

TECHNICAL REPORT



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Our Ref.: TCMSF21293

Date: 12th March 2008

Date delivered: 4th March 2008

Date of tests: 4th March 2008

For the attention of Mr Tony Jones

SAMPLE(S) FOR TEST :

Commercial Fusion Handrail

TEST REQUIREMENTS :

BS 6180: 1999: Barriers in and about buildings – Code of practice
- General Contract use – Clauses 6.4.1

RESULT :

PASS*

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INTRODUCTION

As part of the BM TRADA Certification Ltd Balustrade Product Conformity Scheme, FIRA was commissioned to undertake structural testing of Richard Burbidge Decking Balustrade With Metal Infill in accordance with the requirements of the following documents:

BS 6180: 1999: Barriers in and about buildings – Code of practice

BS 6399: Part 1: 1996: Loading for buildings - Code of practice for dead and imposed loads

BS 5268: Part 2: 2002: Structural use of timber – Code of practice for permissible stress design, materials and workmanship

The intention of the testing was to assess whether the products were structurally suitable for use commercial arenas. Their failure mode and critical failure load were to be established in order to assess and improve upon future designs with the outcome that the developed design could be included in the BM TRADA Certification Ltd Balustrade Product Conformity Scheme.

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TEST SPECIMEN(S)

Description of Specimen

Richard Burbidge Commercial Fusion handrail system consisting of a timber handrail and 5 wall mounting brackets. Tested to 0.74kN/m & 1.5kN/m

System	Richard Burbidge Commercial Fusion Handrail System
Timber Species	Pine- <i>Pinus sylvestris</i>
Handrail dimensions	Dia. 54.10mm
Handrail length	3600mm
Bracket Type	Brus90 degree wraparound
Fixings Used	3 off No.10 50mm woodscrews 4 off No.8 40mm woodscrews (supplied with bracket)

Product descriptions produced by FIRA International Ltd give basic Construction, Material and Dimensional information and are not intended to represent a complete product specification. Overall product dimensions will be recorded accurately. Where variations in material thickness occur, dimensions will be taken as standard thickness.

TEST PROCEDURE

The Handrail is mounted horizontally using 5 specified brackets screwed into the underside of the wall-bars.

Balustrade Handrail Stiffness Test

A uniformly distributed load is applied to the handrail using calibrated weights and load bags suspended vertically from the handrail.

It has been found that in general the aforementioned test method causes timber based balustrades to deflect by amounts greater than the 25mm required by the standard. However in such cases the increased deflection does not necessarily present a safety hazard to the user, as the balustrade remains intact. In such cases the BM TRADA Certification Ltd Balustrade Product Conformity Scheme states that, where the aforementioned deflection limit is exceeded, the unit will be deemed to have satisfied the requirements of the scheme provided that it is capable of passing the strength of handrail test.

Handrail Strength Test

A uniformly distributed load is applied to the handrail using calibrated weights and load bags suspended vertically from the handrail. The load is maintained for a period of 15 minutes, at the end of which the balustrade is inspected for structural damage.

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TEST RESULTS

BS 6180: 1999, Clause 6.4.1 Balustrade horizontal deflection test

Item: Commercial Fusion Handrail
Test Level: Light Commercial and Heavy Commercial Applications
Initial Inspection: No apparent faults.

Load Table

3.6m Handrail		Design Load	DL x 5268-2: 2002	DL x Q-Mark
Light Commercial 0.74 kN/m	Required Load	266kg	599kg	666kg
	Actual Load	266kg	N/A*	N/A*
Heavy Commercial 1.5 kN/m	Required Load	532kg	1198kg	1332kg
	Actual Load	532kg	N/A*	N/A*

Deflection Table*

Light Commercial	Deflection after loading	2mm	1mm	2mm	2mm
	Deflection after 15 minutes	3mm	3mm	2mm	2mm
Heavy Commercial	Deflection after loading	6mm	4mm	4mm	4mm
	Deflection after 15 minutes	6mm	5mm	4mm	4mm

* See COMMENTS

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COMMENTS

As the deflection of the balustrade was less than 25 mm during the test to communal domestic loading levels there was no need to assess the sample to the BS 5268: Part 2: 2002 Safety Factor for light and heavy applications.

As the handrail was mounted to the bottom of a wall-bar with 5 brackets the deflection was taken at the 4 midpoints between the brackets.

