

FORTRESS RAILING PRODUCTS TEST REPORT

SCOPE OF WORK

ICC-ES AC273 TESTING ON 8 FT BY 40 IN HORIZONTAL CABLE GUARDRAIL SYSTEM FE26 3" × 45.5" ROBOT WELDED POST

REPORT NUMBER

180315013SHF-BP-3

TEST DATE(S)

03/23/18 - 04/09/18

ISSUE DATE

08/29/18

PAGES

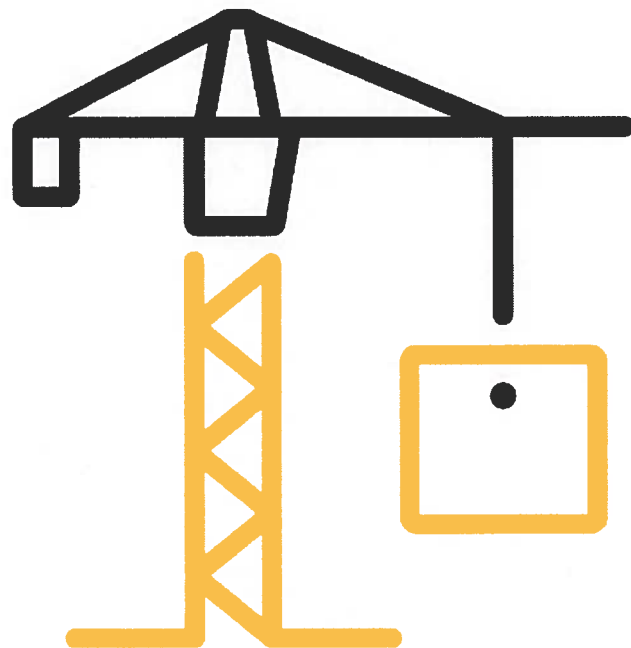
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Plant 5, No. 6958 Daye Road, Fengxian District
Shanghai, China

Telephone: 86-21-61136116
Facsimile: 86-21-61189921
www.intertek.com/building

TEST REPORT FOR FORTRESS RAILING PRODUCTS

Report No.: 180315013SHF-BP-3

Date: 08/29/18

REPORT ISSUED TO

FORTRESS RAILING PRODUCTS

1720 N. First St Garland

TX 75040

SECTION 1

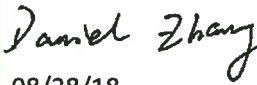
SCOPE

Intertek Building & Construction (B&C) was contracted by Fortress Railing Products to perform material and structural testing in accordance with ICC-ES™ AC273 on their 8 ft by 40 in Horizontal Cable Guardrail System Fe26 3" x 45.5" robot Welded Post. Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at Intertek Testing Services Ltd., Shanghai test facility in Plant 5, No. 6958 Daye Road, Fengxian District, Shanghai, China.

Intertek Testing Services Ltd., Shanghai has demonstrated compliance with ISO/IEC International Standard 17025 and is consequently accredited as a Testing Laboratory (TL-394) by International Accreditation Service, Inc. (IAS). Intertek B&C is accredited to perform all testing reported herein.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory.

For INTERTEK B&C:

COMPLETED BY:	Daniel Zhang
TITLE:	Operation Supervisor – Intertek B&C Shanghai
SIGNATURE:	
DATE:	08/28/18

REVIEWED BY:	Jodie Zhou
TITLE:	Asst. Technical Manager Intertek B&C Shanghai
SIGNATURE:	
DATE:	08/28/18



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SECTION 2

TEST METHOD(S)

The specimens were evaluated in accordance with the following:

ICC-ES™ AC273 (March 1, 2008 - editorially revised February 2014), Acceptance Criteria for Handrails and Guards

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

2006, 2009, 2012, 2015 *International Building Code*®, International Code Council

2006, 2009, 2012, 2015 *International Residential Code*®, International Code Council

1997 *Uniform Building Code*™ (UBC)

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

Testing is limited to satisfying the IRC - One- and Two-Family Dwellings requirements of ICC-ES™ AC273.

SECTION 3

MATERIAL SOURCE

The specimen(s) were selected by Intertek B&C Mason Wang. The specimens were witnessed during production and tagged prior to shipment on 03/15/2018. See photograph in Section 10 for typical sampling mark.

