Architectural Testing

TEST REPORT

Rendered to:

AFCO INDUSTRIES, INC.

For:

PRODUCT: *Redi-Rail™*

TYPE: Aluminum Level Guardrail System

Report No: A5899.01-119-19
Report Date: 01/03/11

130 Derry Court
York, PA 17406-8405
phone: 717-764-7700
fax: 717-764-4129
www.archtest.com

Architectural Testing

TEST REPORT

A5899.01-119-19
January 3, 2011

TABLE OF CONTENTS

Architectural Testing

TEST REPORT

Rendered to:

AFCO INDUSTRIES, INC.
3400 Roy Street
Alexandria, Louisiana 71307

Report No.: A5899.01-119-19
Test Date: 12/15/10
Report Date: 01/03/11

1.0 General Information

1.1 Product

Redi-Rail ™

1.2 Type

Aluminum Guardrail System

1.3 Project Description

Architectural Testing was contracted by AFCO Industries, Inc. to conduct structural performance tests on the 96 in wide by 42 in high *Redi-Rail ™* aluminum level guardrail system. The system was evaluated for the design load requirements of the following building codes:

2009 *International Building Code®*, International Code Council

2009 *International Residential Code®*, International Code Council

Structural tests were performed according to Chapter 17 (Structural Tests and Special Inspections) of IBC 2009.

1.4 Limitations

All tests performed were to evaluate structural performance of the guardrail assembly to carry and transfer imposed loads to the supporting structure. The test specimens evaluated included the infill, rails and rail brackets. The posts are not a tested component and are included in the test setup only to facilitate the rail bracket anchorage.

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1.5 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.

1.6 Product Description

AFCO Industries, Inc. provided the fully-assembled test specimens with the following details:

Top Rail: 2 in high by 2.3 in wide contoured 6063-T6 aluminum extrusion with 0.08 in wall

Bottom Rail: 1.5 in wide by 1.25 in deep 6063-T6 aluminum extrusion with 0.08 in wall

Pickets (In-Fill): - 0.75 in square 6063-T6 aluminum extrusion with 0.05 in wall

- 0.75 in diameter 6063-T6 aluminum extrusion with 0.05 in wall

Baluster Connector: 0.63 in diameter (at bottom) by 0.67 in high glass-filled nylon connector with one 0.19 in diameter hole in the center for attachment to the rail using a #10 x 3/4 in pan-head, sheet-metal screw

Top Rail Bracket: 2 in wide by 1.3 in high 6063-T6 aluminum extruded saddle bracket with separate 1.5 in wide by 1.2 in high 6063-T6 aluminum extruded contoured top cap

Bottom Rail Bracket: 1.7 in wide by 1.7 in high 6063-T6 aluminum extruded socket bracket

Fasteners: #10 by 2" self-drilling, pan head, stainless steel, sheet-metal screw (two in bracket/post)

#8 by 3/4" self-drilling, pan-head, sheet-metal screw (one in rail/bracket)

Post: 3 in square 6005A-T61 aluminum extrusion with 0.125 in wall

Support Foot: 0.75 in diameter baluster cut to length and secured to underside of bottom rail at the mid-span with glass-filled nylon connector with a single #10 x 3/4" screw

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 42 in high level guardrail assembly was installed and tested as a single railing section by directly securing the aluminum posts into a rigid steel test fixture, which rigidly restrained the posts from deflecting. The posts are not a tested component and are included in the test setup only to facilitate the rail bracket anchorage. 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 level guardrail assemblies for the design load requirements of the codes referenced. Deflection and permanent set were component deflections relative to their end-points; they were not overall system displacements. All loads and displacement measurements were horizontal, unless noted otherwise.

Key to Test Results Tables:

Load Level: Target test load

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

2.4 Test Results (Continued)

Test Series No. 1
96 in by 42 in *Redi-Rail* Aluminum Level Guardrail System
with 3/4 in Diameter Aluminum Balusters
IBC – All Use Groups

Test No. 1 – 12/15/10 **Design Load: 50 lb / 1 Square Ft at Center of In-Fill (on Two Balusters)**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	25	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	101	00:30	0.30	0.83	0.53	0.42
Initial Load	25	02:06	0.00	0.00	0.01	0.00
100% Recovery from 2.0 x Design Load						
2.5x Design Load	125	02:24	Achieved Load without Failure			

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

Test No. 2 – 12/15/10 **Design Load: 50 lb / 1 Square Ft at Bottom of In-Fill (on Two Balusters)**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	25	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	100	00:21	0.04	0.75	0.03	0.72
Initial Load	25	01:55	0.00	0.02	0.00	0.02
97% Recovery from 2.0 x Design Load						
2.5x Design Load	132	02:15	Achieved Load without Failure			

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

Test No. 3 – 12/15/10 **Design Load: 50 plf x (96 in ÷ 12 in/ft) = 400 lb Horizontal Uniform Load on Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Rail Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	100	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	802	01:13	0.10	3.13	0.07	3.05
Initial Load	100	02:50	0.00	0.25	0.00	0.25
92% Recovery from 2.0 x Design Load						
2.5x Design Load	1000	04:17	Achieved Load without Failure			

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

2.4 Test Results (continued)

Test Series No. 1 (continued)

Test No. 4 – 12/15/10 Design Load: 200 lb Concentrated Load at Ends of Top Rail (Brackets)				
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Rail Displacement (in)**	
			Rail End #1	**Rail End #2**
Initial Load	100	00:00	0.00	0.00
2.0x Design Load	809	01:25	0.22	0.20
Initial Load	100	03:03	0.01	0.01
95% Recovery from 2.0 x Design Load				
2.5x Design Load	1005	04:12	Achieved Load without Failure	

[1] *A spreader beam was used to impose loads on* both *ends of the railing system; therefore, loads were doubled.*

Test Series No. 2
120 in by 42 in *Redi-Rail* Aluminum Level Guardrail System
with 3/4 in Square Aluminum Balusters
IRC – One- and Two-Family Dwellings

Test No. 1 – 12/15/10 Design Load: 50 lb / 1 Square Ft at Center of In-Fill (on Two Balusters)						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	25	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	100	00:26	0.51	1.06	0.94	0.34
Initial Load	25	02:06	0.00	0.01	0.05	0.00
100% Recovery from 2.0 x Design Load						
2.5x Design Load	126	02:28	Achieved Load without Failure			

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

Test No. 2 – 12/15/10 Design Load: 50 lb / 1 Square Ft at Bottom of In-Fill (on Two Balusters)						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	25	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	100	00:32	0.05	1.26	0.05	1.21
Initial Load	25	01:55	0.00	0.01	0.00	0.01
99% Recovery from 2.0 x Design Load						
2.5x Design Load	126	02:17	Achieved Load without Failure			

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

2.4 Test Results (continued)

Test Series No. 2 (continued)

Test No. 3 – 12/15/10 Design Load: 200 lb Concentrated Load at Midspan of Top Rail						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Rail Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
Initial Load	50	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	400	01:01	0.07	4.37	0.07	4.30
Initial Load	50	02:26	0.01	0.51	0.00	0.51
88% Recovery from 2.0 x Design Load						
2.5x Design Load	500	03:43	Achieved Load without Failure			

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

Test No. 4 – 12/15/10 Design Load: 200 lb Concentrated Load at Ends of Top Rail (Brackets)				
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Rail Displacement (in)**	
			Rail End #1	**Rail End #2**
Initial Load	100	00:00	0.00	0.00
2.0x Design Load	803	00:45	0.25	0.27
Initial Load	102	02:27	0.01	0.02
93% Recovery from 2.0 x Design Load				
2.5x Design Load	1006	03:24	Achieved Load without Failure	

[1] *A spreader beam was used to impose loads on* both *ends of the railing system; therefore, loads were doubled.*

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 the use of railing assemblies reported herein as installed between adequate supports with guardrail details and Occupancy Classification as shown in the following table:

Maximum Guardrail System Dimensions*	**Guardrail Type**	**Support Post used in Testing**	**Code Occupancy Classification**
96 in by 42 in *Redi-Rail (Aluminum)*	Level	3 in Square Aluminum Post	IBC – All Use Groups
120 in by 42 in *Redi-Rail (Aluminum)*	Level	3 in Square Aluminum Post	IRC - One- and Two-Family Dwellings

** Guardrails are qualified up to and including the listed maximum guardrail system dimensions for use in the referenced Code Occupancy Classification*

The posts are not a tested component and are included in the test setup only to facilitate the rail bracket anchorage.

