TEST REPORT

Rendered to:

BREUER METAL CRAFTSMEN, INC.

For:

Aluminum Rail with Flanged Stainless Steel Post Attachment

Report No.:	**E6612.01-119-19**
Report Date:	**05/12/15**
Test Record Retention Date:	**04/29/19**
Revision 1:	**06/02/15**

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TEST REPORT

E6612.01-119-19
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Rendered to:

BREUER METAL CRAFTSMEN, INC.
500 Beichl Avenue
Beaver Dam, Wisconsin 53916

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1.0 General Information

1.1 Product

10 ft Wide by 43 in High and 9 ft Wide by 43 in High Aluminum Railing System

1.2 Project Description

Architectural Testing, Inc., an Intertek company ("Intertek-ATI"), was contracted by Breuer Metal Craftsmen, Inc. to conduct structural performance tests on their 10 ft by 43 in and 9 ft by 43 in aluminum railing system. The system was evaluated using similar methods as outlined in the following ASTM standards:

ASTM E935-13e1, *Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings*

ASTM E985-00 (2006), *Standard Specification for Permanent Metal Railing Systems and Rails for Buildings*

1.3 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). Intertek-ATI is accredited to perform all testing reported herein.

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 rails, rail connections 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 Product Description

Breuer Metal Craftsmen, Inc. provided the 9 ft wide by 43 in high and 10 ft wide by 43 in high aluminum pipe railings with the following details:

Top / Mid Rail: 1.895 in outside diameter by 0.145 in thick wall 6005-T5 aluminum extrusion

Support Post: 1.895 in outside diameter by 0.185 in thick wall 6005-T5 aluminum extrusion

Base Plate: 6-1/2 in by 3 in by 3/8 in thick 304 stainless steel plate with (2) 5/8 in diameter holes and 1.500 in outside diameter by 0.185 in thick wall by 5 in long 304 stainless steel pipe attached to the base plate with a 3/16 in fillet weld all around

Rail Connection Condition: 1-7/16 in high by 1-1/2 in wide by 3/4 in deep by 0.118 in thick C-shaped 304 stainless steel bracket with connection details as found in Section 1.6 Fastening Schedule

See drawings in Appendix A for additional details.

1.6 Fastening Schedule

Connection	Fastener
Bracket to Post	One 5/16-14 x 3/4" (0.222 in minor diameter) hex head stainless steel bolt
Rail to Bracket	One 3/8-16 x 1-1/2" (0.309 in minor diameter) stainless steel set screw

2.0 Structural Performance Testing of Assembled Railing Systems

2.1 Scope

Aluminum railing specimens were tested according to the test methods described in ASTM E 935. Testing was conducted in a laboratory set to maintain temperature in the range of 68 ± 4 ºF and humidity in the range of 50 ± 5% RH.

2.2 Test Load and Deflection Criteria

The test load criteria for the 10 ft by 43 in aluminum guardrail system were 200 lb concentrated load and 20 plf uniformly distributed load; for the 9 ft by 43 in aluminum guardrail system were 200 lb concentrated load and 50 plf uniformly distributed load. The deflection criteria for top rail were as defined in ASTM E 985, Section 7.2.

2.3 Test Equipment

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.

2.4 Test Setup

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 prior to testing. The specimen was a 10 ft wide by 43 in high level guardrail assembly consisting of two 60 in (center-to-center of post) sections, or a 9 ft wide by 43 in high level guardrail assembly consisting of two 54 in (center-to-center of post) sections. Anchorage of the specimen was accomplished by bolting the support shoe to a rigid steel test fixture (i.e. simulate building steel) using 3/8-16 hex head steel bolts. Transducers mounted to independent reference frames were located to record guardrail system deflection at the point(s) of loading. See photographs in Appendix B for individual test setups.

