



TEST REPORT

Rendered to:

PRL ALUMINUM ARCHITECTURAL PRODUCTS

For:

HRBDS (Handrail Base Shoe "Dry-Set")

Report No: G0616.02-303-44

Test Dates: 09/30/16 Through: 04/27/17

Report Date: 05/05/17

Test Record Retention Date: 04/27/17





TEST REPORT

G0616.02-303-44 May 05, 2017

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TEST REPORT

Rendered to:

PRL ALUMINUM ARCHITECTURAL PRODUCTS 14760 Don Julian Road City of Industry, California 91746

Report No.: G0616.02-303-44

Test Dates: 09/30/16 Through: 04/27/17

Report Date: 05/05/17

Test Record Retention Date: 04/27/21

1.0 General Information

1.2 Product

96 in wide by 42-1/2 in high HRBDS (Handrail Base Shoe "Dry-Set")

1.3 Project Description

Architectural Testing, Inc., an Intertek company ("Intertek-ATI"), was contracted by PRL Aluminum Architectural Products to conduct structural performance tests on their 96 in wide by 42 in high HRBDS (Handrail Base Shoe "Dry-Set"). 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ASTM E985-00 (2006), WITHDRAWN 2015, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings

The ANZI Z97.1 impact tests and ASTM E2025 pendulum impact tests defined within ASTM E2358 were not performed as part of this test program. In addition, ASTM E2353 requires a minimum of three representative replicate specimens of each type system. For this test program only one representative replicate specimen was tested as per the client's request.

1.4 Qualifications

Architectural Testing in Lake Forest, California has demonstrated compliance with ANS/ISO/IEC Standard 17025 and is consequently accredited as a Testing Laboratory (TL-444) by International Accreditation Service, Inc. Architectural Testing is accredited to perform all testing reported herein.





1.5 Limitations

All tests performed were to evaluate structural performance of the guardrail / handrail assembly to carry and transfer imposed loads to the supporting structure.

1.6 Product Description

PRL Aluminum Architectural Products provided the partially-assembled test specimens with the following details:

Top Rail Cap: 1-29/32 in diameter by 96 in long aluminum extrusion

Infill: (2) 47-3/4 in by 40-1/16 in tempered glass panel

<u>Support Base Shoe</u>: 3-7/8 in high by 2-23/64 in wide by 96 in long aluminum extrusion which included ridged PVC shims at each stainless steel cup point set screw. The glass panels were captured by alloy steel cup point socket screws that were tightened against 2-5/8 in. wide by 3 in high by 0.120 thick stainless steel angle inserted at shim exterior between shim and shoe channel set screw.

See drawings in Appendix A for additional details.

2.0 Structural Performance Testing of Assembled Railing Systems

2.1 Scope

One specimen, comprised of two glass panels, was tested according to two of the four test methods described in ASTM E935. Testing was performed in factory ambient conditions.

2.2 Test Load and Deflection Criteria

The test load criteria for rail and post members were 365 lb. concentrated load defined in ASTM E 985, Section 7.1. The test load criterion for in-fill members was 50 lb. as defined in ASTM E 985, Section 7.1 for all end-use categories. The deflection criteria for top rail were as defined in ASTM E985, Section 7.2.





2.3 Test Equipment

The guardrail assembly was tested on a self-contained rigid steel test fixture designed to accommodate anchorage of the rail assembly and application of the required test loads. The specimens were loaded using hydraulics cylinders mounted to a rigid steel test frame. Load distribution plates and spreader beams were used to impose test loads on the specimens. Applied load was measured using an electronic load cells located in-line with the loading system. Electronic linear displacement transducers were used to measure deflections. Deflections and load values were electronically recorded continuously throughout the loading process.

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 96 in wide by 42 in high level guardrail assembly consisting of two individual glass panels. Anchorage of the specimen was accomplished by bolting the support shoe to a rigid steel test fixture (i.e. simulate building steel) using 1/2"-13 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

Test procedures were conducted according to the referenced standards and are further defined below.

