



ASTM E 1886 and ASTM E 1996 TEST REPORT

Report No.: D1090.02-301-44

Rendered to:

PRL ALUMINUM ARCHITECTURAL PRODUCTS
City of Industry, California

PRODUCT TYPE: Bi-Fold Door
SERIES/MODEL: Accordion Bi-Fold

Test Dates: 08/29/13
Through: 09/05/13
Report Date: 01/13/14

1.0 Report Issued To: PRL Aluminum Architectural Products
14760 Don Julian Road
City of Industry, California 91746

2.0 Test Laboratory: Architectural Testing, Inc.
4 Rancho Circle
Lake Forest, California 92630
949-460-9600

3.0 Project Summary:

3.1 Product Type: Bi-Fold Door

3.2 Series/Model: Accordion Bi-Fold

3.3 Compliance Statement: Results obtained are tested values and were secured by using the designated test methods. The samples tested met the performance requirements set forth in the referenced test procedures for a ± 1920 Pa (± 40.10 psf) Design Pressure with missile impacts corresponding to Missile Level D and Wind Zone 2.

3.4 Test Dates: 08/29/2013 – 09/05/2013

3.5 Test Record Retention End Date: All test records for this report will be retained until September 5, 2017.

3.6 Test Location: Architectural Testing, Inc. test facility in Lake Forest, California.

3.7 Test Sample Source: The test specimens were provided by the client. Representative samples of the test specimens will be retained by Architectural Testing for a minimum of four years from the test completion date.

3.8 Drawing Reference: The test specimen drawings are located in Appendix C.

3.9 List of Official Observers:

<u>Name</u>	<u>Company</u>
Frank Fisher	PRL Aluminum Architectural Products
David Olague	PRL Aluminum Architectural Products
Jarod Hardman	Architectural Testing, Inc.

4.0 Test Specifications:

ASTM E 1886-05, *Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.*

ASTM E 1996-05, *Standard Specification for Performance of Exterior Windows, Glazed Curtain Walls, Doors and Storm Shutters Impacted by Wind Borne Debris in Hurricanes.*

5.0 Test Specimen Description:

5.1 Product Sizes:

Test Specimens #1 - #3:

Overall Area: 6.25 m ² (67.31 ft ²)	Width		Height	
	millimeters	inches	millimeters	inches
Overall size	2565	101	2438	96
Panel size	1223	48-1/8	2350	92-1/2

5.2 Frame Construction:

Frame Member	Material	Description
Head	Aluminum	Thermally broken extrusion, Part #BF-01
Head	Aluminum	Head track end damn plate, Part #777-02-F01
Sill	Aluminum	Thermally broken extrusion, Part #BF-03
Sill	Aluminum	Clip in bottom roller track insert, Part #BF-03C-F03

5.0 Test Specimen Description: (Continued)

5.2 Frame Construction: (Continued)

Frame Member	Material	Description
Sill	Polyvinyl Chloride	Clip in roller track guide track, Part #999VY-11-F03
Jambs	Aluminum	Thermally broken extrusion, Part #BF-04

	Joinery Type	Detail
Head	Butt	Secured through head extrusion with two #8 x 3" drill point Phillips flat head sheet metal screws and sealed with silicone sealant.
Sill	Butt	Secured through jamb extrusion with two #8 x 1" Phillips flat head sheet metal screws and sealed with silicone sealant.

5.3 Panel Construction:

Active Hinge Panel:

Panel Member	Material	Description
Top, bottom, sides	Aluminum	Thermally broken extrusion, Part #BF-21-F50
Vertical Stile	Aluminum	Cover plate, Part #BF-61-F02, located on the top and bottom of both vertical stiles secured with two 1/2" Flat-head screws.
Top, bottom, sides	Aluminum	Glass stop extrusion, Part #BF-41, clip in

Fixed Hinge Panel:

Panel Member	Material	Description
Top, bottom, sides	Aluminum	Thermally broken extrusion, Part #BF-21-F50
Vertical Stile	Aluminum	Cover plate, Part #BF-61-F02, located on the top and bottom of the vertical stile opposite the lock stile secured with two 1/2" Flat-head screws.
Vertical Lock Stile	Aluminum	Door stile gear box, Part# BF-60-F04, located on the top and bottom of the lock stile secured with two 1/2" Flat-head screws.
Top, bottom, sides	Aluminum	Glass stop extrusion, Part #BF-41

5.0 Test Specimen Description: (Continued)

5.3 Panel Construction: (Continued)

	Joinery Type	Detail
All corners	Coped	Secured through top and bottom rails with one #10 x 1/2" Phillips flat head screw into the aluminum corner block, Part # BF-61-F01, mounted at each corner on the stiles.

5.4 Weatherstripping:

Description	Quantity	Location
3/8" high vinyl wrapped foam bulb gasket	2 Rows	One row located at the interior and the exterior edge of each panel at the head and sill.
1/4" high vinyl wrapped foam bulb gasket	2 Rows	One row located at the interior and the exterior edge of each panel at the vertical stiles.
1/4" high vinyl wrapped foam bulb gasket	1 Row	One row centered in the frame at the head, sill, and jambs.
3/8" high foam wedge gasket	1 Row	One row at the interior leg of the frame at the head, sill, and jambs.

5.5 Glazing: *No conclusions of any kind regarding the adequacy or inadequacy of the glass in any glazed test specimens can be made.*

Glass Type	Spacer Type	Interior Lite	Exterior Lite	Glazing Method
1" IG	3/8" A1-D	7/16" overall laminated, 3/16" tempered-1/16" PVB-3/16" tempered	3/16" Annealed	Exterior glazed with snap in glazing bead.

Location	Quantity	Daylight Opening		Glass Bite
		millimeters	inches	
Panel	2	1029 x 2159	40-1/2 x 85	1/2"-3/4"

5.0 Test Specimen Description: (Continued)

5.6 Drainage:

Drainage Method	Size	Quantity	Location
Weephole	1/2" x 1/4"	3	4" from each end and mid-span through the exterior leg of the snap in sill roller track assembly.

