Intertek | Architectural Testing

TEST REPORT

Rendered to:

FORTRESS RAILING PRODUCTS

For:

***Al[13] Traditional Aluminum Railing* with**
***Al[13] Evolve External* Brackets and *Al[13] Evolve P2* Brackets**

Report No.: F5647.01-119-19
Report Date: 05/09/16
Test Record Retention Date: 04/07/20
Revision 1: 05/20/16

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Intertek | Architectural Testing

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F5647.01-119-19
May 9, 2016
Revision 1: May 20, 2016

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TEST REPORT

Rendered to:

FORTRESS RAILING PRODUCTS
1720 North 1st Street
Garland, Texas 75040

Report No.:	F5647.01-119-19
Test Dates:	04/04/16
Through:	04/07/16
Report Date:	05/09/16
Test Record Retention Date:	04/07/20
Revision 1:	05/20/16

1.0 General Information

1.1 Product

Al[13] Traditional Aluminum Railing with *Al[13] Evolve External* Brackets and *Al[13] Evolve P2* Brackets

1.2 Project Description

Architectural Testing, Inc., an Intertek company ("Intertek-ATI"), was contracted by Fortress Railing Products to perform structural performance testing on their 8 ft by 42 in *Al[13] Traditional Aluminum Railing* with *Al[13] Evolve External* brackets and *Al[13] Evolve P2* brackets in a level configuration. This report is in conjunction with Intertek-ATI Report No.'s B7787.01-119-19 and D6180.01-119-19, which include structural performance testing of the *Al[13]* post mount and assembly fastener test results respectively. The purpose of the testing is performance testing in accordance with Section 4.2.1 of the following criteria:

> ICC-ES™ AC273 (March 1, 2008 - Editorial Revised January 2012), *Acceptance Criteria for Handrails and Guards*

ICC-ES™ AC273-08 was developed by the ICC Evaluation Service, Inc. (ICC-ES™) as acceptance criteria to evaluate compliance with the following building codes:

> 2012 *International Building Code®*, International Code Council
>
> 2012 *International Residential Code®*, International Code Council

1.3 Limitations

All tests performed were to evaluate structural performance of the railing assembly to carry and transfer imposed loads to the supports (posts). The test specimen evaluated included the pickets, rails, rail brackets, posts, and attachment to the supporting structure. The support posts, at one end, were conventional construction and were included in the test specimen only to facilitate anchorage of the rail brackets. The support posts, at the other end, were *Al*^{13} aluminum post mounts. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

Materials used for testing were not sampled in accordance with Section 2.4 of ICC-ES™ AC273.

1.4 Qualifications

Intertek-ATI in York, Pennsylvania has demonstrated compliance with ISO/IEC International Standard 17025 and is consequently accredited as a Testing Laboratory (TL-144) by International Accreditation Service, Inc. (IAS).

1.5 Product Description

The *Al*^{13} *Traditional Aluminum Railing* is comprised of aluminum rails and pickets which are pre-welded into a panel section and attached to both *Al*^{13} posts and conventional 4x4 treated wood posts using the *Al*^{13} *Evolve External* brackets and *Al*^{13} *Evolve P2* brackets. Test specimens consisted of one product color: Gloss Black. Drawings are included in Appendix A to verify the overall dimensions and other pertinent information of the tested product, its components, and any constructed assemblies.

1.6 Product Sampling

All components utilized for testing reported herein were directly supplied to Intertek-ATI by Fortress Railing Products and were not independently sampled and selected by an independent inspection agency.

1.7 Witnessing

Jeremy Jordan, Kevin Burt, and Kevin Flat of Fortress Railing Products were present on 4/05/16 and 4/06/16 to witness the structural performance testing of assembled railing systems.

1.8 Conditions of Testing

Unless otherwise indicated, all testing reported herein was conducted in a laboratory set to maintain temperature in the range of 68 ± 4ºF and humidity in the range of 50 ± 5% RH.

2.0 Structural Performance Testing of Assembled Railing Systems

Re: ICC-ES™ AC273 - Section 4.2.1

2.1 General

Railing assemblies were tested in a self-contained structural frame designed to accommodate anchorage of a rail assembly and application of the required test loads. The specimen was 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 specimen. Applied load was measured using an electronic load cell located in-line with the loading system. Deflections were measured to the nearest 0.01 in using electronic linear displacement transducers.

2.2 Railing Assembly Description

The *Al[13] Traditional Aluminum Railing* consisted of pre-welded aluminum top and bottom rails with spaced pickets between the rail members. The level (in-line) guardrail systems had an overall top rail length (inside of post to inside of post) of 93-1/8 in and 93-5/8 in with an overall rail height (top of top rail to bottom of bottom rail) of 40 in. Top and bottom rails attached to an aluminum post mount (*Al[13]*) on one end and a conventional 4x4 wood post on the other end via *Al[13] Evolve External* brackets and *Al[13] Evolve P2* brackets. See Section 2.4 Fastening Schedule for connection details. No support block on the bottom rail was used for testing. See drawings in Appendix A and photographs in Appendix B for additional details.

2.3 Series / Model

The scope of testing performed and reported herein was intended to evaluate the *Al[13] Traditional Aluminum Railing* consisting of the following components (see Appendix A for drawings):

Top and Bottom Rails: 1.62 in wide by 1.11 in high by 0.13 in wall extruded rectangular 6063-T5 aluminum profile

Brackets: - *Evolve External* Bracket: 2.08 in wide by 1.29 in high by 1.25 in deep cast aluminum bracket
- *Evolve P2* Bracket: 2.57 in wide by 0.91 in high by 1.42 in deep thick cast aluminum bracket

Balusters: 0.75 in square by 0.06 in wall extruded 6063-T5 aluminum picket; pickets are welded at each end to top and bottom rails

Support Posts: - *Al[13] Post*: 3 in square by 0.16 in wall, 6063-T5 aluminum tube post welded to a nominal 5-1/2 in square by 0.40 in thick 6063-T5 aluminum base plate with four 0.47 in diameter holes with the center of the holes located approximately 5/8 in in from each edge. The center to center spacing of the holes was approximately 4-1/4 in. One 0.98 in diameter hole was located in the center of the base plate. A 3/8" continuous fillet weld connected the tube to the base plate. The post base was surface-mounted to a rigid steel test surface (simulated concrete) as described in Section 2.4 Fastening Schedule.
- Wood Post: Conventional preservative-treated wood (Southern Yellow Pine) 4x4 post in rigid vertical stanchions

See drawings in Appendix A and photographs in Appendix B for additional details.

