Architectural Testing

TEST REPORT

Rendered to:

FORTRESS IRON RAILING & FENCE SYSTEMS

For:

Fortress Pre-Galvanized Steel Balusters
Vintage Series - Round and Square
Vienna Series - Belly

Report No: 89869.01-119-19
Report Date: 05/22/09

130 Derry Court
York, PA 17406-8405
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89869.01-119-19
May 22, 2009

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Rendered to:

FORTRESS IRON RAILING & FENCE SYSTEMS
P.O. Box 831268
Richardson, Texas 75083

Report No.:	89869.01-119-19
Test Date Started:	03/31/09
Test Date Completed:	04/01/09
Report Date:	05/22/09

1.0 General Information

1.1 Product

Fortress Pre-Galvanized Steel Balusters - *Vintage Series and Vienna Series*

1.2 Project Description

Architectural Testing was contracted by Fortress Iron Railing & Fence Systems to conduct structural performance tests on the following styles of pre-galvanized steel balusters: *Vintage Series Round (with EZ Mount)*, *Vintage Series Square*, and *Vienna Series Belly*. The system was evaluated for the design load requirements of the following building codes:

2006 *International Building Code*®, International Code Council

2006 *International Residential Code*®, International Code Council

Structural tests were performed according to Chapter 17 (Structural Tests and Special Inspections) of IBC 2006.

1.3 Limitations

All tests performed were to evaluate structural performance of the in-fill, pre-galvanized steel balusters, attached to 2x4 cedar railings. Testing is limited to in-fill testing only and to test loads equal to 2.5 times the design load.

1.4 Qualifications

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

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1.5 Product Description

Fortress Iron Railing & Fence Systems provided the baluster test specimens and hardware with the following details:

Vintage Series Square Baluster: 5/8 in square by 31 in long, pre-galvanized steel square baluster with 0.05 in wall

Vintage Series Round Baluster: 3/4 in diameter by 32 in long, pre-galvanized steel round baluster with 0.05 in wall

Vienna Series Baluster: 1 in wide by 31 in long pre-galvanized steel, bent, flat bar baluster with 3/16 in wall

Vintage Series Square and *Vienna Series* Baluster Fasteners: #12 x 1-1/4 in flat-head, Phillips drive, wood screws (four total - two top and two bottom)

EZ Mount Round Baluster Connectors: #12 x 2 in stainless steel, flat-head, Phillips drive, wood screws with nylon standard EZ Mount (two per baluster)

Top and Bottom Rails: Cedar 2x4's with a measured moisture content of 12%

Architectural Testing provided the cedar 2x4 for the top and bottom rails mounted to pressure treated 4x4 wood posts. 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 96 in wide by 33 in high guardrail assembly utilized for the *Vintage Series Square* and *Vienna Series* baluster systems were installed and tested as a single railing section by directly securing the wood 4x4 posts into a rigid steel test fixture, which rigidly restrained the posts from deflecting. A 96 in wide by 36 in high guardrail system was used for the *Vintage Series Round* baluster system. 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. Due to the irregular shape of the *Vienna Series* baluster, recovery was conservatively based on mid in-fill displacement.

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
Vienna Series

Test No. 1 of 2 - 03/31/09 **Design Load: 50 lb / 1 Square Ft at Center of In-Fill (on Three Balusters)**					
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**In-Fill Displacement (in)**		
			End	**Mid**	**End**
Initial Load	10	00:00	0.00	0.00	0.00
2.0x Design Load	100 - 104	00:27 - 00:30	0.28	0.90	0.02
Initial Load	10	02:02 - 02:12	0.00	0.14	0.76
85% Recovery from 2.0 x Design Load*					
2.5x Design Load	125 - 128	02:27 - 02:30	Achieved Load without Failure		

** Due to the irregular shape of the baluster, recovery was conservatively based on mid in-fill displacement.*

2.4 Test Results (Continued)

Test Series No. 1 (Continued)

Test No. 2 of 2 - 03/31/09 Design Load: 50 lb / 1 Square Ft at Bottom of In-Fill (on Three Balusters)						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Bottom Rail Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	10	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	100 - 100	02:15 - 02:17	0.05	1.13	0.05	1.08
Initial Load	10 - 12	03:52 - 04:05	-0.01	0.00	-0.01	0.01
99% Recovery from 2.0 x Design Load						
2.5x Design Load	125 - 126	04:23 - 04:25	Achieved Load without Failure			