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: Adam J. Schrum

Adam J. Schrum
Technician II
Structural Systems Testing

Digitally Signed by: Travis Hoover

Travis A. Hoover
Program Manager
Structural Systems Testing

AJS:ajs/tah

Attachments (pages): *This report is complete only when all attachments listed are included.*
Appendix A - Drawings (11)
Appendix B - Photographs (5)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	01/03/11	N/A	Original report issue

APPENDIX A

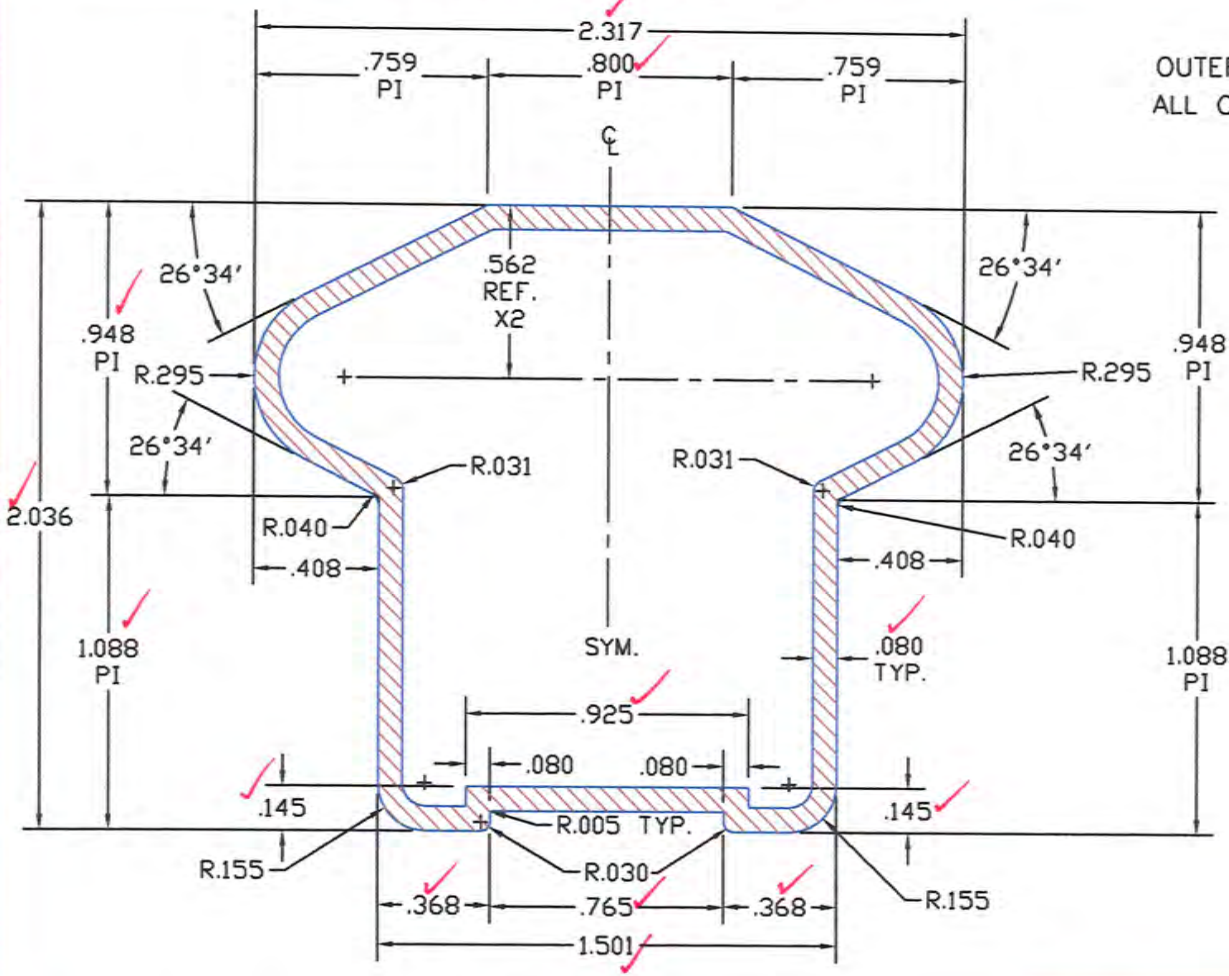
Drawings

PART NO. STRT TOP RAIL

THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

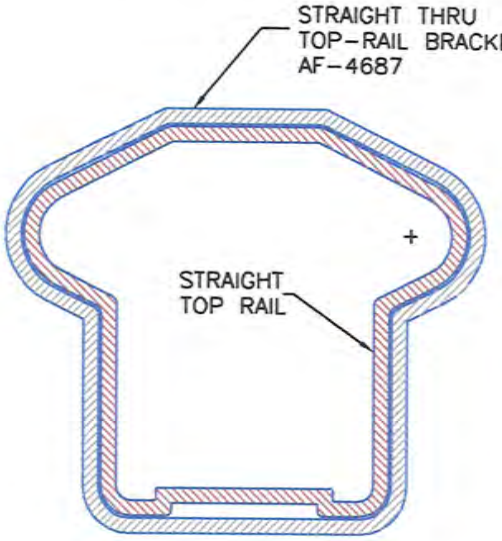
SF 9 | 0 | AF- 4689

AFHR0819100 09/01/2010



SCALE: 1.6X

OUTER PERIMETER = 7.619
ALL OUTSIDE EXPOSED.



APPROXIMATE SIZE

Architectural Testing

Test sample complies with these details. Deviations are noted.

Report# A5899.01-119-19

Date 12/22/10 Tech AJS

RUN OUT SURFACE WILL HAVE BLACK CARBON MARKS, LIGHT SCRATCHES AND SCUFF MARKS.
ABBREVIATIONS: REF.=REFERENCE, P.I.=POINT INTERSECTION, SYM=SYMMETRICAL, DP=DEEP, TYP=TYPICAL.
TAN = TANGENT TO CIRCLE OR RADIUS, CD = CRITICAL DIMENSION, CENT = CENTER LINE
DIMENSIONAL LIMITS APPLY BEFORE COATING. DO NOT SCALE THE DRAWING.
ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG. FOR QUOTATION; KK 09/01/2010		
–	REL. FOR TOOLING, ECN#101164, DL 10/12/10		

.080 TYPICAL WALL EXCEPT AS SHOWN

SEE DWG. BREAK SHARP CORNERS

CUSTOMER:	AFCO ALUMINUM
PRODUCT NAME:	STRAIGHT TOP RAIL
CUST DWG. & REV.:	NA

AFCO ALUMINUM PRODUCTS
P.O. BOX 5085
3400 ROY STREET
ALEXANDRIA, LA 71302

ALLOY:	6063	TEMPER:	T-6	TYPE DIE:	HOLLOW
DIE SIZE:	9X5	No. OF HOLES:	1	BACKER:	–
BOLSTER:	2131	FEEDER PLT:	–	BILLET:	7X27
EST. AREA:	.593	EST. PERIMETER:	14.778	FACTOR:	21
EST. WT/FT:	.712	CIRCUMSCRIBED CIR. DIA:		7"	
FINISH:	PAINTED			RATIO:	65
DRAWN BY:	K.T.	DATE:	9/01/2010	SCALE:	1.6X

Architectural Testing

Test sample complies with these details.
Deviations are noted.

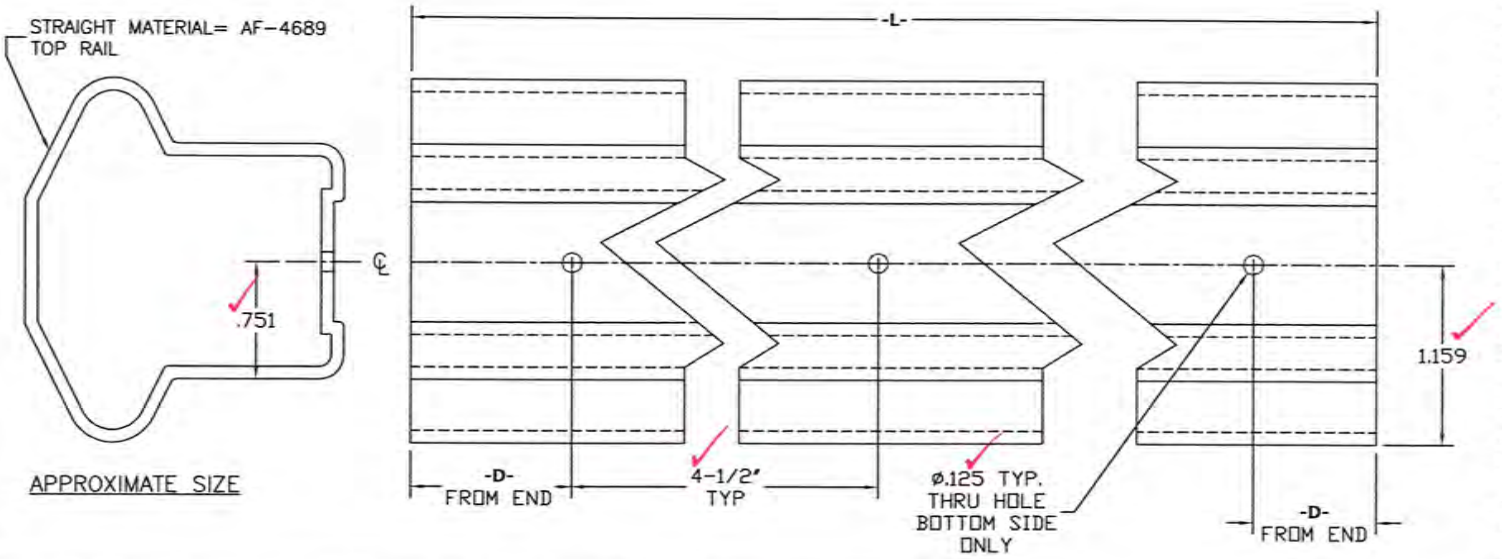
Report # AS899.01-119-19
Date 12/22/10 Tech AJS

PART NO. LEVEL TOP RAIL | THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

SF 9 | 0 | AF– FAB4689TOPRAIL

FAB4689TOPRAIL 11/03/2010

LEVEL RAIL UNIT



PLEASE FILL OUT ALL INFORMATION AT RIGHT OF PAGE

DIE # +	DESCRIPTION	ITEM CODE	PART NO.	QTY/UNIT	-L-	FINISH	-D- FROM END	NO. HOLES
AF–4689	LEVEL TOP RAIL	4689FXXXX	TBD	1	47.25"	PAINT	3–3/8"	10
AF–4689	LEVEL TOP RAIL	4689FXXXX	TBD	1	71.25"	PAINT	1–7/8"	16
AF–4689	LEVEL TOP RAIL	4689FXXXX	TBD	1	95.25"	PAINT	2–5/8"	21
AF–4689	LEVEL TOP RAIL	4689FXXXX	TBD	1	119.25"	PAINT	3–3/8"	26

OUTER PERIMETER = 7.619
ALL OUTSIDE EXPOSED.