2.4 Fastening Schedule

Connection	Fastener
Rail Bracket to *Al[13]* Post *	Two #12-24 by 3/4" star-drive, trim-head, thread cutting, carbon steel screws
Top / Bottom Rail Bracket to Rail * *(Evolve P2* Bracket*)*	
Top / Bottom Rail Bracket to Rail * *(Evolve External* Bracket*)*	One #12-24 by 3/4" star-drive, trim-head, thread cutting, carbon steel screws (protected side of deck)
Rail Bracket to Wood Post	Two #12-10 by 2-1/2" (0.154 in minor diameter) star-drive, trim-head screws
Al[13] Post to Substructure (Rigid Steel Channel)	Four 3/8 in Grade 8 hex head bolts with washers

** 3/16 in diameter pre-drill used*

2.5 Test Setup

The railing assembly was installed and tested as a single railing section by directly securing (surface-mounting) the base of the *Al*[13] post mounts to a rigid steel test frame. The conventional 4x4 wood post (Southern Pine) were secured to a rigid test frame. The railing was assembled by an Intertek-ATI technician. Transducers mounted to an independent reference frame were located to record movement of reference points on the railing system components (ends and mid-point) to determine net component deflections. See photographs in Appendix B for test setups.

2.6 Test Procedure

Testing and evaluation was performed in accordance with Section 4.2.1 of ICC-ES™ AC273. The 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. One specimen was used for all load tests which were performed in the order reported. Each design load test was performed using the following procedure:

1. Zeroed transducers and load cell at zero load;
2. Increased load to specified test load in no less than ten seconds; and
3. Held test load for no less than one minute.

2.7 Test Results

Unless otherwise noted, all loads and displacement measurements were normal to the rail (horizontal). The test results apply only to the railing assembly between supports and anchorage to the support.

Key to Test Results Tables:

Load Level: Target test load

Test Load: Actual applied load at the designated load level (target). Where more than one value is reported, the test load was the range (min. - max.) that was held during the time indicated in the test.

Elapsed Time (E.T.): The amount of time into the test with zero established at the beginning of the loading procedure. Where more than one value is reported, the time was the range (start-end) that the designated load level was reached and sustained.

2.7 Test Results (Continued)

Test Series No. 1
93-5/8 in by 42 in *Al[13] Traditional Aluminum Railing* (In-Line Application)
Utilizing *Al[13] Evolve External* Brackets Attached to *Al[13]* Post at One End
and Preservative Treated (SYP) 4x4 Wood Post at the Other End
IBC – All Use Groups / ICC-ES™ AC273

Specimen No. 1 of 3

Test No. 1 - Test Date: 04/04/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	126 - 129	00:27 - 01:30	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 04/04/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	132 - 135	00:14 - 01:16	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 04/04/16 **Design Load: 50 plf x (93-5/8 in ÷ 12 in/ft) = 390 lb Uniform Load at 45º from Horizontal on Top Rail [1]**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
975 lb (2.50 x D.L.)	976 - 982	01:11 - 02:17	Withstood load equal to or greater than 975 lb without failure

[1] *Uniform load was simulated with quarter point loading.*

2.7 Test Results (Continued)

Test Series No. 2 (Continued)

Specimen No. 1 of 3 (Continued)

Test No. 4 - Test Date: 04/04/16 **Design Load: 200 lb Concentrated Load at Mid-Span of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	201	00:41	0.03	1.36	0.20	1.25
500 lb (2.50 x D.L.)	499 - 508	01:12 - 02:16	**Result [2]**: Withstood load equal to or greater than 500 lb for one full minute without failure			
Deflection Evaluation: Maximum rail deflection at 201 lb = 1.25 in on an 8 ft rail (93.625 in) Limits per AC273: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.625}{96}\right)=2.73">1.25"\therefore$ ok and $\frac{h}{12}=\frac{42}{12}=3.50">1.25"\therefore$ ok						

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

[2] *The load fell below the target load for 1 second throughout the duration of the test.*

Test No. 5 - Test Date: 04/04/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1001 - 1016	00:39 - 01:42	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

Test No. 6 - Test Date: 04/04/16 **Design Load: 200 lb Concentrated Load at Top of Post Mount (42 in High)**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**
200 lb (D.L.)	200	00:24	0.42
Ultimate Load	713	01:18	**Failure Mode**: Weld broke
Deflection Evaluation: Maximum post deflection at 200 lb = 0.42 in on a 42 in high post Limits per AC273: $\frac{h}{12}=\frac{42}{12}=3.0">0.42"\therefore$ ok			

2.7 Test Results (Continued)

Test Series No. 3 (Continued)

Specimen No. 2 of 3

Test No. 1 - Test Date: 04/05/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	128 - 139	00:47 - 01:51	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 04/05/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	125 - 132	00:38 - 01:40	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 – Test Date: 04/05/16 **Design Load: 50 plf x (93-5/8 in ÷ 12 in/ft) = 390 lb Uniform Load at 45º from Horizontal on Top Rail [1]**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
975 lb (2.50 x D.L.)	976 - 985	00:49 - 01:52	Withstood load equal to or greater than 975 lb without failure

[1] *Uniform load was simulated with quarter point loading.*

2.7 Test Results (Continued)

Test Series No. 4 (Continued)

