

# FORTRESS RAILING PRODUCTS TEST REPORT

**SCOPE OF WORK**

STRUCTURAL PERFORMANCE TESTING ON THE *AL13 HOME GUARDRAIL SYSTEM*

**REPORT NUMBER**

I6590.01-119-19 R0

**TEST DATE(S)**

12/20/18 - 02/01/19

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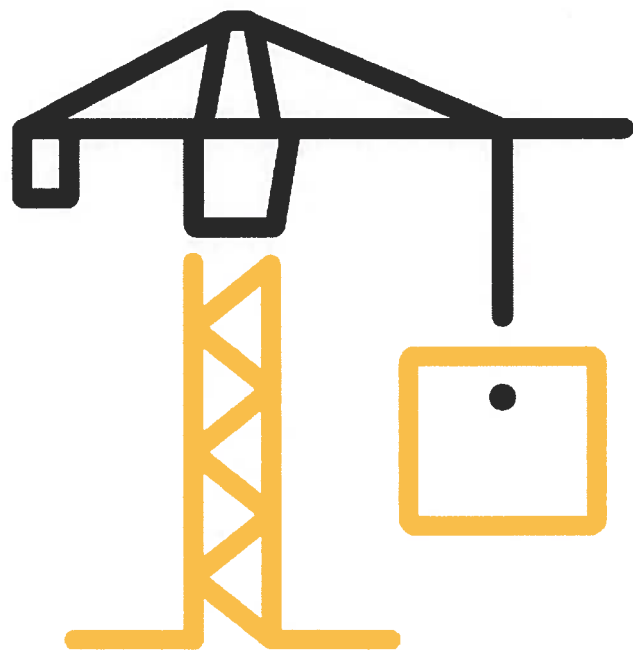
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## TEST REPORT FOR FORTRESS RAILING PRODUCTS

Report No.: I6590.01-119-19 R0

Date: 02/07/19

### REPORT ISSUED TO FORTRESS RAILING PRODUCTS

1720 North 1<sup>st</sup> Street  
Garland, Texas 75040

### SECTION 1 SCOPE


Intertek Building & Construction (B&C) was contracted by Fortress Railing Products to perform structural performance testing on their 94 in wide by 42 in high *AL13 Home* aluminum guardrail system. The systems were evaluated for the design load requirements of the following building codes:

- 2018 International Building Code®, International Code Council
- 2018 International Residential Code®, International Code Council
- 2002 Australian/New Zealand Standard™, Structural Design Actions

All tests performed were to evaluate structural performance of the guardrail assembly to carry and transfer imposed loads to the supporting structure. The test specimens evaluated included the infill, rails, rail brackets, and support posts. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at the Intertek B&C test facility in York, Pennsylvania. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory.

For INTERTEK B&C:

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**SECTION 2**

**SUMMARY OF TEST RESULTS**

The railing assemblies reported herein meet the 2018 IBC design load performance requirements for use in IRC-One-and Two-Family Dwellings when installed between adequate supports with the details as shown in the following table:

GUARDRAIL SYSTEM	GUARDRAIL TYPE	SUPPORT POSTS	BALUSTER	SPACER
8 ft (94 in) by 42 in AL13 Home with round top rail cap	Level (In-Line application)	2 in square aluminum post mount and	5/8 in square aluminum picket	Continuous or non-continuous
8 ft (94 in) by 42 in AL13 Home with flat top rail cap		3 in square aluminum post mount		Continuous

Testing was also performed in order to evaluate for use according to AS/NZS 1170 (Australia/New Zealand Standard). Review and approval by a professional engineer licensed in Australia (or the intended territory of use) would be required to verify compliance.

**SECTION 3**

**TEST METHOD(S)**

The specimens were evaluated in accordance with the following:

2018 *International Building Code*®, International Code Council

2018 *International Residential Code*®, International Code Council

Structural tests were performed according to Chapter 17 (Structural Tests and Special Inspections) for the loads noted within Section 1607.8.1.

