Architectural Testing

TEST REPORT

Rendered to:

FAIRWAY BUILDING PRODUCTS, LP

For:

PVC Guardrail Systems
Standard* and *Contour

Report No: 63086.01-119-19
Report Date: 08/10/06

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63086.01-119-19
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Rendered to:

FAIRWAY BUILDING PRODUCTS, LP
P.O. Box 37
Mount Joy, Pennsylvania 17552

Report No:	63086.01-119-19
Test Date:	03/31/06
Through:	04/19/06
Report Date:	08/10/06

1.0 General Information

1.1 Product

PVC Guardrail System - Fairway Vinyl Systems *Standard* and *Contour*

1.2 Project Description

Architectural Testing, Inc. (ATI) was contracted by Fairway Building Products, LP to perform material and structural testing on their *Standard* and *Contour* vinyl (PVC) guardrail (railing) systems. The purpose of the testing was code compliance evaluation in accordance with the following criteria:

> ICC-ES™ AC174 (July 1, 2005), *Acceptance Criteria for Deck Board Span Ratings and Guardrail Systems* (*Guards and Handrails*).

In addition to testing for evaluation to AC174, flexural testing was performed on the rail system components (rails and pickets) to determine the flexural properties of the members used in the railing tests. The flexural property values are contained herein.

1.3 Product Description

The 36" and 42" height railing systems were comprised of mono-extruded PVC pickets, posts, and aluminum reinforced mono-extruded PVC rails and molded brackets. One product color (white) was used in all tests.

The Fairway Vinyl Systems *Standard* and *Contour* railing systems tested and reported herein consisted of the following components:

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1.3 Product Description: (Continued)

Top Rails:

1. *Standard*: 2" x 3-1/2" x 0.115" nominal wall Rectangular, PVC hollow extrusion
2. *Contour*: 3" wide x 2-1/4" high x 0.085" nominal wall "bread loaf", PVC hollow extrusion

Bottom Rails:

2" x 3-1/2" x 0.115" nominal wall Rectangular, PVC hollow extrusion

Top Rail Reinforcements (Inserts):

1. *Standard*: 1-3/4" x 3-1/4" extruded 6105-T5 aluminum, **H** section with 1-3/8" opening width for 1-3/8" pickets, full length of top rail
2. *Contour*: 2-3/4" x 2-1/8" extruded 6105-T5 aluminum section with 1.5" opening width for 1-3/8" pickets, full length of top rail

Pickets:

1-3/8" x 1-3/8" x 0.06" wall, PVC hollow extrusion

Rail Attachment Brackets:

1. *Standard*: 2-3/4" high by 3-1/8" wide black Nylon bracket base, hidden with separate white bracket trim cover. The brackets were installed with the flange radii up.
2. *Contour*: 1-5/16" high x 2-15/16" wide small black contoured ABS handrail saddle bracket hidden with separate white bracket trim cover.

Bracket Fasteners:

Standard brackets were attached to 4 x 4 PVC sleeved 4 x 4 wood posts with four #10 by 1-1/4" square drive, pan-head, stainless steel, Hi-Lo wood screws in the bracket's outboard holes.

Contour brackets were attached to 4 x 4 PVC sleeved 4 x 4 wood posts with four #10 by 1-3/4" square drive, pan-head, stainless steel, Hi-Lo wood screws.

Brackets were attached to reinforced and non-reinforced rails with four (*Standard*) or two (*Contour*) #8 by 3/4" pan-head, square drive, self-drilling, stainless steel, sheet metal screws.

1.4 Product Sampling

A representative of ATI visited the Fairway Building Products, LP manufacturing facility in Mount Joy, Pennsylvania on February 22, 2006 to observe manufacturing and select the components used for testing. All samples selected for testing were marked for identification and were the samples used for all tests reported herein.

1.5 Conditions of Testing

Unless otherwise indicated, the conditions of testing were laboratory ambient conditions with temperature in the range of 68 ± 4ºF. All test specimen materials were stored in the laboratory conditions indicated for no less than 40 hours prior to testing.

2.0 Reference Standards

ASTM D 1761-00, *Standard Test Methods for Mechanical Fasteners in Wood.*

ASTM D 6109-97, *Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber.*

ASTM D 7032-04, *Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite Deck Boards and Guardrail Systems (Guards or Handrails).*

IBC-2000 / ICC - *International Code Council*

IRC-2000 - *International Residential Code for One- and Two-Family Dwellings*

3.0 Component Flexural Tests

Re: AC174 - Sections 6.3.1.1

3.1 General

Flexural tests were performed on railing components (rails and balusters) used in the railing assemblies for the purpose of establishing baseline values that can be used for comparison with future production in conjunction with Q.C. procedures. To suit these purposes, tests were performed using methods and in a manner that can be duplicated in the production setting. The test results are not suitable for use as design values or for any purpose other than that indicated.

3.2 Test Specimens

Each control set consisted of fifteen test samples and each was conditioned for a minimum of 40 hours at standard laboratory conditions prior to testing.

3.3 Test Procedure

Tests were performed using the methods described by ASTM D 6109. Testing was performed in a computer-monitored and -controlled SATEC Universal Test Machine (50UD) with a third-point loading arrangement. The specimens were supported on 1-1/4" diameter support noses. The loading span was one-third of the bending span and used 1-1/4" diameter loading noses. Midspan deflection was measured to an accuracy of 0.001". Shapes that were not symmetrical about their x-axis (horizontal) were tested in the same orientation as shown by the product drawing provided in Appendix A. Any exceptions are noted in the test results tables below. See photographs in Appendix B for test setup.

3.4 Test Results

Stiffness properties were derived from load/deflection data using a least squares fit between 10% and 40% of the maximum test load. Peak load and Mu are defined at ultimate bending strength. Ultimate load was that load at which bending failure occurred on the bottom side (tensile stress). No peak loads were limited by an outer surface strain of 0.03 in/in as determined in Section 10.1.7 of ASTM D 6109.

***Standard* 2 in x 3-1/2 in Rail Support Span = 33 in Cross-Head Speed = 0.60 in/min Tested in flat orientation (width = 3-1/2 in, depth = 2 in)**				
Sample ID	**Ultimate Load (lb)**	**Tangent Modulus (lbf/in)**	**Mu (in·lb)**	**EI (lb·in^2)**
1	380	446	2090	284264
2	404	433	2222	276064
3	423	438	2327	279253
4	385	434	2118	276975
5	412	439	2266	280164
6	413	445	2272	283808
7	382	441	2101	280984
8	401	447	2206	284992
9	422	446	2321	284264
10	404	429	2222	273330
11	405	441	2228	281075
12	383	448	2107	285721
13	394	447	2167	284992
14	391	439	2151	280255
15	420	441	2310	281075
		Minimum:	2090	273330
		Maximum:	2327	285721
		Average:	2207	281148
		Standard Deviation:	82	3652
		Coefficient of Variation:	4%	1%

3.4 Test Results: (Continued)

***Contour* Top Rail** **Support Span = 39 in** **Cross-Head Speed = 0.625 in/min** **Profiles are tested in an inverted orientation and utilize load distribution blocks at each support** [1]				
Sample ID	**Ultimate Load (lb)**	**Tangent Modulus (lbf/in)**	**Mu (in·lb)**	**EI (lb·in^2)**
1	295	209	1918	220371
2	300	210	1950	221392
3	295	210	1918	221424
4	293	213	1905	224231
5	296	212	1924	223179
6	296	212	1924	223529
7	294	209	1911	219988
8	295	210	1918	220722
9	296	209	1924	220020
10	295	212	1918	222828
11	291	207	1892	217947
12	301	216	1957	227390
13	298	209	1937	219733
14	293	211	1905	222477
15	288	206	1872	217213
		Minimum:	1872	217213
		Maximum:	1957	227390
		Average:	1918	221496
		Standard Deviation:	21	2568
		Coefficient of Variation:	1%	1%