UNLESS OTHERWISE SPECIFIED, THE FOLLOWING TOLERANCES APPLY FOR DIMENSIONS ARE IN INCHES			MACHINE HOLE DIAMETER TOLERANCES
1 PLACE DECIMAL: ±.031	3 PLACE DECIMAL: ±.015	FRACTIONS ±1/32	ø.000 – ø.250: ±.004
2 PLACE DECIMAL: ±.020	ANGULARITY: ±2°		ø.251 – ø.500: ±.008
			ø.501 UP: ±.012

ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG. FOR APPROVAL; KK 11/03/2010		

.080 TYPICAL WALL EXCEPT AS SHOWN | SEE DWG. BREAK SHARP CORNERS

CUSTOMER: AFCO ALUMINUM		AFCO ALUMINUM PRODUCTS P.O. BOX 5085 3400 ROY STREET ALEXANDRIA, LA 71302
PRODUCT NAME: LEVEL TOP RAIL		
CUST DWG. & REV.: NA		
ALLOY: 6005A	TEMPER: T–61	TYPE DIE: HOLLOW
DIE SIZE: 9X5	No. OF HOLES: 1	BACKER: –
BOLSTER: 2131	FEEDER PLT: –	BILLET: 7X27
EST. AREA: .593	EST. PERIMETER: 14.778	FACTOR: 21
EST. WT/FT: .712	CIRCUMSCRIBED CIR. DIA: 7"	
FINISH: PAINTED	RATIO: 65	
DRAWN BY: KRK	DATE: 11/03/2010	SCALE: FULL

DRAWING APPROVAL

RETURN ONE (1) COPY TO AFCO

{PLEASE FILL OUT ENTIRE AREA BELOW THIS INFORMATION IS NECESSARY IN ORDERING THIS DIE WITHOUT DELAY.}

PLEASE GIVE EXPOSED SURFACES AND A LOCATION FOR AN AFCO I.D. MARK IF NIETHER IS ALREADY SHOWN ON THIS DRAWING.

CUSTOMER: _____
BY: _____
TITLE: _____
DATE: _____
P.O.#: _____
PART No.: _____
CUT LENGTHS: _____

ALLOY: _____
TEMPER: _____
END USE: _____

NOTE: DIE SERVICE CHARGES COVERS ONLY THE BASIC COST OF BUILDING AN EXTRUSION DIE. CONTINUING DIE MAINTENANCE OR EXTRUSION DIE REPLACEMENT IS OF NO CHARGE TO CUSTOMERS. AFCO RETAINS ALL RIGHTS TO EXTRUSION DIE OWNERSHIP.

DIE CHARGE: _____

SAMPLE REQUESTED:

YES ☐ NO ☐

LENGTHS: _____
NO. PCS.: _____
PAINT: _____
COMMENTS: _____

QC. FORM NO. 065 REV. 5

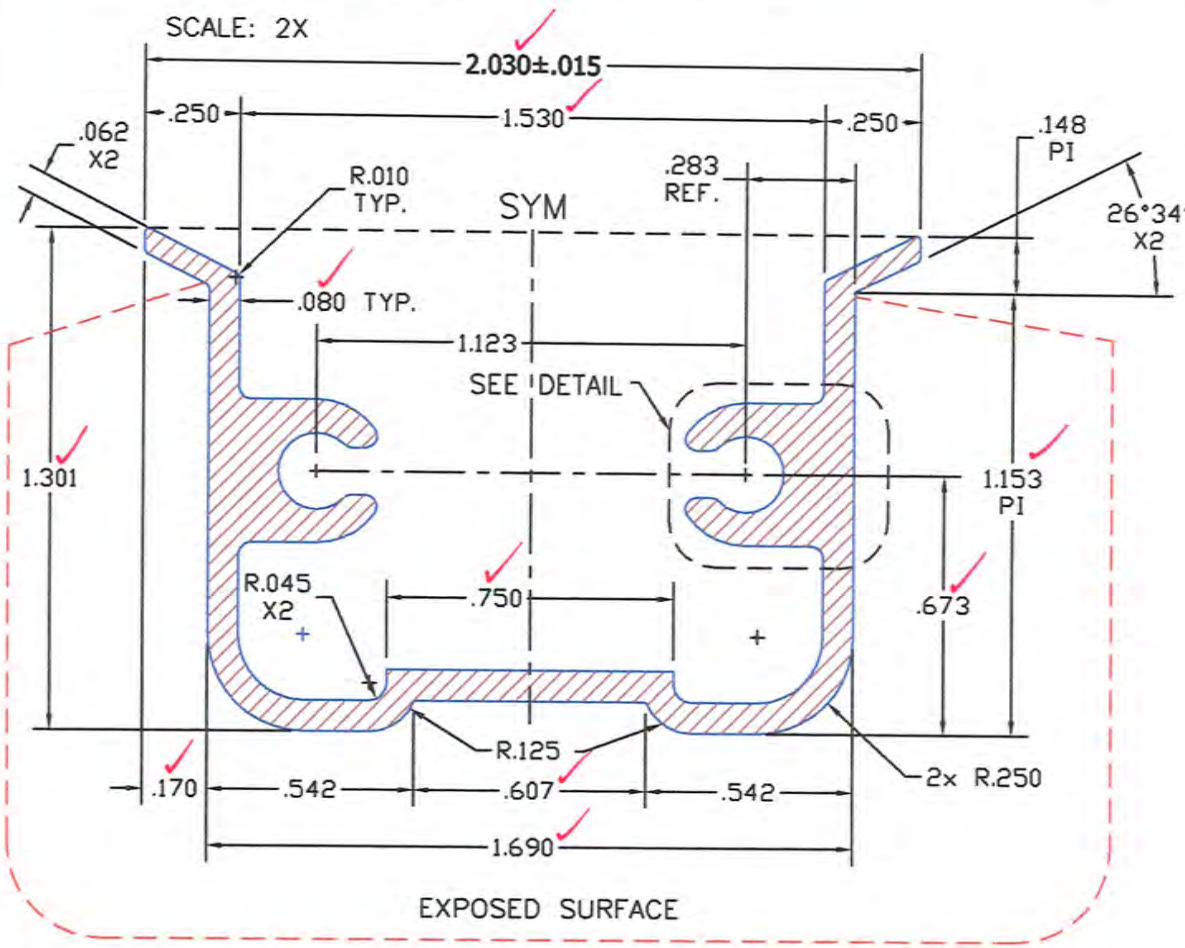
PART NO. TB PART"B"

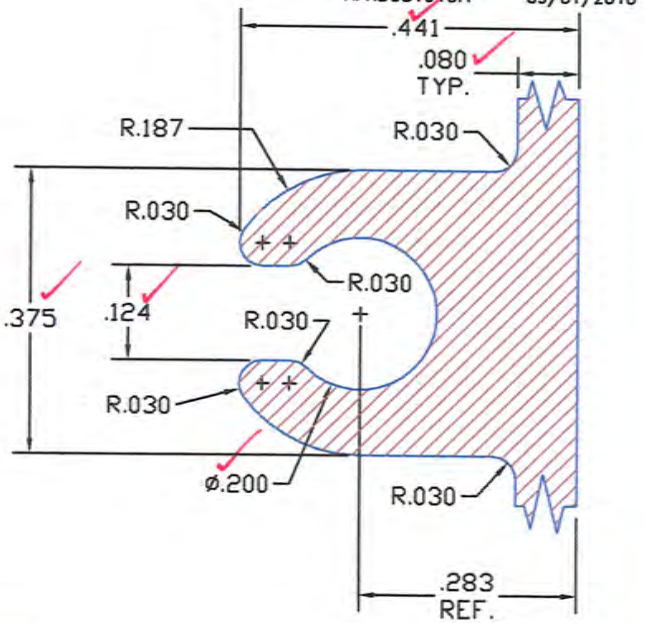
THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

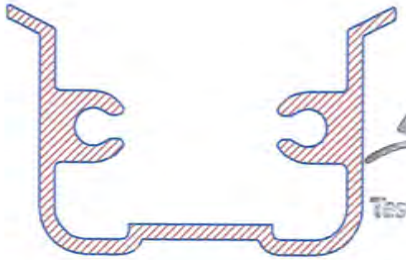
SF 9 0

AF- 4682

AFHD081910H 09/01/2010







DETAIL
SCALE: 4X
2 PLACES

APPROXIMATE SIZE

Architectural Testing

Test sample complies with these details. Deviations are noted.