[1] *Net displacement was the bottom rail displacement relative to its ends.*

Test Series No. 2
***Vintage Series Square* Baluster**

Test No. 1 of 2 - 04/01/09 Design Load: 50 lb / 1 Square Ft at Center of In-Fill (on Three Balusters)						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**In-Fill Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	10	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	100 - 101	00:13 - 00:16	0.23	0.49	0.62	0.07
Initial Load	10	02:03 - 02:13	0.01	0.02	0.02	0.01
82% Recovery from 2.0 x Design Load						
2.5x Design Load	126 - 128	02:31 - 02:44	Achieved Load without Failure			

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

Test No. 2 of 2 - 04/01/09 Design Load: 50 lb / 1 Square Ft at Bottom of In-Fill (on Three Balusters)						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Bottom Rail Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	10	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	100 - 102	00:11 - 00:17	0.03	0.78	0.05	0.74
Initial Load	10	02:23	0.00	0.01	0.00	0.01
99% Recovery from 2.0 x Design Load						
2.5x Design Load	126 - 129	03:00 - 03:08	Achieved Load without Failure			

[1] *Net displacement was the bottom rail displacement relative to its ends.*

2.4 Test Results (Continued)

Test Series No. 3
***Vintage Series Round* Baluster Installed with EZ Mounts**

Test No. 1 of 2 - 04/01/09 **Design Load: 50 lb / 1 Square Ft at Center of In-Fill (on Three Balusters)**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**In-Fill Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	10	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	100 - 104	00:13 - 00:33	0.12	0.33	0.17	0.18
Initial Load	10	02:18	0.00	0.01	0.00	0.01
96% Recovery from 2.0 x Design Load						
2.5x Design Load	125 - 127	02:48 - 03:00	Achieved Load without Failure			

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

Test No. 2 of 2 - 04/01/09 **Design Load: 50 lb / 1 Square Ft at Bottom of In-Fill (on 3 Balusters)**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Bottom Rail Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	10	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	102 - 105	00:15 - 00:31	0.01	0.26	0.02	0.25
Initial Load	10 - 11	02:41 - 03:12	0.00	0.00	-0.01	0.01
97% Recovery from 2.0 x Design Load						
2.5x Design Load	126 - 129	03:32 - 03:43	Achieved Load without Failure			

[1] *Net displacement was the bottom rail displacement relative to its ends.*

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 in wide by 36 in high railing assembly containing the *Vintage Series Round* style balusters and for the 96 in wide by 33 in high railing assembly containing the *Vienna Series* and *Vintage Series Square* style balusters reported herein.

3.0 Closing Statement

Detailed drawings, data sheets, representative samples of test specimens, a copy of this test report, and all other supporting evidence will be retained by Architectural Testing for a period of four years from the original test date. At the end of this retention period, said materials shall be discarded without notice, and the service life of this report by Architectural Testing shall expire. Results obtained are tested values and were secured using the designated test methods. This report neither constitutes certification of this product nor expresses an opinion or endorsement by this laboratory; it is the exclusive property of the client so named herein and relates only to the tested specimens. This report may not be reproduced, except in full, without the written approval of Architectural Testing.

For ARCHITECTURAL TESTING:

Digitally Signed by: Julia L. Allison

Julia L. Allison
Technician II
Structural Systems Testing

Digitally Signed by: Justin M. Mann

Justin M. Mann
Laboratory Supervisor
Structural Systems Testing

JMM:jmm/alb

Attachments (pages): This report is complete only when all attachments listed are included.
Appendix A: Drawings (3)
Appendix B: Photographs (5)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	05/22/09	N/A	Original report issue

