

FORTRESS RAILING PRODUCTS TEST REPORT

SCOPE OF WORK

STRUCTURAL PERFORMANCE TESTING ON THE *AL13 HOME* GUARDRAIL SYSTEM PER SELECTED SECTIONS OF THE FOLLOWING:

- 2015 NATIONAL BUILDING CODE OF CANADA (NBC) SECTION 9.8.8.2 *LOADS ON GUARDS*
- 2012 ONTARIO BUILDING CODE (OBC), SECTION 9.8.8.2 *LOADS ON GUARDS*
- 2018 BRITISH COLUMBIA BUILDING CODE (BCBC), SECTION 9.8.8.2 *LOADS ON GUARDS*
- 2014 ALBERTA BUILDING CODE (ABC), SECTION 9.8.8.2 *LOADS ON GUARDS*

REPORT NUMBER

I6590.02-119-19 R2

TEST DATE(S)

12/20/18 - 02/01/19

ISSUE DATE

02/18/19

REVISED DATE

04/03/19

RECORD RETENTION END DATE

02/01/23

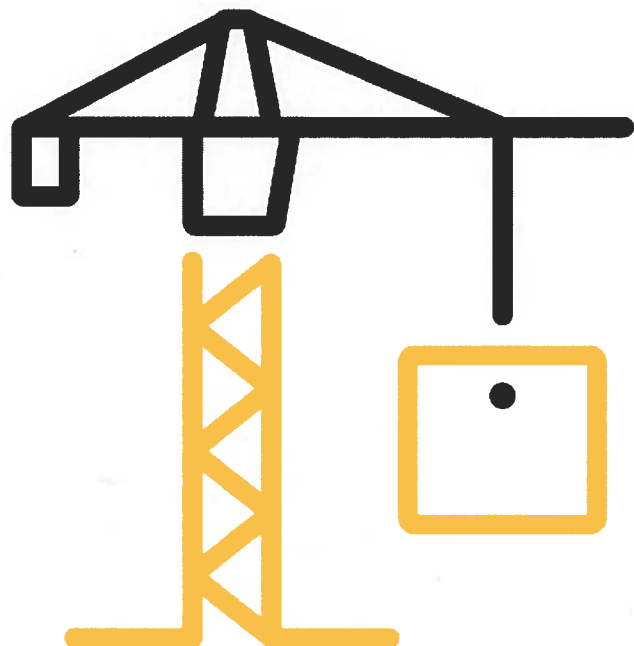
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TEST REPORT FOR FORTRESS RAILING PRODUCTS

Report No.: I6590.02-119-19 R2

Date: 02/18/19

REPORT ISSUED TO FORTRESS RAILING PRODUCTS

1720 North 1st Street
Garland, Texas 75040

SECTION 1 SCOPE

Intertek Building & Construction (B&C) was contracted by Fortress Railing Products to perform structural performance testing in accordance with Section 9.8.8.2 *Loads on Guards* from the 2015 National Building Code of Canada, 2012 Building Code Compendium Ontario, 2018 British Columbia Building Code, Office of Housing and Construction Standards, and 2014 Alberta Building Code for "Guards within dwelling units and exterior guards serving not more than 2 dwelling units", on their 94 in wide by 42 in high *AL13 Home* aluminum guardrail system. 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:

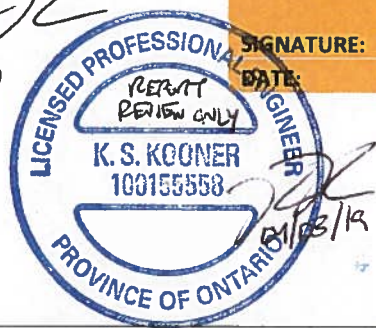
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ECR/vtm:aaS

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SECTION 2

SUMMARY OF TEST RESULTS

The specimen(s) met the performance requirements for the 2015 National Building Code of Canada, Canadian Commission on Building and Fire Codes, the 2012 Building Code Compendium Ontario, the 2018 British Columbia Building Code, Office of Housing and Construction Standards, and the 2014 Alberta Building Code, National Research Code Council for "Guards within dwelling units and exterior guards serving not more than 2 dwelling units" 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 3 in square aluminum post mount	5/8 in square aluminum picket	Continuous and non-continuous
8 ft (94 in) by 42 in AL13 Home with flat top rail cap				Continuous