[1] *Wood blocks were used at supports to reduce local crushing at the support noses. The top surface of the blocks was cut to match the curved surface of the profile. A 1-1/4" diameter concave bottom surface rested on the loading nose and allowed rotation under load. Bearing blocks were 1-3/4" long, 3-1/2" wide and 2" tall (see Photographs in Appendix B).*

3.4 Test Results: (Continued)

1-3/8" Square Picket Support Span = 30 in Cross-Head Speed = 0.85 in/min				
Sample ID	**Ultimate Load (lb)**	**Tangent Modulus (lbf/in)**	**Mu (in·lb)**	**EI (lb·in^2)**
1	130	84	650	40250
2	137	84	685	40424
3	137	84	685	40076
4	133	86	665	41034
5	133	84	665	40424
6	132	84	660	40163
7	138	86	690	41295
8	135	85	675	40947
9	136	86	680	41208
10	138	87	690	41644
11	137	84	685	40076
12	137	87	685	41818
13	137	85	685	40715
14	136	85	680	40889
15	133	86	665	41034
		Minimum:	650	40076
		Maximum:	690	41818
		Average:	676	40800
		Standard Deviation:	12	557
		Coefficient of Variation:	2%	1%

4.0 Assembly Fastener Testing

Re: AC174 - Section 5.2

4.1 General

The purpose of this testing was 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/angled condition.

4.2 Test Specimens

Short sections of the *Standard* and *Contour* top rails were attached to short sections of posts in accordance with the manufacturers' installation instructions. The rail brackets were attached to PVC-sleeved conventional 4x4 wood posts (Southern Pine). Each *Standard* bracket was secured to a post section with four #10 by 1-1/4" square drive, pan-head, stainless steel, Hi-Lo wood screws. Each *Contour* bracket was secured to a post section with four #10 by 1-3/4" square drive, pan-head, stainless steel, Hi-Lo wood screws. Each bracket was secured to the reinforced rail section with four (*Standard*) or two (*Contour*) #8 by 3/4" self-drilling, square drive, pan-head, stainless steel, sheet metal screws.

4.3 Test Setup

The testing machine was fitted with the post sections at the top and bottom to accommodate anchorage of the rail and brackets. The top post section was attached to the test machine's crosshead with a swivel mechanism, and the bottom post section was attached rigidly to the base of the test machine. Three specimens were tested in this manner with each of the three specimens including two connections for a total of six connections. Reference photographs in Appendix B for test setups.

4.4 Test Procedure

Testing was performed in accordance with ASTM D 1761 and by using a computer-monitored and -controlled Universal Test Machine (SATEC Model 50UD). Tests were run at a crosshead speed of 0.05 in/min, and each specimen was tested in tension to its ultimate load capacity.

4.5 Test Results

***Standard* Rail and Mounting Bracket**

Specimen No.	Ultimate Load (lb)	Deviation From Average
1	808	4%
2	802	5%
3	920	9%
Average	843	
Allowable Capacity [1]	**281**	**> 200 lb ∴ OK**

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

***Contour* Rail and Mounting Bracket**

Specimen No.	Ultimate Load (lb)	Deviation From Average
1	1064	18%
2	989	9%
3	660	27%
Average	904	
Allowable Capacity [1]	**301**	**> 250 lb ∴ OK**

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

4.6 Test Summary/Conclusion

The maximum design load rating required for use in One- and Two-Family Dwellings is 200 lb. Therefore, fasteners/connectors reported herein met the performance requirements of AC174 for use in One- and Two-Family Dwellings (IRC) for corner/angled conditions

The maximum design load rating required for use in Residential applications for rails up to and including 8 ft is 200 lb. Therefore, fasteners/connectors reported herein met the performance requirements of AC174 for use in Group R Occupancy (R-1, R-2, R-3 and R-4) End-Use Code Requirements (IBC) for supporting rail lengths up to and including 8 ft for corner/angled conditions.

5.0 Test Load Adjustment Factors

Re: Section 5.4 of ASTM D 7032 as specified by Section 4.0 of AC174

5.1 General

Data from ATI Report No. 57339.01-119-19 was used for determination of applicable adjustment factors.

5.2 Test Load Adjustment Factors

Comparison (% Change) with Standard (Control) Conditions

End Use Factors	Strength (Moment or M.O.R. [1])	Stiffness (EI [2] or M.O.E. [3])	Acceptance Criteria (ASTM D 7032 as referenced by AC174)	Adjustment Factor	
				Strength	Stiffness
UV	+19%	+6%	Strength loss within 10%	0%	0%
Freeze-Thaw	-6%	-2%	Strength loss within 10%	0%	0%
Greatest of: +125ºF	-25%	-22%	Strength loss within 15%	10%	7%
-20ºF	+32%	+13%			
Moisture	N/A	N/A			
			Cumulative Adjustment:	10%	7%

[1] *M.O.R. - Modulus of Rupture*
[2] *EI - The product of M.O.E. and the Moment of Inertia*
[3] *M.O.E. - Modulus of Elasticity*

Pursuant to compliance with AC174, the test loads on non-reinforced PVC components were increased by the amount in excess of 10 percent for UV exposure and freeze-thaw cycling, as well as 15 percent for temperature effect. This set the cumulative adjustment factor at +10 percent. Therefore, tests on non-reinforced PVC members (pickets) were performed to a maximum test load equal to 2.75 times design load (2.5 x 1.10 = 2.75).

In addition, the deflection observed at design load should be adjusted for the cumulative effect on PVC component stiffness properties in excess of the same tolerances specified for strength, which was +7% or 107%.

5.3 Relative Stiffness Analysis

For rails reinforced with aluminum, adjustment factors were further evaluated for their effect on the combined PVC/Aluminum by applying the strength or stiffness loss only to the percentage carried by the PVC which was determined by relative stiffness analysis.

Standard Rail and Aluminum "H" Channel

Member	E (ksi)	I_y (in^4)	EI_y	% Carried
PVC	358	0.7376	264	6%
Alum	10000	0.3840	3840	94%
		∑EI=	4104	

Contour Rail and 2-3/4" x 2-1/8" Aluminum Channel

Member	E (ksi)	I_y (in^4)	EI_y	% Carried
PVC	358	0.7486	268	5%
Alum	10000	0.4712	4712	95%
		∑EI=	4980	

Worst case was 6% carried by PVC component (more dependent on PVC). Greatest property loss for strength or stiffness was -25%. Applying this only to the PVC component, the overall effect was: 0.06 (1-0.25) + 0.94 = 0.985. This represented a 1-1/2 % loss for the combined PVC/Aluminum component. AC174 allows 15%; therefore, no adjustment factor was required for deflection or test loads applied to aluminum reinforced rails.

6.0 Structural Performance Testing of Assembled Railing Systems

Re: AC174 - Section 5.0

6.1 General

Railing assemblies were tested in a self-contained structural frame designed to accommodate anchorage of a rail assembly and application of the required test loads. The specimen was loaded using an electric winch mounted to a rigid steel test frame. High strength steel cables, nylon straps, and load distribution beams were used to impose test loads on the specimen. Applied load was measured using an electronic load cell located in-line with the loading system. Deflections were measured to the nearest 0.01" using electronic linear displacement transducers.