APPENDIX A

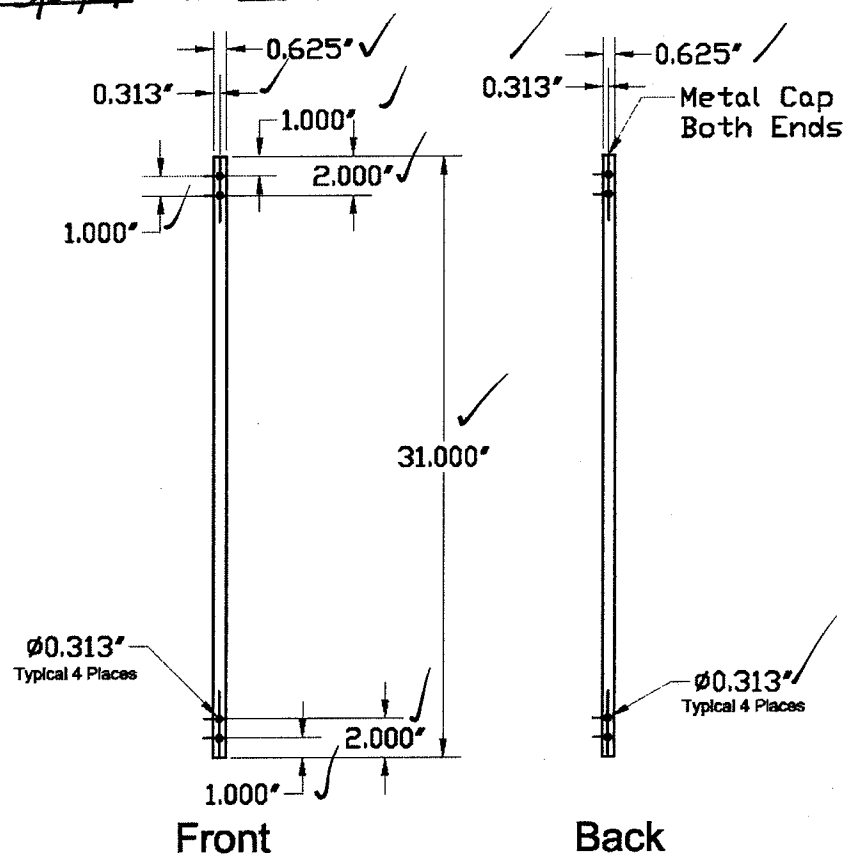
Drawings

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# 89869.01-119-A

Date 5/22/09 Tech JLA



Notes:

1. Materials are Galvanized, G60 Sheet, 45,000psi, formed and welded full length
2. Tube welds are ground or scrapped smooth with no sharp edges or points and zinc thermal sprayed
3. After cutting to length product is cleaned then either Zinc Phosphate Washed or Dipped, then powder coated.

REV	DATE	BY	DESCRIPTION
0	03/10/06	DI	Initial Drawing Generation

FORTRESS Iron Railing & Fence Systems

Fortress Iron, LP
1800 Jay Ell, Suite 200
Richardson, TX 75081

TITLE: Square Baluster
31 Inch Square Baluster, Plain

DRAWN BY: David Irick
DATE: 03/09/06
SCALE: As Shown
DWG NAME: 31" Square Baluster
REV: 0

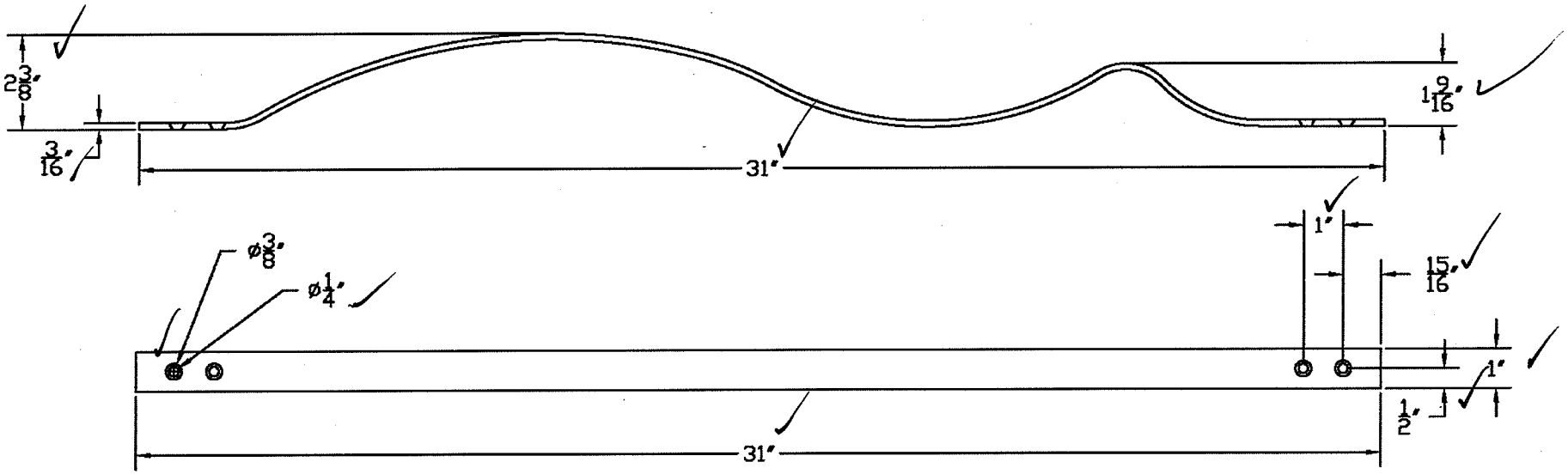
Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# 89869.01-119-19

