

TEST REPORT

Lucideon Reference: UK20524 (QT-55049/1/JB)/Ref. 3

Project Title: Testing of SWR Round Modular 42.4 mm Base Mounted Balustrade System in Accordance with BS 6180:2011 Barriers in and about Buildings

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1 INTRODUCTION

Lucideon Limited were commissioned by the client - SWR Ltd, to carry out load testing in accordance with BS 6180:2011 Barriers in and about buildings, to allow their balustrade system to be classified for use in accordance with the Code of Practice included within the Standard.

The testing was carried out at Lucideon's facilities at Queens Road, Penkhull, Stoke on Trent.

This report summarises the test results obtained during the test programme and does not provide interpretation of those results.

2 TEST SAMPLES

The system tested was designated as follows:

Round Modular 42.4 mm Base Mounted Balustrade System.

The systems and glass were installed by SWR Ltd's personnel.

Figures 1 and 2 show the system configuration.

3 TEST PROGRAMME

3.1 Line Load

A horizontal line load was applied to the following systems:

- Round Modular, 42.4 mm Base Mounted Balustrade System Incorporating 10 mm x 952 mm x 1105 mm Clear Toughened Glass Panel
- Round Modular, 42.4 mm Base Mounted Balustrade System without Glass.

3.2 Point Load and Uniformly Distributed Load

A point load and uniformly distributed load (UDL) were applied to the following system:

- Round Modular, 42.4 mm Base Mounted Balustrade System Incorporating 10 mm x 952 mm x 1105 mm Clear Toughened Glass Panel.

4 TEST PREPARATION

The 42.4 mm Round Modular System was base mounted on to the concrete block at 1200 mm centres, using 4 No. M8 x 91 mm FXA through bolts per post. The bolts were hammered into position and tightened using a wrench. The glass panel was held in position, using four D shaped glass clamps.

5 TEST METHOD

A horizontal imposed line load was applied to the system at a height of 1.1 m above the datum level of the floor, and the deflection measured at the top central point of the system 1.1 m above the datum level of the floor. The load was applied via a hydraulic ram and the deflection measured, using a linear voltage displacement transducer.

A point load was applied to the centre point of the infill panel, the Standard deems that the point load should be applied at the centre point of the glass infill panel, and deflection measured at the position where most deflection is likely to occur. The top centre point of the glass panel was established as the worst case scenario. The load was applied via a hydraulic ram through a 50 mm diameter indenter with deflection measured, using a linear voltage displacement transducer.

A UDL was applied to the infill panel by means of a 700 mm x 600 mm panel. The load was applied via a hydraulic ram with deflection measured, using a linear voltage displacement transducer.

In all tests, the load was measured using a calibrated load cell and the data recorded, using calibrated Delphin data logger.

The general test configurations can be found in Plates 1-2.

6 RESULTS

The tests were carried out in accordance with the guidance given in BS 6180 Barriers in and about buildings – Code of Practice. The Standard states that the maximum allowable deflection for a glass protective barrier panel is 25 mm.

Table 2 of BS 6180 Barriers in and about buildings – Code of Practice categorises parapets, barriers and balustrades for areas of use, depending on the loads they have achieved under testing.

The loads achieved by the SWR Ltd systems, tested under horizontal imposed line load, point load and uniformly distributed load to the maximum deflection of 25 mm are given in Tables 1 and 2. All figures quoted in the tables contain no safety factors, and are direct loads as achieved by the system under test conditions.

Tables 3-5 summarise the suitability of the tested systems in accordance with Table 2 of BS 6180:2011.

NOTE: The results given in this report apply only to the samples that have been tested.