2.5 Test Procedure

Testing and evaluation was performed in accordance with Section 10 of ASTM E 935. 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. A load of 25% of test load was applied and deflection readings were zeroed
2. Increased load to specified test load in no less than ten seconds
3. Maintained test load for a period of at least 1 minute
4. Removed test load and allowed specimen to relax for a period of at least 1 minute
5. A load of 25% of test load was applied and deflection readings were recorded and used to analyze residual deflection

2.6 Test Results

The following tests were performed on the test specimens in accordance with the test load requirements of the referenced standards.

Key to Test Results Tables:

Load Level: Target test load expressed as percent of test load criterion and (lb)

Applied Load: Actual applied load - Where more than one value is reported, the applied load was the range (min. - max.) that was held during the time indicated for the test

Elapsed Time (E.T.): The length 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 applied load was maintained.

Displacement: Total specimen displacement measured at or adjacent to point of load unless noted otherwise

2.6 Test Results (Continued)

Test Series No. 1
10 ft by 43 in Aluminum Pipe Railing

Test No. 1 - Test Date: 04/29/15 **Test Load: 20 plf x (60 in ÷ 12 in/ft) = 100 lb Vertical Uniform Load on Top Rail [1]**				
Load Level [2]	**Applied Load (lb)**	**E.T. (min:sec)**	**Net Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (25 lb) x 2	50	00:21	0.00	0.00
100% (100 lb) x 2	200 - 208	00:57 - 2:00	**0.04**	**0.03**
25% (25 lb) x 2	50	3:23	**0.00**	**0.00**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left: $\frac{l}{96} = \frac{60}{96} = 0.63 > 0.04 \therefore ok$

Maximum Allowable Deflection at Test Load on Right: $\frac{l}{96} = \frac{60}{96} = 0.63 > 0.03 \therefore ok$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{60}{96}\right) = 0.13 > 0.00 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.00 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{60}{96}\right) = 0.13 > 0.00 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.00 \therefore ok$$

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

[2] *Load was imposed on* both *spans (left and right) of rail simultaneously using a spreader beam; therefore, loads were doubled.*

2.6 Test Results (Continued)

Test Series No. 1
(Continued)

Test No. 2 - Test Date: 04/29/15 **Test Load: 20 plf x (60 in ÷ 12 in/ft) = 100 lb Horizontal Uniform Load on Top Rail [1]**				
Load Level [2]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (25 lb) x 2	50	00:37	0.00	0.00
100% (100 lb) x 2	200 - 206	1:21 - 2:37	**0.07**	**0.06**
25% (25 lb) x 2	50	4:52	**0.02**	**0.01**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left: $\frac{h}{24}+\frac{l}{96}=\frac{43}{24}+\frac{60}{96}=2.42>0.07\ \therefore ok$

Maximum Allowable Deflection at Test Load on Right:

$$\frac{h}{24}+\frac{l}{96}=\frac{43}{24}+\frac{60}{96}=2.42>0.06\ \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\%\times\left(\frac{h}{24}+\frac{l}{96}\right)=0.2\times2.42=0.48>0.02\ \therefore ok \quad \text{or} \quad 1/2\text{ in}>0.02\ \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\%\times\left(\frac{h}{24}+\frac{l}{96}\right)=0.2\times2.42=0.48>0.01\ \therefore ok \quad \text{or} \quad 1/2\text{ in}>0.01\ \therefore ok$$

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

[2] *Load was imposed on* both *spans (left and right) of rail simultaneously using a spreader beam; therefore, loads were doubled.*

2.6 Test Results (Continued)

Test Series No. 1
(Continued)