Date 5/22/09 Tech JLA

Notes:
1. Materials are formed sheet, 45,000psi.
2. After cutting and shaping to size product is zinc electroplated then cleaned, given a zinc phosphate coating, and powder coated.



REV	DATE	BY	DESCRIPTION
0	02/03/07	DI	Initial Drawing Generation

FORTRESS Iron Railing & Fence Systems

Fortress Iron, LP
1800 Jay Ell, Suite 200
Richardson, TX 75081

TITLE: Vienna Belly Baluster
31" Belly Baluster

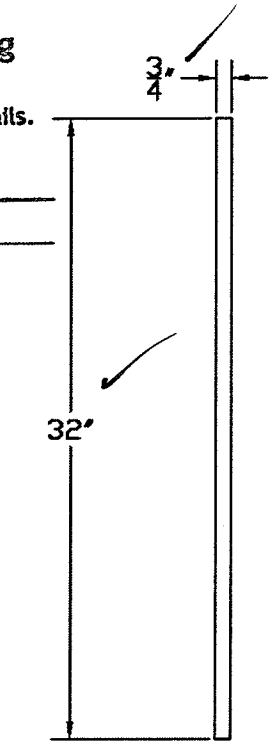
DRAWN BY: David Irick
DATE: 02/03/07
SCALE: As Shown
DWG NAME: 31" Vienna Belly Baluster
REV: 0

Architectural Testing

Test sample complies with these details.
Deviations are noted.

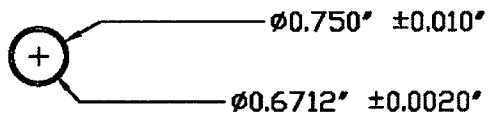
Report# 89869.01-119-19

Date 5/22/09 Tech JLA



Notes:

1. Materials are Galvanized, G60 Sheet, 45,000psi, formed and welded full length
2. Tube welds are ground or scrapped smooth with no sharp edges or points and zinc thermal sprayed
3. After cutting to length product is cleaned then either Zinc Phosphate Washed or Dipped, then powder coated.



Picket End View - Scale 4X

Note: Picket OD varies based on powder coating type and with manufacturing runs.
Picket ID varies based on manufacturing runs and based on amount of powder coating inside picket.

REV	DATE	BY	DESCRIPTION
0	07/13/06	DI	Initial Drawing Generation

FORTRESS Iron Railing & Fence Systems

Fortress Iron, LP
1800 Jay Ell, Suite 200
Richardson, TX 75081

TITLE: Round Baluster
32 Inch Round Baluster, Plain

DRAWN BY: David Irick
DATE: 07/13/06
SCALE: As Shown
DWG NAME: DRAWING NO. 32" Round Baluster
REV. 0