Specimen No. 2 of 3 (Continued)

Test No. 4 - Test Date: 04/05/16 **Design Load: 200 lb Concentrated Load at Mid-Span of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	200	00:23	0.03	1.33	0.22	1.21
500 lb (2.50 x D.L.)	502 - 509	00:46 - 01:49	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			
Deflection Evaluation: Maximum rail deflection at 200 lb = 1.21 in on an 8 ft rail (93.625 in) Limits per AC273: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.625}{96}\right)=2.73">1.21"\therefore$ ok and $\frac{h}{12}=\frac{42}{12}=3.50">1.21"\therefore$ ok						

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

Test No. 5 - Test Date: 04/05/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1001 - 1017	00:40 - 01:42	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

Test No. 6 - Test Date: 04/05/16 **Design Load: 200 lb Concentrated Load at Top of Post Mount (42 in High)**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**
200 lb (D.L.)	204	00:14	0.43
Ultimate Load	643	00:41	**Failure Mode**: Weld broke
Deflection Evaluation: Maximum post deflection at 204 lb = 0.43 in on a 42 in high post Limits per AC273: $\frac{h}{12}=\frac{42}{12}=3.50">0.43"\therefore$ ok			

2.7 Test Results (Continued)

Test Series No. 5 (Continued)

Specimen No. 3 of 3

Test No. 1 - Test Date: 04/05/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	126 - 133	00:40 - 01:43	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 04/05/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	131 - 136	00:45 - 01:46	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 04/05/16 **Design Load: 50 plf x (93-5/8 in ÷ 12 in/ft) = 390 lb Uniform Load at 45º from Horizontal on Top Rail [1]**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
975 lb (2.50 x D.L.)	976 - 984	00:54 - 01:57	Withstood load equal to or greater than 975 lb without failure

[1] *Uniform load was simulated with quarter point loading.*

2.7 Test Results (Continued)

Test Series No. 6 (Continued)

Specimen No. 3 of 3 (Continued)

Test No. 4 - Test Date: 04/05/16 **Design Load: 200 lb Concentrated Load at Mid-Span of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	202	00:23	0.03	1.29	0.23	1.16
500 lb (2.50 x D.L.)	503 - 514	00:42 - 01:45	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			
Deflection Evaluation: Maximum rail deflection at 202 lb = 1.16 in on an 8 ft rail (93.625 in) Limits per AC273: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.625}{96}\right)=2.73">1.16"\therefore$ ok and $\frac{h}{12}=\frac{42}{12}=3.50">1.16"\therefore$ ok						

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

Test No. 5 - Test Date: 04/05/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1000 - 1017	00:36 - 01:41	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

Test No. 6 - Test Date: 04/05/16 **Design Load: 200 lb Concentrated Load at Top of Post Mount (42 in High)**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**
200 lb (D.L.)	202	00:25	0.45
Ultimate Load	699	01:03	**Failure Mode**: Weld Broke
Deflection Evaluation: Maximum post deflection at 202 lb = 0.45 in on a 42 in high post Limits per AC273: $\frac{h}{12}=\frac{42}{12}=3.50">0.45"\therefore$ ok			

2.7 Test Results (Continued)

Test Series No. 2
93-1/8 in by 42 in *Al[13] Traditional Aluminum Railing* (In-Line Application)
Utilizing *P2* Brackets Attached to *Al[13]* Post at One End
and Preservative Treated (SYP) 4x4 Wood Post at the Other End
IBC – All Use Groups / ICC-ES™ AC273

Specimen No. 1 of 3

Test No. 1 - Test Date: 04/05/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	125 - 132	00:39 - 01:37	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 04/05/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	125 - 137	00:19 - 01:26	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 04/05/16 **Design Load: 50 plf x (93-1/8 in ÷ 12 in/ft) = 388 lb Uniform Load at 45º from Horizontal on Top Rail [1]**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
970 lb (2.50 x D.L.)	973 - 980	01:03 - 02:06	Withstood load equal to or greater than 970 lb without failure

[1] *Uniform load was simulated with quarter point loading.*

2.7 Test Results (Continued)

Test Series No. 2 (Continued)

Specimen No. 1 of 3 (Continued)

Test No. 4 - Test Date: 04/05/16 **Design Load: 200 lb Concentrated Load at Mid-Span of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	200	00:38	0.03	1.27	0.20	1.16
500 lb (2.50 x D.L.)	502 - 510	01:11 - 02:14	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			
Deflection Evaluation: Maximum rail deflection at 200 lb = 1.16 in on an 8 ft rail (93.125 in) Limits per AC273: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.125}{96}\right)=2.72">1.16"\therefore$ ok and $\frac{h}{12}=\frac{42}{12}=3.50">1.16"\therefore$ ok						

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

Test No. 5 - Test Date: 04/05/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1003 - 1020	00:46 - 01:50	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

2.7 Test Results (Continued)

Test Series No. 2 (Continued)

Specimen No. 2 of 3

Test No. 1 - Test Date: 04/07/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	127 - 137	00:20 - 01:23	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 04/07/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	127 - 136	00:12 - 01:16	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 04/07/16 **Design Load: 50 plf x (93-1/8 in ÷ 12 in/ft) = 388 lb Uniform Load at 45º from Horizontal on Top Rail [1]**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
970 lb (2.50 x D.L.)	971 - 984	01:01 - 02:04	Withstood load equal to or greater than 970 lb without failure

[1] *Uniform load was simulated with quarter point loading.*

2.7 Test Results (Continued)

Test Series No. 2 (Continued)

Specimen No. 2 of 3 (Continued)

Test No. 4 - Test Date: 04/07/16 **Design Load: 200 lb Concentrated Load at Mid-Span of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	201	00:28	0.05	1.23	0.23	1.09
500 lb (2.50 x D.L.)	500 - 510	00:58 - 02:02	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			