CONCLUSION

When tested the Commercial Fusion Handrail supplied by Richard Burbidge Ltd satisfied the selected combined rules of BS 6180: 1999: Barriers in and about buildings and BS 5268: Part 2: 2002: Structural use of timber – Code of practice for permissible stress design, materials and workmanship.

The Commercial Fusion Handrail is therefore considered to be suitable for light and heavy commercial applications when used in spans of 3600mm and when mounted with 5 mounting brackets spaced evenly along the length.

The handrail tested has been manufactured from Pine, *Pinus sylvestris*, this is considered to be the weakest of all timbers that it will be manufactured from. Therefore timbers below are also considered to meet the requirements of the standard;

Hemlock, *Tsuga heterophylla*
Sapele, *Entandrophragma cylindricum*
Beech, *Fagus sylvatica*
Red Oak, *Quercus rubra*
White Oak, *Quercus alba*
American Ash, *Fraxinus americana*
American (Rock or Hard) Maple, *Acer saccharum*
American Cherry, *Prunus serotina*
Chinese Birch, *Betula platyphylla*

NOTE(S)

A, B,C,C1,C2,C3,C5(x),D,E,F and G are the full range of applications for which the products are suitable as specified by BS 6399: Part 1: 1996. For more information see ANNEX B.

Tested by: D Bowey/ R Odhavji

Reported by: Rishi Odhavji

Approved by: Phil Reynolds
Testing Manager

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Plate 1: Commercial Fusion Handrail loaded for light commercial test



Plate 2: Commercial Fusion Handrail loaded for heavy commercial test.

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Plate 3: Technical Drawing of Handrail

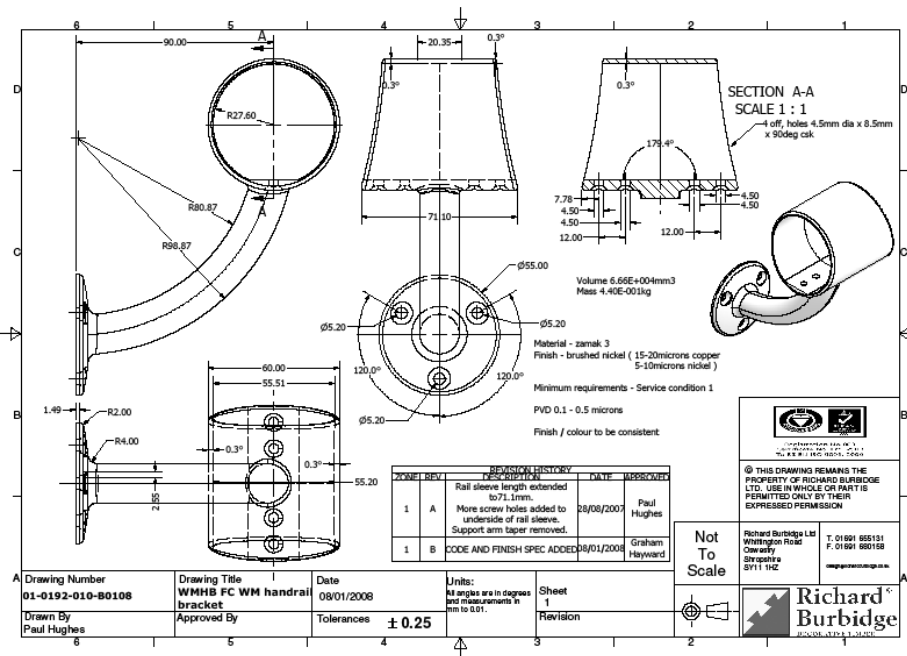


Plate 4: Technical drawing of wall mounting bracket



Plate 5: Wall mounting bracket

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ANNEX A

Test Requirements

Hand rail test

Stiffness test

Initially a stiffness test is to be carried out by applying the test loads for 15 minutes checking that the net deflection of the handrail at mid length between supports is less than 25mm. In accordance with BS 6180, the test loads were taken from BS 6399-1, table 4. These are based on the building-use categories, which are defined in Table 6.2.

The net handrail deflection is defined as:

$$d_{h,net} = d_{h,total} - d_{newel} - d_{stringer}, \text{ where}$$

$d_{h,total} =$	Total deflection at mid span of handrail in the direction of the load
$d_{newel} =$	Deflection of the newel in the direction of the load. Deflection is to be measured at the crossing point between centreline of hand rail and centre line of newel.
$d_{stringer} =$	Deflection of mid span of the stringer in the direction of load. Deflection is to be measured at mid span of the stringer. This measurement is not applicable to balustrades with cut stringers (raised bottom rail).