The specimens were also evaluated in accordance with the following international standards:

AS/NZS 1170.0:2002, *General Principles*

AS/NZS 1170.1:2002, *Permanent, Imposed, and Other Actions*

Structural tests were performed in general accordance with 1170.1 Appendix B, Section B2 Proof Testing for the design loads noted in 1170.2 Section 3.6, Barriers.

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### SECTION 4

#### MATERIAL SOURCE/INSTALLATION

Test samples were provided by the client. Representative samples of the test specimen(s) will be retained by Intertek B&C for a minimum of four years from the test completion date.

The 94 in wide by 42 in high guardrail assemblies were installed and tested as single railing sections by directly securing the posts into a rigid steel C-channel, which simulated a concrete connection. Transducers mounted to an independent reference frame were located to record movement of reference points on the guardrail system components (ends and mid-point) to determine net component deflections. See photographs in Section 11 for individual test setups.

### SECTION 5

#### EQUIPMENT

The guardrails were tested in a self-contained structural frame designed to accommodate anchorage of the guardrail assembly and application of the required test loads. The specimens were loaded using an electric winch mounted to a rigid steel test frame. High strength steel cables, nylon straps, and load distribution beams were used to impose test loads on the specimens. Applied load was measured using an electronic load cell located in-line with the loading system. Electronic linear motion transducers were used to measure deflections.

### SECTION 6

#### LIST OF OFFICIAL OBSERVERS

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### SECTION 7

#### TEST PROCEDURE

Each test specimen was inspected prior to testing to verify size and general condition of the materials, assembly, and installation. No potentially compromising defects were observed prior to testing.

An initial load, not exceeding 50% of design load, was applied and transducers were zeroed. Load was then applied at a steady uniform rate until reaching 2.0 times design load in no less than 10 seconds. After reaching 2.0 times design load, the load was released. After allowing a minimum period of one minute for stabilization, load was reapplied to the initial load level used at the start of the loading procedure, and deflections were recorded and used to analyze recovery. Load was then increased at a steady uniform rate until reaching 2.5 times design load or until failure occurred. The testing time was continually recorded from the application of initial test load until the ultimate test load was reached.

Deflection and permanent set were component deflections relative to their end-points; they were not overall system displacements. All loads and displacement measurements were horizontal, unless noted otherwise.

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**SECTION 8**

**TEST SPECIMEN DESCRIPTION**

Fortress Railing Products assembled the test specimens with the following details:

<b>PRODUCT</b>	<i>AL13 Home</i>
<b>TYPE</b>	Aluminum guardrail system
<b>OVERALL DIMENSIONS</b>	94 in wide (inside of post to inside of post) by 42 in high (nominal); 40-3/8 in high (top of top rail to bottom of bottom rail)
<b>TOP RAIL (LOWER SECTION)</b>	1-1/8 in high by 1-1/8 in wide by 0.065 in wall aluminum extrusion
<b>TOP RAIL (UPPER SECTION)</b>	1-1/4 in high by 1-1/4 in wide by 0.035 in wall aluminum extrusion
<b>FLAT TOP RAIL CAP</b>	1-5/8 in high by 2-3/8 in wide by 0.070 in wall aluminum extrusion
<b>ROUND TOP RAIL CAP</b>	2-1/16 in high by 2-3/8 in wide by 0.070 in wall contoured aluminum extrusion
<b>TOP RAIL SPACER</b>	1-7/16 in high by 2-3/16 in wide by 0.060 in wall aluminum extrusion (continuous or 1-3/4 in long located 2 in from each end and spaced 15 in on center)
<b>BOTTOM RAIL</b>	1-1/4 in high by 1-1/4 in wide by 0.035 in wall aluminum extrusion
<b>PICKETS (IN-FILL)</b>	5/8 in square aluminum extrusion with 0.035 in wall
<b>RAIL BRACKETS</b>	1-1/2 in high by 1-5/8 in wide by 1 in deep (0.160/0.200 in wall) cast aluminum collar brackets
<b>POST</b>	2 in square by 0.120 in extruded aluminum tube with an integral screw chase at each corner, connected to a 4-1/2 in square by 0.23 in thick steel base plate with four M8 by 70 mm long flat head machine screws; the base plate included four 1/2 in diameter holes, four 7/16 in diameter holes, and one 3/4 in diameter hole
	3 in square by 0.125 in thick aluminum tube connected to a 5-1/2 in square by 0.40 in thick steel base plate with a 3/8 in continuous fillet weld; the base plate included four 1/2 in diameter holes and one 1 in diameter hole
<b>SUPPORT FOOT</b>	5/8 in square by 2-1/8 in high cast aluminum tube with an integral 1-3/16 in wide by 9/16 in high U-shaped head located at midspan of bottom rail

