TRADA TECHNOLOGY

Chiltern House, Stocking Lane, Hughenden Valley,
High Wycombe, Buckinghamshire HP14 4ND, UK
Tel: UK: 01494 563091 Intl: +44 1494 563091
Fax: UK: 01494 565487 Intl: +44 1494 565487

TESTING OF FIVE SAMPLE STAIR RAIL ASSEMBLIES IN ACCORDANCE WITH THE PRINCIPLES OF BS 585: PART 2: 1985 AND BS 6180: 1995

Commercial in Confidence

Report Number	:	TMT/F95024/03
Date	:	March 1997
Prepared For	:	Richard Burbidge Ltd Whittington Road Oswestry Shropshire SY11 1HZ
Prepared By	:	Product Testing Section

CONTENTS

1. INTRODUCTION

As part of the TRADA Certification Ltd (TCL) Balustrade Product Conformity Scheme, TRADA Technology Ltd (TTL) was commissioned to undertake testing of five Richard Burbidge Ltd pre-assembled stair rail units in accordance with the domestic use requirements of the following documents:

- BS 585: Part 2: 1985 "Wood Stairs - specification for performance requirements for domestic stairs constructed of wood based materials".
- BS 6180: 1995 "Barriers in and about buildings".
- Balustrade Product Conformity Scheme for timber and wood based sheet materials, Performance Requirements, reference 22/19, issue July 1995.

Specimen delivery, installation and testing was carried out during the period April to July 1996.

This work followed on from a full series of stair and landing rail tests covered in TTL Report No. TMT/F95024, dated October 1995 and TMT/F95024/02 dated January 1996..

2. OBJECTIVES

To carry out the following tests where appropriate:

2.1 Baluster point load test, BS 6180, clause 6.3.4, to be carried out on each baluster for stair rail units.

2.2 Balustrade static load test, BS 585, clause B4.

2.3 Balustrade impact load test, BS 585, clause B5, to be carried out on the stair rail only.

2.4 Horizontal deflection test, BS 6180, Clause 6.4.1.

3. TEST SPECIMENS

A full specification for the unit tested is given in the Appendix II-VI attached to the rear of this report. The following table shows a summary of units which were tested.

Specimen No	System ID	Material	Unit Type	Handrail Type	Spindle Section (mm)	Nom. Span (m)	Comments
12B	CONT	Hemlock	Stair	LHR	32	4.2	Balustrade static load re test
12C	CONT	Hemlock	Stair	LHR	32	3.6	Balustrade static load re test
16	B/FIX	Hemlock	Stair	HDR	41	4.2	Unit for German market. Handrail design load 0.52 kN/m
17	B/FIX	Hemlock	Stair	HDR	41	4.2	Unit for German market. Handrail design load 0.52 kN/m
V7	Volute	Hemlock	Stair	HDR	32	3.6	Unit supplied complete with stair flight

4. TEST PROCEDURE

4.1 Baluster point load test

The complete assembly was laid horizontally approximately 1m from the ground, supported at the newel posts.

A calibrated load bag with a hook attachment was suspended from the centre point of each baluster in turn. The applied load which each baluster was required to sustain (specimens 12B, 12C and V7) was 25.5kg. The derivation of this load is given in Appendix I.

Specimens 16 and 17 were required to sustain 37kg, see Appendix I for derivation.

4.2 Balustrade Static Load Test

The stair rail was mounted on a scaffolding rig with newel posts vertical. The upper newel was secured both top and bottom, while the lower newel was secured at the bottom only. The stringer was fixed at five positions along its length to scaffold bracing in order to simulate the stiffening effect of the stairs. A point load was applied horizontally to the handrail using calibrated load bags via a wire rope and pulley. The deflection of the assembly was measured using displacement transducers positioned at handrail midspan, stringer midspan and at the top of the lower newel post.

The design load to be applied as a point load to the handrail was 0.27kN/m x handrail length (m). Under this load the net midspan deflection of the handrail should not exceed 25mm (BS6180 Clause 6.4.1).

The performance requirements of the Product Conformity Scheme state that, where the deflection limit given above is exceeded, the unit will be deemed to have satisfied the requirements of the scheme provided that it is capable of supporting 2.5 times the design load given above, for a period of 15 minutes.

4.3 Balustrade Impact Load Test

The stair rail remained mounted in the test rig as for item 4.2. A calibrated 30kg load bag, suspended from a point 2100mm above the midspan of the handrail, was raised 300mm above and aimed "uphill" at an angle of 45° to the rail. The bag was released and allowed to swing freely against the stair rail. This was repeated three times and the assembly was checked for damage after each impact.

4.4 Horizontal deflection test - stair rails (specimens 16 and 17 only)

The stair rail was laid horizontally and mounted in a universal test rig with both newels fully supported on steel channel sections. The upper newel was clamped to the supporting steelwork at the top and bottom while the lower newel was clamped at the bottom only. The newels were clamped in this manner in order to simulate as closely as possible the fixings to be used in practice. A pair of 100mm x 100mm softwood members was fixed to the stringer along its length in order to simulate the stiffening effect of the stairs.

