength provides a substantial safety margin.

Additionally, the measured deflection of the side wall at the design pressure was minimal. The low deflection is attributed to the high stiffness of the composite structure, which ensures dimensional stability and structural integrity during operation. It also removes the requirement for internal bracing during the installation, and the need for concrete backfill.

Four horizontal load tests were performed- three with a central point load and one with a distributed load. Full setups and results are detailed in Appendices C and D, with a summary provided in the table below.

Chamber size	Load type	Load plate contact area	Deflection at 42kN/m ²	Load at failure	Deflection at failure
900(L) x 900(W) x 900(H)	Concentrated (to EN1917)	0.045 m ²	Not measured	44 kN	Not measured
900(L) x 900(W) x 900(H)	Concentrated	0.07 m ²	0.96 mm	45 kN	10.89 mm
3000(L) x 600(W) x 900(H)	Concentrated	0.04 m ²	1.41 mm	48 kN	40.88 mm
900(L) x 900(W) x 900(H)	Distributed	0.74 m ²	1.65 mm	147 kN	8.98 mm

A note on the important role of chamber side-wall stiffness

Stiffness is a key design parameter in underground access chambers, directly influencing structural integrity, load-bearing performance, and long-term durability. Traditionally, concrete has been the preferred material due to its inherent stiffness and ability to resist substantial loads. However, advancements in composite materials has enabled a comparable stiffness to be achieved. This is important for a number of reasons. However, advancements in composite materials has enabled a comparable stiffness to be achieved.

Structural Integrity: Adequate stiffness ensures the chamber maintains its shape and stability under soil pressure and surface loads. Industry standards, such as ANSI/SCTE 77 2013, often specify allowable deflection limits- commonly less than 2% of the span length- to prevent deformation or collapse.

Load-Bearing Capacity: High stiffness enables the chamber to support heavy loads, including vehicular traffic, without compromising structural performance.

Durability: Stiffer materials better resist environmental stresses such as groundwater pressure, temperature variation, and chemical exposure, contributing to longer service life and reduced maintenance.

Functional Fit: Excessive deflection can lead to misalignment between the chamber and its cover or frame, affecting installation accuracy and operational reliability.

Fibre-reinforced composites, particularly those with unidirectional fibre alignment, as used in the EJ chamber, offer a significant performance advantage. This specific fibre orientation enhances both stiffness and flexural strength, delivering superior load-bearing capacity and fatigue resistance compared to composite structures with randomly oriented fibres.

4. Material Properties

COMMAX™ is manufactured using thermoset glass fibre reinforced composite material. This advanced material offers an exceptional balance of strength, durability, and resistance to environmental degradation. Unlike traditional materials, composites do not corrode, are non-conductive, and maintain their structural integrity under extreme conditions. The thermoset matrix ensures excellent dimensional stability and long-term performance, even in chemically aggressive or high-load environments. Detailed information on the physical, mechanical, and chemical resistance of the composite material can be found in Appendix E.

5. Environmental Data

COMMAX™ offers significant environmental advantages over traditional concrete alternatives. Manufactured from lightweight thermoset glass fibre reinforced composite, the product reduces reliance on high-emission materials like concrete, contributing to a lower overall environmental footprint. The reduced weight not only minimises raw material usage but also leads to lower transportation emissions, enhancing the product's sustainability performance throughout its lifecycle. An Eco Report, provided in Appendix F, offers detailed insights into the environmental impact of a sample Standard Profile section weighing 4.6 kg. The Global Warming Potential (GWP) is calculated at 2.26 kg CO₂ equivalent per kg of material. These benefits, combined with the durability and long service life of composites, make this solution a more sustainable choice for modern infrastructure applications.

Appendix A – Vertical loading testing

Vertical load testing was carried out using the performance requirements of EN124:2015, at F900 load class (900kN). Chambers were freestanding, without any additional support or backfill. A chamber with clear opening of 900x900mm, and depth of 900mm (6 rings) was tested.