6.2 Railing Assembly Description

The guardrail systems consisted of aluminum reinforced PVC top rails and PVC bottom rails with spaced pickets inserted into to the rail members providing approximately 3-3/4" clear space between pickets. The railing systems had overall rail lengths (inside of post to inside of post) of 120" and 96" with an overall rail height of 36" and 42". Top and bottom rails attached to traditional 4x4 wood posts (Southern Pine) sleeved by 4x4 PVC post covers via plastic brackets. Each *Standard* rail bracket was secured to a support with four (4) #10 by 1-1/4" pan-head stainless steel Hi-Lo wood screws, and each *Contour* rail bracket was secured to a support with four (4) #10 by 1-3/4" pan-head stainless steel Hi-Lo wood screws. Each bracket was secured to the reinforced rail section with four (for the *Standard rail*) or two (for the *Contour* rail) #8 by 3/4" self-drilling pan-head stainless steel sheet metal screws. See drawings in Appendix A and photographs in Appendix B for additional details.

6.3 Test Setup

The railing assembly was installed and tested as a single railing section by directly securing the supports to a rigid test frame. The PVC-sleeved 4x4 wood posts were included only to facilitate anchorage of the test specimen and were not tested components. Transducers mounted to an independent reference frame were located to record movement of reference points on the railing system components (ends and mid-point) to determine net component deflections. See photographs in Appendix B for test setups.

6.4 Test Procedure

Testing and evaluation was performed in accordance with Section 5.1 of AC174. 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
3. Held specified test load for no less than one minute

6.5 Test Results

Unless otherwise noted, all loads and displacement measurements were normal to the rail (horizontal). The test results apply only to the railing assembly between supports and anchorage to the support. The test load adjustment factor was increased from 2.5 x design load to 2.75 x design load. This 10% increase in required maximum test loads was determined from test results as summarized in Section 5.0 Test Load Adjustment Factors.

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.

8 ft x 42 in *Standard* PVC Guardrail
Residential End-Use / AC174

Test No. 1 - 04/06/06 **Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	Sustained load equal to or greater than 138 lb for minimum of one minute
138 lb (2.75x D.L.)	142 - 147	00:23 - 01:31	

Test No. 2 - 04/06/06 **Design Load: 50 plf Uniform Horizontal Load [1] on Top Rail**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	Sustained load equal to or greater than 1,000 lb for minimum of one
1,000 lb (2.5x D.L.)	1,003 - 1,012	00:35 - 01:42	

[1] *Uniform load was simulated with 2 equal point loads located at 1/4-pts. 8 ft x 50 plf = 400 lb x 2.5 = 1000 lb*

Test No. 3 - 04/06/06 **Design Load: 50 plf Vertical Uniform Load [1] on Top Rail**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	Sustained load equal to or greater than 1,000 lb for minimum of one
1,000 lb (2.5x D.L.)	1,004 - 1,024	00:24 - 01:29	

[1] *Uniform load was simulated with 2 equal point loads located at 1/4-pts. 8 ft x 50 plf = 400 lb x 2.5 = 1000 lb*

6.5 Test Results: (Continued)

Test No. 4 - 04/06/06 **Design Load: 200 lb Concentrated Load at Midspan of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net** [1]
200 lb (D.L.)	201	00:21	0.04	0.90	0.06	0.85
500 lb (2.5x D.L.)	504 - 513	00:37 - 01:44	Sustained load equal to or greater than 500 lb for minimum of one minute			
Deflection Evaluation [2]: Maximum rail deflection at 201 lb = 0.85" on an 8 ft rail (96") Limits per AC174: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{96}{96}\right)=2.50" > 0.85" \therefore ok$ and $\frac{h}{12}=\frac{36}{12}=3.00" > 0.85" \therefore ok$						

[1] *Each end displacement was measured at the center of the 4x4 support post. Net displacement was the rail displacement relative to the supports.*

[2] *Deflection limit calculation was based on worse case 36" railing height.*

Test No. 5 - 04/06/06 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)** [1]				
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
400 lb (D.L.)	421	00:12	0.15	0.20
1,000 lb (2.5x D.L.)	1,010 - 1,041	00:31 - 01:39	Sustained load equal to or greater than 1,000 lb for minimum of one minute	

[1] *Load was imposed using a spreader beam to distribute load equally to both ends of the rail.*

6.5 Test Results: (Continued)

8 ft x 42 in *Contour* PVC Guardrail
Residential End-Use / AC174

Test No. 1 - 04/06/06 **Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	Sustained load equal to or greater than 138 lb for minimum of one minute
138 lb (2.75x D.L.)	138 - 147	00:33 - 01:38	

Test No. 2 - 06/13/06 **Design Load: 50 plf Uniform Horizontal Load [1] on Top Rail**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	Sustained load equal to or greater than 1,000 lb for minimum of one minute
1,000 lb (2.5x D.L.)	1,004 - 1028	00:53 - 02:00	

[1] *Uniform load was simulated with 2 equal point loads located at 1/4-pts. 8 ft x 50 plf = 400 lb x 2.5 = 1000 lb*

Test No. 3 - 06/13/06 **Design Load: 50 plf Vertical Uniform Load[1] on Top Rail**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	Sustained load equal to or greater than 1,000 lb for minimum of one minute
1,000 lb (2.5x D.L.)	1,007 - 1029	00:26 - 01:32	

[1] *Uniform load was simulated with 2 equal point loads located at 1/4-pts. 8 ft x 50 plf = 400 lb x 2.5 = 1000 lb*

Test No. 4 - 04/06/06 **Design Load: 200 lb Concentrated Load at Midspan of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	200	00:21	0.05	1.07	0.07	1.01
500 lb (2.5x D.L.)	503 - 514	00:38 - 01:46	Sustained load equal to or greater than 500 lb for minimum of one minute			
Deflection Evaluation [2]: Maximum rail deflection at 200 lb = 1.01" on an 8 ft rail (96") Limits per AC174: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{96}{96}\right)=2.50">1.01"\therefore ok$ and $\frac{h}{12}=\frac{36}{12}=3.00">1.01"\therefore ok$						

[1] *Each end displacement was measured at the center of the 4x4 support post. Net displacement was the rail displacement relative to the supports.*

[2] *Deflection limit calculation was based on worse case 36" railing height.*

6.5 Test Results: (Continued)

Test No. 5 - 04/06/06 Design Load: 200 lb Concentrated Load at End of Top Rail (Bracket)			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**
200 lb (D.L.)	201	00:27	0.24
500 lb (2.5x D.L.)	509 - 525	00:47 - 01:52	Sustained load equal to or greater than 500 lb for minimum of one minute

10 ft x 36 in *Contour* PVC Guardrail
Limited to Use for One- and Two-Family Dwellings / AC174

Test No. 1 - 04/06/06 Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	Sustained load equal to or greater than 138 lb for minimum of one minute
138 lb (2.75x D.L.)	142 - 145	00:27 - 01:36	

Test No. 2 - 04/06/06 Design Load: 200 lb Concentrated Load at Midspan of Top Rail						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	202	00:27	0.06	1.55	0.06	1.49
500 lb (2.5x D.L.)	504 - 512	00:53 - 02:02	Sustained load equal to or greater than 500 lb for minimum of one minute			
Deflection Evaluation: Maximum rail deflection at 202 lb = 1.49" on an 10 ft rail (120") Limits per AC174: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{120}{96}\right)=2.75">1.49"\therefore ok$ and $\frac{h}{12}=\frac{36}{12}=3.00">1.49"\therefore ok$						