A simulated uniformly distributed load was applied to the handrail using hydraulic cylinders and a series of hardwood load spreaders. The applied load was measured using a slave cylinder and calibrated dynamometer. The deflection of the assembly was measured at the handrail and stringer midpoints using displacement transducers and a digital display unit.

The design load was given by Richard Burbridge Ltd as 0.52kN/m relating to use in Germany. The deflection limit of 25mm given in BS 6180 was applied.

Where the handrail deflection exceeded the 25mm limit, the strength test given in the performance requirements of the Product Conformity Scheme was followed, as outlined in item 4.2.

5. RESULTS

Full test results together with any comments, observations and photographs, are presented in Appendix II-VI at the rear of this report. The following table provides a summary of the performance of the specimen against the requirements of the individual tests conducted, together with an overall pass/fail in respect of BS 585, BS 6180 and the performance requirements of the Product Conformity Scheme, where appropriate.

Specimen No	BS 6180 cl. 6.3.4	BS 6180 cl. 6.4.1	BS 585 cl. B4	BS 585 cl. B5	Overall
V7	pass	NA	pass	pass	pass
NC - test not conducted					

Report written by:

S. Edwards.

S Edwards
Head of Product Testing

Issued under the authority of:

Dr G S Hall
Technical Director

24 March 1997

Date

APPENDIX I

DERIVATION OF MINIMUM PERMISSIBLE FAILURE LOAD

APPENDIX I

DERIVATION OF MINIMUM PERMISSIBLE FAILURE LOAD

General

BS 5268: Part 2: 1991, the structural timber design code, states under Section 8, clause 57 that "load testing is ..... an equally acceptable alternative to calculation and in certain cases can be a more positive method of establishing the adequacy of a particular design". Furthermore, where a component or assembly is tested, the design should be regarded as satisfactory if the ultimate load recorded is 2.5 times design load or, in the case of 5 or more identical items, if the lowest ultimate load recorded is at least 2.0 times design load (clause 6.2.3 and Table 91).

Landing and stair rail balusters

BS 6180 clause 6.3.4 states that "..... each baluster should be designed to resist half the concentrated load given in annex A, applied at mid-height". The half load of $\frac{0.25}{2}$kN = 0.125kN for domestic use is the design load. The minimum permissible failure load for more than five identical balusters would therefore be design load times factor of safety or 0.125 x 2 = 0.25kN for domestic use.

Landing and stair rail assembly

For landing and stair rail assemblies, the factor of safety to be applied to the design load to give the minimum permissible failure load would be 2.5 where one specimen is tested and 2.3 where two identical specimens are tested.

Units for German market

It is understood that specimens 16 and 17 are required to withstand a handrail UDL of 0.52kN/m. As such, it is reasonable to assume, based on knowledge of UK design loadings, that individual balusters may be required to sustain a design load of 0.25kN x $\frac{0.52\text{kN/m}}{0.36\text{kN/m}}$ = 0.361kN (37kg)

APPENDIX VI

APPENDIX VI

SPECIMEN NUMBER V1

SPECIFICATION

Species	Hemlock
System	Continuous/Volute
Handrail section (mm)	59 (w) x 59 (d)
Handrail length between newels (mm)	3400
Baluster section (mm)	32 x 32
Bluster length between handrail and stringer (mm)	757
Baluster turning length (mm)	453
Newel cross section (mm)	82 x 82
Handrail to newel joint	Richard Burbidge Ltd Continuous System.
Handrail butt joint	Richard Burbidge Ltd rail bolt system. Reference instruction leaflet "LFLT-LHR". Also included was a 25x150x3mm thick steel plate fixed across the underside of all butt joints using 5 No 1" number 8 screws.
Vertical turn joint assembly	Glued mitre joint with a single 10mm dia dowel.

RESULTS

Baluster point load test

All balusters withstood the applied load without damage.

APPENDIX VI

Balustrade static load test

Deflection and strength test results are presented below:

Applied load kg	Deflection (mm) Handrail	Deflection (mm) Newel	Nett handrail deflection (mm)	Permissible deflection (mm)
0	0	0	0	
20	5.9	1.2	4.7	
40	12.6	2.8	9.8	
60	19.9	4.7	15.2	
80	27.7	6.8	20.8	
Design	34.0	8.6	25.4	
Design +5 mins	36.8	10.5	26.3	25.0

Strength test conducted after 5 mins at design load
The unit sustained 2.5 x design load for a period of 15 minutes without structural failure. Slight cracking at the bottom UE to handrail connection and at the base of the lower newel was noted at 1.5 x design load.

Balustrade impact test

The specimen withstood three impact loads without damage.