5.7 Hardware:

Description	Quantity	Location
Hinge, Part #BF-63-F01	4	1/2" from top and bottom of the panel jamb stile.
Hinge, Part #BF-62-F02	3	1/2" from the top and bottom of the vertical stile between panels, midspan of the vertical stile between panels.
Hinge, Part #BF-62-F01	3	Directly opposite of Hinge Part #BF-62-F02
Hinge pin & handle assembly, Part #BFH-07	1	Located midspan of the vertical stile between panels in the hinge.
Lock rods, Part# 777-03-F01	2	Located at the center hinge stile of the active panel.
Intermediate hinge pin, Part #BFH-05	2	Located at the head and sill of the vertical stile between panels in the hinge assemblies.
Bottom sill jamb pivot, Part #BFH-03	1	Located at the sill corner of the fixed jamb panel on the exterior face of the panel stile.
Top jamb starter pivot, Part #BFH-01	1	Located at the head corner of the fixed jamb panel directly above Part #BFH-03 on the exterior face of the panel stile.
Half sill guide assembly, Part #BFH-09	1	Located at the sill corner of the active jamb panel on the exterior face of the panel stile.
Half roller assembly, Part #BFH-08	1	Located at the head corner of the active jamb panel directly above Part BFH-09 on the exterior face of the panel stile.

5.8 Reinforcement: No reinforcement was utilized.

5.9 Screen Construction: No screen was utilized.

6.0 Installation:

The specimen was installed into an aluminum channel buck. The rough opening allowed for a 0" shim space. The exterior perimeter of the window was sealed with polyurethane sealant.

Location	Anchor Description	Anchor Location
Jambs	#12 x 3-1/4" Phillips flat head screws.	10" from each corner through the jamb of the frame into the aluminum buck.
Head and sill	#10 x 1" Phillips pan head screws.	6" from the corner and 8" on center.

7.0 Test Results: The results are tabulated as follows:

ASTM E 1886, Large Missile Impact

Conditioning Temperature: 29.3°C (84.8°F)
Missile Weight: 4127 g (9.10 lbs)
Missile Length: 2.46 m (8'1")
Muzzle Distance from Test Specimen: 4.27 m (14'0")

Test Unit #1: Orientation within $\pm 5^\circ$ of horizontal

Impact #1: Missile Velocity: 15.2 m/s (49.9 fps)	
Impact Area:	Center of panel without hinge at jamb
Observations:	Missile hit target area, 1-1/8" tear at point of impact.
Results:	Pass

Test Unit #2: Orientation within $\pm 5^\circ$ of horizontal

Impact #1: Missile Velocity: 15.4 m/s (50.4 fps)	
Impact Area:	Lower left corner of panel without hinge at jamb
Observations:	Missile hit target area, no penetration or tearing.
Results:	Pass

Test Unit #3: Orientation within $\pm 5^\circ$ of horizontal

Impact #1: Missile Velocity: 15.5 m/s (50.9 fps)	
Impact Area:	Top right corner of panel without hinge at jamb
Observations:	Missile hit target area, 1.5"x3.5" rectangular tear, 3" diameter solid sphere not able to pass through opening.
Results:	Pass

Note: See Architectural Testing Photo #1-3 for impact locations.

7.0 Test Results: (Continued)

ASTM E 1886, Air Pressure Cycling

Test Unit #1

Design Pressure: ±1920 Pa (±40.10 psf)

POSITIVE PRESSURE

Pressure Range Pa (psf)	Number of Cycles	Average Cycle Time (seconds)	Maximum Deflection at Indicator mm (inches)					
			#1	#2	#3	#4	#5	#6
384 to 960 (8.0 to 20.0)	3500	2.33	6.35 (0.25)	10.67 (0.42)	4.83 (0.19)			
0 to 1152 (0.0 to 24.0)	300	3.20	6.35 (0.25)	11.68 (0.46)	5.08 (0.20)			
960 to 1536 (20.0 to 32.0)	600	2.35	6.35 (0.25)	13.46 (0.53)	5.59 (0.22)			
576 to 1920 (12.0 to 40.1)	100	3.06	6.35 (0.25)	16.51 (0.65)	6.10 (0.24)			

NEGATIVE PRESSURE

Pressure Range Pa (psf)	Number of Cycles	Average Cycle Time (seconds)	Maximum Deflection at Indicator mm (inches)					
			#1	#2	#3	#4	#5	#6
576 to 1920 (12.0 to 40.1)	50	2.80	8.89 (0.35)	19.30 (0.76)	8.13 (0.32)			
960 to 1536 (20.0 to 32.0)	1050	2.85	8.38 (0.33)	16.76 (0.66)	6.35 (0.25)			
0 to 1152 (0.0 to 24.0)	50	3.15	7.37 (0.29)	14.73 (0.58)	6.10 (0.24)			
384 to 960 (8.0 to 20.0)	3350	2.71	3.81 (0.15)	6.10 (0.24)	3.05 (0.12)			

Observations: No additional damage or deglazing was observed.

Result: Pass

Note: See Architectural Testing Sketch #1 for indicator locations. Deflections not required per test standard, taken at request of customer.