[1] *Each end displacement was measured at the center of the 4x4 support post. Net displacement was the rail displacement relative to the supports.*

6.5 Test Results: (Continued)

Test No. 3 - 04/06/06 Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets) [1]				
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
400 lb (D.L.)	420	00:44	0.23	0.19
1,000 lb (2.5x D.L.)	1,005 - 1,024	01:03 - 02:12	Sustained load equal to or greater than 1,000 lb for minimum of one minute	

[1] *Load was imposed using a spreader beam to distribute load equally to both ends of the rail.*

10 ft x 36 in *Standard* PVC Guardrail
Limited to Use for One- and Two-Family Dwellings / AC174

Test No. 1 - 04/06/06 Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	Sustained load equal to or greater than 138 lb for minimum of one minute
138 lb (2.75x D.L.)	142 - 146	00:28 - 01:33	

Test No. 2 - 04/06/06 Design Load: 200 lb Concentrated Load at Midspan of Top Rail						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net** [1]
200 lb (D.L.)	201	00:23	0.04	1.55	0.05	1.51
500 lb (2.5x D.L.)	506 - 517	00:38 - 01:46	Sustained load equal to or greater than 500 lb for minimum of one minute			
Deflection Evaluation: Maximum rail deflection at 201 lb = 1.51" on an 10 ft rail (120") Limits per AC174: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{120}{96}\right)=2.75">1.51"\therefore ok$ and $\frac{h}{12}=\frac{36}{12}=3.00">1.51"\therefore ok$						

[1] *Each end displacement was measured at the center of the 4x4 support post. Net displacement was the rail displacement relative to the supports.*

6.5 Test Results: (Continued)

Test No. 3 - 04/06/06 Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets) [1]				
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
400 lb (D.L.)	402	00:43	0.12	0.16
1,000 lb (2.5x D.L.)	1,003 - 1,034	00:53 - 02:05	Sustained load equal to or greater than 1,000 lb for minimum of one minute	

[1] *Load was imposed using a spreader beam to distribute load equally to both ends of the rail.*

7.0 Summary and Conclusions

The *Standard* and *Contour* railing assemblies tested and described herein met the structural performance requirements of Section 5.1 of AC174 when installed between adequate supports as follows:

AC174 - Group R Occupancy (R-1, R-2, R-3 and R-4) End-Use Code Requirements (IBC) - Rail lengths up to and including 96 inches between posts and top rail heights up to and including 42 inches.

AC174 - One- and Two-Family Dwelling Code Requirements (IRC) - Rail lengths up to and including 120 inches between posts and top rail heights up to and including 36 inches.

A copy of this report and all supporting data will be retained by ATI for a period of four years. This report is the exclusive property of the client so named herein and is applicable only to the samples tested. Results obtained are tested values and do not constitute an opinion or endorsement by this laboratory. This report may not be reproduced, except in full, without the approval of Architectural Testing.

For ARCHITECTURAL TESTING, INC.:

Digitally Signed by: Justin M. Mann

Justin M. Mann
Senior Technician

Digitally Signed by: David H. Forney

David H. Forney, P.E.
Senior Project Engineer

2006.08.14 13:44:29 -04'00'

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
DAVID HOWARD FORNEY
ENGINEER No. PE-19553E

DHF:dhf/nlb

Attachments (pages):
Appendix A - Drawings (7)
Appendix B - Photographs (4)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	08/10/06	N/A	Original report issue

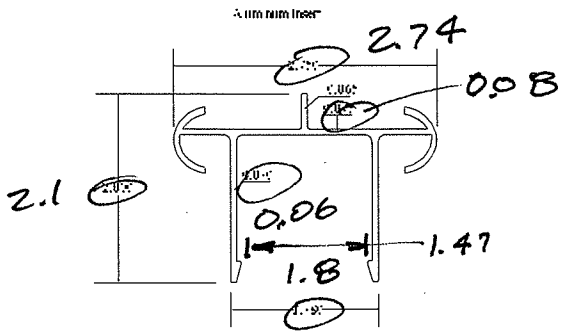
APPENDIX A

Drawings

Fairway Vinyl Systems / Rail Profiles & Aliminum Inserts

Contour Top Rail

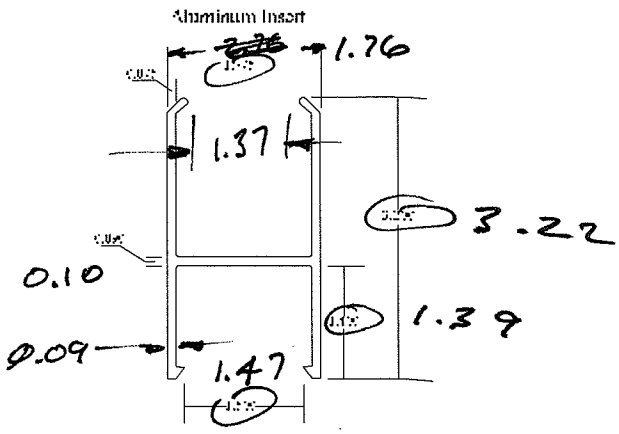
Small Contoured 2 1/4" x 3" Open Hand Rail



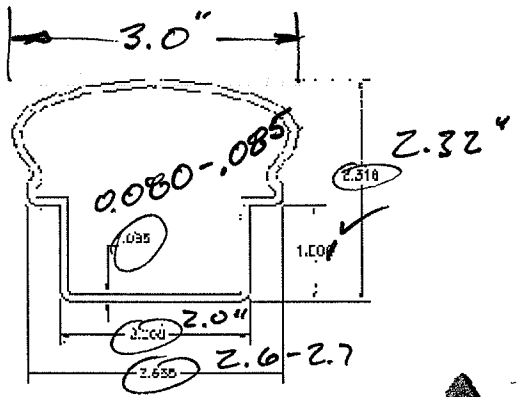
Material : 6105-T5 or 6005-T5

Standard Top Rail

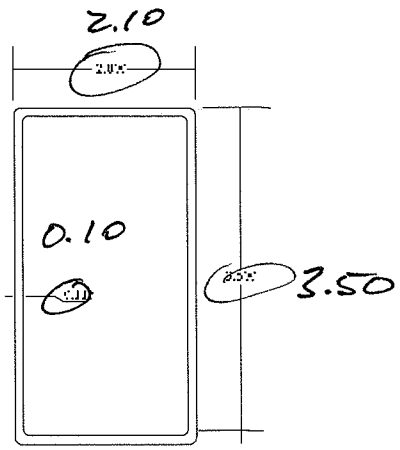
Standard 2.000 x 3.500 Open Profile H- Channel



Material : 6105-T5 or 6005-T5



Small Contoured Hand Rail Open Profile



2.000 x 3.500 Standard Open - Profile

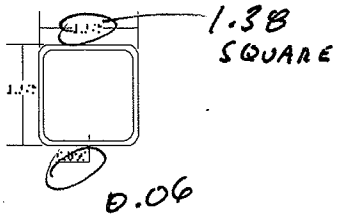
Architectural Testing

Test sample complies with these details.
Deviations are noted.