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### Fastening Schedule

CONNECTION	FASTENER
Rail Bracket to Post	Two #12-14 by 1 in (0.157 in minor diameter) Torx drive, flat-head, self-drilling screws
Rail Bracket to Rail	One #12-14 by 1 in (0.157 in minor diameter) Torx drive, flat-head, self-drilling screw on the protected side of the rail
Rail Spacer to Rail	#10-16 by 1/2 in (0.127 in minor diameter) hex head, self-drilling screws; two per piece (one protected side; one exterior side) when spacer is non-continuous; 2 in from each end and 18 in on center staggered (protected side/exterior side) when spacer is continuous
Baluster to Top Rail (Lower Section) and Bottom Rail	Slip fit into routing and tack welded to rail section
Support Block to Bottom Rail	Channel fit - no mechanical connection to rail
Steel Post Mount to Substructure	Four 3/8 in Grade 5 hex-head bolts with nut and washer

### SECTION 9

#### TEST RESULTS

##### Key to Test Results Tables:

Load Level: Target test load

Test Load: Actual applied load at the designated load level (target).

Elapsed Time (E.T.): The amount of time into the test with zero established at the beginning of the loading procedure.

##### Test Series No. 1

94 in by 42 in *AL13 Home Level Guardrail (In-Line Application)* with No Top Rail Cap and Continuous Top Rail Spacer attached to 2 in Posts

Limited to Use in IRC - One- and Two-Family Dwellings / ICC-ES™ AC273

##### Test No. 1 - 12/20/18

Design Load: 50 lb / 11.81 in square area at Center of In-fill

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
Initial Load (0.2 x Design Load)	20	00:00	0.00
100 lb (2.0 x Design Load)	103	00:20	1.46
Initial Load (0.2 x Design Load)	20	01:39	0.09
94% Recovery from 2.0 x Design Load			
125 lb (2.5x Design Load)	253	02:17	Achieved Load without Failure

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**Test No. 2 - 12/20/18**

**Design Load: 50 lb / 11.81 in square area at Bottom of In-fill**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
Initial Load (0.2 x Design Load)	20	00:00	0.00
100 lb (2.0 x Design Load)	100	00:16	1.00
Initial Load (0.2 x Design Load)	20	01:42	0.02
98% Recovery from 2.0 x Design Load			
125 lb (2.5x Design Load)	278	02:16	Achieved Load without Failure

**Test No. 3 - 12/20/18**

**Design Load: 200 lb Concentrated Load at Ends of Top Rail (Brackets)**

LOAD LEVEL <sup>1</sup>	TEST LOAD (lb)	E.T. (min:sec)	RAIL DISPLACEMENT (in)	
			RAIL END #1	RAIL END #2
Initial Load (0.2 x Design Load)	80	00:00	0.00	0.00
800 lb (2.0 x Design Load) x 2	801	01:11	7.29	6.82
Initial Load (0.2 x Design Load)	80	02:44	3.78	3.94
48% / 42% Recovery from 2.0 x Design Load				
1000 lb (2.5x Design Load) x 2	1012	03:34	Achieved Load without Failure	

<sup>1</sup> A spreader beam was used to impose loads on both ends of the railing system; therefore, loads were doubled.