2.5.1 Test Methods A and B, and C

Method A - Application of Horizontal Static Load at Top of Panel

Method B - Application of Vertical Static Load at Top of Panel

Method C - Application of Horizontal Static Load to In-fill Areas of Baluster and Panel Railing Systems

- A preload of 50% of test load was applied and then released
- A load of 25% of test load was applied and deflection readings were zeroed
- Load was increased to 40% of test load and maintained for at least 2 minutes
- Load was increased to 55% of test load and maintained for at least 2 minutes
- Load was increased to 70% of test load and maintained for at least 2 minutes
- Load was increased to 85% of test load and maintained for at least 2 minutes
- Load was increased to the full test load and maintained for at least 2 minutes
- Load was decreased to 25% of test load and deflections recorded
- Deflections were also recorded at the conclusion of each 2 minute hold period





2.5.2 Test Sequence

Test Specimen 1 and 3

Method B - Vertical concentrated load at mid-span of top edge of top cap

Method B - Vertical concentrated load on top edge of top cap at end of glass panel

Method A - Horizontal concentrated load at top corner edge of the right glass panel

Method C - Horizontal concentrated load on one square foot area at mid-height of the glass infill

Test Specimen 2

Method B - Vertical concentrated load at mid-span of the top edge of the top cap

Method B - Vertical concentrated load on the top edge of the top cap at the end of glass panel

Method A - Horizontal concentrated load at the top mid-span of glass panel

Method C - Horizontal concentrated load on one square foot area at mid-height of the glass infill

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.





Specimen 1 of 3

Test Method B 365 lb. Vertical Concentrated Load at Mid-Span of Top Edge of Glass Panel Test Date: 09/30/16

	Applied Load	E.T. (min:sec)	Displacement (in)	
Load Level	(lb.)		Left Panel	Right Panel
0% (0 lb.)	0	0:00	-	-
50% (182.5 lb.)	182-185	2:00-4:00	-	-
25% (91.25 lb.)	91-94	4:30-6:30	0.00	0.00
40% (146 lb.)	146-149	6:50-8:50	0.00	0.00
55% (200.75 lb.)	200-201	9:30-11:30	0.00	0.00
70% (255.5 lb.)	255-256	12:00-14:00	0.00	0.00
85% (310.25 lb.)	311-313	14:30-16:30	0.00	0.00
100% (365 lb.)	365-366	17:00-19:00	0.00	0.00
25% (91.25 lb.)	91-93	20:00-22:00	0.00	0.00

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load:

$$\frac{l}{96} = \frac{48}{96} = 0.50 > 0.00 \therefore ok$$

Maximum Allowable Residual Deflection at 20% Load:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{48}{96}\right) = 0.10 > 0.00 : ok \text{ or } 1/2 \text{ in } > 0.00 : ok$$

Test Method B 365 lb. Vertical Concentrated Load at Top Corner Edge of the Right Glass Panel ¹ Test Date: 09/30/16

Load Level	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)
0% (0 lb.)	0	0:00	-
50% (182.5 lb.)	182-184	2:00-4:00	-
25% (91.25 lb.)	91-92	5:00-7:00	0.00
40% (146 lb.)	146	7:45-9:45	0.00
55% (200.75 lb.)	200-202	10:30-12:30	0.00
70% (255.5 lb.)	255-257	14:00-16:00	0.00
85% (310.25 lb.)	311-312	16:30-18:30	0.00
100% (365 lb.)	365	19:30-21:30	0.00
25% (91.25 lb.)	92	22:00-23:00	0.00

¹ There is no deflection requirement for this test.





Specimen 1 of 3 (Continued)

Test Method A

365 lb. Horizontal Concentrated Load at Top Corner Edge of the Right Glass Panel

Test Date: 09/30/16

Load Level	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)
0% (0 lb.)	0	0:00	-
50% (182.5 lb.)	182-183	0:00-2:00	-
25% (91.25 lb.)	91-94	3:00-5:00	0.00
40% (146 lb.)	146-149	5:30-7:30	0.36
55% (200.75 lb.)	200-201	8:30-10:30	0.91
70% (255.5 lb.)	255-259	11:00-13:00	1.58
85% (310.25 lb.)	311-312	13:30-15:30	2.21
100% (365 lb.)	365-366	16:00-18:00	2.92
25% (91.25 lb.)	91-92	19:00-20:00	0.31

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load:

$$\frac{h}{12} = \frac{42.5}{12} = 3.54 > 2.92 \therefore ok$$

Maximum Allowable Residual Deflection at 20% Load:

$$20\% \times \left(\frac{h}{12}\right) = 0.2 \times 3.54 = 0.71 > 0.31 : ok \text{ or } 1/2 \text{ in } > 0.31 : ok$$





Test Specimen 1 of 3 (Continued)

Test Method C 50 lb. Horizontal Concentrated Load on One Square Foot Area at Mid-Height of Glass Panel ¹

Test Date: 09/30/16

2000 2000 000 000 000						
Load Level	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)			
0% (0 lb.)	0	0:00	-			
50% (25 lb.)	25	0:30	-			
25% (12.5 lb.)	12.5	1:00	0.00			
40% (20 lb.)	20	1:30-3:30	0.00			
55% (27.5 lb.)	28	4:00-6:00	0.00			
70% (35 lb.)	35	6:30-8:30	0.00			
85% (42.5 lb.)	42.5-43	9:00-11:00	0.00			
100% (50 lb.)	50-51	11:30-13:30	0.00			
25% (12.5 lb.)	12.5	14:00-15:00	0.00			
100	·					

¹ There is no deflection requirement for this test.





