



TEST REPORT

Rendered to:

SUNCOR® STAINLESS, INC.

PRODUCTS: *RailEasy™ Nautilus*
RailEasy™ Spectrum (Fascia Mount only)
SunRail™ Nautilus

TYPE: **Stainless Steel Guardrail Systems**

Report No.: **E1690.01-119-19**
Report Date: **02/20/15**
Test Record Retention Date: **12/19/18**
Revision 1: **04/27/18**



TEST REPORT

E1690.01-119-19
February 20, 2015

TABLE OF CONTENTS

1.0 General Information..... 1

 1.1 Product..... 1

 1.2 Type 1

 1.3 Project Description 1

 1.4 Limitations 1

 1.5 Product Description 2

2.0 Structural Performance Testing of Assembled Railing Systems 3

 2.1 Test Equipment..... 3

 2.2 Test Setup 3

 2.3 Test Procedure 3

 2.4 Test Results..... 4

 2.4 Summary and Conclusions 9

3.0 Closing Statement 10

Revision Log..... 11

Appendix A - Drawings

Appendix B - Photographs



TEST REPORT

Rendered to:

SUNCOR® STAINLESS, INC.
70 Armstrong Road
Plymouth, Massachusetts 02360

Report No.: E1690.01-119-19
Test Start Date: 11/12/14
Test Completion Date: 12/19/14
Report Date: 02/20/15
Test Record Retention Date: 12/19/18
Revision 1: 04/27/18

1.0 General Information

1.1 Product

RailEasy™ Nautilus
RailEasy™ Spectrum (Fascia Mount only)
SunRail™ Nautilus

1.2 Type

Stainless Steel Guardrail System

1.3 Project Description

Intertek-ATI was contracted by Suncor® Stainless, Inc. to conduct structural performance tests on their *RailEasy™ Nautilus*, *RailEasy™ Spectrum* (Fascia Mount only), and *SunRail™ Nautilus* stainless steel guardrail systems. The systems were evaluated for the design load requirements of the following building code:

2018 *International Building Code*®, International Code Council

Structural tests were performed according to Chapter 17 (Structural Tests and Special Inspections) of IBC 2018.

1.4 Limitations

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

1.5 Qualifications

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

1.6 Product Description

Suncor® Stainless, Inc. provided the test specimens with the following details:

Top Rail: - *RailEasy™ Nautilus* - 2 in O.D. by 0.062 in wall 316 stainless steel tube
- *RailEasy™ Spectrum* - 1-1/2 in high x 3-1/2 wide Mahogany
- *SunRail™ Nautilus* - 2 in O.D. by 0.062 in wall 316 stainless steel tube

In-Fill: - *RailEasy™ Nautilus* - 5/32 in diameter 1x19, 316 stainless steel cable
- *RailEasy™ Spectrum* - 1/8 in diameter 1x19, 316 stainless steel cable
- *SunRail™ Nautilus* - 5/32 in diameter 1x19, 316 stainless steel cable

Rail Brackets: - *RailEasy™ Nautilus* - Slip fit bracket; 3-1/2 in O.D. and 2-1/2 in O.D. by 0.11 in wall by 1-1/4 in long, cast 316 stainless steel flange with set screw
- *RailEasy™ Spectrum* - 6-1/2 in by 1-1/2 in by 0.12 in thick irregular shaped 316 stainless steel mounting plate with numerous holes
- *SunRail™ Nautilus* - 316 cast stainless steel slip fit 90° elbow and tee shaped brackets

Fasteners: - *RailEasy™ Nautilus:*
Bracket to post - (3) #10-12 x 1-1/2 in (0.131 in minor diameter) phillips drive, flat head, stainless steel wood screw
Bracket to rail (1) M6 flat point set screw, 1/8 in allen drive
Infill tensioner to post - (3) #8-15 x 1-1/2 in (0.118 in minor diameter) phillips drive, flat head, stainless steel wood screw
- *RailEasy™ Spectrum:*
Bracket to post - (2) 1/4-20 x 1/2 in phillips drive, flat head, stainless steel machine screws
Bracket to rail - (6) #12-11 x 1 in (0.155 in minor diameter) phillips drive, flat head, stainless steel wood screw
- *SunRail™ Nautilus:*
90° elbow and tee to post - Loctite 326® brand adhesive
Base plate to post - Loctite 326® brand adhesive
Support Foot to base (4) 5/16 in flat head bolts