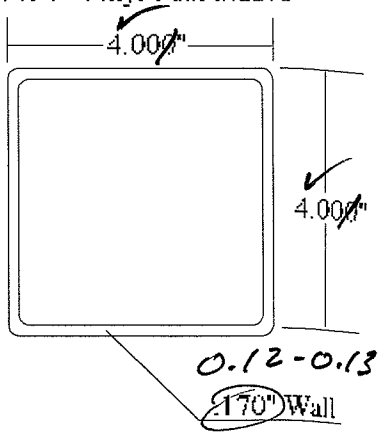
Report# 63086.01-119-19

Date 6-27-06 Tech DHF

1 3/8"x 1 3/8" Square Baluster

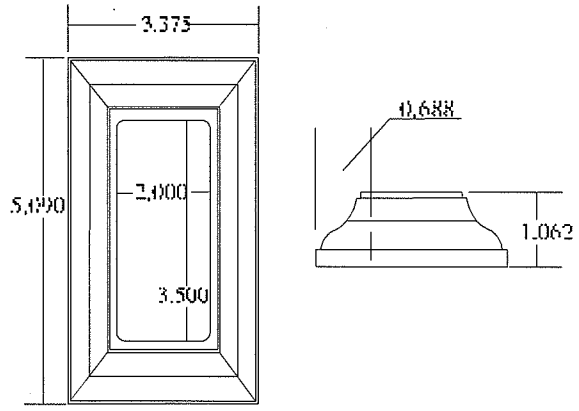


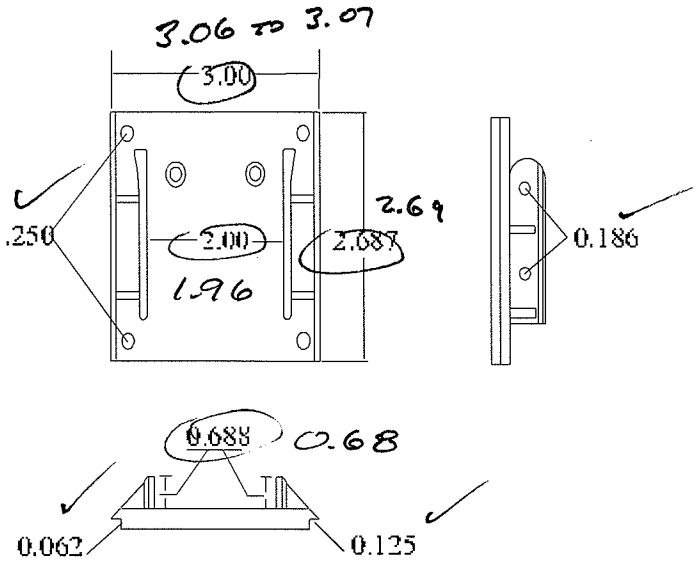
4"x 4" Vinyl Post Sleeve



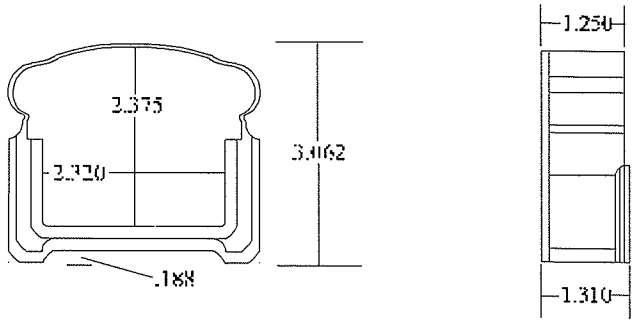
Fairway Vinyl Systems

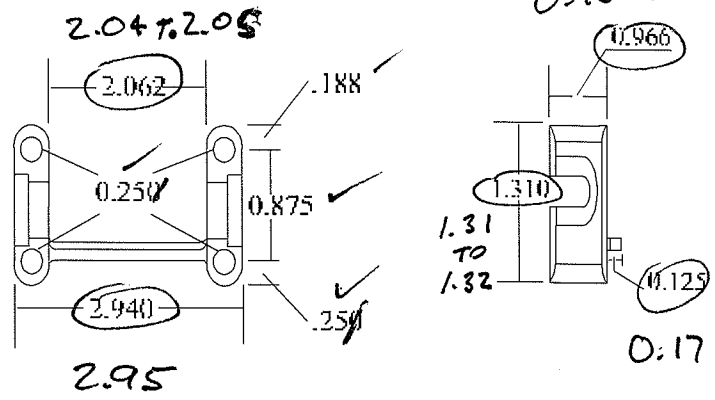
Standard Level Bracket





Contour Level Top Rail Bracket





Architectural Testing

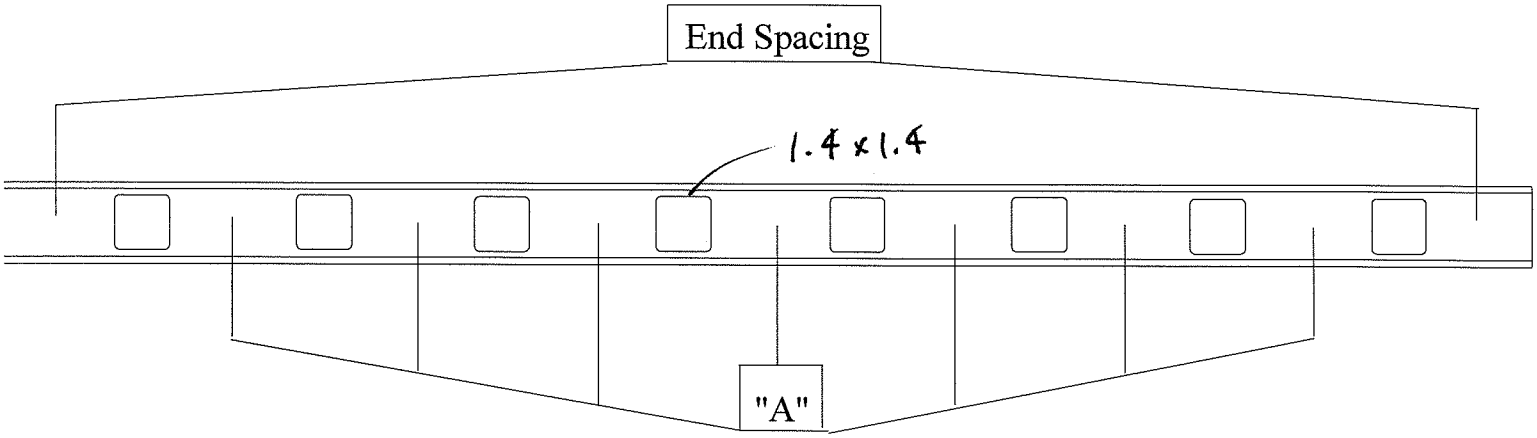
Test sample complies with these details.
Deviations are noted.