Report# A5899.01-119-19

Date 12/22/10 Tech MJS

RUN OUT SURFACE WILL HAVE BLACK CARBON MARKS, LIGHT SCRATCHES AND SCUFF MARKS.
ABBREVIATIONS: REF.=REFERENCE, P.I.=POINT INTERSECTION, SYM=SYMMETRICAL, DP=DEEP, TYP=TYPICAL.
TAN = TANGENT TO CIRCLE OR RADIUS, CD = CRITICAL DIMENSION, CENT = CENTER LINE
DIMENSIONAL LIMITS APPLY BEFORE COATING. DO NOT SCALE THE DRAWING.
ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG. FOR QUOTATION; KK 09/01/2010		
–	REL. FOR TOOLING, ECN#101154, DL 09/02/10		

.080 TYPICAL WALL EXCEPT AS SHOWN

SEE DWG. BREAK SHARP CORNERS

CUSTOMER:	AFCO ALUMINUM		
PRODUCT NAME:	TOP RAIL BRACKET		
CUST DWG. & REV.:	PART "B"		
ALLOY: 6063	TEMPER: T-6	TYPE DIE: SOLID	
DIE SIZE: 10X1.5	No. OF HOLES: 2	BACKER: 4682 10X2	
BOLSTER: R2-D2	FEEDER PLT: 4682 10X1.5	BILLET: 7X28.8	
EST. AREA: .507	EST. PERIMETER: 10.772	FACTOR: 18	
EST. WT/FT: .608	CIRCUMSCRIBED CIR. DIA: 7"		
FINISH: PAINT	RATIO: 37		
DRAWN BY: K.T.	DATE: 9/01/2010	SCALE: 2X	

AFCO ALUMINUM PRODUCTS
P.O. BOX 5085
3400 ROY STREET
ALEXANDRIA, LA 71302

PART NO. TRB PART "A"

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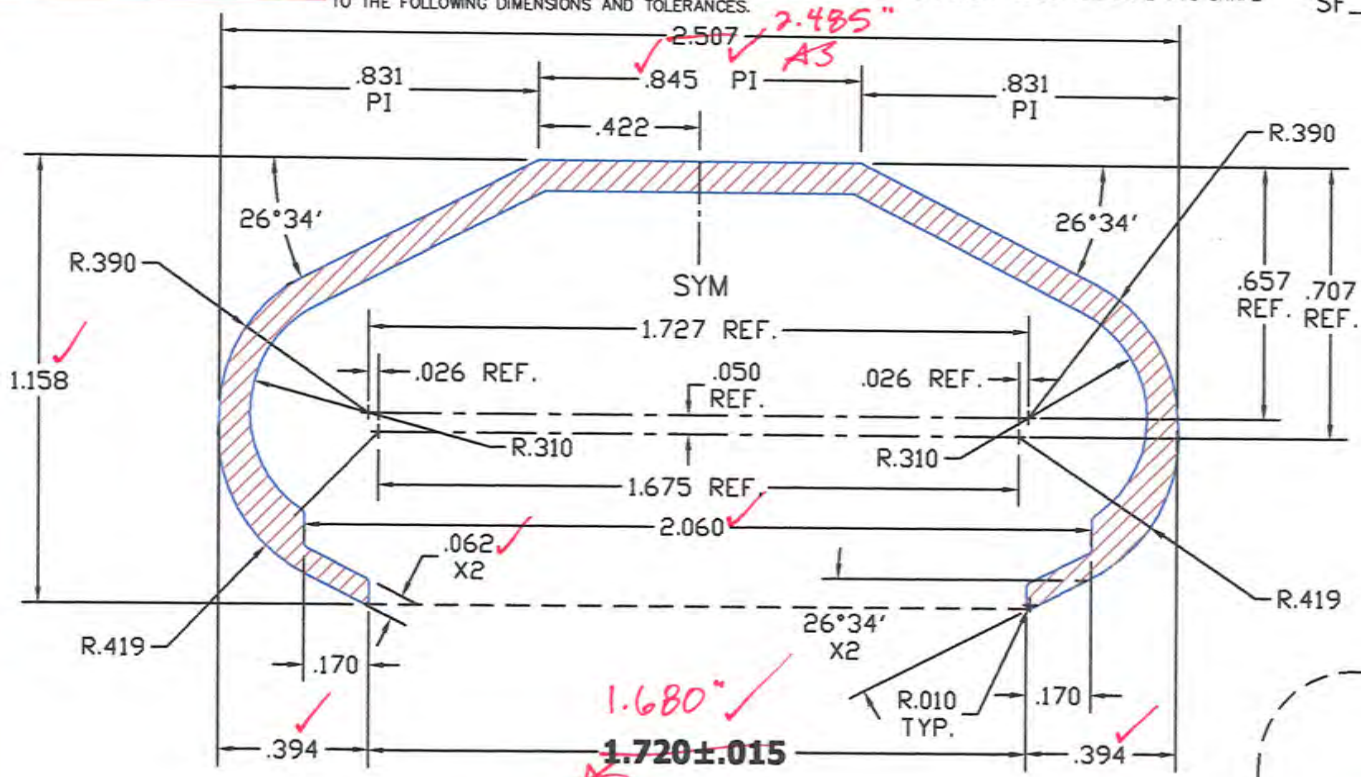
SF 9 0

AF- 4681

AFHR081910G 08/23/2010



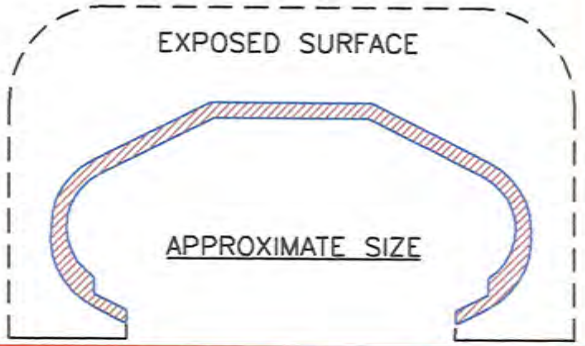
SCALE: 2X

Architectural Testing

Test sample complies with these details. Deviations are noted.

Report# A5899.01-119-19

Date 12/22/10 Tech AJS



RUN OUT SURFACE WILL HAVE BLACK CARBON MARKS, LIGHT SCRATCHES AND SCUFF MARKS.
ABBREVIATIONS: REF.=REFERENCE, P.I.=POINT INTERSECTION, SYM=SYMMETRICAL, DP=DEEP, TYP=TYPICAL.
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DIMENSIONAL LIMITS APPLY BEFORE COATING. DO NOT SCALE THE DRAWING.
ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG. FOR QUOTATION; KK 08/23/2010		
–	REL. FOR TOOLING, ECN#101154, DL 09/02/10		

.080 TYPICAL WALL EXCEPT AS SHOWN

SEE DWG. BREAK SHARP CORNERS

CUSTOMER:	AFCO ALUMINUM
PRODUCT NAME:	TOP RAIL BRACKET
CUST DWG. & REV.:	PART "A"

AFCO ALUMINUM PRODUCTS
P.O. BOX 5085
3400 ROY STREET
ALEXANDRIA, LA 71302

ALLOY: 6063	TEMPER: T-6	TYPE DIE: SOLID	
DIE SIZE: 10X1.5	No. OF HOLES: 2	BACKER: 4681 10X2	
BOLSTER: R2 D2	FEEDER PLT: 4681 10X1.5	BILLET: 7X28.8	
EST. AREA: .350	EST. PERIMETER: 8.608	FACTOR: 20	
EST. WT/FT: .420	CIRCUMSCRIBED CIR. DIA: 7"		
FINISH: PAINT	RATIO: 55		
DRAWN BY: K.T.	DATE: 8/23/2010	SCALE: 2X	