Post: - *RailEasy™ Nautilus* - Conventional preservative-treated wood (Southern Yellow Pine) 4x4 secured to a rigid steel fixture
- *RailEasy™ Spectrum* - 1-1/2 in square by 0.12 in wall, 316 stainless steel, fascia mount
- *SunRail™ Nautilus* - 2 in O.D. by 0.062 in wall 316 stainless steel tube

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

2.0 Structural Performance Testing of Assembled Railing Systems

2.1 Test Equipment

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

2.2 Test Setup

The *RailEasy™ Nautilus* guardrail assemblies were installed and tested as a single railing section by directly securing the posts into a rigid steel test fixture, which rigidly restrained the posts from deflecting. The *RailEasy™ Spectrum* guardrail assemblies were installed and tested as a double railing section (two 48 in spans) by directly securing the posts to the face of a rigid steel 'I' beam (fascia mount) with 3/8 in grade 5 hex head bolts with nut and washers. *The fascia mount anchorage was not evaluated during this testing.* The *SunRail™ Nautilus* guardrail assemblies were installed and tested as a double railing section (two 48 in spans) by directly securing the posts to rigid steel channels with four (4) 5/16 in grade 5 hex head bolts with nut and washers. Transducers mounted to an independent reference frame were located to record movement of reference points on the guardrail system components (ends and mid-point) to determine net component deflections. See photographs in Appendix B for individual test setups.

2.3 Test Procedure

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

2.4 Test Results

The following tests were performed on the guardrail assemblies for the design load requirements of the codes referenced. Deflection and permanent set were component deflections relative to their end-points; they were not overall system displacements. All loads and displacement measurements were horizontal, unless noted otherwise.

Key to Test Results Tables:

Load Level: Target test load

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

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

Test Series No. 1
48 in by 42 in RailEasy™ Nautilus
Level Guardrail (In-Line Application)

Test No. 1 - 11/12/14						
Design Load: 50 lb / 1 Square Ft at Center of In-Fill						
Load Level	Test Load (lb)	E.T. (min:sec)	Displacement (in)			
			End	Mid	End	Net ¹
Initial Load	12	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	104	00:10	0.02	0.44	0.02	0.42
Initial Load	10	01:16	0.01	0.00	0.00	0.00
100% Recovery from 2.0 x Design Load						
2.5x Design Load	141	01:22	Achieved Load without Failure			

¹ Net displacement was the infill displacement relative to its top and bottom.

2.4 Test Results (Continued)

**Test Series No. 2
(Continued)**

Test No. 2 - 11/12/14						
Design Load: 200 lb Concentrated Load at Midspan of Top Rail						
Load Level	Test Load (lb)	E.T. (min:sec)	Rail Displacement (in)			
			End	Mid	End	Net ¹
Initial Load	45	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	434	00:05	0.04	0.25	0.04	0.21
Initial Load	42	00:55	0.00	0.02	0.00	0.02
90% Recovery from 2.0 x Design Load						
2.5x Design Load	547	01:02	Achieved Load without Failure			

¹ Net displacement was rail displacement relative to the supports.

Test No. 3 - 11/12/14						
Design Load: 50 plf x (48 in ÷ 12 in/ft) = 200 lb Horizontal Uniform Load on Top Rail ^{2, 3}						
Load Level	Test Load (lb)	E.T. (min:sec)	Rail Displacement (in)			
			End	Mid	End	Net ¹
Initial Load	80	00:00	0.00	0.00	0.00	0.00
2.0 x Design Load	888	00:08	0.09	0.36	0.09	0.27
Initial Load	86	00:59	0.00	0.01	0.00	0.01
96% Recovery from 2.0 x Design Load						
2.5 x Design Load	1030	01:06	Achieved Load without Failure			

¹ Net displacement was rail displacement relative to the supports.

² Uniform load was simulated with quarter point loading.

³ Horizontal uniform loading resulted in an end reaction of 500 lb at each end of the guardrail; concentrated load at end of top rail (brackets) test would have also resulted in a 500 lb load at each end of the guardrail, therefore the concentrated load test was not conducted.