Deflection Evaluation:

Maximum rail deflection at 201 lb = 1.09 in on an 8 ft rail (93.125 in)

Limits per AC273: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.125}{96}\right)=2.72">1.09"\therefore$ ok and $\frac{h}{12}=\frac{42}{12}=3.50">1.09"\therefore$ ok

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

Test No. 5 - Test Date: 04/07/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1000 - 1011	00:43 - 01:45	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

2.7 Test Results (Continued)

Test Series No. 2 (Continued)

Specimen No. 3 of 3

Test No. 1 - Test Date: 04/07/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	126 - 130	00:52 - 01:56	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 04/07/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
125 lb (2.50 x D.L.)	131 - 141	00:35 - 01:39	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 04/07/16 **Design Load: 50 plf x (93-1/8 in ÷ 12 in/ft) = 388 lb Uniform Load at 45º from Horizontal on Top Rail [1]**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
970 lb (2.50 x D.L.)	972 - 986	01:13 - 02:16	Withstood load equal to or greater than 970 lb without failure

[1] *Uniform load was simulated with quarter point loading.*

2.7 Test Results (Continued)

Test Series No. 2 (Continued)

Specimen No. 3 of 3 (Continued)

Test No. 4 - Test Date: 04/07/16 **Design Load: 200 lb Concentrated Load at Mid-Span of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	200	00:37	0.04	1.27	0.24	1.13
500 lb (2.50 x D.L.)	503 - 510	01:09 - 02:13	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			

Deflection Evaluation:

Maximum rail deflection at 200 lb = 1.13 in on an 8 ft rail (93.125 in)

Limits per AC273: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.125}{96}\right)=2.72">1.13"\therefore$ ok and $\frac{h}{12}=\frac{42}{12}=3.50">1.13"\therefore$ ok

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

Test No. 5 - Test Date: 04/07/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1001 - 1016	00:33 - 01:36	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

2.8 Summary and Conclusions

When installed between adequate supports, the railing assemblies reported herein meet the structural performance requirements of Section 4.2.1 of ICC-ES™ AC273 with guardrail details and Occupancy Classification as shown in the following table:

Al[13] Traditional Aluminum Railing	Guardrail Type	Bracket Type	Support Posts	Code Occupancy Classification
8 ft by 42 in	Level / In-Line Application	*Al[13] Evolve External* Bracket	*Al[13] Post* (Simulated Concrete Application) or Preservative Treated (Southern Pine) 4x4 Wood Posts	IBC – All Use Groups
8 ft by 42 in		*Al[13] Evolve P2* Bracket		

Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

***Al[13]* Post Mount Test Summary**

Sample No.	Ultimate Load (lb)	Deviation From Average	Mode of Failure
1	713	4.1%	Weld failure at base of post mount
2	643	-6.1%	
3	699	2.0%	
Average	**685**		
Allowable Span [1] *(center-to-center of posts)*	**5.5 ft**		

[1] *Average ultimate load divided by 125 plf*

Based on the average ultimate loads achieved from testing, the maximum rail length that the *Al[13]* post mount can support is 5.5 ft (center-to-center of posts) for IBC - All Use Groups code occupancy classifications.

3.0 Closing Statement

Intertek-ATI will service this report for the entire test record retention period. Test records that are retained such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation will be retained by Intertek-ATI for the entire test record retention period.

Results obtained are tested values and were secured using the designated test methods. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to the specimens tested. This report may not be reproduced, except in full, without the written approval of Intertek-ATI.

For INTERTEK-ATI:

Digitally Signed by: Emily C. Riley

Emily C. Riley
Project Manager

Digitally Signed by: Virgal Thomas Mickley, Jr.

Virgal T. Mickley, Jr., P.E.
Senior Project Manager

ECR:vtm/jas

Attachments (pages): This report is complete only when all attachments listed are included.
Appendix A - Drawings (8)
Appendix B - Photographs (4)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	05/09/16	N/A	Original report issue
1	05/20/16	Appendix A	Updated drawings

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

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

Photo No. 3
Uniform Load Test at 45º from Horizontal on Top Rail

Photo No. 4
Concentrated Load Test at Mid-Span of Top Rail

Photo No. 5
Concentrated Load Test at End of Top Rail (Brackets)

Photo No. 6
Concentrated Load Test at Top of Stand Alone Post Mount

Photo No. 7
Rail Bracket to Post Connection (*Evolve P2 Bracket*)

Photo No. 8
Rail Bracket to Post Connection (*Evolve External Brackets*)

TEST REPORT

REPORT NUMBER: 101536549COQ-001
ORIGINAL ISSUE DATE: April 1, 2014

EVALUATION CENTER

INTERTEK TESTING SERVICES NA LTD.
1500 BRIGANTINE DRIVE
COQUITLAM, BC V3K 7C1

RENDERED TO

FORTRESS RAILING PRODUCTS
1800 JAY ELL DRIVE SUITE 200
RICHERSON, TX 75081

PRODUCT EVALUATED: P2 and Evolve External Brackets

EVALUATION PROPERTY: Load Requirements

Report of P2 and Evolve External Brackets for compliance with the applicable requirements of the following criteria:

- **2010 *National Building Code of Canada***
  - **Section 9.8.8.2, 9.8.8.3, 9.8.8.5, and 9.8.8.6**
- **2012 *Ontario Building Code***
  - **Section 9.8.8.2, 9.8.8.3, 9.8.8.5, and 9.8.8.6**
- **2006 *Alberta Building Code***
  - **Section 9.8.8.2, 9.8.8.3, 9.8.8.5, and 9.8.8.6**

1 Table of Contents

2 Introduction

Intertek Testing Services NA Ltd. (Intertek) has conducted a test program on two railing brackets submitted by Fortress Railing Products. The evaluation was carried out to determine whether their AL[13] Aluminum Railing when installed with different bracket configurations would resist the required loads for dwelling units and exterior guards serving not more than 2 dwelling units, as specified in the following Building Codes:

- 2010 *National Building Code of Canada* (NBC)
  - Section 9.8.8.2, *Loads On Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Design of Guards to Not Facilitate Climbing*
- 2012 Ontario Building Code (OBC)
  - Section 9.8.8.2, *Loads On Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Guards Designed Not to Facilitate Climbing*
- 2006 Alberta Building Code (ABC)
  - Section 9.8.8.2, *Loads On Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Design to Prevent Climbing*

This evaluation was conducted in the month of March 2014.