7.0 Test Results: (Continued)

ASTM E 1886, Air Pressure Cycling

Test Unit #2

Design Pressure: ±1920 Pa (±40.10 psf)

POSITIVE PRESSURE

Pressure Range Pa (psf)	Number of Cycles	Average Cycle Time (seconds)	Maximum Deflection at Indicator mm (inches)					
			#1	#2	#3	#4	#5	#6
576 to 1920 (12.0 to 40.1)	50	2.60	6.60 (0.26)	9.65 (0.38)	3.56 (0.14)			
960 to 1536 (20.0 to 32.0)	1050	2.79	6.60 (0.26)	10.41 (0.41)	3.81 (0.15)			
0 to 1152 (0.0 to 24.0)	50	2.41	7.11 (0.28)	13.97 (0.55)	4.57 (0.18)			
384 to 960 (8.0 to 20.0)	3350	3.15	7.37 (0.29)	15.94 (0.61)	4.57 (0.18)			

NEGATIVE PRESSURE

Pressure Range Pa (psf)	Number of Cycles	Average Cycle Time (seconds)	Maximum Deflection at Indicator mm (inches)					
			#1	#2	#3	#4	#5	#6
576 to 1920 (12.0 to 40.1)	50	3.35	6.10 (0.24)	14.99 (0.59)	5.33 (0.21)			
960 to 1536 (20.0 to 32.0)	1050	3.19	4.57 (0.18)	12.70 (0.50)	4.83 (0.19)			
0 to 1152 (0.0 to 24.0)	50	3.24	4.06 (0.16)	12.19 (0.48)	4.57 (0.18)			
384 to 960 (8.0 to 20.0)	3350	3.21	4.06 (0.16)	9.65 (0.38)	3.56 (0.14)			

Observations: No additional damage or deglazing was observed.

Result: Pass

Note: See Architectural Testing Sketch #1 for indicator locations. Deflections not required per test standard, taken at request of customer.

7.0 Test Results: (Continued)

ASTM E 1886, Air Pressure Cycling

Test Unit #3

Design Pressure: ±1920 Pa (±40.10 psf)

POSITIVE PRESSURE

Pressure Range Pa (psf)	Number of Cycles	Average Cycle Time (seconds)	Observations
576 to 1920 (12.0 to 40.1)	3500	2.41	No additional damage or deglazing
960 to 1536 (20.0 to 32.0)	300	2.62	No additional damage or deglazing
0 to 1152 (0.0 to 24.0)	600	2.49	No additional damage or deglazing
384 to 960 (8.0 to 20.0)	100	2.89	No additional damage or deglazing

NEGATIVE PRESSURE

Pressure Range Pa (psf)	Number of Cycles	Average Cycle Time (seconds)	Observations
576 to 1920 (12.0 to 40.1)	50	3.40	No additional damage or deglazing
960 to 1536 (20.0 to 32.0)	1050	3.38	No additional damage or deglazing
0 to 1152 (0.0 to 24.0)	50	3.71	No additional damage or deglazing
384 to 960 (8.0 to 20.0)	3350	3.61	No additional damage or deglazing

Result: Pass

General Note: *Upon completion of testing, the specimens met the requirements of Section 7 of ASTM E 1996.*

8.0 Test Equipment:

Cannon: Constructed from steel piping utilizing compressed air to propel the missile

Missile: 2x4 Southern Pine

Timing Device: Electronic Beam Type

Cycling Mechanism: Computer controlled centrifugal blower with electronic pressure measuring device

Deflection Measuring Device: Linear transducers

Tape and film were used to seal against air leakage during structural testing. In our opinion, the tape and film did not influence the results of the test.



Architectural Testing 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 Architectural Testing, Inc. for the entire test record retention period.

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 Architectural Testing, Inc.

For ARCHITECTURAL TESTING, Inc.

Jarod Hardman
Laboratory Manager

Leaton Kirk
Director – Regional Operations

JH: ms

Attachments (pages): This report is complete only when all attachments listed are included.

- Appendix-A: Sketches (1)
- Appendix-B: Photographs (3)
- Appendix-C: Drawings (22)