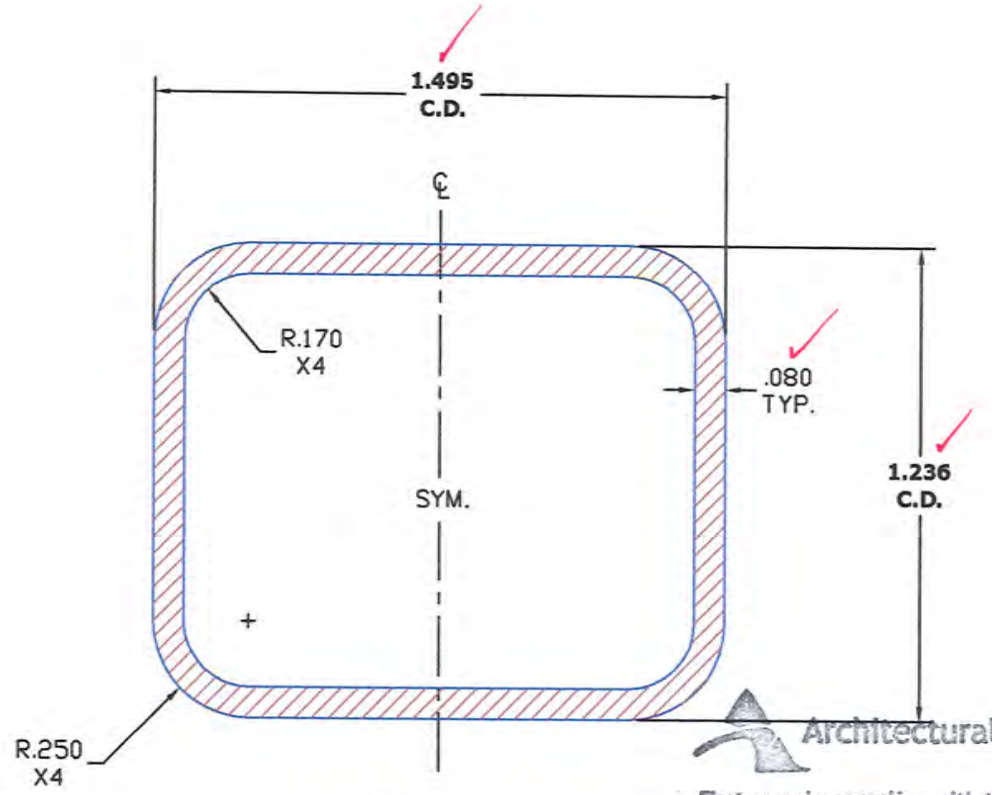
PART NO. STRT BOTTOM RAIL

THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

SF 9 0

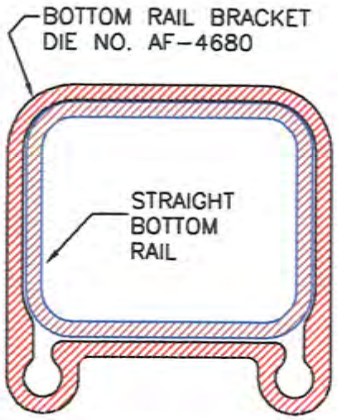
AF- 4690

AFHD081910P 09/01/2010



SCALE: 2X

OUTER PERIMETER = 5.033
ALL OUTSIDE EXPOSED



APPROXIMATE SIZE

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# AS699.01-119-19

Date 12/22/10 Tech AJS

RUN OUT SURFACE WILL HAVE BLACK CARBON MARKS, LIGHT SCRATCHES AND SCUFF MARKS.
ABBREVIATIONS: REF.=REFERENCE, P.I.=POINT INTERSECTION, SYM=SYMMETRICAL, DP=DEEP, TYP=TYPICAL.
TAN = TANGENT TO CIRCLE OR RADIUS, CD = CRITICAL DIMENSION, CENT = CENTER LINE
DIMENSIONAL LIMITS APPLY BEFORE COATING. DO NOT SCALE THE DRAWING.
ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG. FOR QUOTATION; KK 09/01/2010		
–	REL. FOR TOOLING, ECN#101164, DL 10/12/10		

.080 TYPICAL WALL EXCEPT AS SHOWN

SEE DWG. BREAK SHARP CORNERS

CUSTOMER:	AFCO ALUMINUM
PRODUCT NAME:	STRAIGHT BOTTOM RAIL
CUST DWG. & REV.:	NA

AFCO ALUMINUM PRODUCTS
P.O. BOX 5085
3400 ROY STREET
ALEXANDRIA, LA 71302

ALLOY:	6063	TEMPER:	T-6	TYPE DIE:	HOLLOW
DIE SIZE:	9X5	No. OF HOLES:	2	BACKER:	–
BOLSTER:	3583	FEEDER PLT:	–	BILLET:	7X28.8
EST. AREA:	.383	EST. PERIMETER:	9.564	FACTOR:	21
EST. WT/FT:	.460	CIRCUMSCRIBED CIR. DIA:		7"	
FINISH:	PAINTED	RATIO:		49	
DRAWN BY:	K.T.	DATE:	9/01/2010	SCALE:	2X

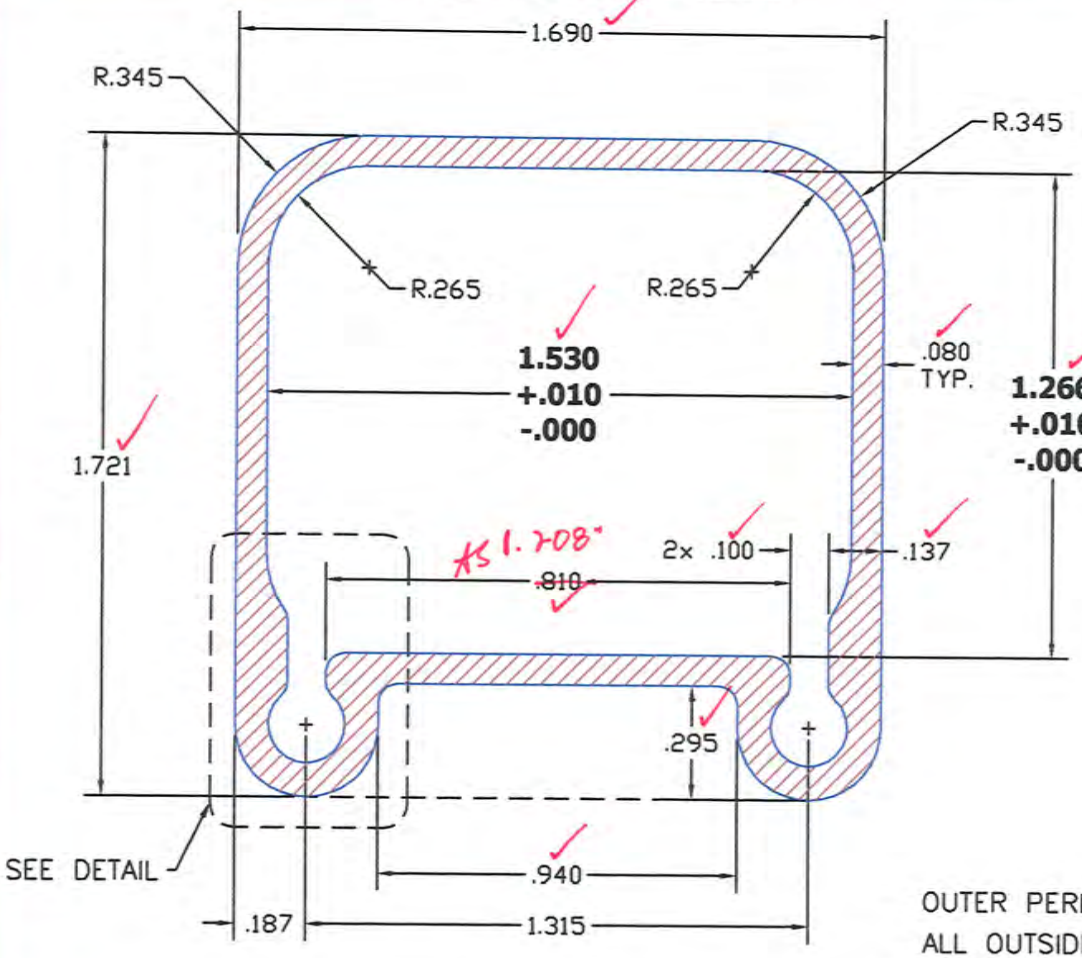
PART NO. BOTTOM RAIL BRACKET

THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

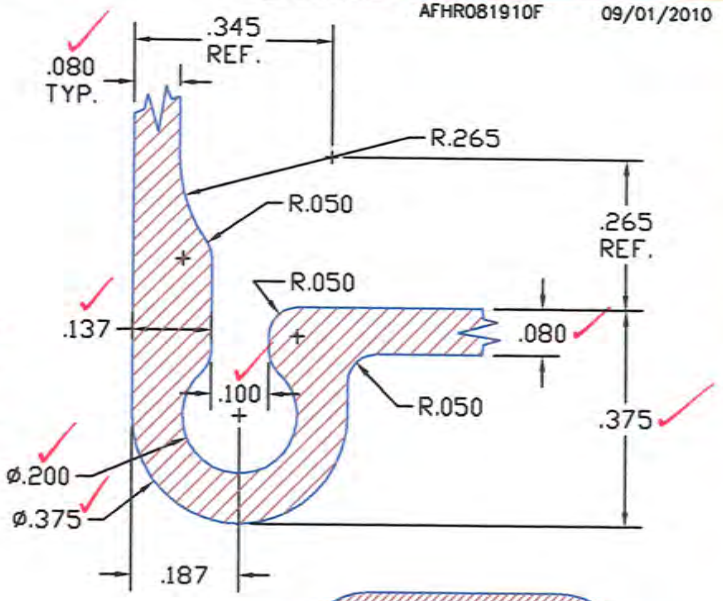
SF 9 0

AF- 4680

AFHR081910F 09/01/2010



SCALE: 2X



DETAIL
SCALE: 3X
2 PLACES

Architectural Testing

Test sample complies with these details. Deviations are noted.

Report# AS899.01-119-19

Date 12/22/10 Tech AJS

APPROXIMATE SIZE

OUTER PERIMETER = 6.751

ALL OUTSIDE SURFACES EXPOSED

RUN OUT SURFACE WILL HAVE BLACK CARBON MARKS, LIGHT SCRATCHES AND SCUFF MARKS.
ABBREVIATIONS: REF.=REFERENCE, P.I.=POINT INTERSECTION, SYM=SYMMETRICAL, DP=DEEP, TYP=TYPICAL.
TAN = TANGENT TO CIRCLE OR RADIUS, CD = CRITICAL DIMENSION, CENT = CENTER LINE
DIMENSIONAL LIMITS APPLY BEFORE COATING. DO NOT SCALE THE DRAWING.
ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG. FOR QUOTATION; KK 09/01/2010		
–	REL. FOR TOOLING, ECN#101154, DL 09/02/10		

.080 TYPICAL WALL EXCEPT AS SHOWN

SEE DWG. BREAK SHARP CORNERS

CUSTOMER:	AFCO ALUMINUM		
PRODUCT NAME:	BOTTOM RAIL BRACKET		
CUST DWG. & REV.:	N/A		
ALLOY: 6063	TEMPER: T-6	TYPE DIE: HOLLOW	
DIE SIZE: 9X5	No. OF HOLES: 1	BACKER: –	
BOLSTER: 2131	FEEDER PLT: –	BILLET: 7X26	
EST. AREA: .579	EST. PERIMETER: 13.217	FACTOR: 19	
EST. WT/FT: .695	CIRCUMSCRIBED CIR. DIA: 7"		
FINISH: PAINT	RATIO: 65		
DRAWN BY: K.T.	DATE: 9/01/2010	SCALE: 2X	

AFCO ALUMINUM PRODUCTS
P.O. BOX 5085
3400 ROY STREET
ALEXANDRIA, LA 71302

Architectural Testing

PART NO. LEVEL BOTTOM RAIL

THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

Details. Deviations are noted.