Report# 63086.01-119-19

Date 6-27-06 Tech DMF

Fairway Vinyl Systems

1 3/8"x 1 3/8" Baluster Spacing / Contour & Standard Top Rail



Baluster Spacing / 1 3/8"x 1 3/8" Square Baluster

	End Spacing	"A"	Balusters Per Section
6' Section	3.750	3.838	13 each
8' Section	3.500 ✓	3.738 ✓	18 each ✓
10' Section	3.875 ✓	3.867 ✓	22 each ✓

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# 63086.01-119-19

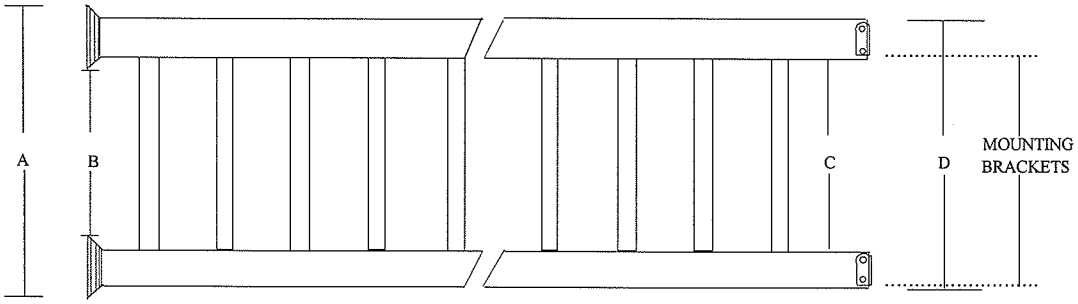
Date 6.27.06 Tech RMF

Fairway Vinyl Systems

Standard and Contour Level Railing Systems

STANDARD LEVEL RAIL MEASUREMENTS

02/05



36" HIGH RAIL

A= 36 1/2"

B= 26 1/2"

C= 28"

D= 35"

BRACKETS ~~31~~ 1/2"

42" HIGH RAIL

A= 43"

B= 33"

C= 34 1/2"

D= 41 1/2"

BRACKETS ~~38~~"

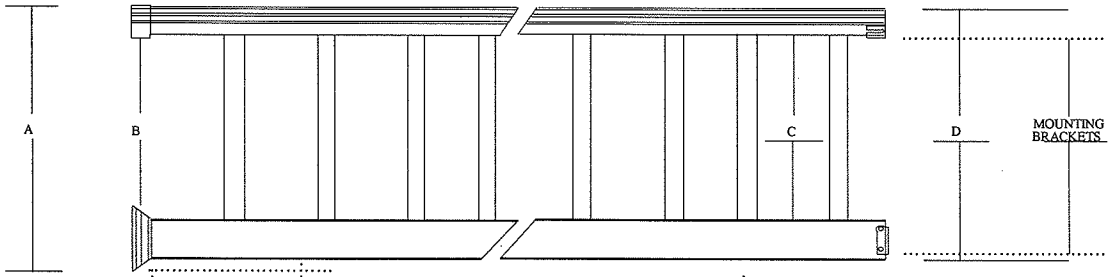
Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# 63086.01-119-19

Date 6-27-06 Tech DHF

CONTOUR LEVEL RAIL MEASUREMENTS



36" HIGH RAIL

A= 34 3/4"

B= 27"

C= 28"

D= 34"

MOUNT BRACKET= 30 3/4"

42" HIGH RAIL

A= 41 3/8"

B= 33 1/2"

C= 34 5/8"

D= 40 1/2"

37 3/8"

FAIRWAY®

Vinyl Systems

www.fairwayvinyl.com

STANDARD & CONTOUR VINYL RAILING

INSTALLATION INSTRUCTIONS

LEVEL & STAIR RAILING APPLICATIONS PLUS RELATED ACCESSORIES

909920

Version 2006v1

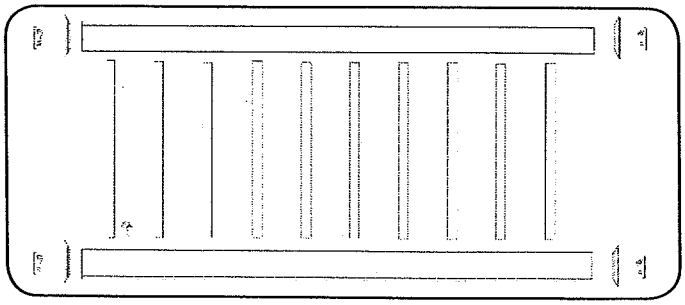
Standard & Contour Vinyl Railing
LEVEL Installation Instructions

FAIRWAY Vinyl Systems

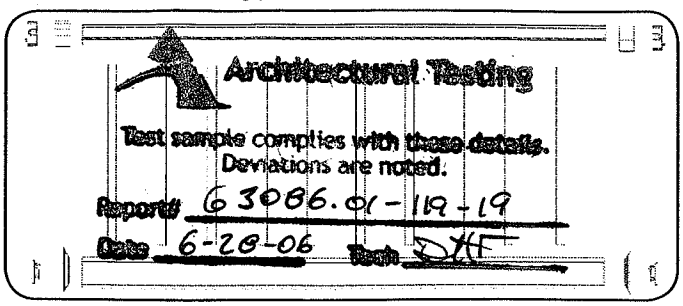
www.fairwayvinyl.com

It is the responsibility of the installer to meet or exceed all code and safety requirements, and to obtain all required building permits. These instructions are only a guide and may not address every circumstance. The deck and railing installer should determine and implement appropriate installation techniques for each situation.
FAIRWAY Vinyl Systems shall not be held liable for improper or unsafe installations.

STANDARD VINYL RAIL



CONTOUR VINYL RAIL



Standard Kit Includes:
- 2 ea. - 2" x 3½" Vinyl Rails
- 2 ea. - Aluminum "H" Channel
- 4 ea. - 2" x 3½" Standard Mounting Brackets
- 1 ea. - Pack S. S. Screws

Number of Vinyl Balusters Included in Kits:

	Square	Turned
6' Kit	13	14
8' Kit	18	19
10' Kit	22	24

Contour Kit Includes:
- 1 ea. - Contour Top Rail
- 1 ea. - 2" x 3½" Standard Bottom Rail
- 1 ea. - Contour Aluminum Insert (Top Rail)
- 1 ea. - Aluminum "H" Channel (Bottom Rail)
- 2 ea. - Contour Mounting Brackets
- 2 ea. - 2" x 3½" Standard Mounting Brackets
- 1 ea. - Pack S. S. Screws

Step 1 Safety Precautions

a) Check all local building codes for design load requirements for your railing applications. Fairway Vinyl Railing meets or exceeds ASTM F964-02 and is approved to meet Boca Building Code Section 1615.8, IBC Section 1607.7.1 and IRC Section R316, requirements pertaining to railing, in accordance with ICC Evaluation Report 22-33.

b) Always use safety equipment when installing our maintenance-free railing.

Step 2 Post Preparation

Install and prepare all mounting surfaces and posts to which your new maintenance-free railing will be installed. We suggest covering wood posts with our matching-color vinyl post sleeves or wraps. Finish with one of our many styles of post caps and base trim rings.

Step 3 Bottom Rail & Bracket Preparation

a) Determine the level placement of bottom rail. This should be no more than 4" and no less than 2½" for 36" high railing and no greater than 2" for 42" high railing. *(2½" or less use a low profile base trim ring.)* Make a pencil mark at the bottom of the lower rail on the post. Measure up 3/8" above previous mark, then square and center the bottom of the black mounting bracket. Mark screw holes in the four corners of the bracket and then pre-drill four 5/32" holes. Screw the bracket base into place with four (4) #12 x 1¼" pan head screws. Repeat on opposite post.

b) After the bottom black mounting bracket is in place, measure from bottom of bracket up and mark with pencil.
Please use the following measurements in accordance with product style and height:
36" Standard Rail = 31¾" • 36" Contour Rail = 31¼" • 42" Standard Rail = 41" • 42" Contour Rail = 37½"
This will be the mounting mark for the bottom of the top bracket. Square and center the top black mounting bracket on mark and pre-drill four 5/32" holes. Screw into place using four (4) #10 x 1¼" for Standard Railing or four (4) #10 x 1½" pan head screws for Contour Railing. Repeat on opposite post.

c) Cut bottom rail to length. Measure span between the inside black mounting brackets for bottom rail. Make sure you have equal and maximum amount of spacing between baluster and post on each end. Cut rail squarely with a power miter box or hacksaw. You may cut vinyl and aluminum insert at same time. *(See manufacturer's specs for saw blades.)*

Step 4 Mounting Bottom Rail

a) With bottom rail cut to length, slide bracket trim ring onto each end of rail, flat side towards end, facing post. Set rail into place and align bottom rail with level placement mark from step 3.

b) With the bottom rail set in place, use the #10 x 1" self-tapping pan head screw through one of the holes along the side of the black mounting bracket through the rail and into the aluminum insert. Only one screw per side is needed. Slide trim ring onto black mounting bracket.