**Test No. 4 - 12/20/18**

**Design Load: 200 lb Concentrated Load at Midspan of Top Rail**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RAIL DISPLACEMENT (in)			
			END	MID	END	NET <sup>1</sup>
Initial Load (0.2 x Design Load)	40	00:00	0.00	0.00	0.00	0.00
800 lb (2.0 x Design Load) x 2	402	00:29	2.15	4.16	1.83	2.17
Initial Load (0.2 x Design Load)	40	02:03	0.19	0.45	0.26	0.23
89% Recovery from 2.0 x Design Load						
500 lb (2.5x Design Load)	500	02:43	Achieved Load without Failure			

<sup>1</sup> Net displacement was mid-rail displacement relative to the rail at the support posts.



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**Test No. 5 - 12/20/08**

**Design Load: Concentrated Load to Failure on a Single Baluster at Center of Infill <sup>1</sup>**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
Ultimate Load	328	00:48	Baluster disengaged from rails

<sup>1</sup> Not required for IBC.

**Test No. 6 - 12/20/18**

**Vertical Uniform Load on Top Rail <sup>1</sup>**

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
1821 lb	1858 lb	01:16	Achieved Load without Failure

<sup>1</sup> Not required for IBC. Uniform load was simulated with four equal point loads.

**Test No.7 - 12/20/18**

**Horizontal Uniform Load on Top Rail <sup>1</sup>**

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
607 lb	603 lb	00:52	Achieved Load without Failure

<sup>1</sup> Not required for IBC. Uniform load was simulated with four equal point loads.

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**Test Series No. 2**

**94 in by 42 in AL13 Home Level Guardrail (In-Line Application) with Round Top Rail Cap and Non-Continuous Top Rail Spacer attached to 2 in Posts**

**Limited to Use in IRC - One- and Two-Family Dwellings / ICC-ES™ AC273**

**Test No. 1 - 12/20/18**

**Design Load: 200 lb Concentrated Load at Midspan of Top Rail**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RAIL DISPLACEMENT (in)			
			END	MID	END	NET <sup>1</sup>
Initial Load (0.2 x Design Load)	40	00:00	0.00	0.00	0.00	0.00
400 lb (2.0x Design Load)	406	00:28	2.06	3.19	1.45	1.44
Initial Load (0.2 x Design Load)	40	01:59	0.00	0.01	0.00	0.01
99% Recovery from 2.0 x Design Load						
500 lb (2.5x Design Load)	511	02:32	Achieved Load without Failure			

<sup>1</sup> Net displacement was mid-rail displacement relative to the rail at the support posts.

**Test No. 2 - 12/20/18**

**Horizontal Uniform Load on Top Rail <sup>1</sup>**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
605 lb	603 lb	01:44	Achieved Load without Failure

<sup>1</sup> Not required for IBC. Uniform load was simulated with four equal point loads.

**Test No. 3 - 12/20/18**

**Vertical Uniform Load on Top Rail <sup>1</sup>**

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
1821 lb	1829 lb	00:59	Achieved Load without Failure

<sup>1</sup> Not required for IBC. Uniform load was simulated with four equal point loads.

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**Test Series No. 3**

**94 in by 42 in AL13 Home Level Guardrail (In-Line Application) with Flat Top Rail Cap and Continuous Top Rail Spacer attached to 2 in Posts Limited to Use in IRC - One- and Two-Family Dwellings / ICC-ES™ AC273**

**Test No. 1 - 12/20/18**

**Design Load: 200 lb Concentrated Load at Midspan of Top Rail**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RAIL DISPLACEMENT (in)			
			END	MID	END	NET <sup>1</sup>
Initial Load (0.2 x Design Load)	40	00:00	0.00	0.00	0.00	0.00
400 lb (2.0x Design Load)	402	00:30	2.00	3.14	1.95	1.17
Initial Load (0.2 x Design Load)	40	01:59	0.18	0.30	0.36	0.03
97% Recovery from 2.0 x Design Load						
500 lb (2.5x Design Load)	506	02:30	Achieved Load without Failure			

<sup>1</sup> Net displacement was mid-rail displacement relative to the rail at the support posts.