Test No. 3 - Test Date: 04/29/15 **Test Load: 200 lb Horizontal Concentrated Load at Midspan of Top Rail**				
Load Level [1]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (50 lb) x 2	100	00:35	0.00	0.00
100% (200 lb) x 2	400 - 407	1:09 - 2:14	**0.23**	**0.17**
25% (50 lb) x 2	100	4:07	**0.02**	**0.02**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left:

$$\frac{h}{24}+\frac{l}{96}=\frac{43}{24}+\frac{60}{96}=2.42>0.23\therefore ok$$

Maximum Allowable Deflection at Test Load on Right:

$$\frac{h}{24}+\frac{l}{96}=\frac{43}{24}+\frac{60}{96}=2.42>0.17\therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\%\times\left(\frac{h}{24}+\frac{l}{96}\right)=0.2\times 2.42=0.48>0.02\therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.02 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\%\times\left(\frac{h}{24}+\frac{l}{96}\right)=0.2\times 2.42=0.48>0.02\therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.02 \therefore ok$$

[1] *Load was imposed on* both *spans (left and right) of rail simultaneously using a spreader beam; therefore, loads were doubled.*

2.6 Test Results (Continued)

Test Series No. 1
(Continued)

Test No. 4 - Test Date: 04/29/15 **Test Load: 200 lb Vertical Concentrated Load at Midspan of Top Rail**				
Load Level [1]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (50 lb) x 2	100	00:42	0.00	0.00
100% (200 lb) x 2	400 - 418	1:06 - 2:08	**0.10**	**0.11**
25% (50 lb) x 2	100	3:42	**0.00**	**0.00**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left:

$$\frac{l}{96} = \frac{60}{96} = 0.63 > 0.10 \therefore ok$$

Maximum Allowable Deflection at Test Load on Right:

$$\frac{l}{96} = \frac{60}{96} = 0.63 > 0.11 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{60}{96}\right) = 0.13 > 0.00 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.00 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{60}{96}\right) = 0.13 > 0.00 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.00 \therefore ok$$

[1] *Load was imposed on* both *spans (left and right) of rail simultaneously using a spreader beam; therefore, loads were doubled.*

2.6 Test Results (Continued)

Test Series No. 1
(Continued)

Test No. 5 - Test Date: 04/29/15 **200 lb Horizontal Concentrated Load on Top Rail Adjacent to End Post**				
Load Level [1]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (50 lb) x 2	100	00:56	0.00	0.00
100% (200 lb) x 2	400 - 406	1:39 - 2:42	**1.79**	**1.70**
25% (50 lb) x 2	100	4:51	**0.09**	**0.13**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left: $\frac{h}{12} = \frac{43}{12} = 3.58 > 1.79 \therefore ok$

Maximum Allowable Deflection at Test Load on Right: $\frac{h}{12} = \frac{43}{12} = 3.58 > 1.70 \therefore ok$

Maximum Allowable Residual Deflection at 25% Load on Left:

$20\% \times \left(\frac{h}{12}\right) = 0.2 \times 3.58 = 0.72 > 0.09 \therefore ok$ or 1/2 in > 0.09 $\therefore ok$

Maximum Allowable Residual Deflection at 25% Load on Right:

$20\% \times \left(\frac{h}{12}\right) = 0.2 \times 3.58 = 0.72 > 0.13 \therefore ok$ or 1/2 in > 0.13 $\therefore ok$

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

Test No. 6 - Test Date: 04/29/15 **200 lb Vertical Concentrated Load on Top Rail Adjacent to End Post [1]**				
Load Level [2]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (50 lb) x 2	100	00:50	0.00	0.00
100% (200 lb) x 2	400 - 421	1:38 - 2:40	**0.01**	**0.01**
25% (50 lb) x 2	100	4:10	**0.00**	**0.00**

[1] *There is no deflection criterion when applying a vertical load adjacent to a post.*

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

2.6 Test Results (Continued)

Test Series No. 1
(Continued)

Test No. 7 - Test Date: 04/29/15 **200 lb Horizontal Concentrated Load at Top of Post**			
Load Level	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**
0% (0 lb)	0	00:00	--
25% (50 lb)	50	00:31	0.00
100% (200 lb)	200 - 205	00:52 - 1:59	**1.30**
25% (50 lb)	50	3:50	**0.04**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load: $\frac{h}{12} = \frac{43}{12} = 3.58 > 1.30 \therefore ok$