Specimen 2 of 3

Test Method B 365 lb. Vertical Concentrated Load at Mid-Span of Top Edge of Glass Panel Test Date: 02/21/17

	Applied Load	E.T. (min:sec)	Displacement (in)	
Load Level	(lb.)		Left Panel	Right Panel
0% (0 lb.)	0	0:00	-	-
50% (182.5 lb.)	183	2:30-5:30	-	-
25% (91.25 lb.)	92-93	6:00-8:00	0.00	0.00
40% (146 lb.)	146-147	9:00-11:00	0.00	0.00
55% (200.75 lb.)	200-201	11:30-13:30	0.00	0.00
70% (255.5 lb.)	255-257	14:15-16:15	0.00	0.00
85% (310.25 lb.)	311-312	17:00-19:00	0.00	0.00
100% (365 lb.)	365	20:00-22:00	0.00	0.00
25% (91.25 lb.)	92-93	23:00-24:00	0.00	0.00

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load:

$$\frac{l}{96} = \frac{48}{96} = 0.50 > 0.00 \therefore ok$$

Maximum Allowable Residual Deflection at 20% Load:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{48}{96}\right) = 0.10 > 0.00 : ok \text{ or } 1/2 \text{ in } > 0.00 : ok$$

Test Method B 365 lb. Vertical Concentrated Load at Top Corner Edge of the Right Glass Panel ¹ Test Date: 02/21/17

1000 0 0 0 0 1 1 1 1					
Load Level	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)		
0% (0 lb.)	0	0:00	-		
50% (182.5 lb.)	183-185	2:00-4:00	-		
25% (91.25 lb.)	91-92	4:30-6:30	0.00		
40% (146 lb.)	145-147	7:15-9:15	0.00		
55% (200.75 lb.)	201-203	10:00-12:00	0.00		
70% (255.5 lb.)	255-256	12:30-14:30	0.01		
85% (310.25 lb.)	311	15:00-17:00	0.02		
100% (365 lb.)	364-366	17:45-19:45	0.02		
25% (91.25 lb.)	92	21:00-22:00	0.00		

¹ There is no deflection requirement for this test.





Specimen 2 of 3 (Continued)

Test Method A 365 lb. Horizontal Concentrated Load at Mid-Span of Top Edge of Glass Panel Test

Date: 02/21/17

	Applied Load (lb.)	Е.Т.	Displacement (in)	
Load Level		(min:sec)	Left Panel	Right Panel
0% (0 lb.)	0	0:00	-	-
50% (182.5 lb.)	182-184	2:30-4:30	-	-
25% (91.25 lb.)	92	5:30-7:30	0.00	0.00
40% (146 lb.)	146-147	8:00-10:00	0.20	0.21
55% (200.75 lb.)	200-201	11:00-13:00	0.41	0.40
70% (255.5 lb.)	256	13:45-15:45	0.89	0.89
85% (310.25 lb.)	311-313	16:30-18:30	1.23	1.24
100% (365 lb.)	365-366	19:00-21:00	1.67	1.69
25% (91.25 lb.)	92	22:30-25:30	0.18	0.19

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load:

$$\frac{h}{24} + \frac{l}{96} = \frac{42.5}{24} + \frac{96}{96} = 2.77 > 1.69 : ok$$

Maximum Allowable Residual Deflection at 20% Load:

$$20\% \times \left(\frac{h}{24} + \frac{l}{96}\right) = 0.2 \times 2.77 = 0.55 > 0.19 : ok \text{ or } 1/2 \text{ in } > 0.19 : ok$$





Test Specimen 2 of 3 (Continued)

Test Method C 50 lb. Horizontal Concentrated Load on One Square Foot Area at Mid-Height of Glass Panel ¹

Test Date: 02/21/17

Load Level	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)
0% (0 lb.)	0	0:00	-
50% (25 lb.)	25	0:30	-
25% (12.5 lb.)	13	1:00	0.00
40% (20 lb.)	20	1:30-3:30	0.00
55% (27.5 lb.)	28	4:00-6:00	0.00
70% (35 lb.)	35	6:30-8:30	0.00
85% (42.5 lb.)	42-46	9:00-11:00	0.00
100% (50 lb.)	50	11:30-13:30	0.00
25% (12.5 lb.)	13	14:00-15:00	0.00

¹ There is no deflection requirement for this test.