SECTION 4

EQUIPMENT

YINUO, Model PST HE-2.0, Loadcell

CHENGLIANG, Model MN5021, Extensometer

SECTION 5

LIST OF OFFICIAL OBSERVERS

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NAME	COMPANY
Kevin Burt	Fortress Building Products
Daniel Zhang	Intertek B&C
Kyle Wang	Intertek B&C

SECTION 6

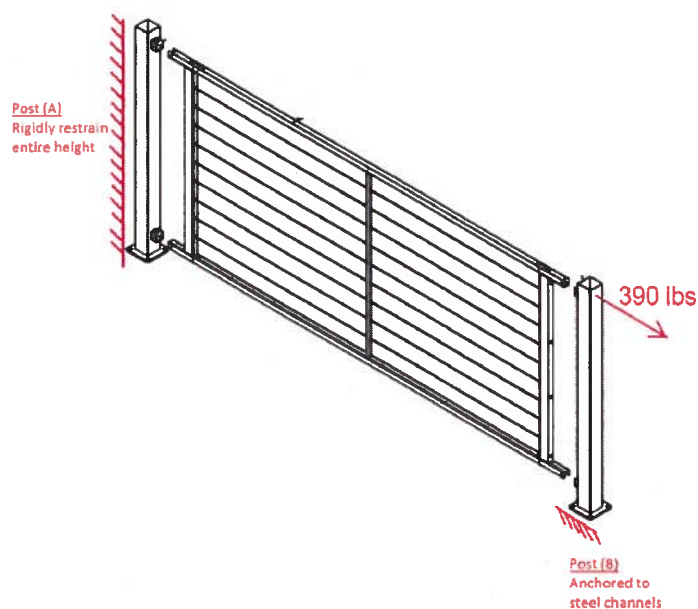
TEST PROCEDURE

Assembly Fastener Testing

Assembly fastener tests were performed per ICC-ES™ AC273, Section 4.2.7 to simulate a 90 degree bracket loading condition, which addresses a situation when the guardrail system is to be installed with the top rails in a corner condition.

For specimens, apply 390 lb load (50lb/ft × 93.5 in.) to top of steel post, parallel to rail, pulling the post away from the rail bracket. Post (A) is rigidly retrained for entire height. Post (B) is anchored to steel channels.

Restrain Post (A) just below the top rail connection keeping it at least 3 inches clear of the connection. In this manner, two bracket connections were loaded and evaluated for the 390 lb. test load simultaneously. By conducting this test on two assemblies, we tested four bracket connections.



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Structural Performance Testing of Assembled Railing Systems

Railing assembly tests were performed per ICC-ES™ AC273, Section 4.2.1 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.

The railing assembly was installed and tested as a single railing section by directly securing (surface-mounting) the base of the post mounts to a rigid steel test frame (simulated concrete). The railing was assembled by an Intertek B&C 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 Section X for test setups.

As a worse-case scenario, no support block on the bottom rail was used for testing.

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.

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.

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SECTION 7

TEST SPECIMEN DESCRIPTION

The 8 ft by 40 in Horizontal Cable Guardrail System Fe26 3" x 45.5" robot Welded Post guardrail system is comprised of formed steel top and bottom rails, steel wire rope screwed to two short posts, and posts. Test specimens consisted of one product color: Black. Drawings are included in Section 11 to verify the overall dimensions and other pertinent information of the tested product, its components, and any constructed assemblies. Photographs are provided in Section 11.

SERIES/MODEL	8 ft by 40 in Horizontal Cable Guardrail System Fe26 3" x 45.5" robot Welded Post
COLOR	Black
MATERIAL	Fe26
TOP RAIL	CR-HORIZONTAL 2078.05mm x 31mm x 31mm, 4mm thickness, material Q195,
RAIL HEIGHT	43.64 in (deck surface to top of top rail)
RAIL ATTACHMENT	Not applicable
COLLAR BRACKET	UB-05 UNIVERSAL BRACKET 1.25" BRACKET
PICKET	9 pieces of $\Phi 3.2$ steel wire rope screwed to two short posts, 952.50mm x 31mm x 50mm; two short posts screwed to top and bottom rails
POST	75.3 square by 1.8mm wall; continuous fillet weld connecting the tube to the base plate
BASE PLATE	Nominal 130 mm square, nominal 7.5mm thick base plate with four nominal 1/2 in diameter holes located approximately 5/8 in on-center in from each edge and approximately 2-3/4 in apart on-center and one 0.50 in diameter hole located in the center

Fastening Schedule

CONNECTION	FASTENER
Top Rail Bracket to Post*	Two 1/4 in.-20x0.75in. T-25 Thread Cutting Flat Head Screw
Bottom Rail Bracket to Post*	Two 1/4 in.-20x0.75in. T-25 Thread Cutting Flat Head Screw
Top Rail Bracket to Rail*	One 1/4 in.-20x0.75in. T-25 Thread Cutting Flat Head Screw
Bottom Rail Bracket to Rail*	One 1/4 in.-20x0.75in. T-25 Thread Cutting Flat Head Screw