Maximum Allowable Residual Deflection at 25% Load:

$20\% \times \left(\frac{h}{12}\right) = 0.2 \times 3.58 = 0.72 > 0.04 \therefore ok$ or $1/2 \text{ in} > 0.04 \therefore ok$

Test No. 8 - Test Date: 04/29/15 **200 lb Vertical Concentrated Load at Top of Post** [1]			
Load Level	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**
0% (0 lb)	0	00:00	--
25% (50 lb)	50	00:26	0.00
100% (200 lb)	201 - 215	00:42 - 1:46	**0.01**
25% (50 lb)	50	3:12	**0.00**

[1] *There is no deflection criterion when applying a vertical load at top of post.*

2.6 Test Results (Continued)

Test Series No. 2
9 ft by 43 in Aluminum Pipe Railing

Test No. 1 - Test Date: 04/30/15 **Test Load: 50 plf x (54 in ÷ 12 in/ft) = 225 lb Vertical Uniform Load on Top Rail [1]**				
Load Level [2]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (56 lb) x 2	112	00:33	0.00	0.00
100% (225 lb) x 2	450 - 463	1:10 - 2:12	**0.06**	**0.06**
25% (56 lb) x 2	112	4:13	**0.01**	**0.01**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left: $\frac{l}{96} = \frac{54}{96} = 0.56 > 0.06 \therefore ok$

Maximum Allowable Deflection at Test Load on Right: $\frac{l}{96} = \frac{54}{96} = 0.56 > 0.06 \therefore ok$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{54}{96}\right) = 0.11 > 0.01 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.01 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{54}{96}\right) = 0.11 > 0.01 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.01 \therefore ok$$

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

[2] *Load was imposed on* both *spans (left and right) of rail simultaneously using a spreader beam; therefore, loads were doubled.*

2.6 Test Results (Continued)

Test Series No. 2
(Continued)

Test No. 2 - Test Date: 04/30/15 **Test Load: 50 plf x (54 in ÷ 12 in/ft) = 225 lb Horizontal Uniform Load on Top Rail [1]**				
Load Level [2]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (56 lb) x 2	112	00:38	0.00	0.00
100% (225 lb) x 2	450 - 459	1:23 - 2:27	**0.12**	**0.07**
25% (56 lb) x 2	112	4:31	**0.02**	**0.01**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left: $\frac{h}{24}+\frac{l}{96}=\frac{43}{24}+\frac{54}{96}=2.35>0.12\ \therefore ok$

Maximum Allowable Deflection at Test Load on Right:

$$\frac{h}{24}+\frac{l}{96}=\frac{43}{24}+\frac{54}{96}=2.35>0.06\ \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\%\times\left(\frac{h}{24}+\frac{l}{96}\right)=0.2\times 2.35=0.47>0.02\ \therefore ok \quad \text{or} \quad 1/2\text{ in}>0.02\ \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\%\times\left(\frac{h}{24}+\frac{l}{96}\right)=0.2\times 2.35=0.47>0.01\ \therefore ok \quad \text{or} \quad 1/2\text{ in}>0.01\ \therefore ok$$

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

[2] *Load was imposed on* both *spans (left and right) of rail simultaneously using a spreader beam; therefore, loads were doubled.*

2.6 Test Results (Continued)

Test Series No. 2
(Continued)

Test No. 3 - Test Date: 04/30/15 **200 lb Horizontal Concentrated Load at Mid-Span of Top Rail**				
Load Level [1]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (50 lb) x 2	100	00:35	0.00	0.00
100% (200 lb) x 2	400 - 408	1:13 - 2:15	**0.14**	**0.09**
25% (50 lb) x 2	100	4:02	**0.00**	**0.00**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left:

$$\frac{h}{24}+\frac{l}{96}=\frac{43}{24}+\frac{54}{96}=2.35>0.14\therefore ok$$

Maximum Allowable Deflection at Test Load on Right:

$$\frac{h}{24}+\frac{l}{96}=\frac{43}{24}+\frac{54}{96}=2.35>0.09\therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\%\times\left(\frac{h}{24}+\frac{l}{96}\right)=0.2\times 2.35=0.47>0.00\therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.00 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\%\times\left(\frac{h}{24}+\frac{l}{96}\right)=0.2\times 2.35=0.47>0.00\therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.00 \therefore ok$$