2.4 Test Results (Continued)

Test Series No. 2
96 in (two 48 in spans) by 42 in RailEasy™ Spectrum (Fascia Mount)
Level Guardrail (In-Line Application)

Test No. 1 - 12/19/14						
Design Load: 50 lb / 1 Square Ft at Center of In-Fill						
Load Level ³	Test Load (lb)	E.T. (min:sec)	Displacement ² (in)			
			Span 1 / Span 2		End	Net ¹
Initial Load	19	00:00	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00
(2.0 x D.L.) x 2	235	00:34	0.11/0.20	1.02/1.09	0.10/0.19	0.92/0.90
Initial Load	20	02:35	0.01/0.01	0.03/0.05	0.00/0.03	0.03/0.03
97% / 97% Recovery from 2.0 x Design Load						
(2.5 x D.L.) x 2	268	02:49	Achieved Load without Failure			

¹ Net displacement was the infill displacement relative to its top and bottom.

² Displacement was measured at (6) locations, (3) at each span.

³ A spreader beam was used to impose loads on both sections of the railing system; therefore, loads were doubled.

Test No. 2 - 12/19/14						
Design Load: 50 plf x (96 in ÷ 12 in/ft) = 400 lb Horizontal Uniform Load on Top Rail ³						
Load Level	Test Load (lb)	E.T. (min:sec)	Rail Displacement ² (in)			
			End	Mid	End	Net ¹
Initial Load	80	00:00	0.00	0.00	0.00	0.00
2.0 x Design Load	884	00:11	1.87	2.31	2.29	0.23
Initial Load	80	02:00	0.14	0.14	0.12	0.01
96% Recovery from 2.0 x Design Load						
2.5 x Design Load	1013	02:17	Achieved Load without Failure			

¹ Net displacement was rail displacement relative to the supports

² Displacement was measured at each post

³ Uniform load was simulated with four equal point loads.

2.4 Test Results (Continued)

Test Series No. 2
(Continued)

Test No. 3 - 12/19/14						
Design Load: 200 lb Concentrated Load at Midspan of Top Rail						
Load Level ³	Test Load (lb)	E.T. (min:sec)	Rail Displacement ² (in)			
			Span 1 / Span 2			
			End	Mid	End	Net ¹
Initial Load	82	00:00	0.00	0.00	0.00	0.00
(2.0 x D.L.) x 2	833	00:13	1.78/2.15	2.15/2.26	2.15/2.00	0.19/0.19
Initial Load	82	01:51	0.01/0.01	0.01/0.00	0.01/0.00	0.00/0.00
100% / 100% Recovery from 2.0 x Design Load						
(2.5 x D.L.) x 2	1034	02:04	Achieved Load without Failure			

¹ Net displacement was rail displacement relative to the supports.

² Displacement was measured at (5) locations; at each post and midspan of each rail.

³ A spreader beam was used to impose loads on both sections of the railing system; therefore, loads were doubled.

Test No. 4 - 12/19/14			
Design Load: 200 lb Concentrated Load at Top of Post Mount ¹			
Load Level	Test Load (lb)	E.T. (min:sec)	Post Displacement (in)
Initial Load	40	00:00	0.00
2.0x Design Load	406	00:13	1.17
Initial Load	40	01:48	0.00
100% Recovery from 2.0 x Design Load			
2.5x Design Load	505	02:01	Achieved Load without Failure

¹ Center post mount was tested

2.4 Test Results (Continued)

**Test Series No. 3
96 in (two 48 in spans) by 42 in SunRail™ Nautilus
Level Guardrail (In-Line Application)**

Test No. 1 - 11/14/14						
Design Load: 50 lb / 1 Square Ft at Center of In-Fill						
Load Level ³	Test Load (lb)	E.T. (min:sec)	Displacement ² (in)			
			Span 1		Span 2	
			End	Mid	End	Net ¹
Initial Load	20	00:00	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00
(2.0 x D.L.) x 2	219	00:08	0.08/0.06	0.80/0.80	0.11/0.10	0.71/0.72
Initial Load	21	00:47	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00
100% / 100% Recovery from 2.0 x Design Load						
(2.5 x D.L.) x 2	280	00:54	Achieved Load without Failure			

¹ Net displacement was the infill displacement relative to its top and bottom.

² Displacement was measured at (6) locations, (3) at each span.

³ A spreader beam was used to impose loads on both sections of the railing system; therefore, loads were doubled.