Specimen 3 of 3

Test Method B 365 lb. Vertical Concentrated Load at Mid-Span of the Left Glass Panel Test Date: 04/27/17

	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)	
Load Level			Left Panel	Right Panel
0% (0 lb.)	0	0:00	-	-
50% (182.5 lb.)	183	2:00-4:00	-	-
25% (91.25 lb.)	92-94	4:30-6:30	0.00	0.00
40% (146 lb.)	146	7:00-9:00	0.00	0.00
55% (200.75 lb.)	200-201	9:45-11:45	0.00	0.00
70% (255.5 lb.)	256-258	13:00-15:00	0.00	0.00
85% (310.25 lb.)	311	16:00-18:00	0.00	0.00
100% (365 lb.)	365	18:30-20:30	0.00	0.00
25% (91.25 lb.)	92	22:00-23:00	0.00	0.00

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load:

$$\frac{l}{96} = \frac{48}{96} = 0.50 > 0.00 \therefore ok$$

Maximum Allowable Residual Deflection at 20% Load:

$$20\% \times \left(\frac{l}{96}\right) = 0.2 \times \left(\frac{48}{96}\right) = 0.10 > 0.00 : ok \text{ or } 1/2 \text{ in } > 0.00 : ok$$

Test Method B 365 lb. Vertical Concentrated Load at Top Corner Edge of the Right Glass Panel ¹ Test Date: 04/27/17

Load Level	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)
0% (0 lb.)	0	0:00	-
50% (182.5 lb.)	182-184	2:00-4:00	-
25% (91.25 lb.)	92-94	4:30-6:30	0.00
40% (146 lb.)	144-146	7:00-9:00	0.00
55% (200.75 lb.)	201	9:30-11:30	0.00
70% (255.5 lb.)	256-257	12:00-14:00	0.00
85% (310.25 lb.)	310-312	14:30-16:30	0.01
100% (365 lb.)	365	17:00-19:00	0.02
25% (91.25 lb.)	92	21:30-22:30	0.00

¹ There is no deflection requirement for this test.





Specimen 3 of 3 (Continued)

Test Method A

365 lb. Horizontal Concentrated Load at Top Corner Edge of the Right Glass Panel

Test Date: 04/27/17

Load Level	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)
0% (0 lb.)	0	0:00	-
50% (182.5 lb.)	183	2:00-4:00	-
25% (91.25 lb.)	92	4:45-6:45	0.00
40% (146 lb.)	145-146	7:30-9:30	0.38
55% (200.75 lb.)	201-203	10:00-12:00	0.84
70% (255.5 lb.)	256	13:00-15:00	1.45
85% (310.25 lb.)	310-313	15:45-17:45	2.06
100% (365 lb.)	364-367	18:15-20:15	2.83
25% (91.25 lb.)	92	21:00-22:00	0.29

Deflection Criteria per Section 7.2 of ASTM E 985:

Maximum Allowable Deflection at Test Load:

$$\frac{h}{12} = \frac{42.5}{12} = 3.54 > 2.83 : ok$$

Maximum Allowable Residual Deflection at 20% Load:

$$20\% \times \left(\frac{h}{12}\right) = 0.2 \times 3.54 = 0.71 > 0.29 : ok \text{ or } 1/2 \text{ in } > 0.29 : ok$$





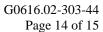
Test Specimen 3 of 3 (Continued)

Test Method C 50 lb. Horizontal Concentrated Load on One Square Foot Area at Mid-Height of Glass Panel ¹

Test Date: 04/27/17

1000 2000 0 112.112.					
Load Level	Applied Load (lb.)	E.T. (min:sec)	Displacement (in)		
0% (0 lb.)	0	0:00	-		
50% (25 lb.)	24-25	0:45	-		
25% (12.5 lb.)	12-13	1:00	0.00		
40% (20 lb.)	20	1:30-3:30	0.00		
55% (27.5 lb.)	28	4:15-6:15	0.00		
70% (35 lb.)	35	6:30-8:30	0.00		
85% (42.5 lb.)	42-43	9:15-11:15	0.00		
100% (50 lb.)	50	12:00-14:00	0.00		
25% (12.5 lb.)	13	14:30-15:30	0.00		
1 551 1 1 1 1					

¹ There is no deflection requirement for this test.