* 6mm diameter pre-drill used

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SECTION 8

TEST RESULTS

Assembly Fastener Testing

Test Date: 03/26/18

Design Load: 50 lbf/ft

Specimen	Post	Test Load	Result	Requirement	Verdict
S180315013SHF.004	A	390 lb	No failure	Without failure	Pass
	B	390 lb	No failure	Without failure	
S180315013SHF.005	A	390 lb	No failure	Without failure	Pass
	B	390 lb	No failure	Without failure	

Structural Performance Testing of Assembled Railing Systems

8 ft by 40 in Horizontal Cable Guardrail System Fe26 3" x 45.5" robot Welded Post

Test No. 1 - Test Date: 03/26/18 to 04/09/18

Design Load: 50 lb / 1 Square ft of In-Fill at Center of panel

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
125 lb (2.50 x D.L.)	125 - 127	00:30 - 01:40	Sustained load equal to or greater than 125 lb for one full minute without failure
125 lb (2.50 x D.L.)	125 - 129	00:35 - 01:47	Sustained load equal to or greater than 125 lb for one full minute without failure
125 lb (2.50 x D.L.)	125 - 128	00:40 - 01:50	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 03/26/18 to 04/09/18

Design Load: 50 lb / 1 Square ft of In-Fill at Center of half panel

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
125 lb (2.50 x D.L.)	125 - 130	00:35 - 01:38	Sustained load equal to or greater than 125 lb for one full minute without failure
125 lb (2.50 x D.L.)	125 - 128	00:30 - 01:40	Sustained load equal to or greater than 125 lb for one full minute without failure
125 lb (2.50 x D.L.)	125 - 129	00:42 - 01:50	Sustained load equal to or greater than 125 lb for one full minute without failure

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Test No. 3 - Test Date: 03/26/18 to 04/09/18

Design Load: 200 lb Vertical 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	01:34	--	0.02	--	--
200 lb (D.L.)	202	01:40	--	0.04	--	--
200 lb (D.L.)	204	01:30	--	0.05	--	--
500 lb (2.50 x D.L.)	500 - 510	01:34 - 02:40	Result: Withstood load equal to or greater than 500 lb for one full minute without failure			
500 lb (2.50 x D.L.)	500 - 507	01:40 - 02:55	Result: Withstood load equal to or greater than 500 lb for one full minute without failure			
500 lb (2.50 x D.L.)	500 - 506	01:45 - 02:59	Result: Withstood load equal to or greater than 500 lb for one full minute without failure			

Design Load: 200 lb Horizontal 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.)	203	01:40	0.20	1.47	0.44	1.15
200 lb (D.L.)	204	01:35	0.22	1.62	0.44	1.29
200 lb (D.L.)	203	01:36	0.25	1.66	0.50	1.28
500 lb (2.50 x D.L.)	500 - 505	01:40 - 02:49	Result: Withstood load equal to or greater than 500 lb for one full minute without failure			
500 lb (2.50 x D.L.)	500 - 504	01:35 - 02:42	Result: Withstood load equal to or greater than 500 lb for one full minute without failure			
500 lb (2.50 x D.L.)	500 - 503	01:36 - 02:40	Result: Withstood load equal to or greater than 500 lb for one full minute without failure			

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Deflection Evaluation:

Maximum rail deflection at 204 lb = 1.29 in on an 8 ft rail (93.5 in)

Limits per AC273:

$$\frac{h}{24} + \frac{l}{96} = \frac{45.5}{24} + \frac{93.5}{96} = 2.87" > 1.29", \therefore OK$$

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

Test No. 4 - Test Date: 03/26/18 to 04/09/18

Design Load: 200 lb Concentrated Load at Top of Post Mount (45.49 in High)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
200 lb (D.L.)	202	00:40	0.56
200 lb (D.L.)	203	00:35	0.62
200 lb (D.L.)	202	00:38	0.42
500 lb (2.50 x D.L.)	500 - 505	01:20 - 02:33	Result: Withstood load equal to or greater than 500 lb for one full minute without failure
500 lb (2.50 x D.L.)	500 - 507	01:28 - 02:35	Result: Withstood load equal to or greater than 500 lb for one full minute without failure
500 lb (2.50 x D.L.)	500 - 508	01:25 - 02:30	Result: Withstood load equal to or greater than 500 lb for one full minute without failure

Deflection Evaluation:

Maximum post deflection at 203 lb = 0.62 in on an 8 ft rail (93.5 in)