For balustrades with glass components, the maximum deflection is $L/65$ or 25 mm whichever is the smaller. The definition of L should be sought in sections 8.3, 8.4 or 8.5 in BS 61800, as it is dependent on the actual design.

If the balustrade fails the deflection test, without experiencing permanent damage, it is suggested that a strength test be carried out.

Strength test

BS 6180 "Code of practice for barriers in and about buildings" only refers to a maximum deflection limit under design load. However for timber balustrades this limit has proven difficult to comply with although timber balustrades have been used safely for many years.

TRADA has taken a practical view on this and suggests that the overall deflection is of less importance providing the balustrade passes a strength test in accordance with Section 8 of BS 5268-2.

In accordance with this method the balustrade is to be loaded with an ultimate load of design load multiplied with the product of K_{73} and K_{85} of BS 5268-2. The balustrade is to sustain this load for 15 minutes without failing (breaking).

As per guidance in BS 6180, the design loads have been taken from Table 4 in BS 6399-1.

TRADA suggests that loads on stairs can be considered "medium term", which means that the overall load safety factor ($K_{73} \times K_{85}$) will range from 1.79 (if five identical balustrades are tested) and 2.24 (if only one balustrade is tested).

The Q-mark scheme was set up when an earlier version of BS 5268-2 was governing. At that time the safety ranged between 2 (for five tests) and 2.5 (for one test). These are equivalent to the overall load safety factor ($K_{73} \times K_{85}$) for "long term" loads on the current version of BS 5268-2. For consistency these factors are still used for the Q-mark tests.

It is suggested that initially the "medium term" loads (given as "5268" loads in table 6.1 is applied for 15 minutes. If the rail passes, additional load to fulfil the Q-mark regulations is applied and the whole load is held for another 15 minutes.

If the balustrade fails to withstand the 15 minutes with "Q-mark" loading, but passes the "5268" load the client will not be able to have the balustrade Q-mark certified, but can receive a test report claiming compliance with combined rules of BS 6180 and 5268-2.

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Spindle / infill tests

Individual spindles

BS 6180 does not give a deflection limit for spindles, which means that a strength test is required unless calculations can prove that the spindles can withstand the design load given in BS 6399-1, Table 4. Clause 6.3.1 in BS 6180 allows the design load to be halved when the infill “consist of successive balusters”.

As these tests are relatively “quick and easy” to do, it is suggested that a minimum of 5 balusters are tested, giving a safety factor of 1.79 for “5268” loads and 2.00 for Q-mark loads. The test loads to be applied are given in table 6.2 in Annex B. It should however be noted that the Q-mark scheme requires all spindles to be tested.

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ANNEX B

Table 6.2 Use of buildings or part buildings

Taken from BS 6399: Part 1: 1996: Loading for buildings - Code of practice for dead and imposed loads.

Building-Use category	Type of occupancy for part of the building or structure	Descriptive title
A	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 (see C3 ix)
		(ii) Other residential, (but also see C)
B and E	Offices and work areas not included elsewhere including storage areas	(iii) Light access stairs and gangways not more than 600 mm wide (not applicable to stair rails)
		(iv) Light pedestrian traffic routes in industrial and storage buildings except designated escape routes
		(v) Areas not susceptible to overcrowding in office and industrial buildings also industrial and storage buildings except as given above
C	Areas where people may congregate	
C1/C2	Areas with tables or fixed seating	(vi) Areas having fixed seating within 530 mm of the barrier, balustrade or parapet
		(vii) Restaurants and bars
C3	Areas without obstacles for moving people and not susceptible to overcrowding	(viii) Stairs, landings, corridors, ramps
		(ix) External balconies and edges of roofs. Footways and pavements within building curtilage adjacent to basement/sunken areas
C5	Areas susceptible to overcrowding	(x) Footways or pavements less than 3 m wide adjacent to sunken areas
		(xi) Theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas, studio. Footways or pavements greater than 3 m wide adjacent to sunken areas
		(xii) Grandstands and stadia
D	Retail areas	(xiii) All retail areas including public areas of banks/building societies or betting shops. For areas where overcrowding may occur, see C5
F/G	Vehicular	(xiv) Pedestrian areas in car parks including stairs, landings, ramps, edges or internal floors, footways, edges of roofs
		(xv) Horizontal loads imposed by vehicles