3.0 Summary and Conclusions

Appendix A - Drawings (9) Appendix B - Photographs (2)

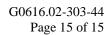
The 96 in wide by 42-1/2 in high HRBDS (Handrail Base Shoe "Dry-Set") system tested and reported herein met all of the load and deflection criteria of the referenced standards.

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:	
Charles Presley Technician	Jarod S. Hardman Laboratory Manager
JSH:ss	
Attachments (pages): This report is comple	ete only when all attachments listed are included.







Revision Log

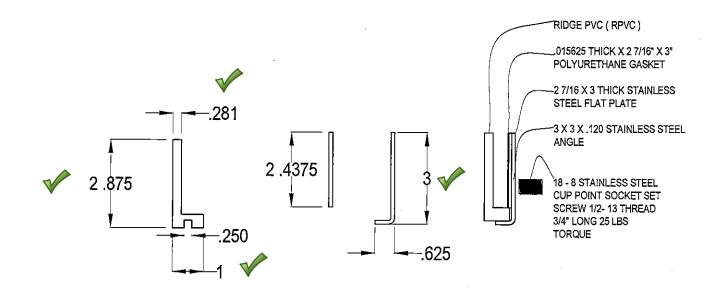
<u>Rev. #</u>	Date	Page(s)	Revision(s)
0	05/05/17	N/A	Original report issue.





APPENDIX A

Drawings



DRYSET PRESSURE PAD

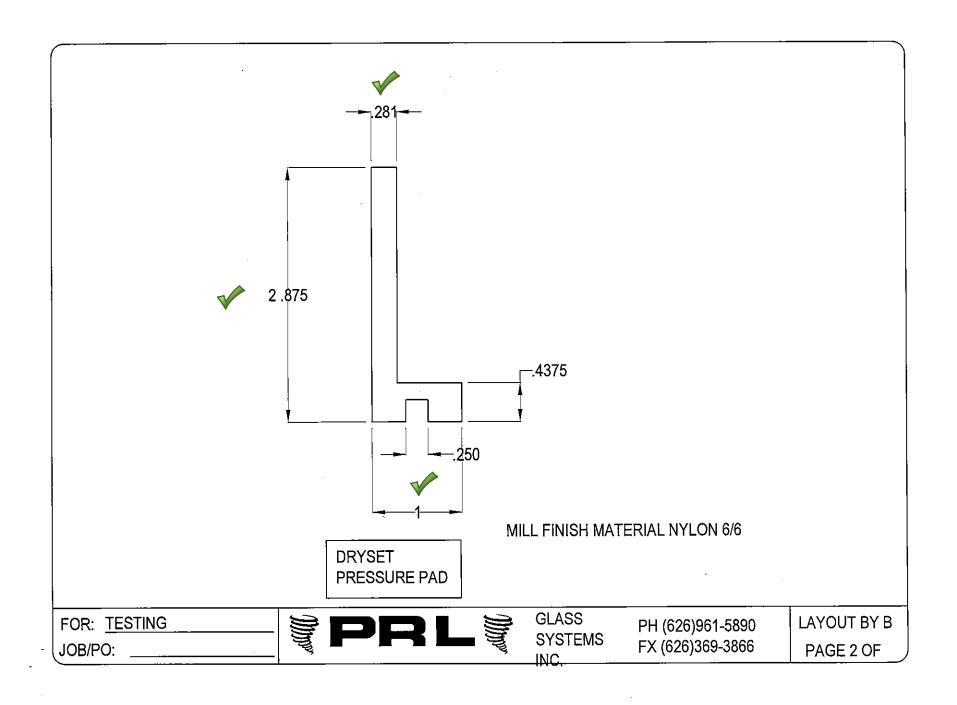
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JOB/PO: ___