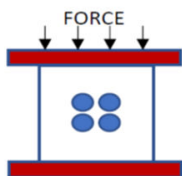
LOAD TEST
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Structural Testing Specialists

Test Certificate - 2050-3

Client: EJ
Roscrea Rd, Birr, Co. Offaly
Contact: Vincent Cooper
Date: 22/04/2025
Project No.: 2050

Test Material: **GRP Chamber 900 x 900 x 900mm (l x w x h)**
Equipment used: 2 x 100t hydraulic cylinders and steel load test frame
Load Requirement: Vertical Load 900kN
Cast Date: N/A
Test Date: 22/05/2025
Quantity Tested: 1
Test Specification: N/A

Vertical load



The load was applied at a rate of 1-5kN/sec continuously and held at the max load of 900kN for 30 seconds. A flat, rigid steel plate construction was placed on top of the chamber to ensure uniform pressure distribution. The chamber was freestanding, without additional support or backfill. The chamber supported the loading without collapse.

Test Type	Load (kN)	PASS/FAIL
Vertical load	900	Pass

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Appendix B - Theoretical load case scenario

EJ engaged an independent Chartered Structural Engineer to evaluate the external stresses acting on the buried structure after installation. Some of the results and findings are summarised below.

The pressure which acts on the walls of the chamber is a combination of:

- **Lateral Earth Pressure P_E** , which increases as the depth of the chamber increases.
- **Surcharge Pressure P_s** , which is independent of chamber depth.

Ground pressure on the side-wall is primarily influenced by the **Lateral Earth Pressure** exerted by the surrounding soil or backfill material. The pressure depends on several factors, including backfill properties and chamber size. The type of soil (e.g., clay, sand) and its density play a crucial role. Different soils have varying coefficients of earth pressure. In addition, as the depth of the chamber increases, the vertical stress from the overlying soil layers also increases, leading to higher lateral earth pressure. Larger chambers have more extensive side-walls, which can distribute the pressure over a larger area. However, the total pressure exerted on the walls will be higher due to the increased contact area.

Surcharge Pressure, refers to the additional vertical pressure exerted on the chamber due to loads applied at or near the ground surface above or adjacent to it. This pressure is in addition to the self-weight of the soil and can significantly influence the structural design and performance of the chamber. Common sources of surcharge pressure are traffic loads, construction loads, nearby structures and backfill compaction.

Example

The Lateral Earth Pressure can be calculated using:

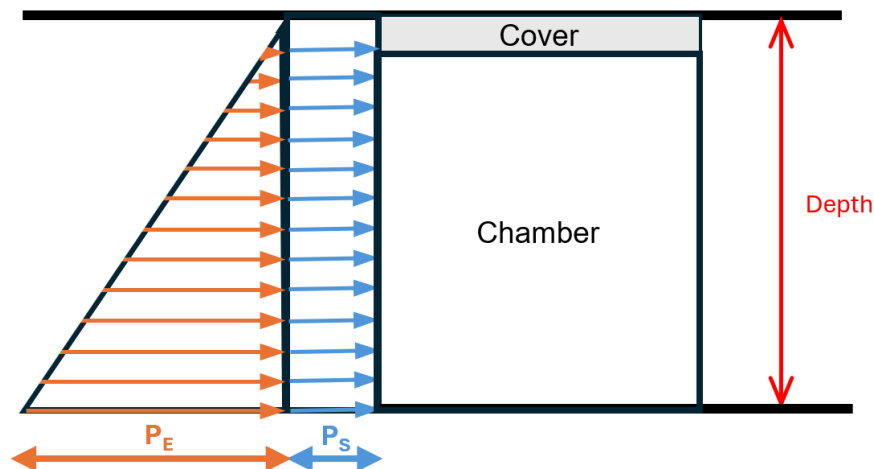
$$P_E = K V h$$

where:

- P_E is the lateral earth pressure, (orange area in sketch below)
- K is the earth pressure coefficient, assume a conservative value of 0.6.
- V is the unit weight of the soil*
- h is the buried depth of the chamber.