**Test No. 2 - 02/01/19**

**Horizontal Uniform Load to Failure on Top Rail <sup>1</sup>**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
Ultimate Load	1097	02:27	Post and bracket failure

<sup>1</sup> Not required for IBC. Uniform load was simulated with four equal point loads.

**Test No. 3 - 12/20/08**

**Concentrated Load to Failure on a Single Baluster at Bottom of Infill <sup>1</sup>**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
Ultimate Load	262	00:48	Failure mode not noted

<sup>1</sup> Not required for IBC

**Test No. 4 - 02/01/19**

**Concentrated Load at Midspan of Top Rail <sup>1</sup> to Failure**

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
Ultimate Load	695	01:15	Bracket failure

<sup>1</sup> Not required for IBC.

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### Test Series No. 4

2 in Structural Post Mount

Limited to Use in IRC - One- and Two-Family Dwellings / ICC-ES™ AC273

#### Test No. 1 - 12/20/18

Design Load: 200 lb Concentrated Load at Top of Stand-Alone <sup>1</sup> Post (42 in high)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	POST DISPLACEMENT (in)
Initial Load (0.2 x Design Load)	40	00:00	0.00
400 lb (2.0x Design Load)	401	01:03	6.54
Initial Load (0.2 x Design Load)	40	02:29	3.87
41% Recovery from 2.0 x Design Load			
Ultimate Load	601	03:28	Failure - Screws Sheared

<sup>1</sup> Post was conservatively tested without a railing attached.

### Test Series No. 5

3 in Structural Post Mount

Limited to Use in IRC - One- and Two-Family Dwellings / ICC-ES™ AC273

#### Test No. 1 - 12/20/18

Design Load: 200 lb Concentrated Load at Top of Stand-Alone <sup>1</sup> Post (42 in high)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	POST DISPLACEMENT (in)
Initial Load (0.2 x Design Load)	40	00:00	0.00
400 lb (2.0x Design Load)	406	00:29	1.15
Initial Load (0.2 x Design Load)	40	01:51	0.18
84% Recovery from 2.0 x Design Load			
Ultimate Load	761	02:40	Weld failure

<sup>1</sup> Post was conservatively tested without a railing attached.

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### SECTION 10 CONCLUSION

Withstanding an ultimate load of 2.5 times design load, the test results substantiate compliance with the 2018 IBC design load performance requirements for use in IRC-One-and Two-Family Dwellings for the 94 in wide by 42 in high railing assembly (*AL13 Home*) and 42 in high support posts (2 in and 3 in) reported herein. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately. **The loading conditions tested and reported herein were also intended to substantiate compliance with AS/NZ 1170. Review and approval by a professional engineer licensed in Australia (or the intended territory of use) would be required to verify compliance.**

### SECTION 11 PHOTOGRAPHS



Photo No. 1  
In-Fill Load Test at Center of Three Pickets

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**Photo No. 2**  
**In-Fill Load Test at Bottom of Three Pickets**



**Photo No. 3**  
**Concentrated Load Test at Midspan of Top Rail**

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**Photo No. 4**  
**Concentrated Load Test at Ends of Top Rail (Brackets)**



**Photo No. 5**  
**Horizontal Uniform Load on Top Rail**

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**Photo No. 6**  
**Vertical Uniform Load on Top Rail**



**Photo No. 7**  
**Concentrated Load Test at Top of Stand-Alone Post (42 in high)**



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**Photo No. 8**  
**Rail Connection**

### SECTION 12 DRAWINGS

The drawings for the *AL13 Home* aluminum guardrail system which follow have been reviewed by Intertek B&C and are representative of the project reported herein. Project construction was verified by Intertek B&C per the drawings included in this report. Any deviations are documented herein or on the drawings.