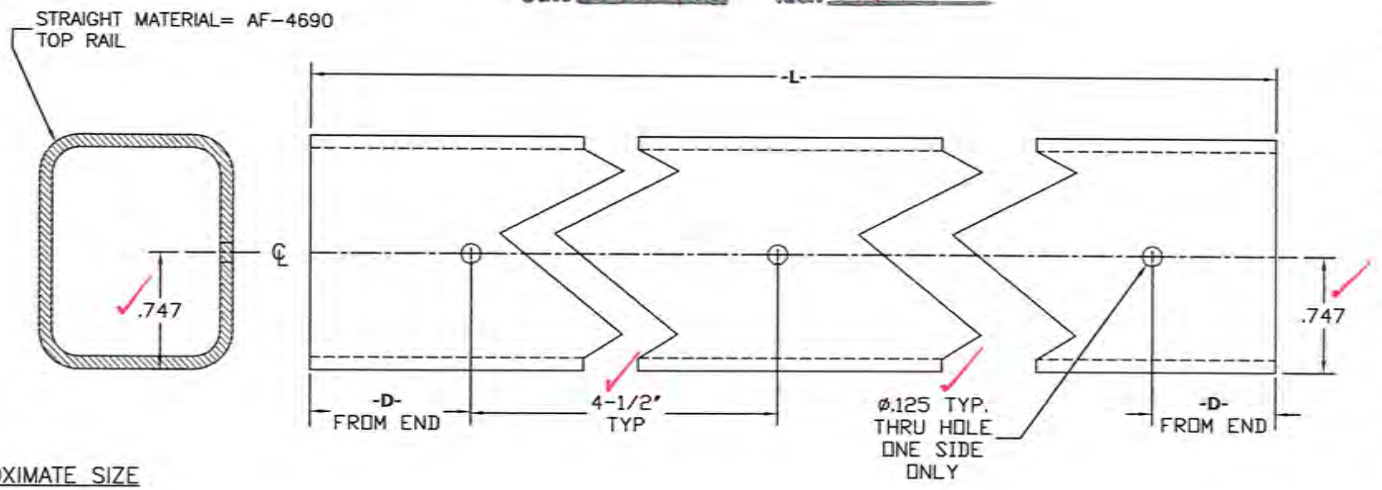
SF 9 | 0 | AF- FAB4690BOTRAIL

FAB4690BOTRAIL 11/04/2010

LEVEL RAIL UNIT

Report# AS899.01-119-19

Date 12/22/10 Tech AJS



APPROXIMATE SIZE

DIE #	DESCRIPTION	ITEM CODE	PART NO.	QTY/UNIT	-L-	FINISH	-D- FROM END	NO. HOLES
AF-4690	LEVEL BOTTOM RAIL	4690FXXXX	TBD	1	48"	PAINT	3-3/4"	10
AF-4690	LEVEL BOTTOM RAIL	4690FXXXX	TBD	1	72"	PAINT	2-1/4"	16
AF-4690	LEVEL BOTTOM RAIL	4690FXXXX	TBD	1	96"	PAINT	3"	21
AF-4690	LEVEL BOTTOM RAIL	4690FXXXX	TBD	1	120"	PAINT	3-3/4"	26

OUTER PERIMETER = 5.033
ALL OUTSIDE EXPOSED

PLEASE FILL OUT ALL INFORMATION AT RIGHT OF PAGE

UNLESS OTHERWISE SPECIFIED, THE FOLLOWING TOLERANCES APPLY FOR DIMENSIONS ARE IN INCHES			MACHINE HOLE DIAMETER TOLERANCES
1 PLACE DECIMAL: ±.031	3 PLACE DECIMAL: ±.015	FRACTIONS	ø.000 – ø.250: ±.004
2 PLACE DECIMAL: ±.020	ANGULARITY: ±2°	±1/32	ø.251 – ø.500: ±.008
			ø.501 UP: ±.012

ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG. FOR APPROVAL; KK 11/04/2010		

.080 TYPICAL WALL EXCEPT AS SHOWN

SEE DWG. BREAK SHARP CORNERS

CUSTOMER: AFCO ALUMINUM		AFCO ALUMINUM PRODUCTS P.O. BOX 5085 3400 ROY STREET ALEXANDRIA, LA 71302
PRODUCT NAME: LEVEL BOTTOM RAIL		
CUST DWG. & REV.: NA		
ALLOY: 6005A	TEMPER: T-61	TYPE DIE: HOLLOW
DIE SIZE: 9X5	No. OF HOLES: 2	BACKER: –
BOLSTER: 3583	FEEDER PLT: –	BILLET: 7X28.8
EST. AREA: .383	EST. PERIMETER: 9.564	FACTOR: 21
EST. WT/FT: .460	CIRCUMSCRIBED CIR. DIA: 7"	
FINISH: PAINTED	RATIO: 49	
DRAWN BY: KRK	DATE: 11/04/2010	SCALE: FULL

DRAWING APPROVAL

RETURN ONE (1) COPY TO AFCO

{PLEASE FILL OUT ENTIRE AREA BELOW THIS INFORMATION IS NECESSARY IN ORDERING THIS DIE WITHOUT DELAY.}

PLEASE GIVE EXPOSED SURFACES AND A LOCATION FOR AN AFCO I.D. MARK IF NIETHER IS ALREADY SHOWN ON THIS DRAWING.

CUSTOMER: _____
BY: _____
TITLE: _____
DATE: _____
P.O.#: _____
PART No.: _____
CUT LENGTHS: _____

ALLOY: _____
TEMPER: _____
END USE: _____

NOTE: DIE SERVICE CHARGES COVERS ONLY THE BASIC COST OF BUILDING AN EXTRUSION DIE. CONTINUING DIE MAINTENANCE OR EXTRUSION DIE REPLACEMENT IS OF NO CHARGE TO CUSTOMERS. AFCO RETAINS ALL RIGHTS TO EXTRUSION DIE OWNERSHIP.

DIE CHARGE: _____

SAMPLE REQUESTED:

YES ☐ NO ☐

LENGTHS: _____
NO. PCS.: _____
PAINT: _____
COMMENTS: _____

QC. FORM NO. 065 REV. 5

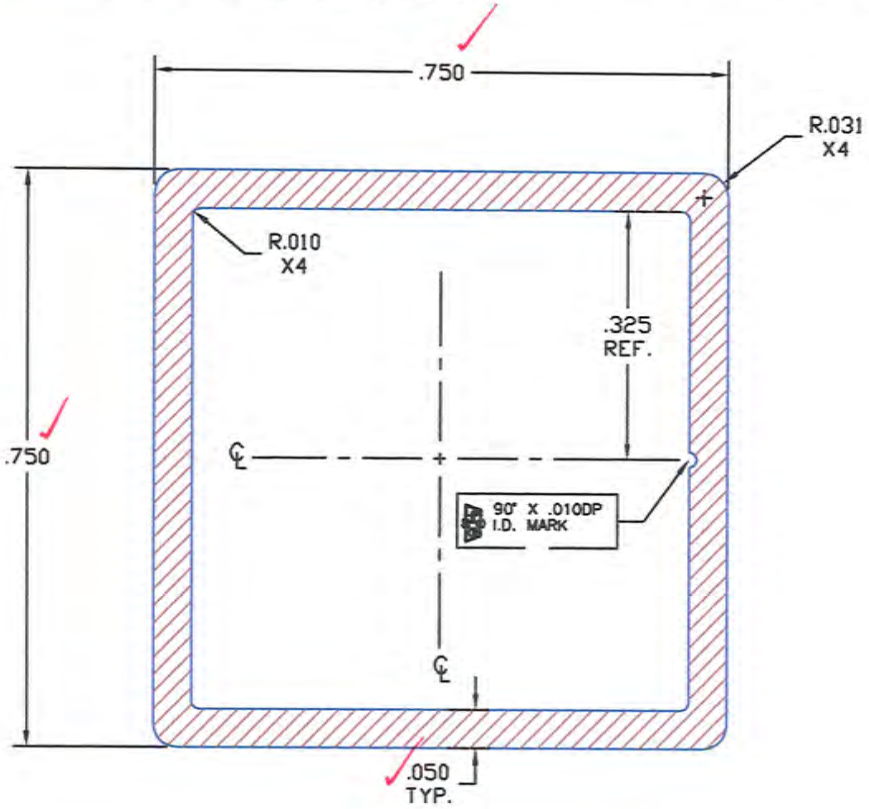
PART NO. TBD

THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

SF 9 0

AF- 4684

AFHR081910J 8/20/2010



SCALE: 4X

ALL OUTSIDE SURFACE EXPOSED

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# AS899.01-119-19

Date 12/22/10 Tech AJS

APPROXIMATE SIZE

OUTSIDE PERIMETER = 2.946"