*The unit weight of soil varies significantly based on factors like soil type, moisture content, and compaction, ranging from around 11 kN/m³ for loose, dry soil to 18 kN/m³ for dense, wet soils. A conservative density of 20 kN/m³ is used.

Taking a chamber size of 0.9m x 0.9m x 0.9m (l x w x h), the load experience can be illustrated as follows:



Lateral Earth Pressure $P_E = 0.6 \times 20 \times 0.9$
 $= 10.8 \text{ kN/m}^2$

Surcharge Pressure $P_s = 30 \times K$ (where K is lateral earth pressure coefficient)
 $= 30 \times 0.6$
 $= 18 \text{ kN/m}^2$

Total unfactored pressure at a given depth = lateral earth pressure + surcharge pressure
 $= 10.8 + 18$
 $= 20.8 \text{ kN/m}^2$

Designing to Eurocode (EN 1997-1) design approach the load factors applied are generally 1.35 for dead loads (earth) and 1.5 for imposed loads (surcharge).

Giving a total pressure of $(10.8 \times 1.35) + (18 \times 1.5)$

$= 41.6 \text{ kN/m}^2$

Therefore a chamber of this dimension must withstand a side-wall pressure of 41.6 kN/m^2 .



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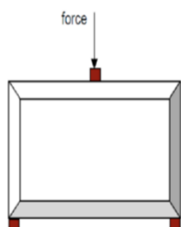
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Test Certificate - 2050-1

Client: EJ
Roscrea Rd, Birr, Co. Offaly
Contact: Vincent Cooper
Date: 18/04/2025
Project No.: 2050

Test Material: **GRP Chamber** **1020 x 1020 x 900mm (l x w x h)**
Equipment used: 2 x 20t hydraulic cylinders and steel load test frame
Load Requirement: Horizontal test to failure load
Cast Date: N/A
Test Date: 11/04/2025
Quantity Tested: 1
Test Specification: IS EN 1917 CONCRETE MANHOLES AND INSPECTION CHAMBERS, UNREINFORCED, STEEL FIBRE AND REINFORCED

Horizontal Test (failure)



The load was applied at a rate of 1-5kN/sec continuously until failure of the chamber was reached.

Deflection was recorded at the loads listed below.

The chamber achieved a maximum load of 44kN. At this load, one corner of the chamber began to crack and thus no further load could be applied.

Test Type	Load (kN)	Deflection (mm)
Horizontal load	28	6.92
	34	7.76
	40	9.11
	44	13.69

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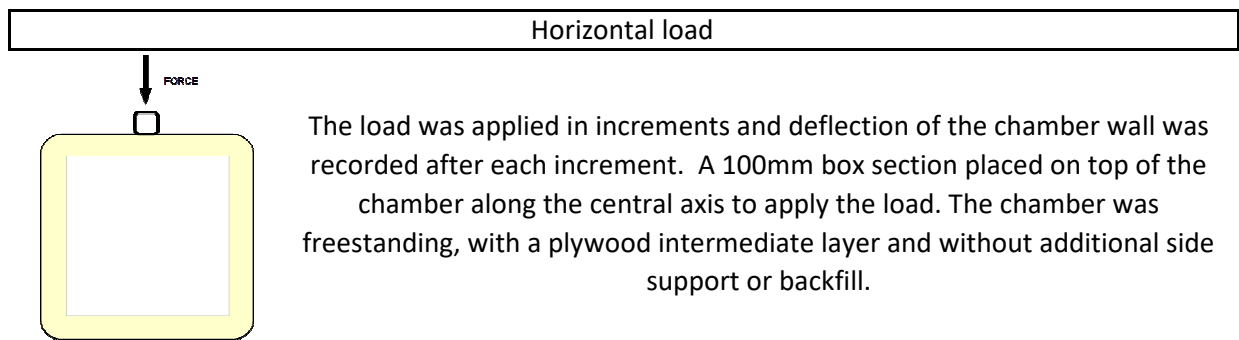