[1] *Load was imposed on* both *spans (left and right) of rail simultaneously using a spreader beam; therefore, loads were doubled.*

2.6 Test Results (Continued)

Test Series No. 2
(Continued)

Test No. 4 - Test Date: 04/30/15 **200 lb Vertical Concentrated Load at Mid-Span of Top Rail**				
Load Level [1]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (50 lb) x 2	100	00:32	0.00	0.00
100% (200 lb) x 2	400 - 417	00:59 - 2:02	**0.07**	**0.07**
25% (50 lb) x 2	100	3:36	**0.01**	**0.01**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left:

$$\frac{l}{96} = \frac{54}{96} = 0.56 > 0.07 \therefore ok$$

Maximum Allowable Deflection at Test Load on Right:

$$\frac{l}{96} = \frac{54}{96} = 0.56 > 0.07 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{54}{96}\right) = 0.11 > 0.01 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.01 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{54}{96}\right) = 0.11 > 0.01 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.01 \therefore ok$$

[1] *Load was imposed on* both *spans (left and right) of rail simultaneously using a spreader beam; therefore, loads were doubled.*

2.6 Test Results (Continued)

Test Series No. 2
(Continued)

Test No. 5 - Test Date: 04/30/15 **200 lb Horizontal Concentrated Load on Top Rail Adjacent to End Post**				
Load Level [1]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (50 lb) x 2	100	00:35	0.00	0.00
100% (200 lb) x 2	400 - 406	1:08 - 2:11	**1.96**	**1.79**
25% (50 lb) x 2	100	3:58	**0.03**	**0.07**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load on Left: $\frac{h}{12} = \frac{43}{12} = 3.58 > 1.96 \therefore ok$

Maximum Allowable Deflection at Test Load on Right: $\frac{h}{12} = \frac{43}{12} = 3.58 > 1.79 \therefore ok$

Maximum Allowable Residual Deflection at 25% Load on Left:

$$20\% \times \left(\frac{h}{12}\right) = 0.2 \times 3.58 = 0.72 > 0.03 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.03 \therefore ok$$

Maximum Allowable Residual Deflection at 25% Load on Right:

$$20\% \times \left(\frac{h}{12}\right) = 0.2 \times 3.58 = 0.72 > 0.07 \therefore ok \quad \text{or} \quad 1/2 \text{ in} > 0.07 \therefore ok$$

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

2.6 Test Results (Continued)

Test Series No. 2
(Continued)

Test No. 6 - Test Date: 04/30/15 **200 lb Vertical Concentrated Load on Top Rail Adjacent to End Post [1]**				
Load Level [2]	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Left	**Right**
0% (0 lb)	0	00:00	--	--
25% (50 lb) x 2	100	00:19	0.00	0.00
100% (200 lb) x 2	401 - 412	00:54 - 1:56	**0.01**	**0.02**
25% (50 lb) x 2	100	3:24	**0.00**	**0.00**

[1] *There is no deflection criterion when applying a vertical load adjacent to a post.*

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

Test No. 7 - Test Date: 04/30/15 **200 lb Horizontal Concentrated Load at Top of Post**			
Load Level	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**
0% (0 lb)	0	00:00	--
25% (50 lb)	50	00:27	0.00
100% (200 lb)	201 - 206	00:46 - 1:49	**1.15**
25% (50 lb)	50	3:32	**0.00**

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load: $\frac{h}{12} = \frac{43}{12} = 3.58 > 1.15 \therefore ok$