RUN OUT SURFACE WILL HAVE BLACK CARBON MARKS, LIGHT SCRATCHES AND SCUFF MARKS.
ABBREVIATIONS: REF.=REFERENCE, P.I.=POINT INTERSECTION, SYM=SYMMETRICAL, DP=DEEP, TYP=TYPICAL.
TAN = TANGENT TO CIRCLE OR RADIUS, CD = CRITICAL DIMENSION, CENT = CENTER LINE
DIMENSIONAL LIMITS APPLY BEFORE COATING. DO NOT SCALE THE DRAWING.
ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG FOR QUOTE; KRK 8/20/2010		
–	REL. FOR TOOLING, ECN#101154, DL 09/02/10		

.050 TYPICAL WALL EXCEPT AS SHOWN

SEE DWG. BREAK SHARP CORNERS

CUSTOMER:	AFCO ALUMINUM		
PRODUCT NAME:	3/4" SQUARE BALUSTER		
CUST DWG. & REV.:	N/A		
ALLOY: 6063	TEMPER: T-6	TYPE DIE:	HOLLOW
DIE SIZE: 9X5	No. OF HOLES: 4	BACKER:	–
BOLSTER: R-4	FEEDER PLT: –	BILLET:	7X24
EST. AREA: .139	EST. PERIMETER: 5.557	FACTOR:	33
EST. WT/FT: .167	CIRCUMSCRIBED CIR. DIA:		7"
FINISH: PAINT		RATIO:	69
DRAWN BY: K.T.	DATE: 8/20/2010	SCALE:	4X

AFCO ALUMINUM PRODUCTS
P.O. BOX 5085
3400 ROY STREET
ALEXANDRIA, LA 71302

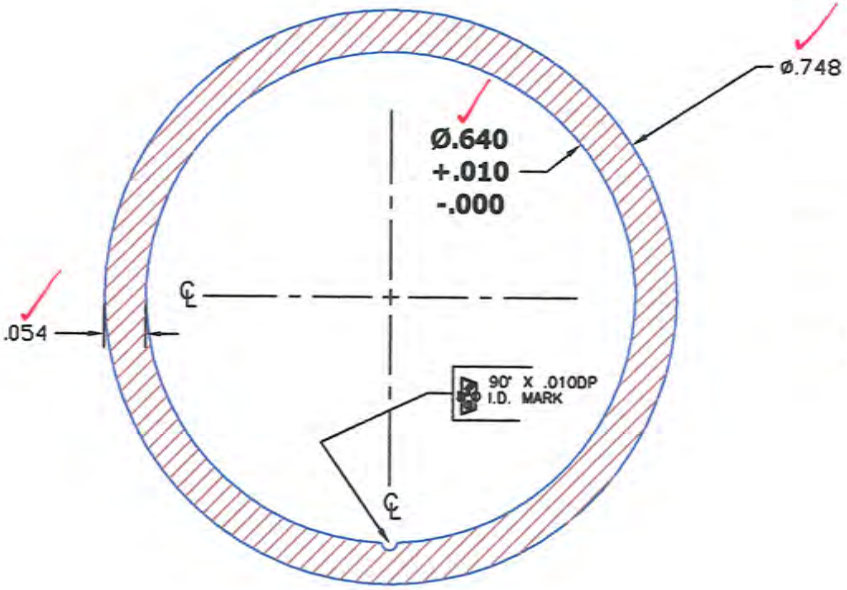
PART NO. TBD

THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

SF 9 0

AF- 4683

AFHR081910I 8/20/2010



SCALE: 4X

ALL OUTSIDE SURFACE EXPOSED

Architectural Testing

Test sample complies with these details. Deviations are noted.

Report# AS899.01-119-19

Date 12/22/10 Tech AJS

APPROXIMATE SIZE

OUTSIDE PERIMETER = 2.350"

RUN OUT SURFACE WILL HAVE BLACK CARBON MARKS, LIGHT SCRATCHES AND SCUFF MARKS.
ABBREVIATIONS: REF.=REFERENCE, P.I.=POINT INTERSECTION, SYM=SYMMETRICAL, DP=DEEP, TYP=TYPICAL.
TAN = TANGENT TO CIRCLE OR RADIUS, CD = CRITICAL DIMENSION, CENT = CENTER LINE
DIMENSIONAL LIMITS APPLY BEFORE COATING. DO NOT SCALE THE DRAWING.
ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG FOR QUOTE; KRK 8/20/2010		
–	REL. FOR TOOLING, ECN#101154, DL 09/02/10		

.054 TYPICAL WALL EXCEPT AS SHOWN

– – BREAK SHARP CORNERS

CUSTOMER:	AFCO ALUMINUM		
PRODUCT NAME:	3/4" ROUND BALUSTER		
CUST DWG. & REV.:	NA		
ALLOY: 6063	TEMPER: T-6	TYPE DIE:	HOLLOW
DIE SIZE: 9X5	No. OF HOLES: 4	BACKER:	–
BOLSTER: R-4	FEEDER PLT: –	BILLET:	7X21
EST. AREA: .117	EST. PERIMETER: 4.372	FACTOR:	31
EST. WT/FT: .140	CIRCUMSCRIBED CIR. DIA:		7"
FINISH: PAINT		RATIO:	82
DRAWN BY: K.T.	DATE: 8/20/2010	SCALE:	4X

AFCO ALUMINUM PRODUCTS
P.O. BOX 5085
3400 ROY STREET
ALEXANDRIA, LA 71302

PART NO. BALUSTER CONN.

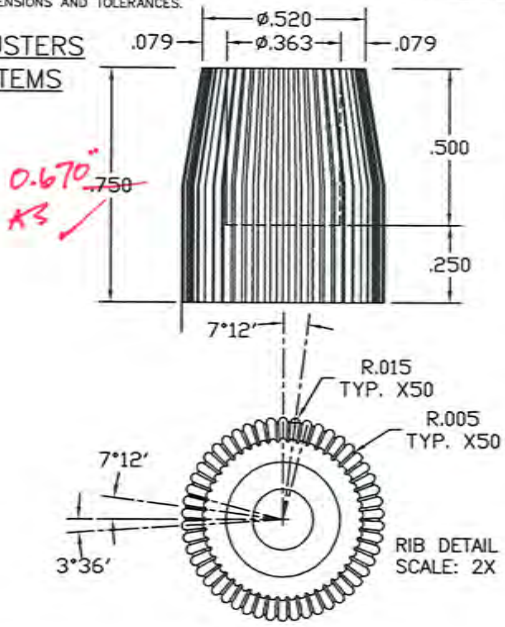
THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

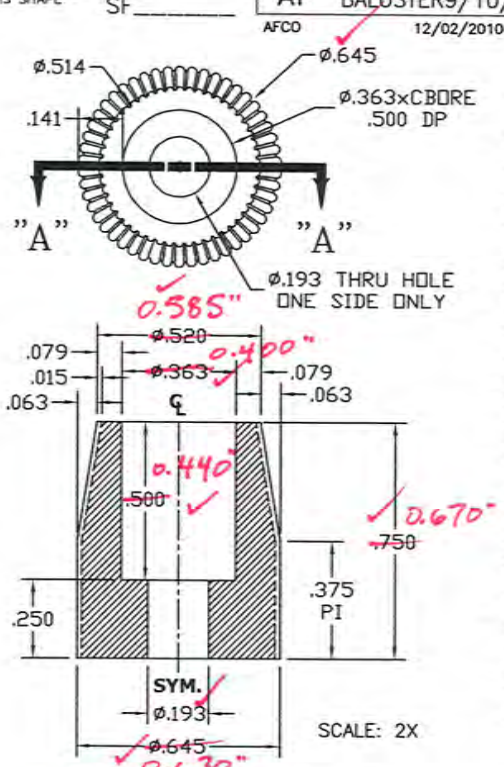
SF_____ AF – BALUSTER9/10/10 AFCO 12/02/2010

FOR SQUARE AND ROUND BALUSTERS FOR LEVEL RAIL\STAIRRAIL SYSTEMS

ISO VIEW
NOT TO SCALE

APPROXIMATE SIZE





SECTION "A-A"

PLEASE FILL OUT ALL INFORMATION AT RIGHT OF PAGE

LEVEL RAIL UNITS					QTY/UNIT			
DESCRIPTION	ITEM CODE	PART NO.	LENGTH	FINISH	48"	72"	96"	120"
BALUSTER CONNECTORS	TBD	TBD	3/4"	NYLON	20	32	42	52

STAIR RAIL UNITS					QTY/UNIT		
DESCRIPTION	ITEM CODE	PART NO.	LENGTH	FINISH	48"	72"	96"
BALUSTER CONNECTORS	TBD	TBD	3/4"	NYLON	20	32	42

UNLESS OTHERWISE SPECIFIED, THE FOLLOWING TOLERANCES APPLY FOR DIMENSIONS ARE IN INCHES				MACHINE HOLE DIAMETER TOLERANCES
1 PLACE DECIMAL: ±.031	3 PLACE DECIMAL: ±.015	FRACTIONS		ø.000 – ø.250: ±.004
2 PLACE DECIMAL: ±.020	ANGULARITY: ±2°	±1/32		ø.251 – ø.500: ±.008
				ø.501 UP: ±.012

ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY FOR EXTRUSION PROFILE ONLY.