Test Certificate - 2072-1

Client: EJ
Roscrea Rd, Birr, Co. Offaly
Contact: Vincent Cooper
Date: 16/07/2025
Project No.: 2072

Test Material: **GRP Chamber** **900 x 900 x 900mm (l x w x h)**
Equipment used: 2 x 100t hydraulic cylinders and steel load test frame
Load beam: **beam width** **beam length** **contact area**
0.1m 0.877m 0.066m²
Load Requirement: Horizontal failure
Cast Date: N/A
Test Date: 16/07/2025
Quantity Tested: 1
Test Specification: N/A



Load (kN)	Load (kN/m ²)	Deflection (mm)
1	15	0.01
3	42	0.96
6	91	2.86
8	122	3.48
10	152	4.08
20	304	5.94
30	456	7.29
40	608	10.89

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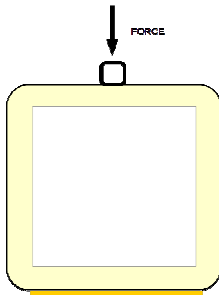
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Test Certificate - 2072-3

Client: EJ
Roscrea Rd, Birr, Co. Offaly
Contact: Vincent Cooper
Date: 16/07/2025
Project No.: 2072

Test Material:	GRP Chamber	3000 x 600 x 900mm (l x w x h)	
Equipment used:	2 x 100t hydraulic cylinders and steel load test frame		
Load beam:	beam width	beam length	contact area
	0.08m	0.877m	0.044m ²
Load Requirement:	Horizontal failure		
Cast Date:	N/A		
Test Date:	16/07/2025		
Quantity Tested:	1		
Test Specification:	N/A		

Horizontal load



The load was applied in increments and deflection of the chamber wall was recorded after each increment. A 80mm box section placed on top of the chamber along the central axis to apply the load. The chamber was freestanding, on a steel base and without additional side support or backfill.

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Load (kN)	Load (kN/m ²)	Deflection (mm)
1.85	42	1.41
4	91	4.43
6	137	7.86
8	182	8.99
10	228	11.67
20	456	21.91
30	639	26.26
40	867	34.87
42	912	36.29
44	958	37.66
46	1003	39.45
48 (failure)	1049	40.88

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Appendix D - Side-wall test with distributed load

A test was carried out using a evenly distributed load, instead of a concentrated load, which is a closer representation to the in-service conditions. This test is similar to the setup required in ANSI/SCTE 77 2013.



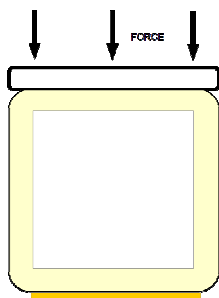
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Test Certificate - 2072-2

Client: EJ
Roscrea Rd, Birr, Co. Offaly
Contact: Vincent Cooper
Date: 16/07/2025
Project No.: 2072

Test Material:	GRP Chamber	900 x 900 x 900mm (l x w x h)	
Equipment used:	2 x 100t hydraulic cylinders and steel load test frame		
Load Plate:	plate width	plate length	contact area
	1m	1m	0.74m ²
Load Requirement:	Horizontal failure		
Cast Date:	N/A		
Test Date:	16/07/2025		
Quantity Tested:	1		
Test Specification:	N/A		

Horizontal load



The load was applied in increments and deflection of the chamber wall was recorded after each increment. A flat, rigid steel plate construction was placed on top of the chamber to ensure uniform pressure distribution. The contact area of the plate was 0.74m². The chamber was freestanding, with a plywood intermediate layer and without additional side support or backfill.