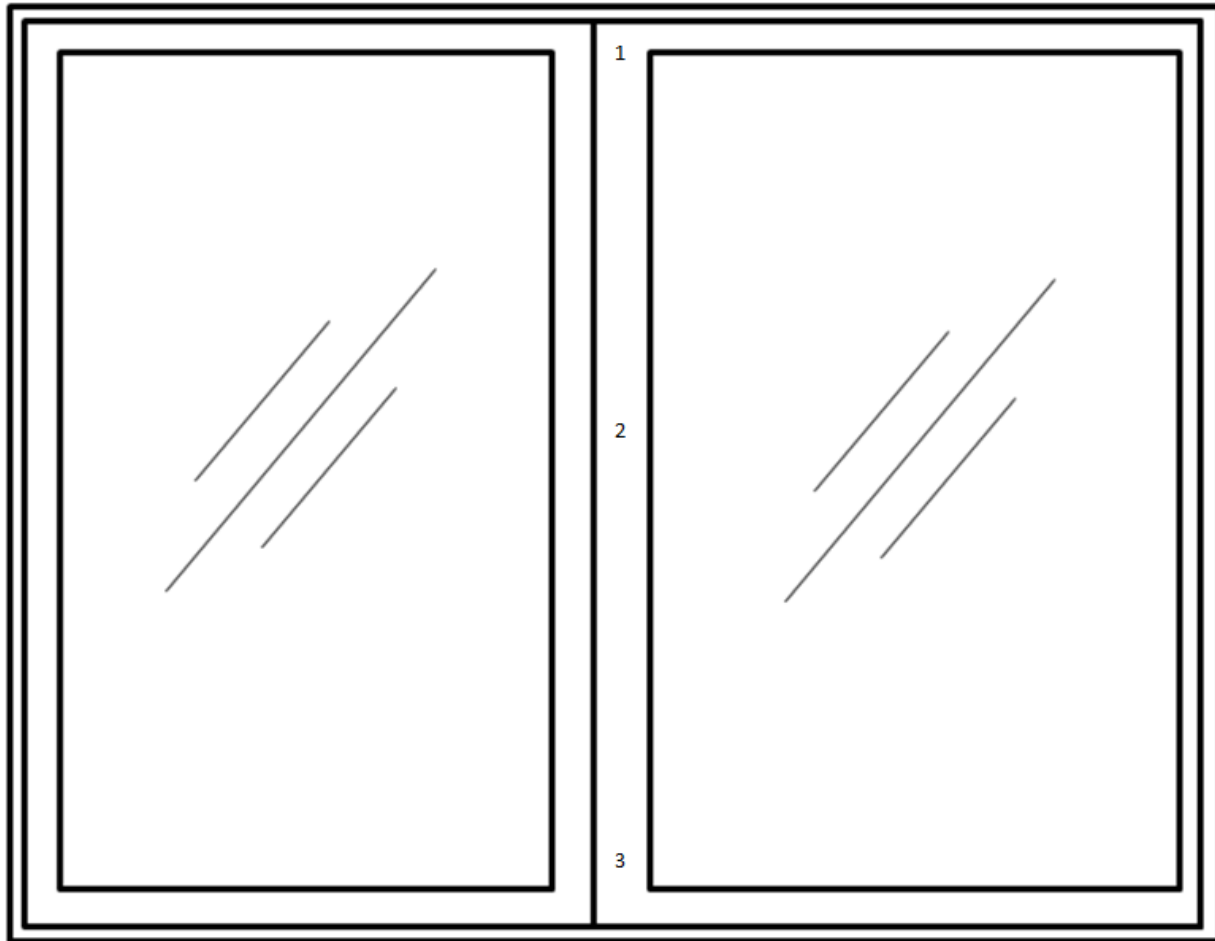


Architectural Testing

Test Report No.: D1090.02-301-44
Report Date: 01/13/14
Record Retention End Date: 09/05/17

Appendix A

Sketches



Sketch #1
Transducer Locations (as viewed from exterior)



Architectural Testing

Test Report No.: D1090.02-301-44
Report Date: 01/13/14
Record Retention End Date: 09/05/17

Appendix B

Photographs



Architectural Testing

Test Report No.: D1090.02-301-44
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Photo No. 1
Impact Specimen #1



Architectural Testing

Test Report No.: D1090.02-301-44
Report Date: 01/13/14
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Photo No. 2
Impact Specimen #2



Architectural Testing

Test Report No.: D1090.02-301-44
Report Date: 01/13/14
Record Retention End Date: 09/05/17



Photo No. 3.
Impact Specimen #3



Architectural Testing

Test Report No.: D1090.02-301-44
Report Date: 01/13/14
Record Retention End Date: 09/05/17

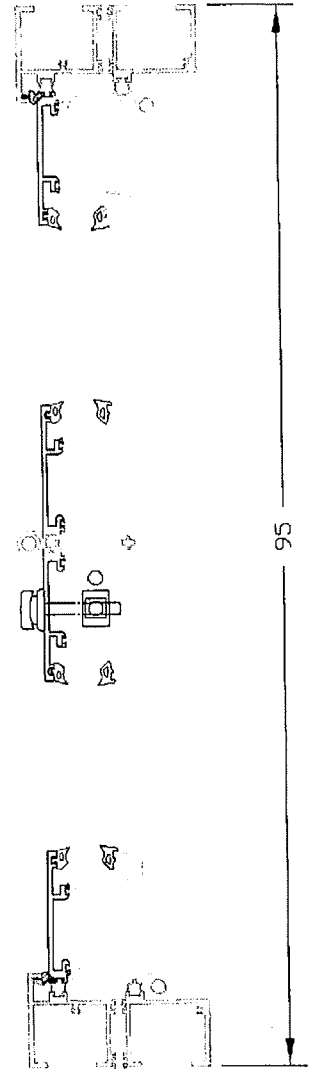
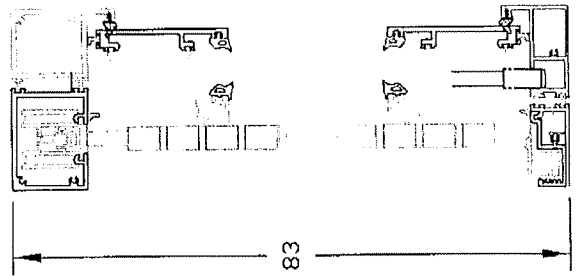
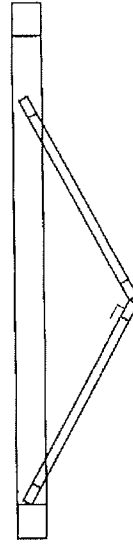
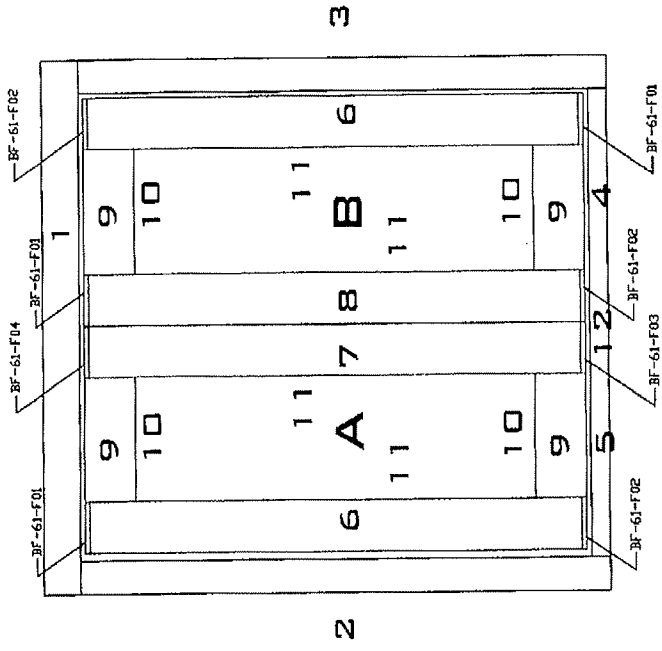
Appendix C

