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FORTRESS RAILING PRODUCTS
TEST REPORT

SCOPE OF WORK
ICC-ES AC273 TESTING ON *FE26 TRADITIONAL* AND *FE26 PLUS* GUARDRAIL SYSTEMS

REPORT NUMBER
J0101.02-119-19 R0

TEST DATE(S)
11/07/18 - 11/09/18

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03/06/19

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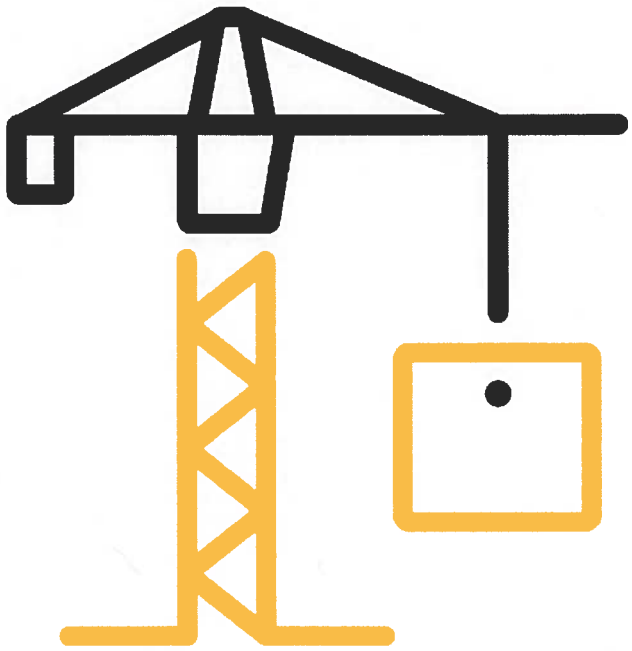

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TEST REPORT FOR FORTRESS RAILING PRODUCTS

Report No.: J0101.02-119-19 R0
Date: 03/06/19

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 testing in accordance with ICC-ES™ AC273 on their 8 ft by 42 in *Fe26 Traditional* and *Fe26 Plus* level railing systems. This report is in conjunction with Intertek report No.'s B2564.01-119-19 which include structural performance testing of the 2 in post mount and J0101.01-103-15 which includes product sampling information. Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at Intertek test facility in York, PA.

Intertek B&C 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). 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:	Adam J. Schrum	**REVIEWED BY:**	V. Thomas Mickley, Jr., P.E.
TITLE:	Lead Technician	**TITLE:**	Senior Staff Engineer
SIGNATURE:	Digitally Signed by: Adam J. Schrum	**SIGNATURE:**	Digitally Signed by: Virgal Thomas Mickley, Jr.
DATE:	03/06/19	**DATE:**	03/06/19

AJS:vtm/aas

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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 March 2016), *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:

2015 *International Building Code®*, International Code Council

2015 *International Residential Code®*, International Code Council

The specimens were also evaluated in accordance with the following:

ASTM D1761-12, *Standard Test Methods for Mechanical Fasteners in Wood*

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.

SECTION 3
MATERIAL SOURCE

The specimens were selected by Intertek B&C personnel. The specimens were witnessed during production and tagged prior to shipment on 10/30/2018, (Reference Intertek B&C Test Specimen Selection Report No. J0101.01-103-15). See photograph in Section 9 for typical sampling mark.

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.

SECTION 4
LIST OF OFFICIAL OBSERVERS

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

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SECTION 5
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.

Short sections of the top rail were attached in accordance with Fortress Railing Products installation instructions to short sections of post. Specimens were assembled by an Intertek B&C technician. Rail brackets were secured to the post and to the rail as described in Section 6, Test Specimen Description.

The testing machine was fitted with the post section at the bottom to accommodate anchorage of the rail and brackets. The rail section was attached at one end to the test machine's crosshead with a swivel mechanism and at the other end to the post section. The post section was attached rigidly to the base of the test machine. Five specimens were tested in this manner. See photographs in Section 9 for test setup.