Step 5 Installing Balusters & Top Rail

a) Measure distance from bracket to bracket where top rail will mount. Cut top rail to length to match bottom rail. If post is plumb, top rail should be same length as bottom rail. Make sure distance from post to baluster is the same both top and bottom. Place a baluster in each hole. Slide bracket trim ring on both ends of top rail *(flat side towards end of rail)*. From one end, begin to insert top of balusters into corresponding pocket holes.

b) Once all balusters are in place, the top rail will rest in the black mounting bracket. Using a #10 x 1" self-tapping pan head screw, align rail and the black mounting bracket appropriately and mount screw into the bracket holes provided, then through the side of the rail and into the aluminum insert. One screw per side is needed.

c) Make sure all four bracket trim ring covers are snapped over black mounting brackets.
NOTE: If ring will not snap on black mounting plate, make sure mounting screws were not over-tightened.

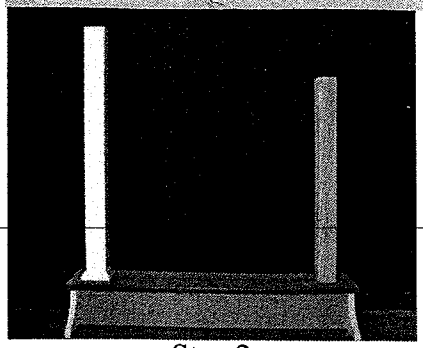
Step 6 Cutting Vinyl Post Sleeve To Height

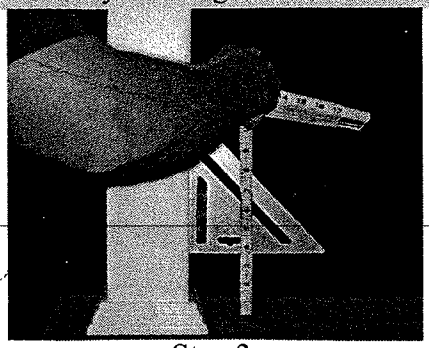
After your railing is installed, you may need to trim the top of the vinyl post sleeves before installing post caps. We recommend measuring up 2½" to 3½" from the top of the mounting bracket trim cover and making a pencil mark prior to cutting. **NOTE:** Finished post height with post cap may be adjusted for personal preference and appearance. Once all marks are satisfactory, cut the vinyl sleeve using a hand or power saw. *(Be sure to cut top of post square)* You are now ready to install your post cap. Apply small amount of PVC glue or silicone caulk to the inside lip of the cap and mount in place.

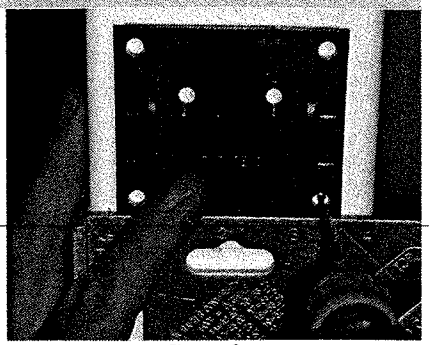
Step 7 Clean up

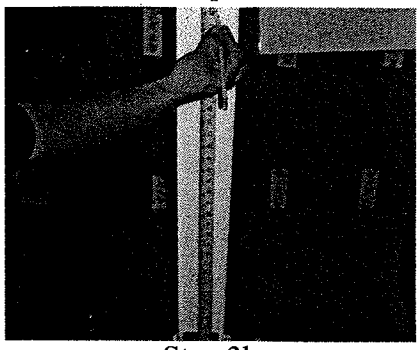
Your job is now complete. Should your railing have any loose dirt on it from the installation, simply hose it off or wipe with a soft cloth. To remove any stubborn dirt or stains use Fairway Vinyl Cleaner and #0000 steel wool.

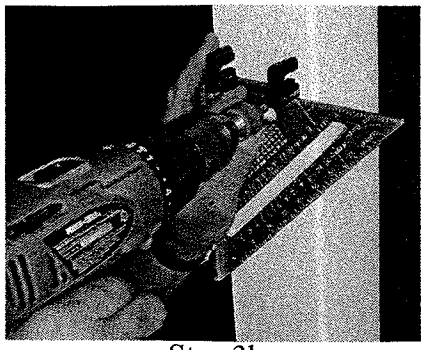
see photo assist >


Step 2


Step 3a


Step 3a


Step 3b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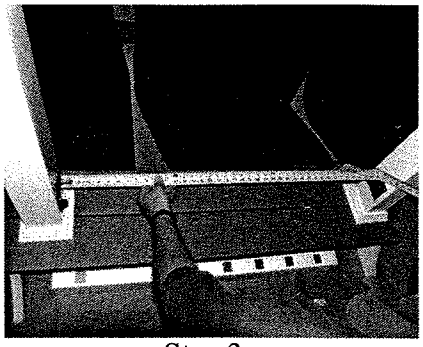
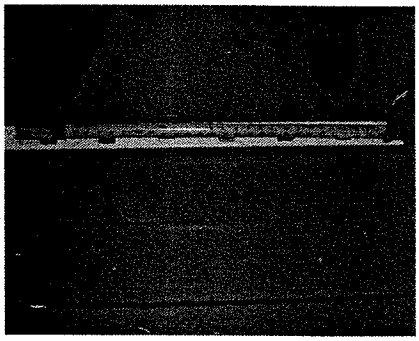

Step 3c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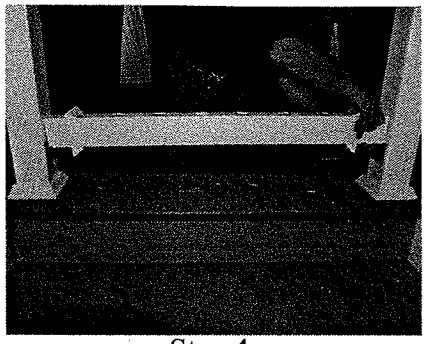
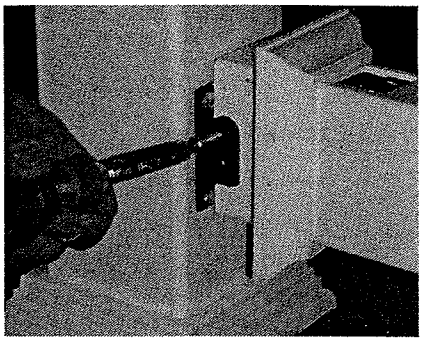