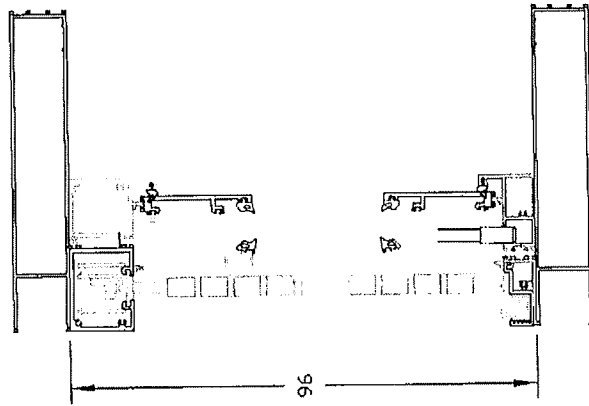
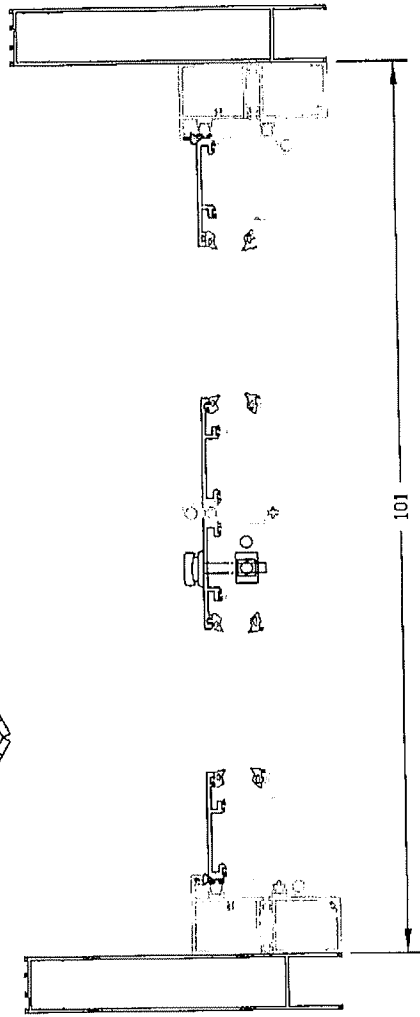
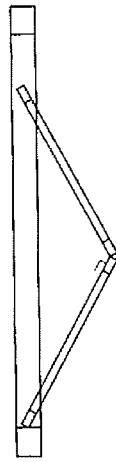
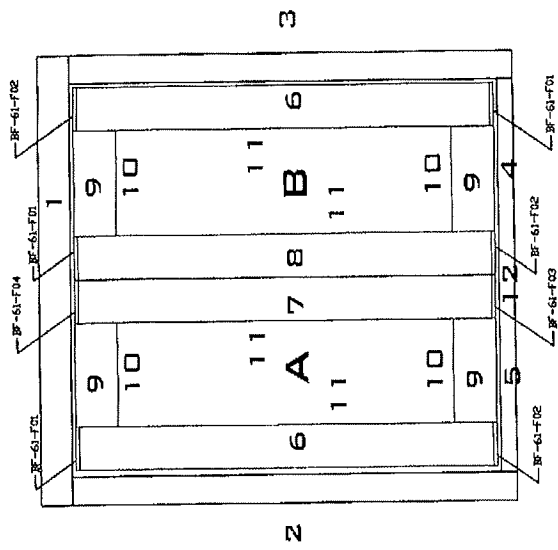
Drawings