Maximum Allowable Residual Deflection at 25% Load:

$20\% \times \left(\frac{h}{12}\right) = 0.2 \times 3.58 = 0.72 > 0.00 \therefore ok$ or $1/2 \text{ in} > 0.00 \therefore ok$

2.6 Test Results (Continued)

Test Series No. 2
(Continued)

Test No. 8 - Test Date: 04/30/15 **200 lb Vertical Concentrated Load at Top of Post [1]**			
Load Level	**Applied Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**
0% (0 lb)	0	00:00	--
25% (50 lb)	50	00:18	0.00
100% (200 lb)	200 - 211	00:41 - 1:43	**0.01**
25% (50 lb)	50	3:10	**0.01**

[1] *There is no deflection criterion when applying a vertical load at top of post.*

3.0 Summary and Conclusions

The 10 ft wide by 43 in high and the 9 ft wide by 43 in high aluminum guardrail assembly, tested and reported herein, met all of the load and deflection criteria of the referenced standards for the static load tests on the fully assembled railing assembly.

4.0 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: Adam J. Schrum

Adam J. Schrum
Technician I
Structural Systems Testing

Digitally Signed for: Thomas Mickley by Julie Shilke

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

AJS:vtm/jas

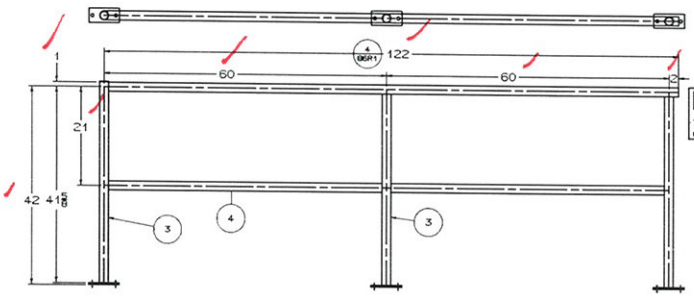
Attachments (pages): This report is complete only when all attachments listed are included.
Appendix A - Drawings (2)
Appendix B - Photographs (4)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	05/12/15	N/A	Original report issue
1	06/02/15	2, Appendix A	In Section 1.5 Product Description, revised alloy from 6105-T5 to 6005-T5 Drawing No. 6001-86 rechecked and stamped

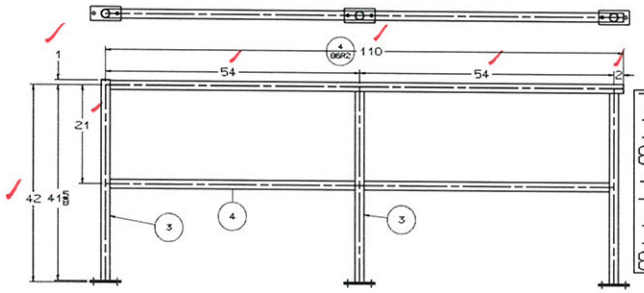
APPENDIX A

Drawings



86R1
3 REQD

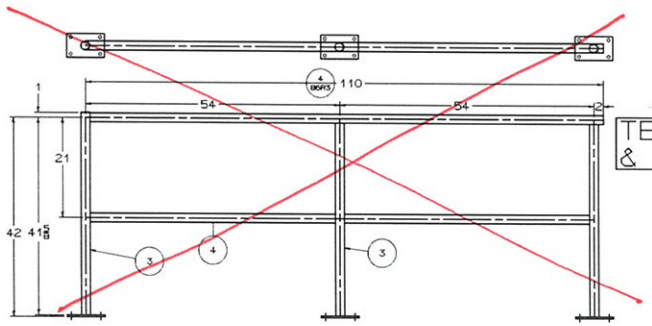
BASE TEST PER QUOTATION
20 PLF & 200LB



86R2
3 REQD

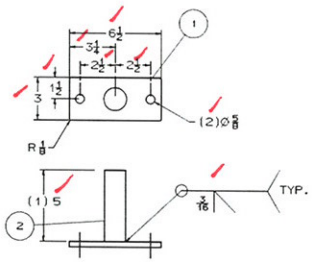
TEST @ 20 PLF & 200LB
IF RAIL TESTS ON
86R1 FAIL