END OF REPORT

TABLES

Table 1 - Summary of Performance of SWR Ltd Round Modular, 42.4 mm Base Mounted Balustrade System Tested under Horizontal Imposed Line Load

Balustrade Type	Panel Type	Test Height (mm)	Imposed Line Load at 25 mm Deflection (kN/m)	Working Line Load for System (kN/m)	Deflection at Working Line Load for System (mm)
Round Modular, 42.4 mm Base Mounted	10 mm Toughened Clear Glass	1100	0.84	0.74	21.46
Round Modular, 42.4 mm Base Mounted	No Glass	1100	0.72	0.36	12.00

Table 2 - Summary of Performance of SWR Ltd Round Modular, 42.4 mm Base Mounted Balustrade System Tested under Uniformly Distributed Load and Point Load

Balustrade Type	Panel Type	Test Type	Working Load for System	Deflection at Working Load for System (mm)
Round Modular, 42.4 mm Base Mounted	10 mm Toughened Clear Glass	Point Load	1.5 kN	12.3
Round Modular, 42.4 mm Base Mounted	10 mm Toughened Clear Glass	UDL	1.5 kN/m ²	8.74

Table 3 - Summary of Suitability of SWR Ltd Round Modular, 42.4 mm Base Mounted Balustrade System under Line Load in Accordance with Table 2 of BS 6180:2011

Type of Occupancy for Part of the Building	Examples of Specific Use	Horizontal Distributed Line Load (kN/m)	10 mm Toughened Glass	No Glass
Domestic and residential activities	(i) all areas within or serving exclusively one single family dwelling, including stairs, landings etc., but excluding external balconies and edges of roofs	0.36	✓	✓
	(ii) other residential, i.e. houses of multiple occupancy and balconies, including Juliette balconies and edges of roofs in single family dwellings	0.74	✓	x
Offices and work areas not included elsewhere, including storage areas	(iii) light access stairs and gangways not more than 600 mm wide	0.22	✓	✓
	(iv) light pedestrian traffic routes in industrial and storage buildings, except designated escape routes	0.36	✓	✓
	(v) areas not susceptible to overcrowding in office and institutional buildings, also industrial and storage buildings, except as given above	0.74	✓	x
Areas where people might congregate	(vi) areas having fixed seating within 530 mm of the barrier, balustrade or parapet	1.50	x	x
Areas with tables or fixed seating	(vii) restaurants and bars	1.50	x	x
Areas without obstacles for moving people and not susceptible to overcrowding	(viii) stairs, landings corridors ramps	0.74	✓	✓
	(ix) external balconies, including Juliette balconies and edges of roofs; footways and pavements within building cartilage adjacent to basement/sunken areas	0.74	✓	x
Areas susceptible to overcrowding	(x) footways or pavements less than 3 m wide adjacent to sunken areas	1.50	x	x
	(xi) theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas, studios; footways or pavements greater than 3 m wide adjacent to sunken areas	3.00	x	x
	(xii) grandstands and stadia	(Note 1)	-	-
Retail areas	(xiii) all retail areas, including public areas of banks/building societies or betting shops	1.50	x	x
Vehicular	(xiv) pedestrian areas in car parks, including stairs, landings, ramps, edges of internal floors, footways, edges of roofs	1.50 (Note 2)	x	x
	(xv) horizontal loads imposed by vehicles	(Note 2)	-	-

Table 4 - Summary of Suitability of SWR Ltd Round Modular, 42.4 mm Base Mounted Balustrade System under Point Load in Accordance with Table 2 of BS 6180:2011