Step 4a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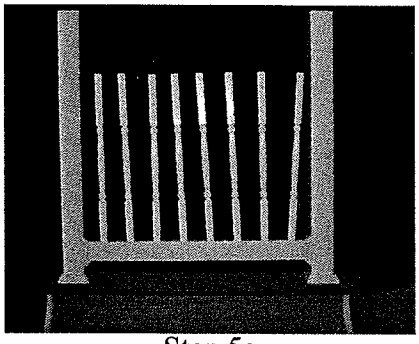
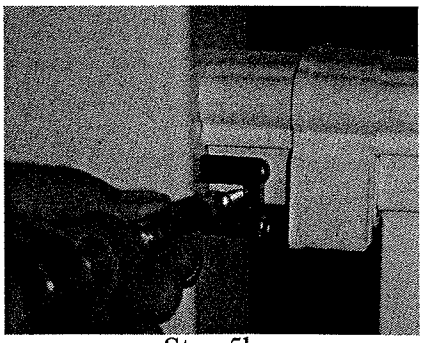

Step 5a


Step 5a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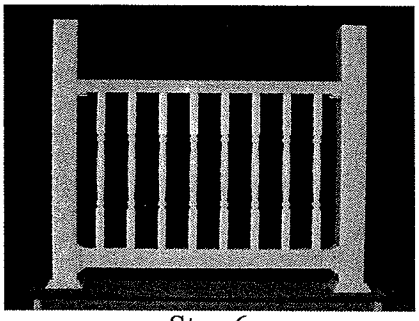
Step 6

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# 63086.01-119-19

Date 6-28-06 Tech DHF


Step 6

APPENDIX B

Photographs

Photo No. 1
Staging of Sampled Components at Mount Joy, PA Manufacturing Facility

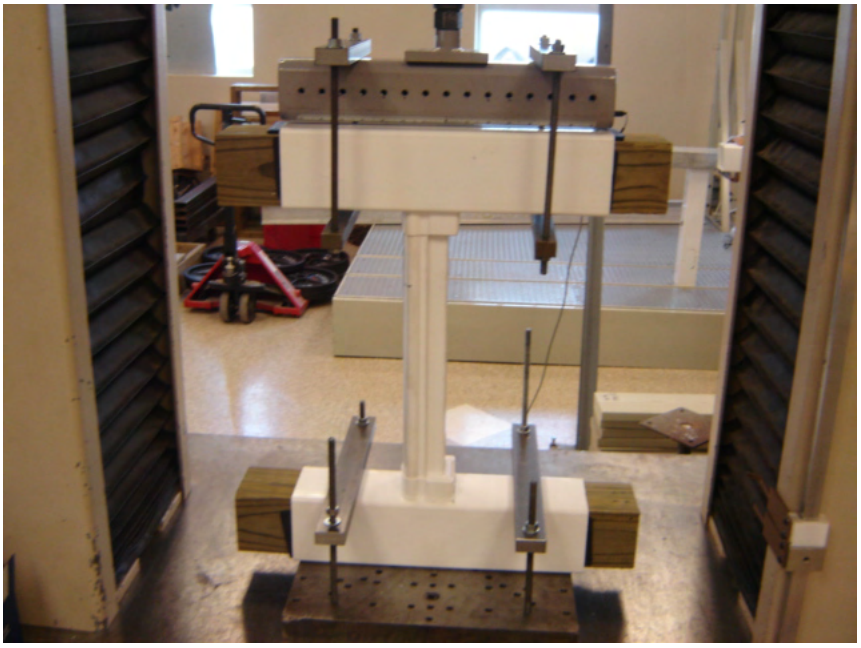

Photo No. 2
Typical Assembly Fastener Test in Process (*Contour)*

Photo No. 3
Infill Loading at Center of Two Pickets (10' *Standard*)

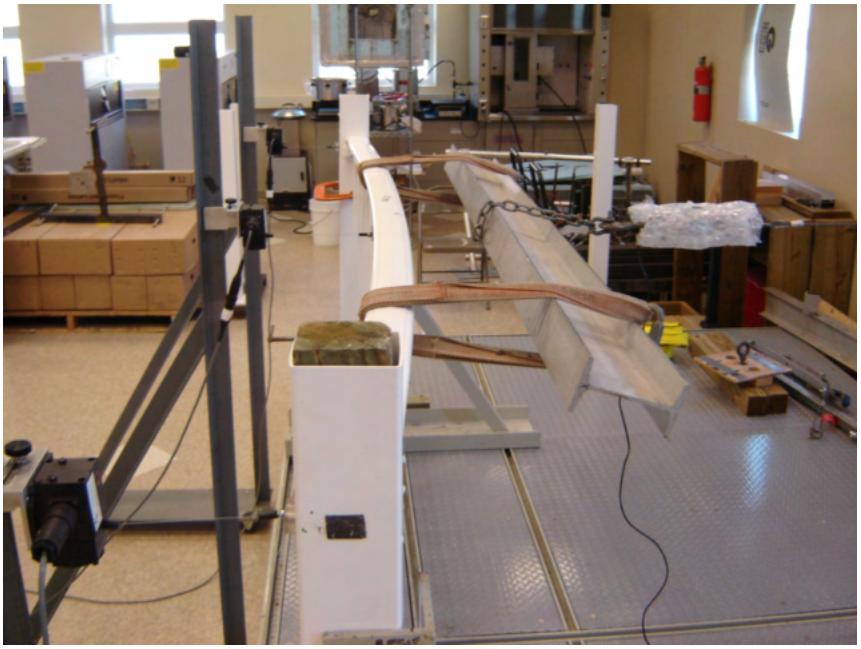

Photo No. 4
Uniform Horizontal Load Test of Top Rail Using Quarter Point Loading

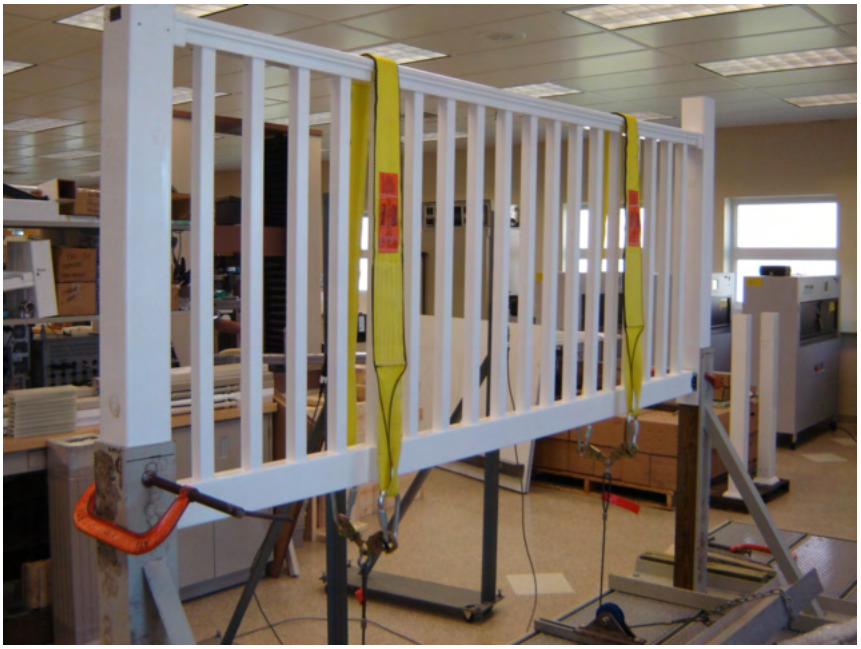

Photo No. 5
Uniform Vertical Load Test of Top Rail Using Quarter Point Loading

Photo No. 6
Concentrated Load at Midspan of Top Rail (10' *Standard*)

Photo No. 7
Concentrated Load at End of Top Rail (Bracket) (8' *Standard*)
Using Spreader Beam to Load Both Brackets Simultaneously