3 Test Samples

3.1. SAMPLE SELECTION

The client submitted various railing components to assemble two (2) 8 ft. guard rail systems to the Evaluation Center on February 18, 2014 (Coquitlam ID# VAN1402181510-001). Components submitted were brackets, posts, and welded pickets with top and bottom rails.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The assembled railing systems were identified as the following:

Table 1. Railing Details

Railing	Posts	Mounting Plate	Picket and Rails	Brackets
8 ft. AI[13] Railing System	1: 3" x 3" aluminum 2: 4" x 4" treated Western Red Cedar	5-1/2" x 5-1/2" x 3/8" thick aluminum	3/4" x 3/4" aluminum pickets welded to 1-5/8" x 1-1/8" top and bottom rails	P2
8 ft. AI[13] Railing System	1: 3" x 3" aluminum 2: 4" x 4" treated Western Red Cedar	5-1/2" x 5-1/2" x 3/8" thick aluminum	3/4" x 3/4" aluminum pickets welded to 1-5/8" x 1-1/8" top and bottom rails	Evolve External

An Intertek representative assembled the railing per the manufacturer's installation instructions using the configuration details outlined for a 40 in. Railing Panel Height (refer to Appendix B for installation instructions). Per the client's request, the railing was assembled using a 4 in. x 4 in. treated Western Red Cedar post on one end, which was restrained during testing to evaluate the

connection. The post to sub-structure fastener evaluation was not evaluated in this report; the aluminum post was mounted to a test frame using four 3/8 in. Grade 5 bolts.

Refer to Figures 1 and 2 below for the P2 and Evolve External Brackets.

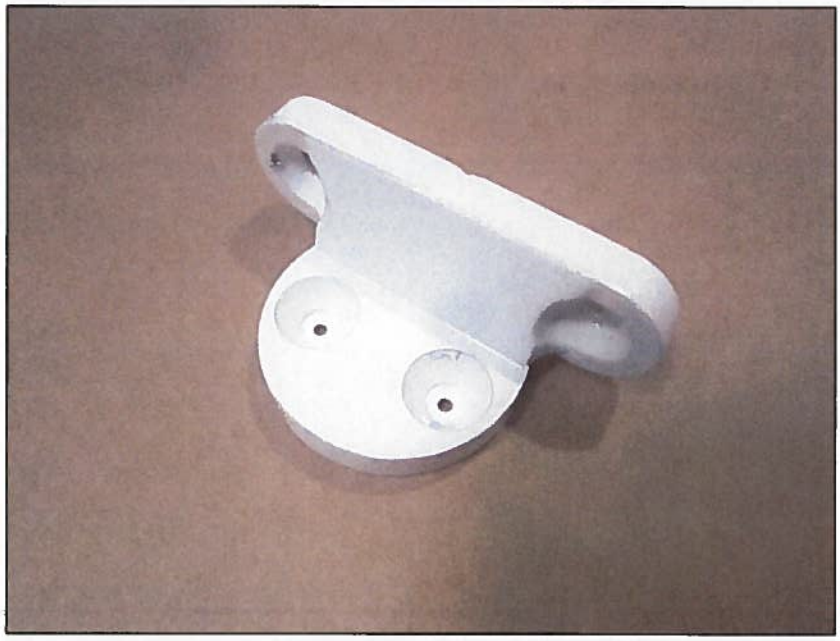

Figure 1. P2 Bracket

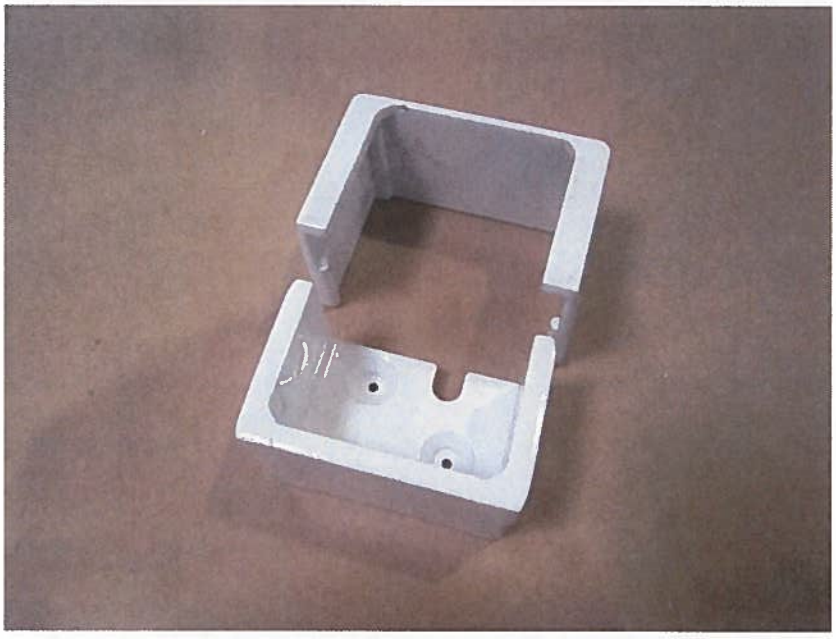

Figure 2. Evolve External Bracket

4 Testing and Evaluation Methods

The test specimens were loaded at a rate to achieve the specified loads between 10 seconds and 5 minutes. The specified test loads were held for one minute before the load was released. As per Section 9.8.8.2 of the 2010 NBC, 2012 OBC, and 2006 ABC, the following tests were conducted for use within dwelling units and exterior guards serving not more than 2 dwelling units:

4.1 2010 NBC / 2012 OBC / 2006 ABC: SECTION 9.8.8.2. *LOADS ON GUARDS*

1) The minimum specified horizontal load applied inward or outward at the top of every required 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.