Type of Occupancy for Part of the Building	Examples of Specific Use	A Point Load Applied to Part of the Infill (kN)	Floor Fix 10 mm Toughened Glass
Domestic and residential activities	(i) all areas within or serving exclusively one single family dwelling, including stairs, landings etc., but excluding external balconies and edges of roofs	0.25	✓
	(ii) other residential, i.e. houses of multiple occupancy and balconies, including Juliette balconies and edges of roofs in single family dwellings	0.50	✓
Offices and work areas not included elsewhere, including storage areas	(iii) light access stairs and gangways not more than 600 mm wide	0.22	✓
	(iv) light pedestrian traffic routes in industrial and storage buildings, except designated escape routes	0.25	✓
	(v) areas not susceptible to overcrowding in office and institutional buildings, also industrial and storage buildings, except as given above	0.50	✓
Areas where people might congregate	(vi) areas having fixed seating within 530 mm of the barrier, balustrade or parapet	1.50	✓
Areas with tables or fixed seating	(vii) restaurants and bars	1.50	✓
Areas without obstacles for moving people and not susceptible to overcrowding	(viii) stairs, landings corridors ramps	0.50	✓
	(ix) external balconies, including Juliette balconies and edges of roofs; footways and pavements within building cartilage adjacent to basement/sunken areas	0.50	✓
Areas susceptible to overcrowding	(x) footways or pavements less than 3 m wide adjacent to sunken areas	1.50	✓
	(xi) theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas, studios; footways or pavements greater than 3 m wide adjacent to sunken areas	1.50	✓
	(xii) grandstands and stadia	(Note 1)	-
Retail areas	(xiii) all retail areas, including public areas of banks/building societies or betting shops	1.50	✓
Vehicular	(xiv) pedestrian areas in car parks, including stairs, landings, ramps, edges of internal floors, footways, edges of roofs	1.50 (Note 2)	✓
	(xv) horizontal loads imposed by vehicles	(Note 2)	-

Table 5 - Summary of Suitability of SWR Ltd Round Modular, 42.4 mm Base Mounted Balustrade System under Uniformly Distributed Load in Accordance with Table 2 of BS 6180:2011

Type of Occupancy for Part of the Building	Examples of Specific Use	Horizontal Uniformly Distributed Load (kN/m ²)	Floor Fix 10 mm Toughened Glass
Domestic and residential activities	(i) all areas within or serving exclusively one single family dwelling, including stairs, landings etc., but excluding external balconies and edges of roofs	0.5	✓
	(ii) other residential, i.e. houses of multiple occupancy and balconies, including Juliette balconies and edges of roofs in single family dwellings	1.0	✓
Offices and work areas not included elsewhere, including storage areas	(iii) light access stairs and gangways not more than 600 mm wide	-	✓
	(iv) light pedestrian traffic routes in industrial and storage buildings, except designated escape routes	0.5	✓
	(v) areas not susceptible to overcrowding in office and institutional buildings, also industrial and storage buildings, except as given above	1.0	✓
Areas where people might congregate	(vi) areas having fixed seating within 530 mm of the barrier, balustrade or parapet	1.5	✓
Areas with tables or fixed seating	(vii) restaurants and bars	1.5	✓
Areas without obstacles for moving people and not susceptible to overcrowding	(viii) stairs, landings corridors ramps	1.0	✓
	(ix) external balconies including Juliette balconies and edges of roofs; footways and pavements within building cartilage adjacent to basement/sunken areas	1.0	✓
Areas susceptible to overcrowding	(x) footways or pavements less than 3 m wide adjacent to sunken areas	1.5	✓
	(xi) theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas, studios; footways or pavements greater than 3 m wide adjacent to sunken areas	1.5	✓
	(xii) grandstands and stadia	(Note 1)	-
Retail areas	(xiii) all retail areas, including public areas of banks/building societies or betting shops	1.5	✓
Vehicular	(xiv) pedestrian areas in car parks, including stairs, landings, ramps, edges of internal floors, footways, edges of roofs	1.5 (Note 2)	✓
	(xv) horizontal loads imposed by vehicles	(Note 2)	-

Note 1 – See requirements of the appropriate certifying authority

Note 2 – Clause 8.1.1 of BS 6180:2011 states that “glass should not be used for vehicle protection barriers.”