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Load (kN)	Load (kN/m ²)	Deflection (mm)
7	9	0.89
10	14	0.89
15	20	1.03
20	27	1.27
25	34	1.42
31	42	1.65
40	54	2.03
50	68	2.46
60	81	2.96
70	95	3.34
80	108	3.70
90	122	4.10
100	135	4.57
110	149	5.11
120	162	5.65
130	176	6.18
140	190	6.95
147	199	8.98

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Appendix E - Material Properties

Standard and Crown profiles.

Material	
Resin system	Polyester
Reinforcement	E-glass mat plus rovings

Physical Properties	Typical Value	Units	Standard
Glass content (by volume)	60 +/- 5	%	EN ISO 1172
Glass content (by weight)	75 +/- 5	%	EN ISO 1172
Density	1.9- 2.1	g/cm ³	ISO 1183

Mechanical Properties	Characteristic value	Units	Standard
Tensile strength (axial)	410	MPa	EN ISO 527-4
Tensile modulus (axial)	27	GPa	EN ISO 527-4
Tensile strength (transverse)	44	MPa	EN ISO 527-4
Tensile modulus (transverse)	3,5	GPa	EN ISO 527-4
Flexural strength (axial)	400	MPa	EN ISO 14125
Flexural modulus (axial)	14	GPa	EN ISO 14125
Flexural strength (transverse)	115	MPa	EN ISO 14125
Flexural modulus (transverse)	8	GPa	EN ISO 14125
Shear strength (axial)	15	MPa	EN ISO 14130
Shear modulus (axial)	4,2	GPa	EN ISO 14130
Compressive strength (axial)	270	MPa	EN ISO 14126
Compressive modulus (axial)	24	GPa	EN ISO 14126
Poisson's ratio (axial)	0,2	-	-
Poisson's ration (transverse)	0,1	-	-

Chemical Properties	Concentration	ISO - Polyester	
		20°C	60°C
Acetic acid	25%	R	NR
Acetone	100%	NR	NR
Ammonium hydroxie	10%	NR	NR
Fatty acids	100%	R	R
Gasoline	100%	R	NR
Hydrochloric acid	15%	R	NR
Mineral oils	100%	R	R
Nitric acid	5%	R	NR
Sodium hydroxide	5%	NR	NR
Sodium hypochlorite	5%	R	NR
Sulphuric acid	10%	R	NR
Water	100%	R	R

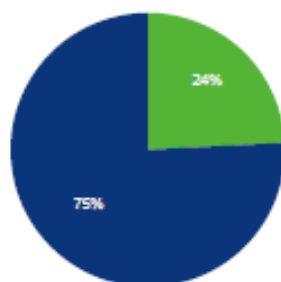
Eco Report

Product: Standard Profile_V17_VC24101

Date: 17-4-2025



Carbon Footprint



Conversion process
Main materials

Carbon Footprint:

10.55 kg

Cumulative energy demand:

187.17 MJ

The International Reference Life Cycle Data Systems (ILCD)

The total score of 1 Standard Profile_V17_VC24101 is calculated with the ILCD 2011 midpoint+ (v1.09) / EU27 2010, equal weighting methodology.

Category	Amount	Unit
Climate change	1.04e+1	kg CO2 eq
Ozone depletion	3.30e-6	kg CFC-11 eq
Human toxicity, non-cancer effects	1.23e-6	CTuh
Human toxicity, cancer effects	1.65e-7	CTuh
Particulate matter	4.30e-3	kg PM2.5 eq
Ionizing radiation HH	9.56e-1	kBq U235 eq
Ionizing radiation E (interim)	3.78e-6	CTUe
Freshwater ecotoxicity	2.78e+1	CTUe
Photochemical ozone formation	7.73e-2	kg NMVOC eq
Acidification	2.89e-2	molc H+ eq
Terrestrial eutrophication	5.68e-2	molc N eq
Freshwater eutrophication	5.86e-4	kg P eq
Marine eutrophication	6.06e-3	kg N eq
Land use	8.89e+0	kg C deficit
Water resource depletion	-2.80e-1	m3 water eq
Mineral, fossil & ren resource depletion	1.24e-4	kg Sb eq

This Eco Report is based on European Industry average figures. Thirdparty verification has not been performed and this report is not an Environmental Product Declaration (EPD). Environmental declarations from different programs may not be comparable.