APPENDIX B

Photographs

Photo No. 1
In-Fill Load Test at Center of Three *Vienna Series* Balusters

Photo No. 2
In-Fill Load Test at Bottom of Three *Vienna Series* Balusters

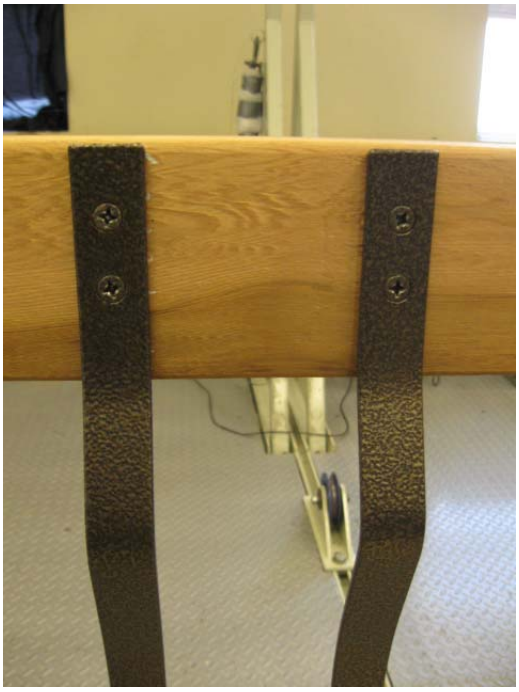


Photo No. 3
***Vienna Series* Baluster Installation (4 in On-Center Spacing)**

Photo No. 4
In-Fill Load Test at Center of Three *Vintage Series Square* Style Balusters

Photo No. 5
In-Fill Load Test at Bottom of Three *Vintage Series Square* Style Balusters

Photo No. 6
***Vintage Series Square* Baluster Installation (4 in On-Center Spacing)**

Photo No. 7
In-Fill Load Test at Center of Three *Vintage Series Round* Style Balusters
(Installed with EZ Mounts)

Photo No. 8
In-Fill Load Test at Bottom of Three *Vintage Series Round* Style Balusters
(Installed with EZ Mounts)

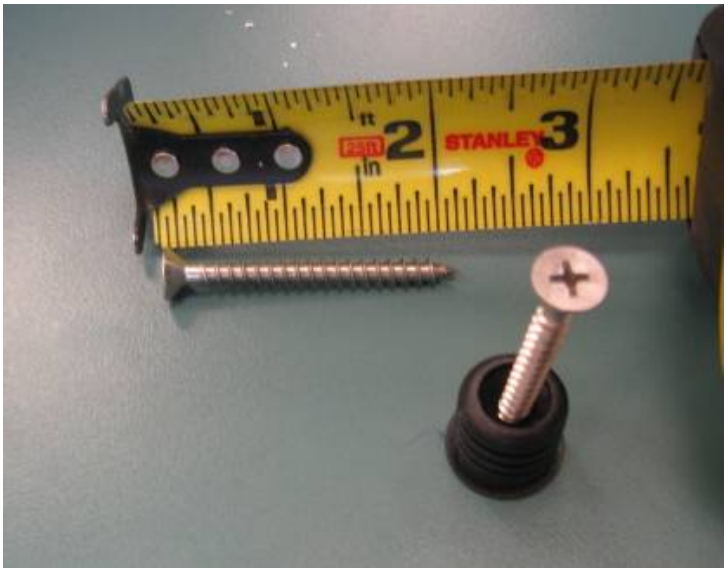


Photo No. 9
Nylon EZ Mounts for Attachment of
***Vintage Series Round* Style Balusters to Rails**

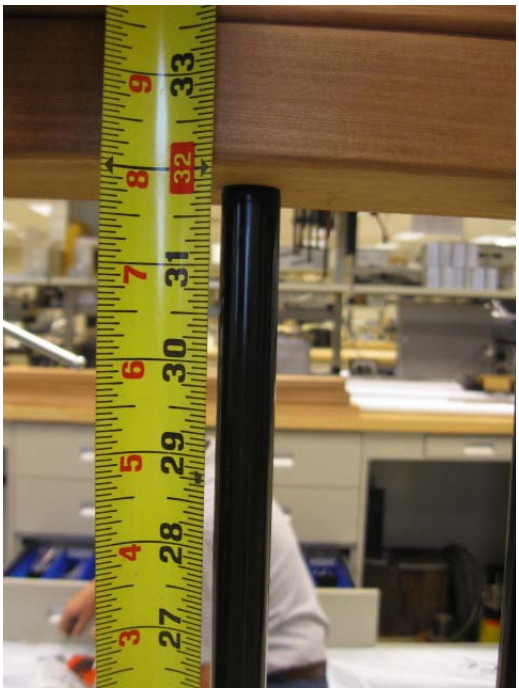


Photo No. 10
***Vintage Series Round* Style Baluster and**
Nylon EZ Mounts - Installation to Top Rail