PLATES



Plate 1 - General Test Configuration Line Load



Plate 2 - General Test Configuration Uniformly Distributed Load



Plate 3 - Foot Fixings



Plate 4 – Glass Clamps

Chart 1 - Load Deflection Curve for Uniformly Distributed Line Load Testing of SWR Round Modular 42.4 mm Base Mounted Balustrade Systems



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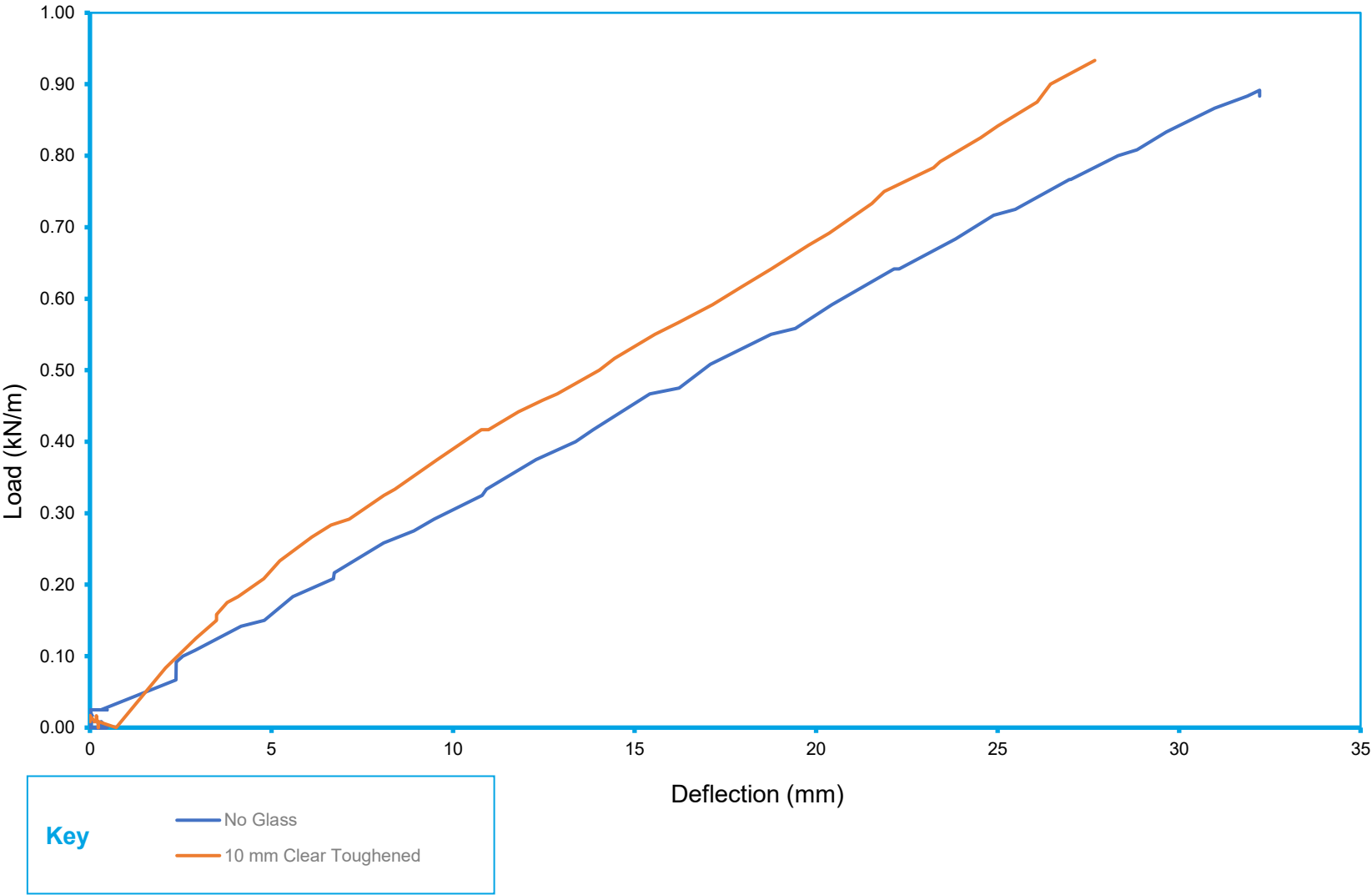
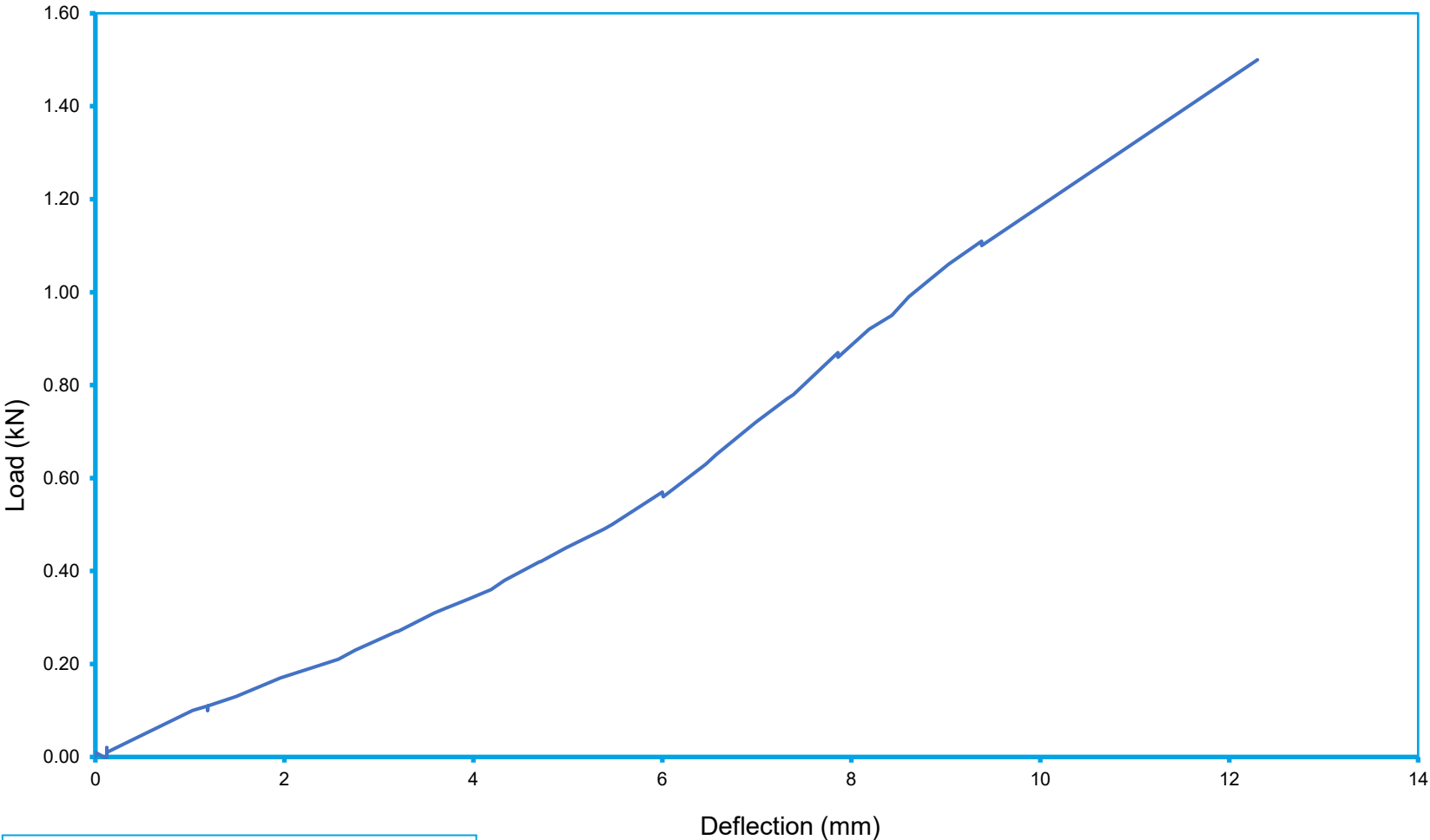