Testing was performed using a computer-monitored and -controlled SATEC Unidrive, Model MII 50 UD Universal Testing Machine. Tests were run at a crosshead speed of 0.05 in/min, and each specimen was tested in tension to its ultimate load capacity.

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 steel post mounts to a rigid steel test frame (simulated concrete) at one end of the assembly and by directly securing the 4x4 wood post to rigid stanchions at the other end. 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 9 for test setups.

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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.

SECTION 6
TEST SPECIMEN DESCRIPTION

The *Fe26 Railing* guardrail system is comprised of pre-galvanized formed steel top and bottom rails, pickets spaced between the rail members, and posts. Drawings are included in Section 10 to verify the overall dimensions and other pertinent information of the tested product, its components, and any constructed assemblies. Photographs are provided in Section 9.

SERIES/MODEL	*Fe26 Traditional* and *Fe26 Plus* Railing
COLOR	*Fe26 Traditional:* Bronze *Fe26 Plus:* Black
MATERIAL	Steel
RAIL LENGTH	*Fe26 Traditional:* 93-3/4 in (inside of post to inside of post)
	Fe26 Plus: 93-5/8 in (inside of post to inside of post)
RAIL HEIGHT	40 in (top of top rail to bottom of bottom rail)
TOP RAIL	*Fe26 Traditional:* 1 in square by 0.055 in thick rail
	Fe26 Plus: 1-1/4 in square by 0.062 in thick rail
BALUSTERS	*Fe26 Traditional:* 5/8 in square by 0.039 in thick steel picket
	Fe26 Plus: 3/4 in square by 0.045 in thick steel picket
COLLAR BRACKET	*Fe26 Traditional: CB-04* ADC12 die cast aluminum socket bracket
	Fe26 Plus: CB-05 ADC12 die cast aluminum socket bracket
POST	*Fe26 Traditional:* 2 in square by 0.091 in thick steel tube connected to a 4 in square by 0.23 in thick steel base plate with a 1/8 in continuous fillet weld; the base plate included four 3/8 in diameter holes and one 15/16 in diameter hole
	Fe26 Plus: 3 in square by 0.075 in thick steel tube connected to a 5-1/8 in square by 0.30 in thick steel base plate with a 3/16 in continuous fillet weld; the base plate included four 1/2 in diameter holes and one 15/16 in diameter hole
	Fe26 and *Fe26 Plus:* Preservative treated Southern Pine 4x4 wood post

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Fastening Schedule

CONNECTION	FASTENER
Rail Bracket to Steel Post*	Two #12-24 by 3/4 in, Torx drive, flat-head, Type F thread cutting point, steel screws
Rail Bracket to Wood Post	Two #12-10 by 2-1/2 in (0.153 in minor diameter) Torx drive, flat-head, Type A point, steel screws
Rail Bracket to Rail*	One #12-24 by 3/4 in, Torx drive, flat-head, Type F thread cutting point, steel screw
Steel Post Mount to Substructure	Four 3/8 in Grade 5 hex-head bolts with washer

* 5/32 in diameter pre-drill used

SECTION 7
TEST RESULTS

Assembly Fastener Testing
Test Date: 11/09/18

***Fe26 Traditional* Railing Attached to Preservative Treated Southern Pine 4x4 Post**

SAMPLE NO.	ULTIMATE LOAD (lb)	DEVIATION FROM AVERAGE	MODE OF FAILURE
1	2350	+19.3%	Bracket failure
2	1663	-15.6%	
3	2053	+4.2%	
4	1939	-1.6%	
5	1844	-6.4%	
AVERAGE	1970		
ALLOWABLE CAPACITY [1]	657	≥ 200 lb ∴ OK	

[1] *Average ultimate load divided by a factor of safety of three (3.0)*

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***Fe26 Traditional* Railing Attached to 2 in Square Steel Post Mount**