SECTION 3

TEST METHOD(S)

The specimens were evaluated in accordance with the following:

2015 National Building Code of Canada, Canadian Commission on Building and Fire Codes, Section 9.8.8.2 Loads on Guards

2012 Building Code Compendium Ontario, Section 9.8.8.2 Loads on Guards

2018 British Columbia Building Code, Office of Housing and Construction Standards, Section 9.8.8.2 Loads on Guards

2014 Alberta Building Code, National Research Code Council, Section 9.8.8.2 Loads on Guards

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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. 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

NAME	COMPANY
Kevin Burt	Fortress Railing Products
Kevin Flatt	Fortress Railing Products
Adam J. Schrum	Intertek B&C
Emily C. Riley	Intertek B&C

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.

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2015 NBC / 2018 BCBC / 2012 OBC / 2014 ABC:

Section 9.8.8.2 Loads on Guards

- 1) The minimum specified horizontal load applied inward or outward at the minimum required height of every guard shall be 0.5 kN/m or a concentrated load of 1.0 kN applied at any point.
- 2) Individual elements within the guard, including solid panels and pickets, shall be designed for a concentrated load of 0.5 kN applied over an area of 300 mm x 300 mm located at any point in the element or elements so as to engage 3 balusters.
- 3) The minimum specified load applied vertically at the top of every required guard shall be 1.5 kN/m.
- 4) None of the loads specified above need be considered to act simultaneously.

Note: A safety factor of 2.24 was applied to the above loads.

2015 NBC / 2018 BCBC / 2012 OBC / 2014 ABC: Section 9.8.8.3 Height of Guards

- 1) All guards shall be not less than 1070 mm high.

2015 NBC / 2018 BCBC / 2012 OBC / 2014 ABC: Section 9.8.8.5 Openings in Guards

- 1) Openings through any guard shall be of a size that will prevent the passage of a spherical object having a diameter of 100 mm unless it can be shown that the location and size of openings that exceed this limit do not present a hazard.

2015 NBC / 2012 BCBC / 2018 OBC / 2014 ABC: Section 9.8.8.6 Design of Guards to Not Facilitate Climbing / Guards Designed Not to Facilitate Climbing

- 1) Guards, except those in industrial occupancies and where it can be shown that the location and size of openings do not present a hazard, shall be designed so that no member, attachment or opening facilitates climbing.
- 2) Guards shall be deemed to comply with Sentence (1) where all elements protruding from the vertical and located within the area between 140 mm and 900 mm above the floor or walking surface protected by the guard conform to one of the following clauses:
 - a) they are located more than 450 mm horizontally and vertically, or
 - b) they provide not more than 15 mm horizontal offset,
 - c) they do not provide a toe-space more than 45 mm horizontally and 20 mm vertically, or
 - d) they present more than a 1-in-2 slope on the offset.

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In-Fill Load Test

A load of 0.5 kN was applied using a 300 mm x 300 mm square block on the center of the railing system normal to the in-fill. After release of the load, the system was evaluated for failure, any evidence of disengagements of any component and visible cracks in any component.

Uniform Load Test

A uniform load of 3.0 kN/m (205 plf) was applied vertically to the top of the guardrail system. A uniform load of 0.5 kN/m (34 plf) was applied horizontally to the top of the guardrail system. After release of the load, the system was evaluated for failure, any evidence of disengagements of any component and visible cracks in any component.

Concentrated Load Test

The top of the guardrail system was subjected to a concentrated load of 1.0 kN (495 lbs) which was applied horizontally at the rail midspan and end.

Height of Guards

All railings formed a protective barrier not less than 1070 mm (42 in.) high.

Openings in Guards

All railings had openings that prevented a sphere 4 in. (100 mm) in diameter to pass.

Design to Prevent Climbing

No member, attachment or opening located between 140 mm and 900 mm above the floor or walking surface protected by the guards facilitated climbing.