Appendix G – Load testing to installed steps

This report documents the load testing of a bolt-on step assembly installed in a COMMAX chamber section to verify compliance with EN 1917. The step assembly successfully met the deflection and load requirements by withstanding the specified 2kN vertical load for one minute without any signs of damage or failure. In addition, a test was conducted to determine the pull-out resistance of the step in accordance with EN 1917. The test confirmed that the steps can withstand a horizontal load of 5kN for a duration of one minute without failure, ensuring compliance and structural integrity.

Note: A steel backing plate was not required in either of the tests above. The composite material provided sufficient strength to ensure secure anchorage and compliance with the relevant standards.



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Test Certificate - 2122-1

Client: EJ
Roscrea Rd, Birr, Co. Offaly
Contact: Vincent Cooper
Date: 16/07/2025
Project No.: 2072

Test Material: **Installed Steps - GRP Chamber 900 x 900mm (l x w)**
Equipment used: 10t hydraulic cylinder, steel load test frame, load cell, deflection gauge
Load Requirement: 1.96kN (200kg)
Test Date: 18/12/2025
Quantity Tested: 1
Test Specification:

Table 1 —Requirements for vertical loading test

Characteristic	Test under initial load		Test under ultimate load		
	Single step	Double step	Single step	Double step	
				Class I	Class II
Load (in kN)	2,0	2,0	4,0	4,0	4,0
Deflection under load (in mm)	5,0	10,0	—	—	—
Permanent deflection (in mm)	1,0	2,0	5,0	10,0	50,0

Vertical load

The load was applied in 4 increments and deflection of the step was recorded after each increment. Residual deflection was recorded after load was removed. The vertical load test was conducted on the step assembly without the inclusion of a backing plate

Load (kN)	Deflection (mm)	Residual Deflection (mm)
0.49	0.40	
0.98	1.78	
1.47	3.26	
1.96	4.88	
0.00		0.77

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Structural Testing Specialists

Test Certificate - 2122-2

Client: EJ
Roscrea Rd, Birr, Co. Offaly
Contact: Daniel England
Date: 05/01/2026
Project No.: 2122

Test Material: **Installed Step - GRP Chamber Section** **900 x 900mm (l x w)**
Equipment used: 20t hydraulic cylinder
Load Requirement: Horizontal load - 5kN
Hold period: 1 minute
Test Date: 18/12/2025
Quantity Tested: 2
Test Specification: EN1917

Horizontal load



Load (kN)	Hold Period (mins)	Pass/Fail
5.00	1	Pass
5.00	1	Pass

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Appendix H – Load testing of cable pull-ring

A cable pull-ring assembly, installed with a steel backing plate, demonstrated exceptional strength during pull-out resistance testing. The connection sustained a maximum force of 36kN before structural failure occurred in the chamber side beam. This demonstrates a very strong connection and confirms its suitability for cable pulling applications.



LOAD TEST
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Structural Testing Specialists

Test Certificate - 2122-3

Client: EJ
Roscrea Rd, Birr, Co. Offaly
Contact: Daniel England
Date: 05/01/2026
Project No.: 2122

Test Material: **Bolted Steel Ring - GRP Chamber Section**
Equipment used: 2 x 40t hydraulic cylinders, reaction frame, pulling rig.
Load Requirement: Failure load

Test Date: 18/12/2025
Quantity Tested: 1
Test Specification: Client requested format

Horizontal load



Load (kN)	Failure type
36.00	Deformation of GRP section under load. Steel ring did not pull out, GRP section continued to deform without an increase in load

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