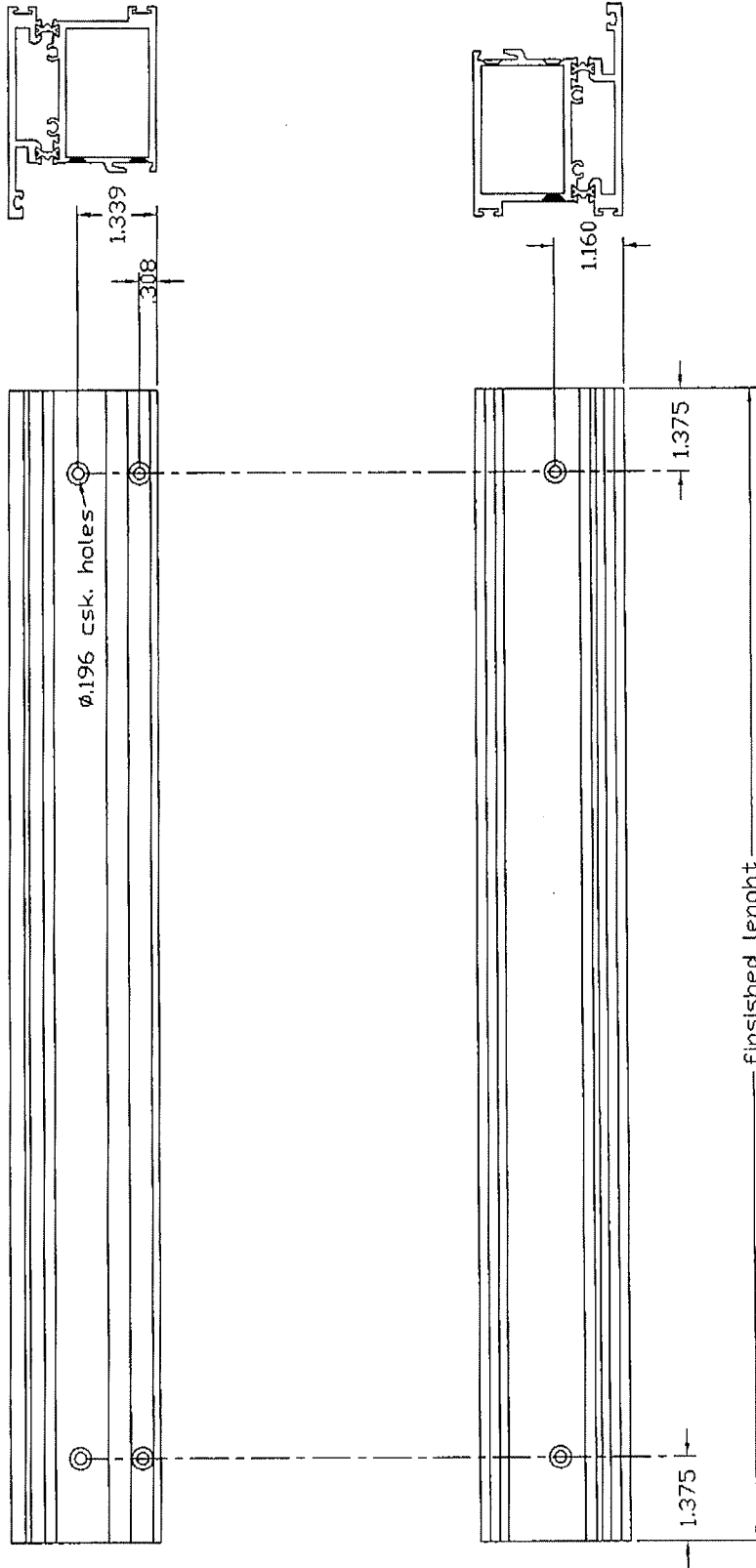
PARTS LIST

BI-FOLD ALUMINUM

PART NO.	DESCRIPTION	COMPANY
BF21	INTERIOR STILE	PRL
XBF-41	GLASS STOP	PRL
BF-63-F01	END HINGE / WALL / HALF	PRL
BF-62-F02	HALF HINGE STILES	PRL
BF-62-F01	HALF HINGE STILES	PRL
BF-61	CORNER BLOCK	PRL
XBF-61-F02	COVER PLATE	PRL
XBF-60-F04	DOOR STILE GEAR BOX	PRL
BF-21-F50	EXTERIOR STILE	PRL
XBF-03	BOTTOM TRACK	PRL
XBF-04	SIDE JAMBS	PRL
XBF-03C	BOTTOM TRACK INSERT	PRL
X999VY-11	SILL GUIDE TRACK	PRL
X777-02-F01	HEAD TRACK END DAM	PRL
777-01-F01	SHIM HEAD STARTER PIVOT	PRL
1B14-F01	GEAR BOX SHIM	PRL
777-03-F01	LOCK RODS	INTERLOCK
777-05F-01	LOCK STRIKE SHIM	PRL
XBF-01	HEAD TRACK	PRL
XBFH-01	TOP JAMB STARTER PIVOT	INTERLOCK
XBFH-03	BOTTOM SILL JAMB PIVOT	INTERLOCK
XBFH-04	INTERMEDIATE ROLLER ASS	INTERLOCK
XBGH-05	INTERMEDIATE HINGE PIN	INTERLOCK
XBFH-06	INTERMEDIATE SILL GUIDE	INTERLOCK
XBFH-07	INTERMEDIATE HINGE PIN & HANDLE	INTERLOCK
XBFH-08	HALF ROLLER ASSEMBLY	INTERLOCK
XBFH-09	HALF SILL GUIDE ASSEMBLY	INTERLOCK



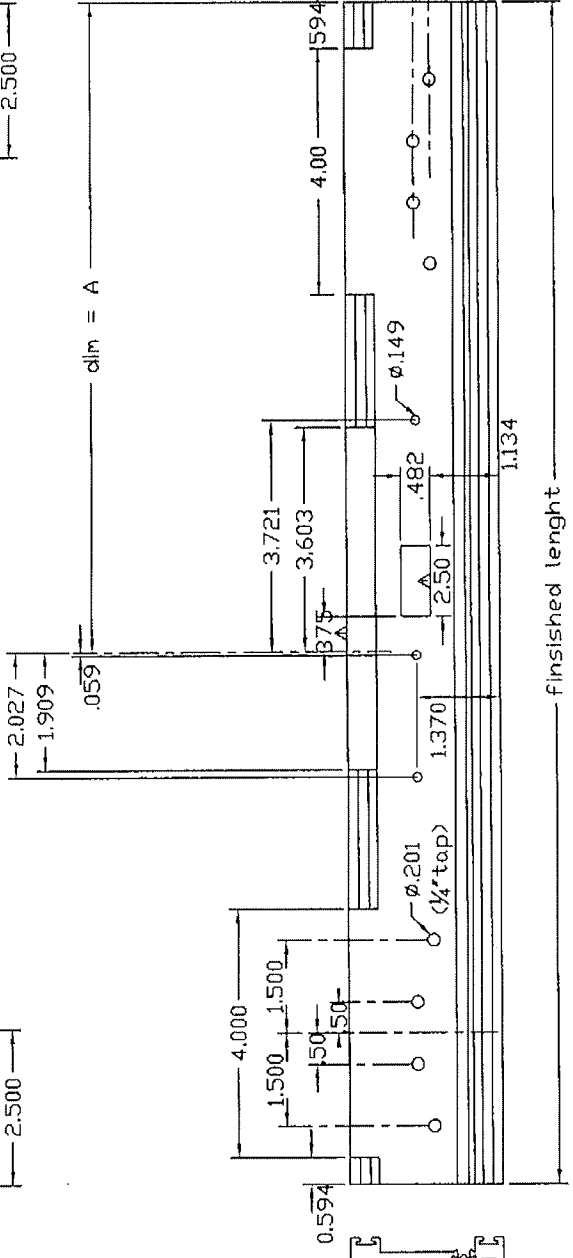
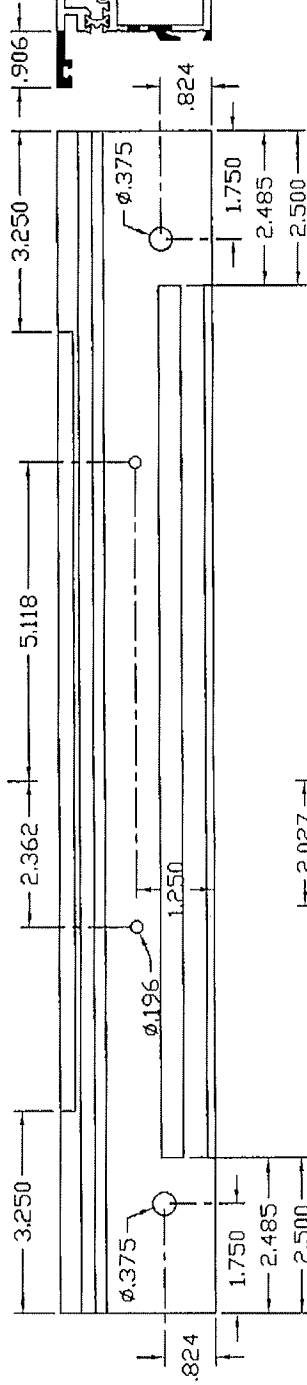
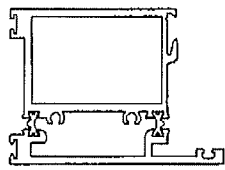