SAMPLE NO.	ULTIMATE LOAD (lb)	DEVIATION FROM AVERAGE	MODE OF FAILURE
1	1994	-0.7%	Bracket failure
2	1985	-1.2%	
3	2218	+10.4%	
4	1936	-3.6%	
5	1914	-4.7%	
AVERAGE	**2009**		
ALLOWABLE CAPACITY [1]	**670**	**≥ 200 lb ∴ OK**	

[1] *Average ultimate load divided by a factor of safety of three (3.0)*

***Fe26 Plus* Railing Attached to Preservative Treated Southern Pine 4x4 Post**

SAMPLE NO.	ULTIMATE LOAD (lb)	DEVIATION FROM AVERAGE	MODE OF FAILURE
1	1981	-2.8%	Bracket failure
2	1980	-2.8%	
3	2133	+4.7%	
4	2026	-0.6%	
5	2069	+1.5%	
AVERAGE	**2038**		
ALLOWABLE CAPACITY [1]	**679**	**≥ 200 lb ∴ OK**	

[1] *Average ultimate load divided by a factor of safety of three (3.0)*

***Fe26 Plus* Railing Attached to 3 in Square Steel Post Mount**

SAMPLE NO.	ULTIMATE LOAD (lb)	DEVIATION FROM AVERAGE	MODE OF FAILURE
1	1787	+2.1%	Bracket failure
2	1757	+0.4%	Fastener withdrawal
3	1656	-5.4%	
4	1763	+0.7%	Bracket failure
5	1788	+2.2%	Fastener withdrawal
AVERAGE	**1750**		
ALLOWABLE CAPACITY [1]	**583**	**≥ 200 lb ∴ OK**	

[1] *Average ultimate load divided by a factor of safety of three (3.0)*

The maximum design load rating required for guardrail systems for use in IRC - One- and Two-Family Dwellings and for rail lengths up to and including 8 ft. for use in IBC - All Use Groups is 200 lb. Therefore, fasteners / connectors reported herein meet the performance requirements of ICC-ES™ AC273 for use in corner conditions.

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Structural Performance Testing of Assembled Railing Systems

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.

Test Series No. 1
8 ft by 42 in *Fe26 Traditional* Level Guardrail (In-Line Application) with 4x4 Wood Post at One End and 2 in Square Steel Post Mount at the Other End
Limited to Use in IRC - One- and Two-Family Dwellings / ICC-ES™ AC273

Specimen No. 1 of 3

Test No. 1 - Test Date: 11/07/18
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 - 132	00:24 - 01:25	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 11/07/18
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.)	126 - 133	00:14 - 01:24	Sustained load equal to or greater than 125 lb for one full minute without failure

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Test No. 3 - Test Date: 11/07/18
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	00:41	0.76	2.64	0.01	2.26
500 lb (2.50 x D.L.)	502 - 508	01:18 - 02:20	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			

Deflection Evaluation:
Maximum rail deflection at 200 lb = 2.26 in on an 8 ft rail (93.75 in)
Limits per AC273:

$$\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.75}{96}\right)=2.73">2.26"\therefore OK$$

and

$$\frac{h}{12}=\frac{42}{12}=3.5">2.26"\therefore OK$$

[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: 11/07/18
Design Load: 200 lb Concentrated Load at Ends of Rail (Brackets)

LOAD LEVEL [1]	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
1000 lb (2.50 x D.L.) x 2	1000 - 1012	00:51 - 01:53	**Result**: Each end withstood load equal to or greater than 500 lb for one full minute without failure

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

Specimen No. 2 of 3

Test No. 1 - Test Date: 11/07/18
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 - 130	00:21 - 01:22	Sustained load equal to or greater than 125 lb for one full minute without failure

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Test No. 2 - Test Date: 11/07/18
Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets

LOAD LEVEL	TEST LOAD [1] (lb)	E.T. (min:sec)	RESULT
125 lb (2.50 x D.L.)	112 - 130	00:15 - 01:18	Sustained load equal to or greater than 125 lb for one full minute without failure