Notes:

1. A minimum safety factor of 1.67 is applicable to the above loads.

4.2 2010 NBC / 2012 OBC / 2006 ABC: SECTION 9.8.8.3 *HEIGHT OF GUARDS*

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

4.3 2010 NBC / 2012 OBC / 2006 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.

4.4 2010 NBC / 2012 OBC / 2006 ABC: SECTION 9.8.8.6 *DESIGN OF GUARDS TO NOT FACILITATE CLIMBING / DESIGN TO PREVENT 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 450mm horizontally and 20 mm vertically, or
b) they provide not more than 15 mm horizontal offset,
c) they do not provide a toe-space more than 45mm horizontally and 20 mm vertically, or
d) they present more than a 2-in-1 slope on the offset.

4.5 IN-FILL LOAD TEST

A load of 1.25 kN (281 lbf) was applied using a 300 mm x 300 mm square block on the center of the railing system normal to the in-fill so as to engage 3 glass balusters. After release of the load, the system was evaluated for failure, any evidence of disengagements of any component and visible cracks in any component.

4.6 UNIFORM LOAD TEST

The top rail of the guardrail system was subjected to two separate tests where a maximum equivalent uniform load of 1.25 kN/m (86 plf) was applied horizontally and 3.75 kN/m (257 plf) was applied vertically. The loads were applied using quarter point loads. After release of the load, the system was evaluated for failure, any evidence of disengagements of any component and visible cracks in any component.

4.7 CONCENTRATED LOAD TEST

The top rail of the guardrail system was subjected to three separate tests where a concentrated load was applied at the following locations:

- 1.67 kN (375 lbs) horizontally at the centre of the guardrail.
- 1.88 kN (421 lbs) horizontally at the top rail adjacent to the aluminum post connection to verify the connection capacity
- 2.5 kN (562 lbs) horizontally at the top rail adjacent to the wood post connection to verify the connection capacity

5 Testing and Evaluation Results

5.1. RESULTS AND OBSERVATIONS

The product test results are shown in Tables 1-2 below and a copy of the test data is located in Appendix A.

Table 1. P2 Bracket

Section	Property	Result	Requirement	Pass/Fail
9.8.8.2	In-fill Load	281 lbs	281 lbs	Pass
	Vertical Uniform Load	2060 lbs	2060 lbs	Pass
	Horizontal Uniform Load	687 lbs	687 lbs	Pass
	Mid-span Concentrated Load	375 lbs	375 lbs	Pass
	Adjacent to Aluminum Post Connection Concentrated Load	421 lbs	421 lbs	Pass
	Adjacent to Wood Post Connection Concentrated Load	562 lbs	562 lbs	Pass
9.8.8.3	Height of Guards	1105 mm	≥ 1070 mm	Pass
9.8.8.5	Openings in Guards	Between pickets: 95 mm Under bottom rail: 89 mm	< 100 mm	Pass
9.8.8.6	Design to Not Facilitate Climbing	No elements protruding from the vertical between 140 mm and 900 mm	No elements from the vertical between 140 mm and 900 mm that facilitate climbing	Pass

Table 1. Evolve External Bracket				
Section	**Property**	**Result**	**Requirement**	**Pass/Fail**
9.8.8.2	In-fill Load	281 lbs	281 lbs	Pass
	Vertical Uniform Load	2060 lbs	2060 lbs	Pass
	Horizontal Uniform Load	687 lbs	687 lbs	Pass
	Mid-span Concentrated Load	375 lbs	375 lbs	Pass
	Adjacent to Aluminum Post Connection Concentrated Load	421 lbs	421 lbs	Pass
	Adjacent to Wood Post Connection Concentrated Load	562 lbs	562 lbs	Pass
9.8.8.3	Height of Guards	1105 mm	≥ 1070 mm	Pass
9.8.8.5	Openings in Guards	Between pickets: 95 mm Under bottom rail: 89 mm	< 100 mm	Pass
9.8.8.6	Design to Not Facilitate Climbing	No elements protruding from the vertical between 140 mm and 900 mm	No elements from the vertical between 140 mm and 900 mm that facilitate climbing	Pass

6 Conclusion

The Fortress Railing Products P2 and Evolve External Brackets identified in this test report has complied with the load requirements for guards within dwelling units and in exterior guards serving not more than 2 dwelling units, as specified in the following Building Codes:

- 2010 *National Building Code of Canada* (NBC)
  - Section 9.8.8.2, *Loads On Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Design of Guards to Not Facilitate Climbing*
- 2012 Ontario Building Code (OBC)
  - Section 9.8.8.2, *Loads On Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Guards Designed Not to Facilitate Climbing*
- 2006 Alberta Building Code (ABC)
  - Section 9.8.8.2, *Loads On Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Design to Prevent Climbing*

The product test results are presented in Section 5 of this report.

INTERTEK TESTING SERVICES NA LTD.