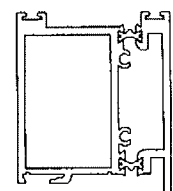
PRL
ALUMINUM INC.

BF-21-F50

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9-11-12



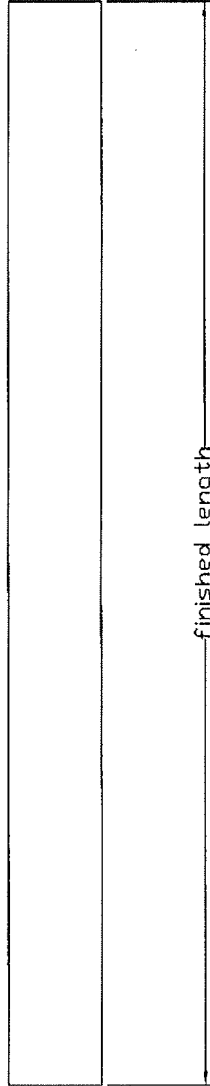
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PRL
ALUMINUM INC.

DRAWN F²
8-28-13

BF-21-F17



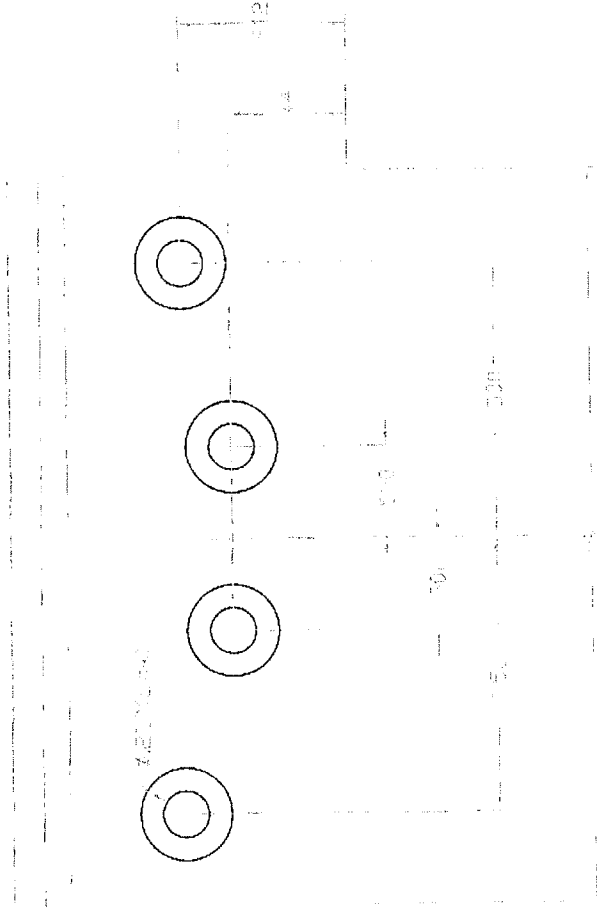
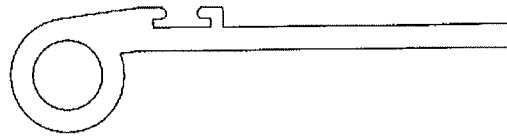
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DRAWN Fz

9-11-12

PRL
ALUMINUM INC.

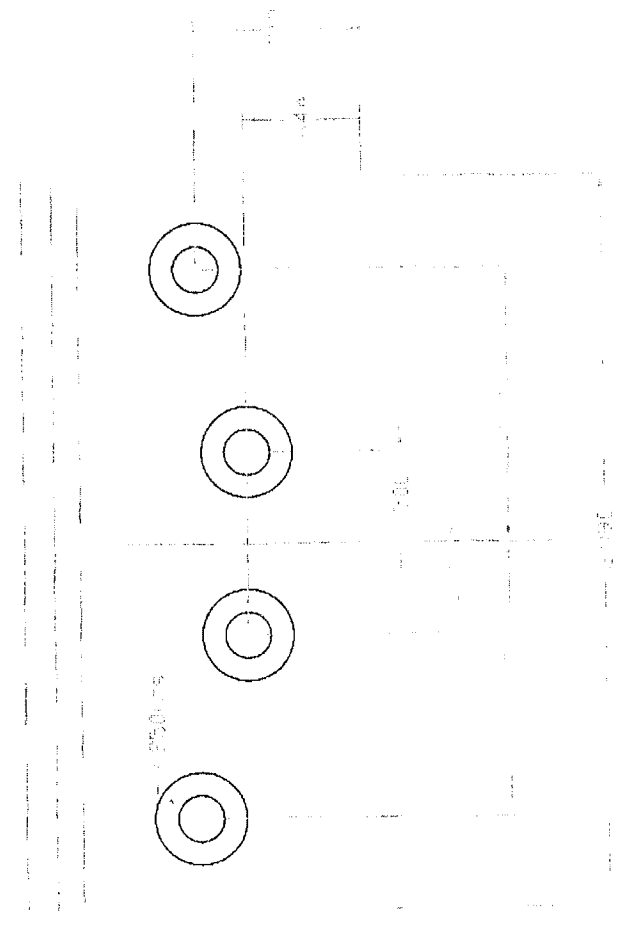
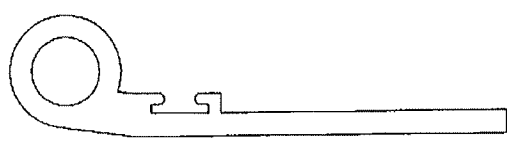
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PRAL
ALUMINUM INC.