[1] *Test load dropped below the target load for 1-1/2 seconds during the one minute hold period.*

Test No. 3 - Test Date: 11/07/18
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	00:34	0.77	2.60	0.01	2.21
500 lb (2.50 x D.L.)	501 - 509	01:14 - 02:32	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			

Deflection Evaluation:
Maximum rail deflection at 200 lb = 2.21 in on an 8 ft rail (93.75 in)
Limits per AC273:

$$\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.75}{96}\right)=2.73"> 2.21" \therefore OK$$

and

$$\frac{h}{12}=\frac{42}{12}=3.5"> 2.21" \therefore OK$$

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

Test No. 4 - Test Date: 11/07/18
Design Load: 200 lb Concentrated Load at Ends of Rail (Brackets)

LOAD LEVEL [1]	TEST LOAD [2] (lb)	E.T. (min:sec)	DISPLACEMENT (in)
1000 lb (2.50 x D.L.) x 2	998 - 1010	00:47 - 01:50	**Result**: Each end withstood load equal to or greater than 500 lb for one full minute without failure

[1] *Load was imposed on both ends of rail using a spreader beam; therefore, loads were doubled.*
[2] *Test load dropped below the target load for 1-1/2 seconds during the one minute hold period.*

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Specimen No. 3 of 3

Test No. 1 - Test Date: 11/07/18
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 - 132	00:18 - 01:20	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 11/07/18
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.)	128 - 131	00:18 - 01:23	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 11/07/18
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	00:22	0.81	2.60	0.00	2.20
500 lb (2.50 x D.L.)	501 - 507	00:54 - 01:58	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			

Deflection Evaluation:
Maximum rail deflection at 201 lb = 2.20 in on an 8 ft rail (93.75 in)
Limits per AC273:

$$\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.75}{96}\right)=2.73">2.20"\therefore OK$$

and

$$\frac{h}{12}=\frac{42}{12}=3.5">2.20"\therefore OK$$

[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: 11/07/18
Design Load: 200 lb Concentrated Load at Ends of Rail (Brackets)

LOAD LEVEL [1]	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
1000 lb (2.50 x D.L.) x 2	1000 - 1010	00:52 - 01:55	**Result**: Each end withstood load equal to or greater than 500 lb for one full minute without failure

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

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TEST REPORT FOR FORTRESS RAILING PRODUCTS
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Test Series No. 2 of 2
8 ft by 42 in *Fe26 Plus* Level Guardrail (In-Line Application) with 4x4 Wood Post at One End and 2 in Square Steel Post Mount at the Other End
IBC - All Use Groups / ICC-ES™ AC273

Specimen No. 1 of 3

Test No. 1 - Test Date: 11/07/18
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 - 130	00:16 - 01:21	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 11/07/18
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 - 139	00:11 - 01:16	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 11/07/18
Design Load: 50 plf x (93-5/8 in ÷ 12 in/ft) = 390 lb Uniform Load Applied on Top Rail [1] at 45° Angle

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
975 lb (2.50 x D.L.)	977 - 985	00:47 - 01:49	Sustained load equal to or greater than 975 lb for one full minute without failure

[1] *Uniform load was simulated with four equal point loads.*

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Test No. 4 - Test Date: 11/07/18
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	00:20	0.21	1.17	0.02	1.06
500 lb (2.50 x D.L.)	500 - 508	00:40 - 01:43	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			

Deflection Evaluation:
Maximum rail deflection at 202 lb = 1.06 in on an 8 ft rail (93.63 in)
Limits per AC273:

$$\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.63}{96}\right)=2.73" > 1.06" \therefore OK$$

and

$$\frac{h}{12}=\frac{42}{12}=3.5" > 1.06" \therefore OK$$

[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: 11/07/18
Design Load: 200 lb Concentrated Load at Ends of Rail (Brackets)