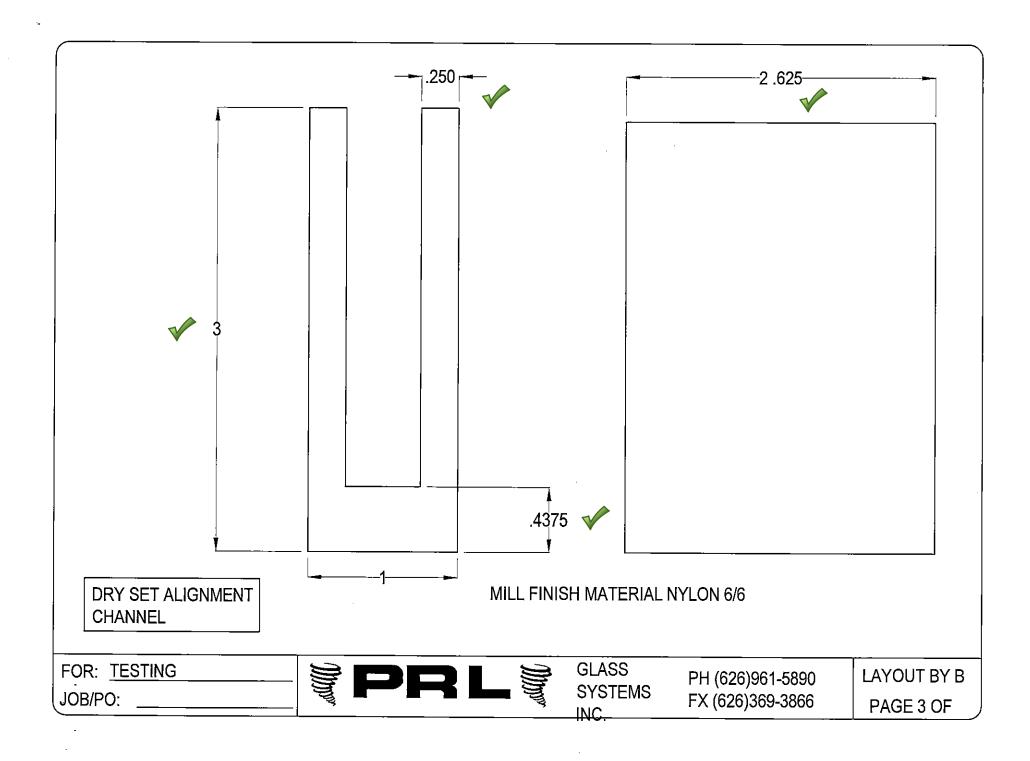


GLASS SYSTEMS INC.

PH (626)961-5890 FX (626)369-3866 LAYOUT BY B

PAGE 1 OF





G0616.02-303-44 Report #: Intertek 04/27/17 Date: Verified by: Q16.4h TOP CAP (6063 T-5) TOP GLASS INSERT 1/2 CLEAR TEMP GLASS 6063 T-5 ALUMINUM BASE SHOE **BULB VINYL** RIDGE PVC (RPVC) 18 - 8 STAINLESS STEEL CUP POINT SET SCREW 1/2 - 13 X 3/4" LONG 1/2 Ø MACHINE BOLT FOR TESTING STEEL CHANNEL (TEST FIXTURE) **GLASS** FOR: TESTING LAYOUT BY B PH (626)961-5890 **SYSTEMS** JÒB/PO: FX (626)369-3866 PAGE 4 OF INC.

UNLESS OTHERWISE SPECIFIED STANDAR ALUMINUM ASSOCIATION TOLERANCES APPLY

DIE NO.

2036-A

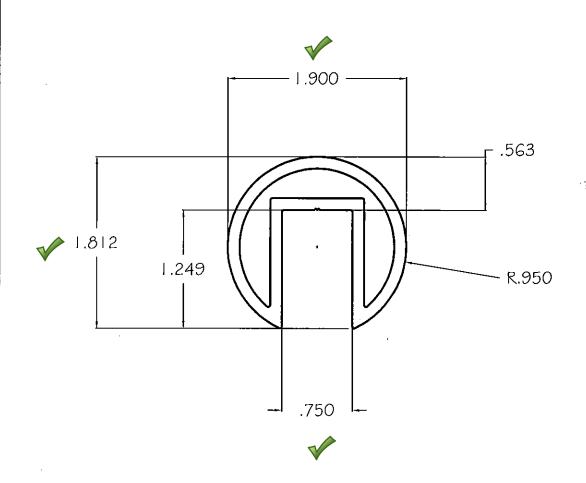
Report Date:

Report #:

G0616.02-303-44 04/27/17

Verified by:

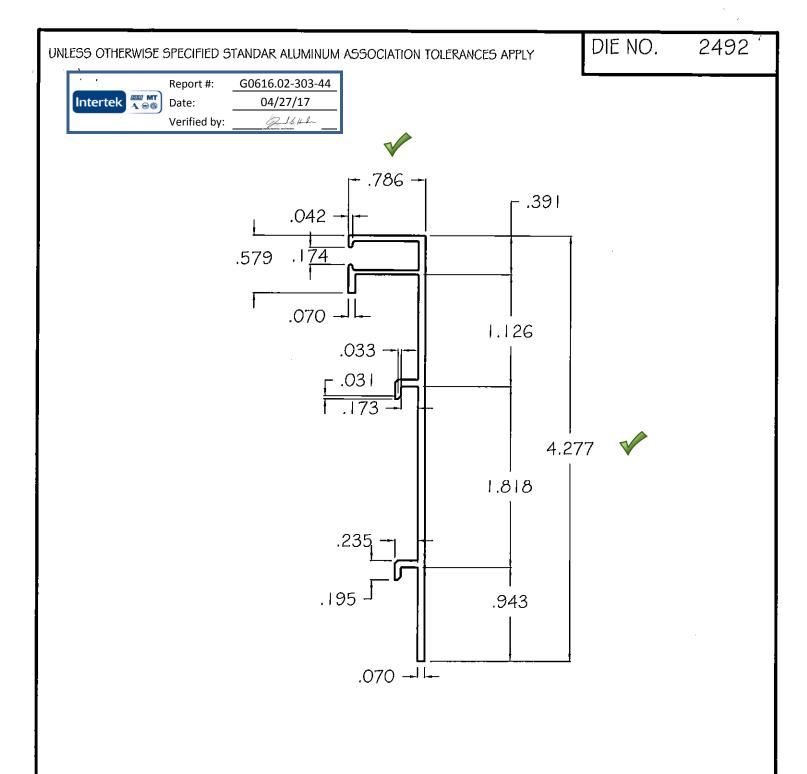
Q16.4h



UNLESS OTHER WISE NOTED - .125 TYP. WALL

UNMARKED CORNERS .020 R.

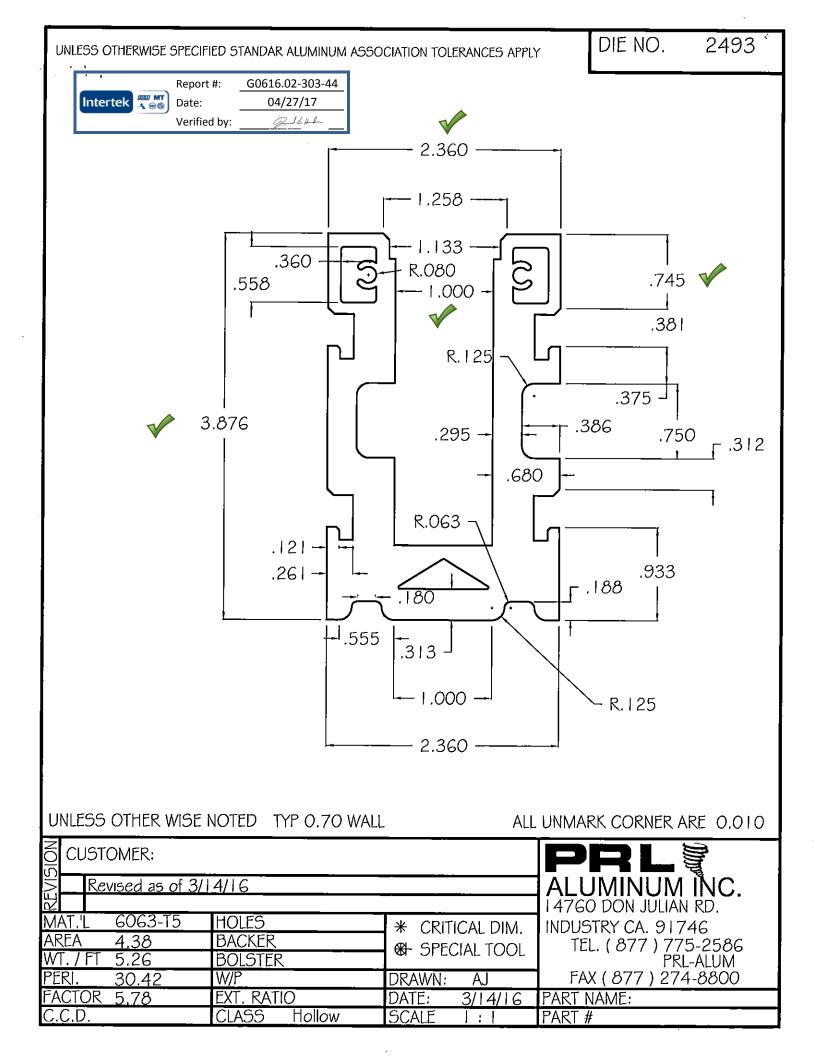
NO STATE OF THE PROPERTY OF TH		ALUMINUM INC. 14760 DON JULIAN RD.
MAT.'L 6063-T5 HOLES I AREA .980 BACKER WT. / FT 1.176 BOLSTER PERI. 15.529 W/P	* CRITICAL DIM. SPECIAL TOOL	INDUSTRY CA. 91746 TEL. (877) 775-2586 PRL-ALUM FAX (877) 274-8800
PERI. 15.529 W/P FACTOR 13.20 EXT. RATIO 51.29 C.C.D. CLASS Hollow	DRAWN AJ DATE: 7-24-07 SCALE I:I	PART NAME: 2" TOP CAP PART # 2TC