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TEST SPECIMEN DESCRIPTION

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

PRODUCT	<i>AL13 Home</i>
TYPE	Aluminum guardrail system
OVERALL DIMENSIONS	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)
TOP RAIL (LOWER SECTION)	1-1/8 in high by 1-1/8 in wide by 0.065 in wall aluminum extrusion
TOP RAIL (UPPER SECTION)	1-1/4 in high by 1-1/4 in wide by 0.035 in wall aluminum extrusion
FLAT TOP RAIL CAP	1-5/8 in high by 2-3/8 in wide by 0.070 in wall aluminum extrusion
ROUND TOP RAIL CAP	2-1/16 in high by 2-3/8 in wide by 0.070 in wall contoured aluminum extrusion
TOP RAIL SPACER	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)
BOTTOM RAIL	1-1/4 in high by 1-1/4 in wide by 0.035 in wall aluminum extrusion
PICKETS (IN-FILL)	(5/8 in) square aluminum extrusion with 0.035 in wall
RAIL BRACKETS	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
POST	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
SUPPORT FOOT	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 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
Guards within Dwelling Units / in Not More Than 2-Dwelling Units**

Test No. 1 - 12/20/18

Design Load: 1.5 kN/m x 2.4 m = 3.6 kN Vertical Uniform Load on Top Rail ¹

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 3.6 kN = 8.1 kN (1821 lb)	8.3 kN (1858 lb)	01:16	Achieved Load without Failure

¹ Uniform load was simulated with four equal point loads.

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Test No. 2 - 12/20/18

Design Load: 0.5 kN/m x 2.4 m = 1.2 kN Horizontal Uniform Load on Top Rail ¹

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 1.2 kN = 2.7 kN (607 lb)	2.7 kN (603 lb)	00:52	Achieved Load without Failure

¹ Uniform load was simulated with four equal point loads.

Test No. 3 - 12/20/18

Design Load: 0.5 kN / 300 square mm Area at Center of In-fill

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 0.5 kN = 1.1 kN (247 lb)	1.1 kN (253 lb)	02:17	Achieved Load without Failure

Test No. 4 - 12/20/18

Design Load: 0.5 kN / 300 square mm Area at Bottom of In-fill

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 0.5 kN = 1.1 kN (247 lb)	1.2 kN (278 lb)	02:16	Achieved Load without Failure

Test No. 5 - 12/20/18

Design Load: 1.0 kN Concentrated Load at Ends of Top Rail (Brackets)

LOAD LEVEL ¹	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 1.0 kN = 2.2 kN (495 lb) x 2	4.5 kN(1012 lb)	03:34	Achieved Load without Failure

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

Test No. 6 - 12/20/18

Design Load: 1.0 kN Concentrated Load at Midspan of Top Rail

LOAD LEVEL ¹	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 1.0 kN = 2.2 kN (495 lb)	2.2 kN(500 lb)	02:43	Achieved Load without Failure

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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
Guards within Dwelling Units / in Not More Than 2-Dwelling Units**

Test No. 1 - 12/20/18

Design Load: 0.5 kN/m x 2.4 m = 1.2 kN Horizontal Uniform Load on Top Rail ¹

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 1.2 kN = 2.7 kN (605 lb)	2.7 kN (603 lb)	01:44	Achieved Load without Failure

¹ Uniform load was simulated with four equal point loads.

Test No. 2 - 12/20/18

Design Load: 1.0 kN Concentrated Load at Midspan of Top Rail

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RAIL DISPLACEMENT (in)
2.24 x 1.0 kN = 2.2 kN (495 lb)	2.3 kN (511 lb)	02:32	Achieved Load without Failure

Test No. 3 - 12/20/18

Design Load: 1.5 kN/m x 2.4 m = 3.6 kN Vertical Uniform Load on Top Rail ¹

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 3.6 kN = 8.1 kN (1821 lb)	8.1 kN (1829 lb)	00:59	Achieved Load without Failure

¹ Uniform load was simulated with four equal point loads.