LOAD LEVEL [1]	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
1000 lb (2.50 x D.L.) x 2	1002 - 1015	00:45 - 01:47	**Result**: Each end withstood load equal to or greater than 500 lb for one full minute without failure

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

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Test No. 6 - Test Date: 11/07/18
Concentrated Load to Failure at Top of Stand-Alone [1] Post Mount (42 in)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
200 lb (D.L.)	207	00:18	0.42
Ultimate Load	1077	00:54	**Mode of Failure**: Post buckled at base

Deflection Evaluation:
Maximum post deflection at 207 lb = 0.42 in on a 42 in high post
Limits per AC273:

$$\frac{h}{12} = \frac{42}{12} = 3.5" > 0.42" \therefore OK$$

[1] *Post mount was conservatively tested without a railing attached.*

Specimen No. 2 of 3

Test No. 1 - Test Date: 11/09/18
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 - 132	00:19 - 01:22	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 11/09/18
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.)	129 - 134	00:11 - 01:15	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 11/09/18
Design Load: 50 plf x (93-5/8 in ÷ 12 in/ft) = 390 lb Uniform Load Applied on Top Rail [1] at 45° Angle

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
975 lb (2.50 x D.L.)	977 - 982	00:55 - 02:01	Sustained load equal to or greater than 975 lb for one full minute without failure

[1] *Uniform load was simulated with four equal point loads.*

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TEST REPORT FOR FORTRESS RAILING PRODUCTS
Report No.: J0101.02-119-19 R0
Date: 03/06/19

Test No. 4 - Test Date: 11/09/18
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	00:27	0.19	1.17	0.01	1.07
500 lb (2.50 x D.L.)	500 - 509	00:46 - 01:51	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			

Deflection Evaluation:
Maximum rail deflection at 200 lb = 1.07 in on an 8 ft rail (93.63 in)
Limits per AC273:

$$\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.63}{96}\right)=2.73">1.07"\therefore OK$$

and

$$\frac{h}{12}=\frac{42}{12}=3.5">1.07"\therefore OK$$

[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: 11/09/18
Design Load: 200 lb Concentrated Load at Ends of Rail (Brackets)

LOAD LEVEL [1]	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
1000 lb (2.50 x D.L.) x 2	1001 - 1012	00:40 - 01:47	**Result**: Each end withstood load equal to or greater than 500 lb for one full minute without failure

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

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TEST REPORT FOR FORTRESS RAILING PRODUCTS
Report No.: J0101.02-119-19 R0
Date: 03/06/19

Test No. 6 - Test Date: 11/09/18
Concentrated Load to Failure at Top of Stand-Alone [1] Post Mount (42 in)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
200 lb (D.L.)	201	00:24	0.33
Ultimate Load	1107	01:32	**Mode of Failure**: Post buckled at base

Deflection Evaluation:
Maximum post deflection at 201 lb = 0.33 in on a 42 in high post
Limits per AC273:

$$\frac{h}{12} = \frac{42}{12} = 3.5" > 0.33" \therefore OK$$

[1] *Post mount was conservatively tested without a railing attached.*

Specimen No. 3 of 3

Test No. 1 - Test Date: 11/09/18
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 - 131	00:21 - 01:25	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 2 - Test Date: 11/09/18
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.)	126 - 131	00:13 - 01:25	Sustained load equal to or greater than 125 lb for one full minute without failure

Test No. 3 - Test Date: 11/09/18
Design Load: 50 plf x (93-5/8 in ÷ 12 in/ft) = 390 lb Uniform Load Applied on Top Rail [1] at 45° Angle

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
975 lb (2.50 x D.L.)	975 - 987	00:45 - 01:49	Sustained load equal to or greater than 975 lb for one full minute without failure

[1] *Uniform load was simulated with four equal point loads.*

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TEST REPORT FOR FORTRESS RAILING PRODUCTS
Report No.: J0101.02-119-19 R0
Date: 03/06/19