Test No. 2 - 11/14/14						
Design Load: 50 plf x (96 in ÷ 12 in/ft) = 400 lb Horizontal Uniform Load on Top Rail ³						
Load Level	Test Load (lb)	E.T. (min:sec)	Rail Displacement ² (in)			
			End	Mid	End	Net ¹
Initial Load	83	00:00	0.00	0.00	0.00	0.00
2.0 x Design Load	804	00:32	2.06	2.68	2.35	0.48
Initial Load	82	02:02	0.66	0.82	0.78	0.10
79% Recovery from 2.0 x Design Load						
2.5 x Design Load	1003	02:20	Achieved Load without Failure			

¹ Net displacement was rail displacement relative to the supports

² Displacement was measured at each post

³ Uniform load was simulated with four equal point loads.

2.4 Test Results (Continued)

Test Series No. 3 (Continued)

Test No. 3 - 11/14/14 Design Load: 200 lb Concentrated Load at Midspan of Top Rail						
Load Level ³	Test Load (lb)	E.T. (min:sec)	Rail Displacement ² (in) Span 1 / Span 2			
			End	Mid	End	Net ¹
Initial Load	85	00:00	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00
(2.0 x D.L.) x 2	825	00:12	1.69/2.13	2.01/2.03	2.13/1.69	0.10/0.12
Initial Load	86	01:27	0.02/0.03	0.02/0.03	0.03/0.02	0.01/0.01
90% / 92% Recovery from 2.0 x Design Load						
(2.5 x D.L.) x 2	1004	01:42	Achieved Load without Failure			

¹ Net displacement was mid-rail displacement relative to the rail at the support posts.

² Displacement was measured at (5) locations; at each post and midspan of each rail.

³ A spreader beam was used to impose loads on both sections of the railing system; therefore, loads were doubled.

Test No. 4 - 11/14/14 Design Load: 200 lb Concentrated Load at Top of Post Mount ¹			
Load Level	Test Load (lb)	E.T. (min:sec)	Post Displacement (in)
Initial Load	40	00:00	0.00
2.0x Design Load	435	00:24	1.44
Initial Load	40	02:17	0.00
100% Recovery from 2.0 x Design Load			
2.5x Design Load	528	02:28	Achieved Load without Failure

¹ Center post mount was tested

2.5 Summary and Conclusions

Using performance criteria of 75% deflection recovery from 2.0 times design load and withstanding an ultimate load of 2.5 times design load, the test results substantiate compliance with the design load requirements of the referenced building codes for the 96" wide (two 48 in spans) by 42" high *RailEasy Spectrum* and *SunRail Nautilus* and the 48" wide by 42" high *RailEasy Nautilus* railing assemblies as well as the 42" high support post reported herein. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

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:

Emily C. Riley
Project Manager
Structural Systems Testing

V. Thomas Mickley, Jr., P.E.
Senior Project Engineer
Structural Systems Testing

ECR:vtm/aaa

Attachments (pages): This report is complete only when all attachments listed are included.

Appendix A - Drawings (33)

Appendix B - Photographs (8)



Revision Log

<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	02/20/15	N/A	Original report issue
1	04/27/18	1	Updated all references to the IBC code to the current code.



E1690.01-119-19-R1

APPENDIX A

Drawings



E1690.01-119-19-R1

APPENDIX B

Photographs



Photo No. 1
In-Fill Load Test - *RailEasy™ Nautilus*



Photo No. 2
Concentrated Load Test at Mid-Span of Top Rail - *RailEasy™ Nautilus*



Photo No. 3
Uniform Load Test of Top Rail (Horizontal) - *RailEasy™ Nautilus*



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



Photo No. 5
Top Rail Bracket - RailEasy™ Nautilus



Photo No. 6
In-Fill Load Test - RailEasy™ Spectrum



Photo No. 7
Concentrated Load Test at Mid-Span of Top Rail – *RailEasy™ Spectrum*



Photo No. 8
Uniform Load Test of Top Rail (Horizontal) - *RailEasy™ Spectrum*



Photo No. 9
Concentrated Load Test at Top of Post Mount - *RailEasy™ Spectrum*



Photo No. 10
Rail to Post Bracket - *RailEasy™ Spectrum*



Photo No. 11
Fascia Mount Post - *RailEasy™ Spectrum*



Photo No. 12
In-Fill Load Test - *SunRail™ Nautilus*



Photo No. 13
Concentrated Load Test at Mid-Span of Top Rail - *SunRail™ Nautilus*



Photo No. 14
Uniform Load Test of Top Rail (Horizontal) - *SunRail™ Nautilus*



Photo No. 15
Concentrated Load Test at Top of Post Mount - *SunRail™ Nautilus*



Photo No. 16
Mid-Post with Tee Bracket - *SunRail™ Nautilus*