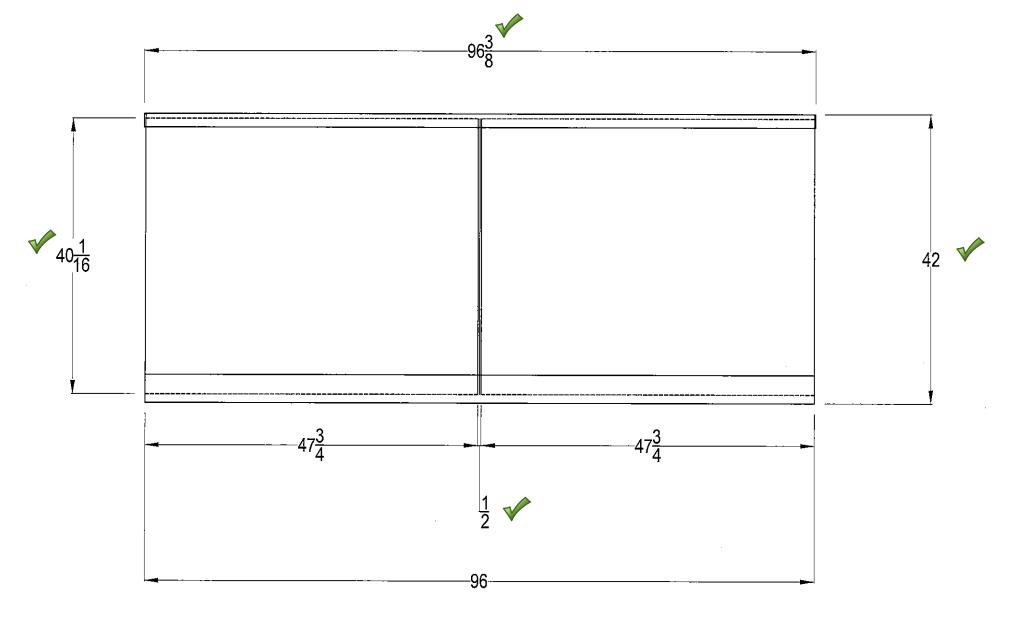


UNLESS OTHER WISE NOTED TYP 0.70 WALL

ALL UNMARK CORNER ARE 0.010

CUSTOMER:			PRL
Revised as of 3/14/16			ALUMINUM INC.
			14760 DON JULIAN RD.
MAT.'L 6063-T5	HOLES	* CRITICAL DIM.	INDUSTRY CA. 91746
AREA 0.435	BACKER	SPECIAL TOOL	TEL. (877) 775-2586
WT. / FT 0.522	BOLSTER		PRL-ALUM
PERI. 13.43	W/P	DRAWN: AJ	FAX (877) 274-8800
FACTOR 26.37	EXT. RATIO	DATE: 3/14/16	PART NAME:
C.C.D <u>.</u>	CLASS Solid	SCALE 1:1	PART #





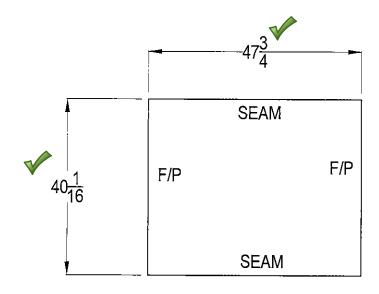
FOR: TESTING

JOB/PO: NEW BASE SHOE



GLASS SIZE: 1/2

GLASS TYPE: CLEAR (TEMPERED)



5 - TOTAL PCS



FOR: TESTING

JOB/PO: NEW BASE SHOE



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APPENDIX B

Photographs







Photo No. 1 Typical identification of glass panel



Photo No. 2 Typical vertical loading deflection setup







Photo No. 3
Typical horizontal loading deflection setup