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE DWG. FOR QUOTATION; KK 09/10/2010		

_____TYPICAL WALL EXCEPT AS SHOWN BREAK SHARP CORNERS

CUSTOMER:	AFCO ALUMINUM	AFCO ALUMINUM PRODUCTS P.O. BOX 5085 3400 ROY STREET ALEXANDRIA, LA 71302
PRODUCT NAME:	BALUSTER CONNECTOR	
CUST DWG. & REV.:	VERSION A2	

ALLOY:	TEMPER:	TYPE DIE:	
DIE SIZE:	No. OF HOLES:	BACKER:	
BOLSTER:	FEEDER PLT:		BILLET:
EST. AREA:	EST. PERIMETER:		FACTOR:
EST. WT/FT:	CIRCUMSCRIBED CIR. DIA:		
FINISH:	GLASS FILLED NYLON	RATIO:	
DRAWN BY: KRK	DATE: 12/02/2010	SCALE: 2X	

DRAWING APPROVAL

RETURN ONE (1) COPY TO AFCO

{PLEASE FILL OUT ENTIRE AREA BELOW THIS INFORMATION IS NECESSARY IN ORDERING THIS DIE WITHOUT DELAY.}

PLEASE GIVE EXPOSED SURFACES AND A LOCATION FOR AN AFCO I.D. MARK IF NIETHER IS ALREADY SHOWN ON THIS DRAWING.

CUSTOMER: _____
BY: _____
TITLE: _____
DATE: _____
P.O.#: _____
PART No.: _____
CUT LENGTHS: _____
_____
ALLOY: _____
TEMPER: _____
END USE: _____

NOTE: DIE SERVICE CHARGES COVERS ONLY THE BASIC COST OF BUILDING AN EXTRUSION DIE. CONTINUING DIE MAINTENANCE OR EXTRUSION DIE REPLACEMENT IS OF NO CHARGE TO CUSTOMERS. AFCO RETAINS ALL RIGHTS TO EXTRUSION DIE OWNERSHIP.

DIE CHARGE: _____

SAMPLE REQUESTED:

YES ☐ NO ☐

LENGTHS: _____
NO. PCS.: _____
PAINT: _____
COMMENTS: _____

QC. FORM NO. 065 REV. 5

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# AS899.01-119-19
Date 12/22/10 Tech AJS

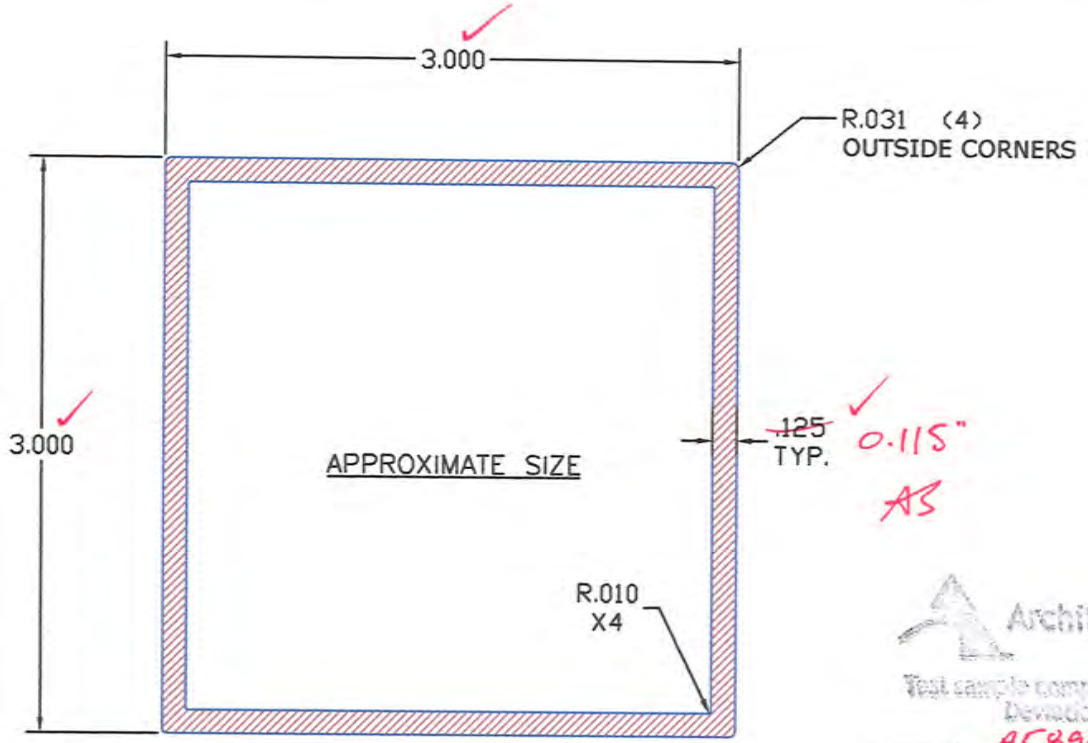
PART NO. 3x3POST

THIS DRAWING REPRESENTS AFCO'S INTERPRETATION OF THE CUSTOMERS DESIGN AND AFCO ASSUMES NO LIABILITY FOR THE FUNCTIONALITY OF EITHER THIS SHAPE OR THE END DESIGN. AFCO WILL MAKE THIS SHAPE TO THE FOLLOWING DIMENSIONS AND TOLERANCES.

SF 9 0

AF- 4723

AFCOHR3X3POST 11/03/2010



Architectural Testing

Test sample complies with these details. Deviations are noted.

Report A5899.01-119-19

Date 12/22/10 Tech AJS

OUTER PERIMETER = 11.846

ALL OUTSIDE SURFACE EXPOSED

RUN OUT SURFACE WILL HAVE BLACK CARBON MARKS, LIGHT SCRATCHES AND SCUFF MARKS.
ABBREVIATIONS: REF.=REFERENCE, P.I.=POINT INTERSECTION, SYM=SYMMETRICAL, DP=DEEP, TYP=TYPICAL.
TAN = TANGENT TO CIRCLE OR RADIUS, CD = CRITICAL DIMENSION, CENT = CENTER LINE
DIMENSIONAL LIMITS APPLY BEFORE COATING. DO NOT SCALE THE DRAWING.
ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS OTHERWISE NOTED

REV.	DESCRIPTION & DATE	REV.	DESCRIPTION & DATE
–	RELEASE FOR QUOTE; KK 11/04/2010		
–	REL. FOR TOOLING, ECN#101174, DL 11/5/10		

.125 TYPICAL WALL EXCEPT AS SHOWN | SEE DWG. BREAK SHARP CORNERS

CUSTOMER:	AFCO INDUSTRIES		
PRODUCT NAME:	3" x 3" x 1/8" POST		
CUST DWG. & REV.:	ALUM HANDRAILS		
ALLOY: 6005A	TEMPER: T-61	TYPE DIE:	HOLLOW
DIE SIZE: 10X5	No. OF HOLES: 1	BACKER:	–
BOLSTER: 1-H	FEEDER PLT: –	BILLET:	7X28
EST. AREA: 1.437	EST. PERIMETER: 22.929	FACTOR:	13
EST. WT/FT: 1.724	CIRCUMSCRIBED CIR. DIA:		7"
FINISH: PAINT		RATIO:	27
DRAWN BY: KRK	DATE: 11/03/2010	SCALE:	FULL

AFCO ALUMINUM PRODUCTS
P.O. BOX 5085
3400 ROY STREET
ALEXANDRIA, LA 71302

APPENDIX B

Photographs

Photo No. 1
In-Fill Load Test at Center of Two Balusters

Photo No. 2
In-Fill Load Test at Bottom of Two Balusters

Photo No. 3
Horizontal Uniform Load on Top Rail

Photo No. 4
Concentrated Load Test at Midspan of Top Rail

Photo No. 5
Concentrated Load Test at Ends of Top Rail (Brackets)

Photo No. 6
Top Rail/Bracket/Post Connection

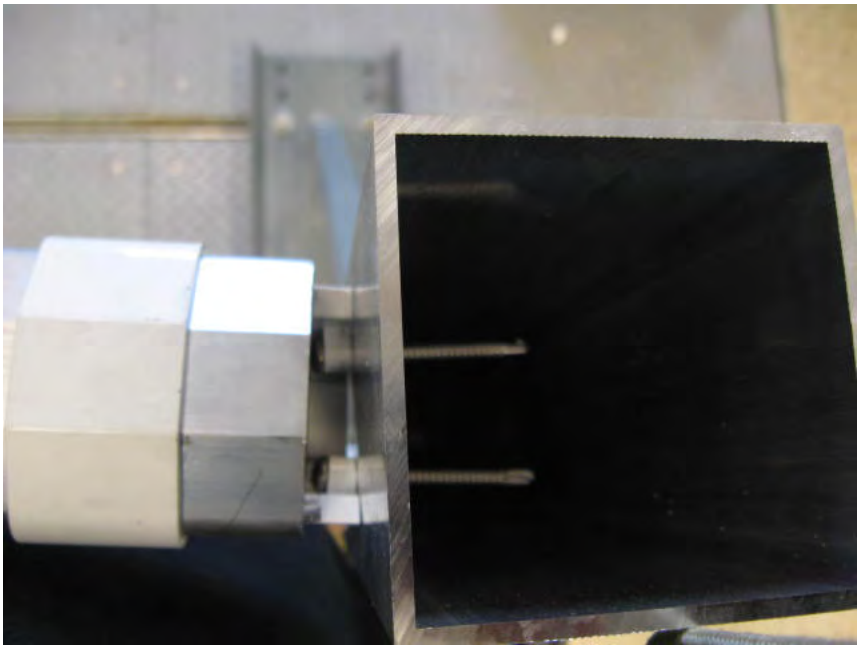


Photo No. 7
Anchorage of Top Rail Bracket to Post

Photo No. 8
Bottom Rail/Bracket/Post Connection