Reported by: _____
Chris Chang, P.Eng.
Engineer, Building Products

04/03/2014

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D. G. LUNGU
28490

04/03/2014

PROFESSIONAL ENGINEER ALBERTA
DAN G. LUNGU

Reviewed by: _____
Dan Lungu, P. Eng.
Engineer, Manufactured Housing

Reviewed by: _____
Kal Kooner, P. Eng.
Manager, Building Products

LICENCED PROFESSIONAL ENGINEER
K. S. KOONER
100196560
PROVINCE OF ONTARIO

04/04/14

APPENDIX A: Test Data (5 pages)

Company	Fortress Railing Products	Technician(s)	Kevin Penner / Paul Randhawa
Project No	G101536549	Reviewer	Riccardo DeSantis
Models	P2 Bracket, Evolve External Bracket	Start/End Date	March 5-7, 2014
Product Name	AL[13] Railing System	Sample ID	VAN1402181510-001
Standard	**2010 NBC/2012 OBC/2006 ABC, Section 9.8.8.2, 9.8.8.3, 9.8.8.5, 9.8.8.6**		

Test Data Package

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Intertek

Test:	**Loads on Guards**	Project:	G101536549
Date:	5-Mar-14	Eng/Tech:	Paul Randhawa
Client:	Fortress Railing Products	Reviewer:	Riccardo DeSantis
Product:	**AL[13] Railing System with P2 Bracket**		
Post Spacing:	8 ft	2.44 m	
Height of Guard:	42 in	1067 mm	
Opening in Guard:	3.875 in	98 mm	

Method: 2010 National Building Code of Canada, 9.8.8.2 Loads on Guards
2012 Ontario Building Code, 9.8.8.2 Loads on Guards
2006 Alberta Building Code, 9.8.8.2 Loads on Guards

Safety Factor: 1.67 (based on a resistance factor Ø = 0.9 for aluminum)
1.875 (based on a resistance factor Ø = 0.8 for shear connection)
2.50 (based on a resistance factor Ø = 0.6 for aluminum to wood connection)

Equipment: Artech 5000 lbf Load Cell (Intertek ID# 9-0343, cal due October 2014)
Vaisala Temp/RH Indicator (Intertek ID# 9-0176, cal due July 2014)
Stopwatch (Intertek ID# P60624, cal due July 23, 2014)
Mitutoyo 2 in. Digital Deflection Gauge (Intertek ID# P60024, cal due May 1, 2014)
Mitutoyo Digital Caliper (Intertek ID# P52626, cal due May 1, 2014)

Time/Temp/RH: 12:05PM / 24.2°C / 48.0%

Direction	Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Deflections (in.)	Pass/Fail
Outward	Individual Elements (over 12 in. x 12 in.)	112	281	-	-	281	1.355	**Pass**
	Vertical Uniform Load (per ft)	103	257	2066	1030	2060	3.405	**Pass**
	Horizontal Uniform Load (per ft)	34	86	689	343	687	3.232	**Pass**
	Midspan Horizontal Concentrated Load	225	375	-	-	375	2.638	**Pass**
	Top Rail Adjacent to Connection Concentrated Load	225	421	-	-	421	2.677	**Pass**
	Top Rail Adjacent to Wood Connection Concentrated Load	225	562	-	-	562	0.237	**Pass**

Direction	Test	Design Load (Inward/ Outward) (kN)	Factored Load	Calculated Moment (kNm)	Equivalent Quarter-Point Load (kN)	Required Proof Load (kN)	Deflections (mm)	Pass/Fail
Outward	Individual Elements (over 300 mm in. x 300 mm)	0.5	1.25	-	-	1.25	34.4	**Pass**
	Vertical Uniform Load (per m)	1.5	3.75	2.80	4.58	9.17	86.5	**Pass**
	Horizontal Uniform Load (per m)	0.5	1.25	0.93	1.53	3.06	82.1	**Pass**
	Midspan Horizontal Concentrated Load	1	1.67	-	-	1.67	67.0	**Pass**
	Top Rail Adjacent to Connection Concentrated Load	1	1.88	-	-	1.88	68.0	**Pass**
	Top Rail Adjacent to Wood Connection Concentrated Load	1	2.50	-	-	2.50	6.0	**Pass**

Test:	**Dimensional Checks**		Project:	G101536549
Date:	5-Mar-14		Eng/Tech:	Chris Chang
Client:	Fortress Railing Products		Reviewer:	Riccardo DeSantis
Product:	**AL^{13} Railing System with P2 Bracket**			
Post Spacing:	8.0	ft	2.44	m
Height of Guard:	43.5	in	1105	mm
Opening in Guard:	3.75	in	95	mm

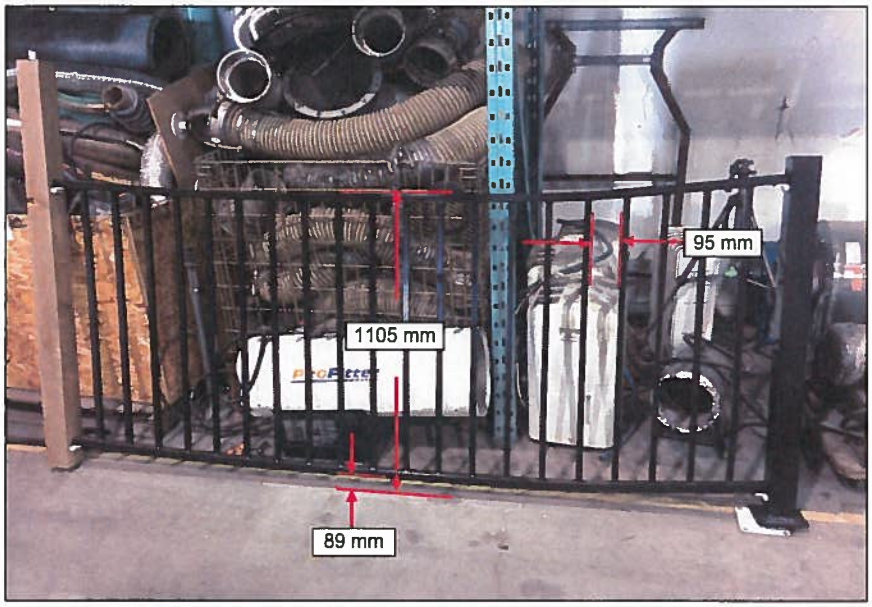
Method:
2010 National Building Code of Canada
2012 Ontario Building Code
2006 Alberta Building Code
9.8.8.3 Height of Guards
9.8.8.5 Openings in Guards
9.8.8.6 Design of Guards to Not Facilitate Climbing / Guards Designed Not to Facilitate Climbing / *Design to Prevent Climbing*