Chart 2 - Load Deflection Curve for Point Load Testing of SWR Round Modular 42.4 mm Base Mounted Balustrade Systems



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Key

10 mm Clear Toughened

Chart 3 - Load Deflection Curve for Uniformly Distributed Load Testing of SWR Round Modular 42.4 mm Base Mounted Balustrade Systems



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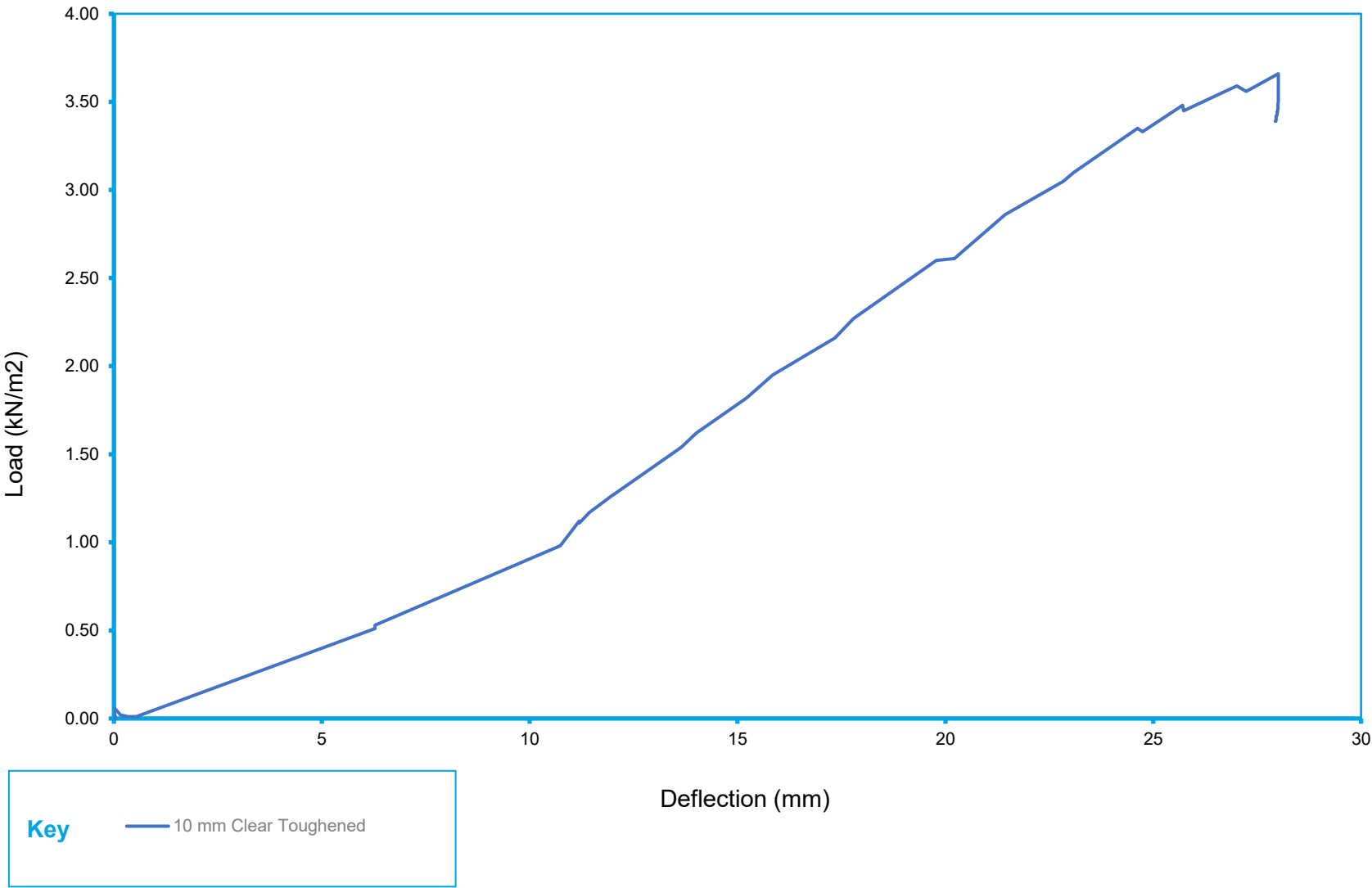