Test No. 4 - Test Date: 11/09/18
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	00:40	0.21	1.21	0.01	1.10
500 lb (2.50 x D.L.)	502 - 513	01:04 - 02:07	**Result**: Withstood load equal to or greater than 500 lb for one full minute without failure			

Deflection Evaluation:
Maximum rail deflection at 200 lb = 1.10 in on an 8 ft rail (93.63 in)
Limits per AC273:

$$\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{42}{24}+\frac{93.63}{96}\right)=2.73">1.10"\therefore OK$$

and

$$\frac{h}{12}=\frac{42}{12}=3.5">1.10"\therefore OK$$

[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: 11/09/18
Design Load: 200 lb Concentrated Load at Ends of Rail (Brackets)

LOAD LEVEL [1]	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
1000 lb (2.50 x D.L.) x 2	1000 - 1015	00:46 - 01:50	**Result**: Each end withstood load equal to or greater than 500 lb for one full minute without failure

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

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TEST REPORT FOR FORTRESS RAILING PRODUCTS
Report No.: J0101.02-119-19 R0
Date: 03/06/19

Test No. 6 - Test Date: 11/09/18
Concentrated Load to Failure at Top of Stand-Alone [1] Post Mount (42 in)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)
200 lb (D.L.)	203	00:16	0.33
Ultimate Load	1091	01:13	**Mode of Failure**: Post buckled at base

Deflection Evaluation:
Maximum post deflection at 203 lb = 0.33 in on a 42 in high post
Limits per AC273:

$$\frac{h}{12} = \frac{42}{12} = 3.5" > 0.33" \therefore OK$$

[1] *Post mount was conservatively tested without a railing attached.*

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SECTION 8
CONCLUSION

***Fe26 Plus* 3 in Post Mount**

SPECIMEN NO.	ULTIMATE LOAD (lbs)	DEVIATION FROM AVERAGE
1	1077	-1.4%
2	1107	1.4%
3	1091	-0.1%
Average:	**1092**	
Standard Deviation:	15	
Coefficient of Variation:	1.4%	
Allowable Post Spacing [1]:	8'-8-3/4"	

[1] *Allowable post spacing (center-to-center of post) = Average Ultimate load / (50 plf x 2.5 safety factor)*

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

GUARDRAIL SYSTEM	GUARDRAIL TYPE	SUPPORT POSTS	BALUSTER	CODE OCCUPANCY CLASSIFICATION
8 ft (93-3/4 in) by 42 in *Fe26 Traditional*	Level (In-Line Application)	2 in Square Steel Post Mount (Steel of Concrete Mounted)	5/8 in square steel picket	IRC - One- and Two-Family Dwellings
8 ft (93-5/8 in) by 42 in *Fe26 Plus*		3 in Square Steel Post Mount (Steel of Concrete Mounted)	3/4 in square steel picket	IBC - All Use Groups