Time/Temp./RH: 12:05PM / 24.2℃ / 48.0%

Equipment: Vaisala Temp/RH Indicator (Intertek ID# 9-0176, cal due July 2014)
Tape Measure (Intertek ID# P60494, cal due August 2014)

Description		Measured Dimension (mm)	Requirement (mm)	Pass/Fail
9.8.8.3 Height of Guards		1105	≥ 1070	Pass
9.8.8.5 Openings in Guards	Between Pickets	95	< 100	Pass
	Under Bottom Rail	89	< 100	Pass

Description	Result	Requirement	Pass/Fail
9.8.8.6 Design of Guards to Not Facilitate Climbing / Guards Designed Not to Facilitate Climbing	No elements protruding from the vertical between 140 mm and 900 mm that facilitate climbing	No elements protruding from the vertical between 140 mm and 900 mm that facilitate climbing	Pass



Intertek

Test:	**Loads on Guards**	Project:	G101536549
Date:	7-Mar-14	Eng/Tech:	Paul Randhawa
Client:	Fortress Railing Products	Reviewer:	Riccardo DeSantis
Product:	**AL[13] Railing System with Evolve External Bracket**		
Post Spacing:	8 ft 2.44 m		
Height of Guard:	42 in 1067 mm		
Opening in Guard:	3.875 in 98 mm		
Method:	2010 National Building Code of Canada, 9.8.8.2 Loads on Guards		
	2012 Ontario Building Code, 9.8.8.2 Loads on Guards		
	2006 Alberta Building Code, 9.8.8.2 Loads on Guards		
Safety Factor:	1.67 (based on a resistance factor Ø = 0.9 for aluminum)		
	1.875 (based on a resistance factor Ø = 0.8 for shear connection)		
	2.50 (based on a resistance factor Ø = 0.6 for aluminum to wood connection)		
Equipment:	Artech 5000 lbf Load Cell (Intertek ID# 9-0343, cal due October 2014)		
	Vaisala Temp/RH Indicator (Intertek ID# 9-0176, cal due July 2014)		
	Stopwatch (Intertek ID# P60624, cal due July 23, 2014)		
	Mitutoyo 2 in. Digital Deflection Gauge (Intertek ID# P60024, cal due May 1, 2014)		
	Mitutoyo Digital Caliper (Intertek ID# P52626, cal due May 1, 2014)		
Time/Temp/RH:	9:05AM / 22.3℃ / 47.0%		

Direction	Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Deflections (in.)	Pass/Fail
Outward	Individual Elements (over 12 in. x 12 in.)	112	281	-	-	281	1.318	**Pass**
	Vertical Uniform Load (per ft)	103	257	2066	1030	2060	3.388	**Pass**
	Horizontal Uniform Load (per ft)	34	86	689	343	687	3.366	**Pass**
	Midspan Horizontal Concentrated Load	225	375	-	-	375	2.488	**Pass**
	Top Rail Adjacent to Connection Concentrated Load	225	421	-	-	421	1.773	**Pass**
	Top Rail Adjacent to Wood Connection Concentrated Load	225	562	-	-	562	0.240	**Pass**

Direction	Test	Design Load (Inward/ Outward) (kN)	Factored Load	Calculated Moment (kNm)	Equivalent Quarter-Point Load (kN)	Required Proof Load (kN)	Deflections (mm)	Pass/Fail
Outward	Individual Elements (over 300 mm in. x 300 mm)	0.5	1.25	-	-	1.25	33.5	**Pass**
	Vertical Uniform Load (per m)	1.5	3.75	2.80	4.58	9.17	86.1	**Pass**
	Horizontal Uniform Load (per m)	0.5	1.25	0.93	1.53	3.06	85.5	**Pass**
	Midspan Horizontal Concentrated Load	1	1.67	-	-	1.67	63.2	**Pass**
	Top Rail Adjacent to Connection Concentrated Load	1	1.88	-	-	1.88	45.0	**Pass**
	Top Rail Adjacent to Wood Connection Concentrated Load	1	2.50	-	-	2.50	6.1	**Pass**

Test:	**Dimensional Checks**		Project:	G101536549
Date:	7-Mar-14		Eng/Tech:	Chris Chang
Client:	Fortress Railing Products		Reviewer:	Riccardo DeSantis
Product:	**AL[13] Railing System with Evolve External Bracket**			
Post Spacing:	8.0	ft	2.44	m
Height of Guard:	43.5	in	1105	mm
Opening in Guard:	3.75	in	95	mm

Method:
2010 National Building Code of Canada
2012 Ontario Building Code
2006 Alberta Building Code
9.8.8.3 Height of Guards
9.8.8.5 Openings in Guards
9.8.8.6 Design of Guards to Not Facilitate Climbing / Guards Designed Not to Facilitate Climbing / *Design to Prevent Climbing*

Time/Temp./RH: 9:05AM / 22.3°C / 47.0%

Equipment:
Vaisala Temp/RH Indicator (Intertek ID# 9-0176, cal due July 2014)
Tape Measure (Intertek ID# P60494, cal due August 2014)

Description		Measured Dimension (mm)	Requirement (mm)	Pass/Fail
9.8.8.3 Height of Guards		1105	≥ 1070	Pass
9.8.8.5 Openings in Guards	Between Pickets	95	< 100	Pass
	Under Bottom Rail	89	< 100	Pass

Description	Result	Requirement	Pass/Fail
9.8.8.6 Design of Guards to Not Facilitate Climbing / Guards Designed Not to Facilitate Climbing	No elements protruding from the vertical between 140 mm and 900 mm that facilitate climbing	No elements protruding from the vertical between 140 mm and 900 mm that facilitate climbing	Pass