TEST @ 50 PLF & 200LB
IF RAIL TESTS ON
86R1 PASS



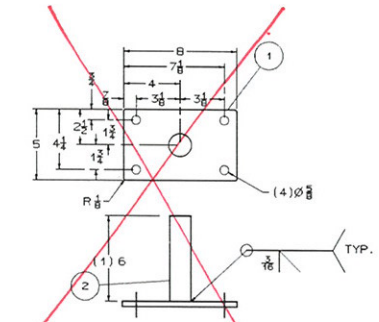
86R3
3 REQD

TEST @ 50 PLF
& 200LB



F1
18 REQD

3X SCALE



F3
9 REQD

BILL OF MATERIAL
6001 - 86
02-12-2015 14:31:19

MATERIAL REF. NUMBER

REF #	SIZE	MATERIAL
1	3/8X48 304•NESTA	PLATE.SST
2	1-1/2X3/16 304 ROUND A511	TUBE.SST
3	1-1/2 SCH80 6005-T5	PIPE.ALM
4	1-1/2 SCH40 6005-T5	PIPE.ALM
5	1/2X2-1/4 HHCS	BOLT.325
6	1/2X1-1/2 HHCS	BOLT.325
7	1/2	NUT.325
8	1/2	WASHER.325
9	BMC TEE	FAB
10	BMC CAP-80	FAB
11	BMC TEE-80	FAB
12	ATSM LAB TESTS-RAILS	SUBLAB1
13	FREIGHT 6001-86	SUBLAB1
14	1/8X5/8 RVT/SST	MISCHDW.SST
15	BMC 4H FLG-S80	FAB

"MILL" RAILING NOTES:

MECHANICAL RAILING WITH MILLED JOINTS AND FASTENED WITH SST HDW

ALUM. ALLOYS:
PIPE = 1-1/2 SCH40 6005-T5 (1.90X.145)
~~-OR 6105-T5~~
(AS FABRICATED)
-->1-1/2 SCH80 6005-T5 (1.90X.200)
~~-OR 6105-T5~~
FOR POSTS ONLY
(AS FABRICATED)

ALL OTHER RAIL COMPONENTS = 6061-T6

SST. ALLOYS:
ALL TYPE "BMC FLG" LISTINGS ARE SHAPES CUT FROM 3/8" THICK 304 SST PLATE.

WELDING PROCESS: (FLANGES)
SST: GMAW - 304
GTAW - 304

STD. HDW. SPECIFICATIONS:
HIGH STRENGTH = A325

NO.	DATE	REVISIONS
3		
2		
1	-	-

BREUER METAL CRAFTSMEN, INC
500 BEICHL AVE.
BEAVER DAM, WI 53916
(920)885-2828 FAX(920)885-2835
WEBSITE: www.breuermetal.com
E-mail: craftsmen@breuermetal.com