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 9
PHOTOGRAPHS

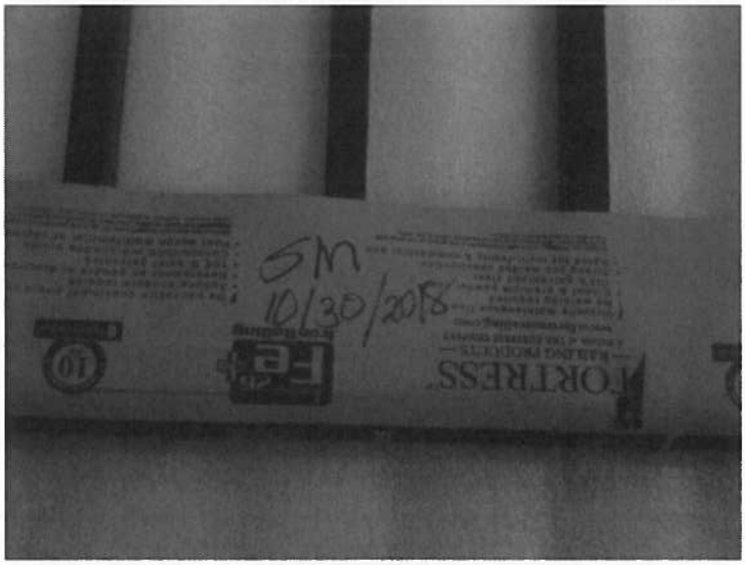

Photo No. 1
Typical Sampling Mark

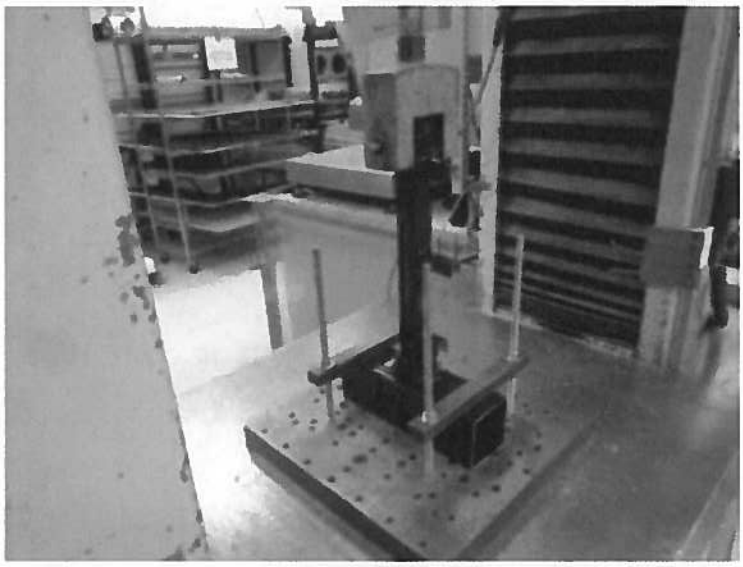

Photo No. 2
Assembly Fastener Test Setup

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

Photo No. 4
In-Fill Load Test at Bottom of Two Pickets

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Photo No. 5
Uniform Load Applied at a 45 degree angle

Photo No. 6
Concentrated Load Test at Mid-Span of Top Rail

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Photo No. 7
Concentrated Load Test at Ends of Top Rail (Brackets)

Photo No. 8
Concentrated Load at Top of Stand-Alone Post Mount

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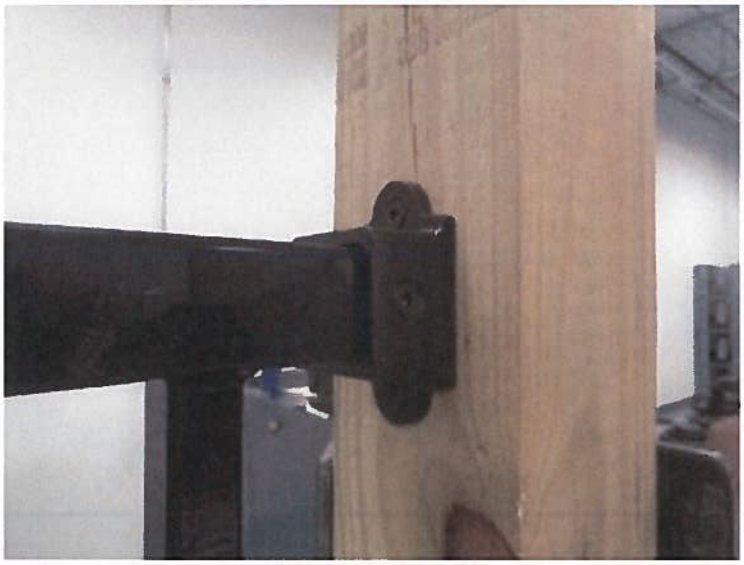

Photo No. 9
Top / Bottom Rail Collar Bracket and Connections

SECTION 10
DRAWINGS

The "As-Built" drawings for the *Fe26 Traditional* and *Fe26 Plus* railing systems, 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.