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
Guards within Dwelling Units / in Not More Than 2-Dwelling Units**

Test No. 1 - 12/20/18

Design Load: 1.0 kN Concentrated Load at Midspan of Top Rail

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 1.0 kN = 2.2 kN (495 lb)	2.3 kN (506 lb)	02:30	Achieved Load without Failure

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Test No. 2 - 02/01/19

Design Load: 0.5 kN/m x 2.4 m = 1.2 kN Horizontal Uniform Load on Top Rail

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	RESULT
2.24 x 1.2 kN = 2.7 kN (605 lb)	2.7 kN (608 lb)	01:07	Achieved Load without Failure

¹ Uniform load was simulated with four equal point loads.

Test Series No. 4

2 in Structural Post Mount

Guards within Dwelling Units / in Not More Than 2-Dwelling Units

Test No. 1 - 12/20/18

Design Load: 1 kN, or 0.5 kN/m x 2.4 m = 1.2 kN, whichever is worst
Concentrated Load to Failure at Top of Stand-Alone ¹ Post (42 in high)

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	ULTIMATE LOAD	RESULT
2.24 x 1.2 kN = 2.7 kN (605 lb)	2.7 kN (601 lb)	03:28	2.7 kN (601 lb)	Failure - Screws Sheared

¹ Post was conservatively tested without a railing attached.

Test Series No. 5

3 in Structural Post Mount

Guards within Dwelling Units / in Not More Than 2-Dwelling Units

Test No. 1 - 12/20/18

Design Load: 1 kN, or 0.5 kN/m x 2.4 m = 1.2 kN, whichever is worst
Concentrated Load to Failure at Top of Stand-Alone ¹ Post (42 in high)

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	ULTIMATE LOAD	RESULT
2.24 x 1.2 kN = 2.7 kN (605 lb)	2.7 kN (604 lb)	02:24	3.4 kN (761 lb)	Weld failure

¹ Post was conservatively tested without a railing attached.

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Test No. 2 - 3/15/19

Design Load: 1 kN, or 0.5 kN/m x 2.4 m = 1.2 kN, whichever is worst

Concentrated Load to Failure at Top of Stand-Alone ¹ Post (42 in high)

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	ULTIMATE LOAD	RESULT
2.24 x 1.2 kN = 2.7 kN (605 lb)	2.7 kN (604 lb)	01:27	2.8 kN (636 lb)	Fastener failure (base plate to post tube)

¹ Post was conservatively tested without a railing attached.

Test No. 3 - 3/15/19

Design Load: 1 kN, or 0.5 kN/m x 2.4 m = 1.2 kN, whichever is worst

Concentrated Load to Failure at Top of Stand-Alone ¹ Post (42 in high)

LOAD LEVEL	TEST LOAD	E.T. (min:sec)	ULTIMATE LOAD	RESULT
2.24 x 1.2 kN = 2.7 kN (605 lb)	2.7 kN (604 lb)	01:45	2.6 kN (591 lb)	Material failure (post tube)

¹ Post was conservatively tested without a railing attached.

SECTION 10

CONCLUSION

The 94 in wide by 42 in high AL13 Home railing assemblies and 2 in and 3 in square 42 in high support posts reported herein withstood the required test loads for Guards within Dwelling Units / in Not More Than 2-Dwelling Units for the referenced codes. 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 following tests were omitted by engineering judgement regarding the equivalency of the configurations tested and reported herein:

- Infill load tests and the concentrated load at rail ends were not performed on Test Series No. 2 because the infill and bracket components and their connections to the rails and posts were the same as those tested in Test Series No. 1
- In-fill load tests and the concentrated load at rail ends were not performed on Test Series No. 3 because the infill and bracket components and their connections to the rails and posts were the same as those tested in Test Series No. 1. The vertical uniform load test was not performed on Test Series No. 3 because the configuration in Test Series No 1 supported the vertical uniform load with no rail cap. The rail construction of the two series was identical except for the addition of a flat rail cap in Series No. 3.

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SECTION 11 PHOTOGRAPHS



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



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

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



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

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Photo No. 5

Concentrated Load Test at Top of Stand-Alone Post (42 in high)



Photo No. 6

Vertical Uniform Load on Top Rail

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Photo No. 7
Horizontal Uniform Load on Top Rail



Photo No. 8
Rail-to-Post Connection