Limits per AC273:

$$\frac{h}{12} = \frac{45.5}{12} = 3.79" > 0.62", \therefore OK$$

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Test No. 5 - Test Date: 03/26/18 to 04/09/18

Design Load: 200 lb Vertical Concentrated Load at Top Rail adjacent to a post (Top Bracket)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
500 lb (2.50 x D.L.)	500 – 508	01:35 - 02:43	Result: Withstood load equal to or greater than 500 lb for one full minute without failure
500 lb (2.50 x D.L.)	500 – 509	01:25 - 02:35	Result: Withstood load equal to or greater than 500 lb for one full minute without failure
500 lb (2.50 x D.L.)	500 - 504	01:29 - 02:40	Result: Withstood load equal to or greater than 500 lb for one full minute without failure

Design Load: 200 lb Horizontal Concentrated Load at Top Rail adjacent to a post (Top Bracket)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
500 lb (2.50 x D.L.)	500 – 510	01:30 - 02:48	Result: Withstood load equal to or greater than 500 lb for one full minute without failure
500 lb (2.50 x D.L.)	500 – 507	01:35 - 02:55	Result: Withstood load equal to or greater than 500 lb for one full minute without failure
500 lb (2.50 x D.L.)	500 - 506	01:25 - 02:40	Result: Withstood load equal to or greater than 500 lb for one full minute without failure

Test No. 6 - Test Date: 03/26/18 to 04/09/18

Design Load: 50 plf Vertical Uniform Load at Top Rail

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
125 plf	974	03:15 - 04:48	Result: Withstood load equal to or greater than 125 plf for one full minute without failure
125 plf	974	03:45 - 05:10	Result: Withstood load equal to or greater than 125 plf for one full minute without failure
125 plf	974	03:30 - 05:05	Result: Withstood load equal to or greater than 125 plf for one full minute without failure

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Design Load: 50 plf Horizontal Uniform Load at Top Rail

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
125 plf	974	03:20 - 04:56	Result: Withstood load equal to or greater than 125 plf for one full minute without failure
125 plf	974	03:18 - 04:40	Result: Withstood load equal to or greater than 125 plf for one full minute without failure
125 plf	974	03:25 - 05:00	Result: Withstood load equal to or greater than 125 plf for one full minute without failure

SECTION 9

CONCLUSION

Assembly Fastener Testing

When installed according to this assemblies, fasteners / connectors reported herein meet the performance requirements of ICC-ES™ AC273.

Structural Performance Testing of Assembled Railing Systems

When installed between adequate supports, the railing assemblies reported herein meet the structural performance requirements of Section 4.2.1 of ICC-ES™ AC273.

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

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SECTION 10
PHOTOGRAPHS



Photo No. 1
Typical Sampling Mark



Photo No. 2
In-Fill Load Test at Center of half panel

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Photo No. 3
In-Fill Load Test at Center of Two Pickets



Photo No. 4
Concentrated load on mid top rail vertically

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Photo No. 5

Concentrated load on mid top rail horizontally



Photo No. 6

Concentrated load on top bracket vertically

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Photo No. 7
Concentrated load on top bracket horizontally



Photo No. 8
Concentrated load on post horizontally

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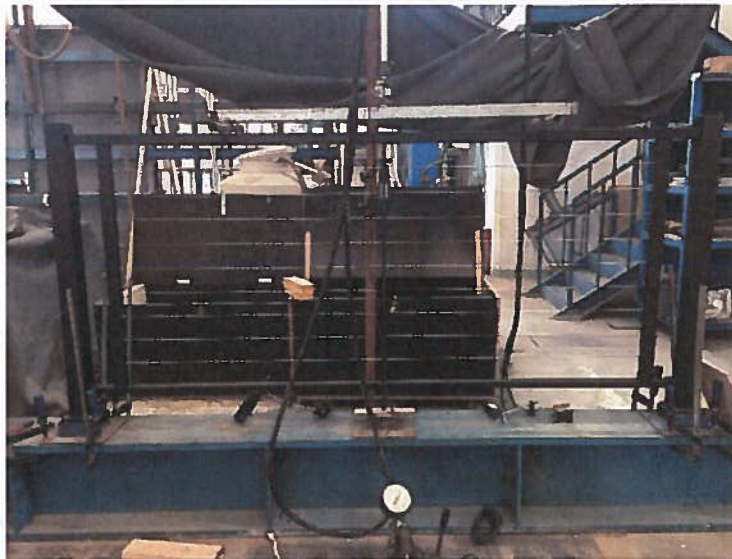


Photo No. 9
Uniform load vertically



Photo No. 10
Uniform load horizontally

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Photo No. 11
Assembly Fastener Test Setup