FIGURE 1

42.4mm tube
10mm toughened glass

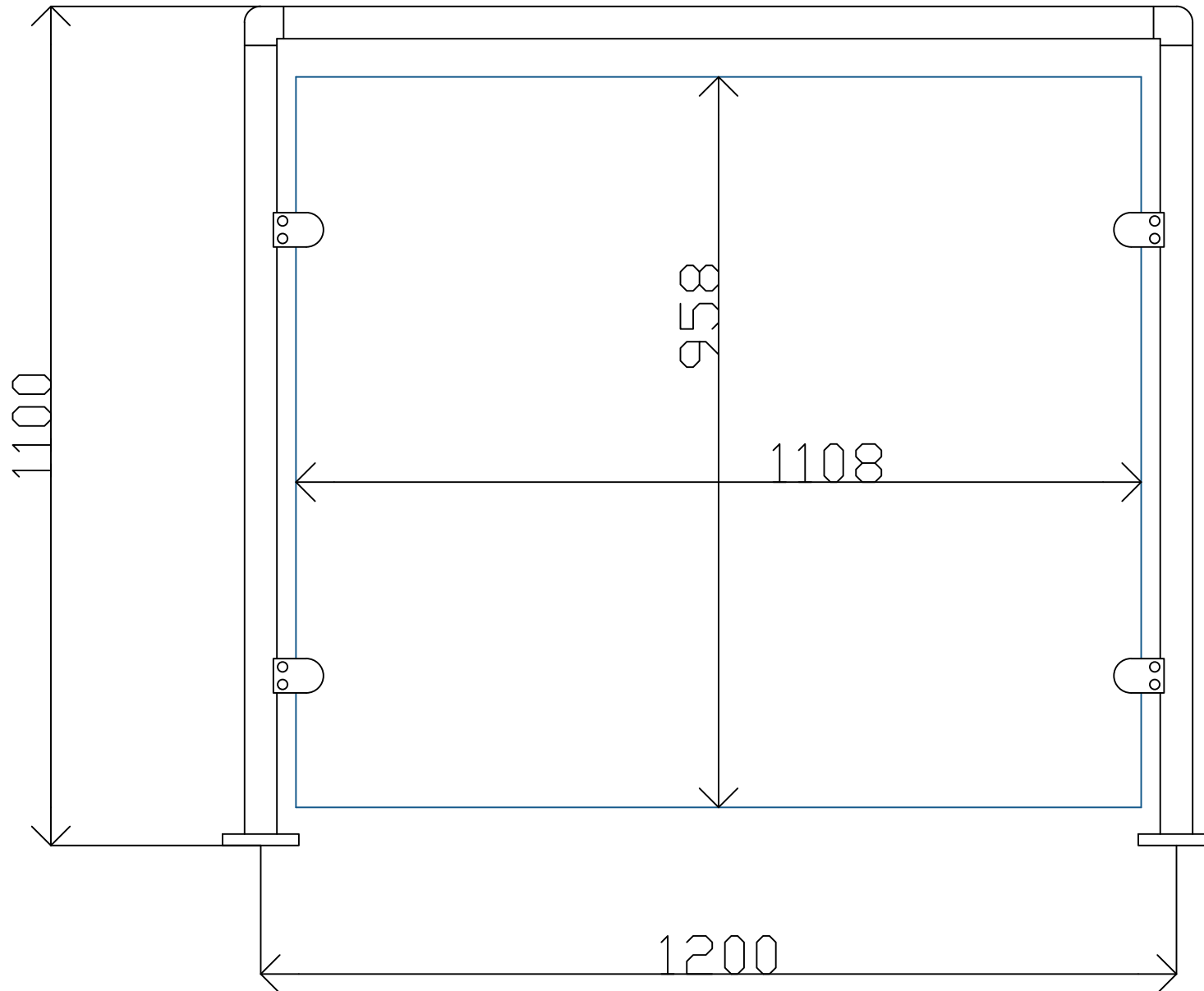


FIGURE 2

42.4mm tube
Unglazed