SCALE 1"=1'-0"	PROJ MGR: PAUL	D.C. BY	APPR BY
DETAILER: PCS	DATE 2/12/14	DATE	DATE

SPECIFICATION SECTION -

ASTM ALUM RAIL TESTS

BMC ASSETS

BREUER METAL CRAFTSMEN, INC. — DRAWING NUMBER 6001-86

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # E6612.01-119-19

Date 6/7/15 **Tech** AJS

APPENDIX B

Photographs

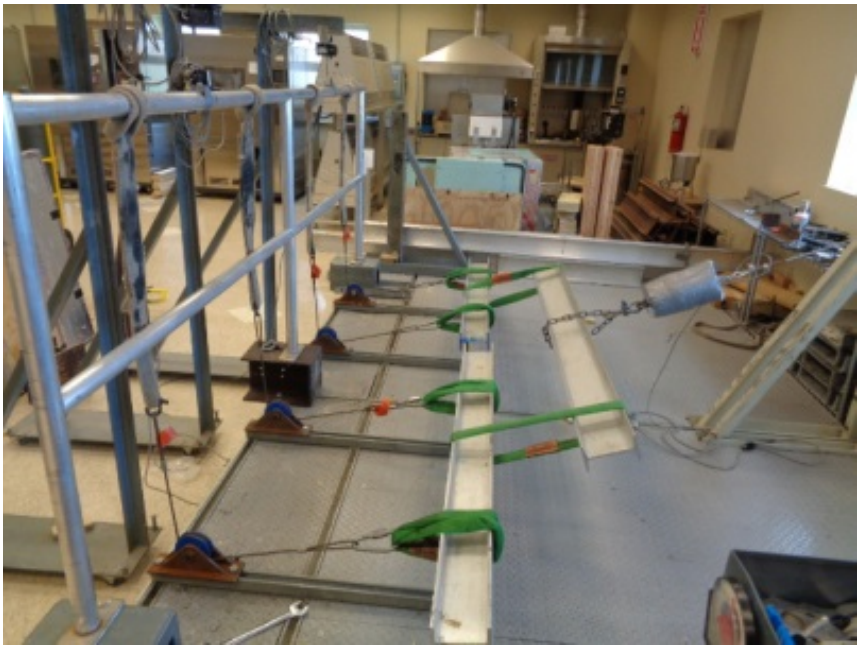


Photo No. 1
Vertical Uniform Load

Photo No. 2
Horizontal Uniform Load

Photo No. 3
Horizontal Concentrated Load at Mid-Span of Top Rail

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

Photo No. 5
Horizontal Concentrated Load on Top Rail Adjacent to End Post

Photo No. 6
Vertical Concentrated Load on Top Rail Adjacent to End Post

Photo No. 7
Concentrated Horizontal Load at Top of Post

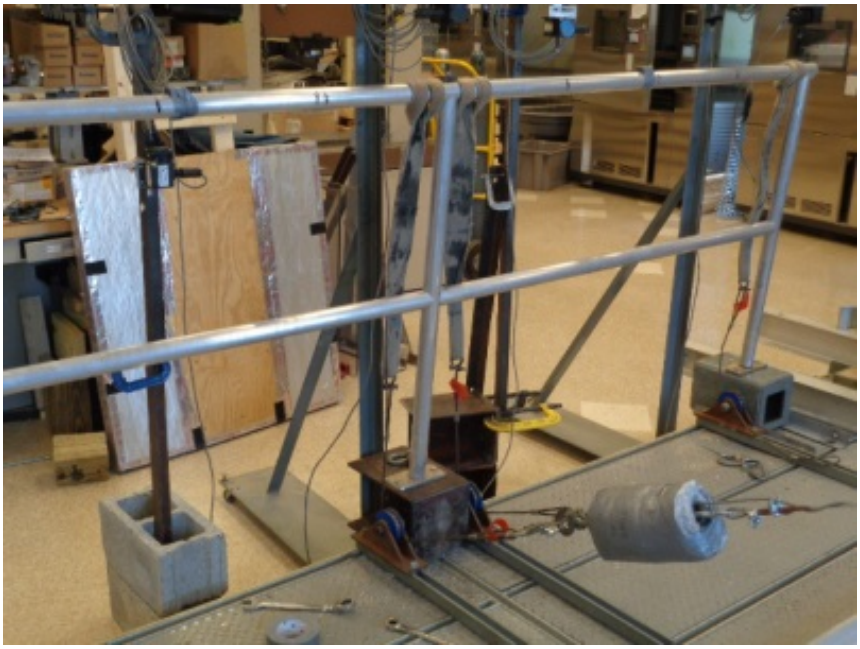


Photo No. 8
Concentrated Vertical Load at Top of Post