BF-63-F01

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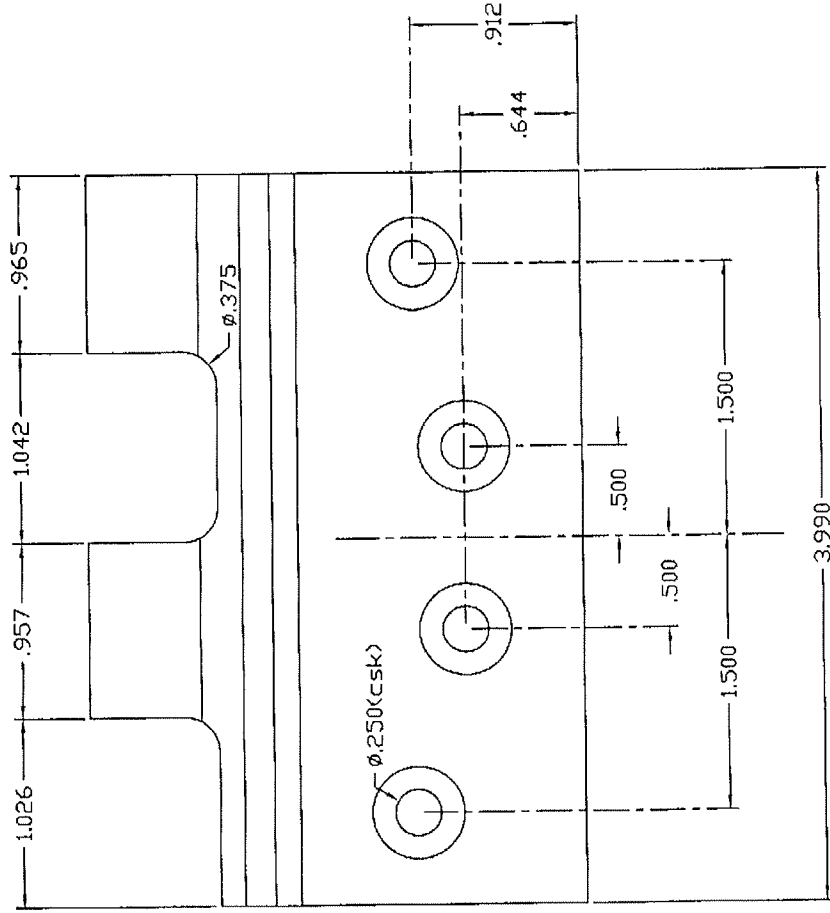
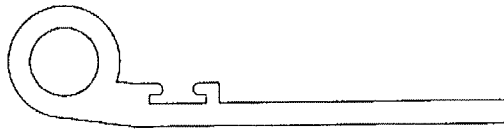


DATE FOR ORDER: 10/11/12
DRAWN BY: J. J. JONES
CHECKED BY: J. J. JONES

PRI
ALUMINUM INC.

DRAWN
9-11-12

BF-62-F02

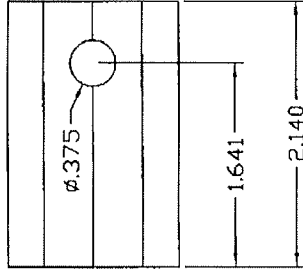
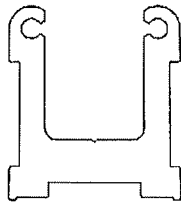


Material: aluminum
clear or black anodize
hinge half

PRL
ALUMINUM INC.

BF-62-F01

DRAWN F-
9-11-12
o.s built 3-15-13

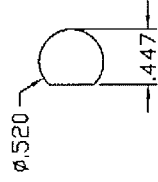
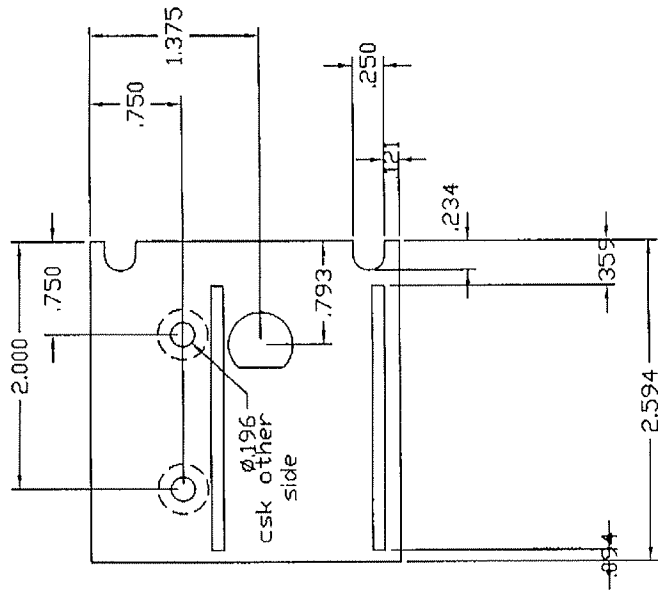
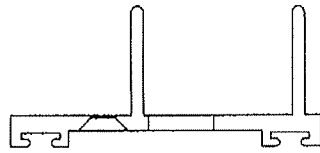


material: mill finish aluminum
corner block

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ALUMINUM INC.

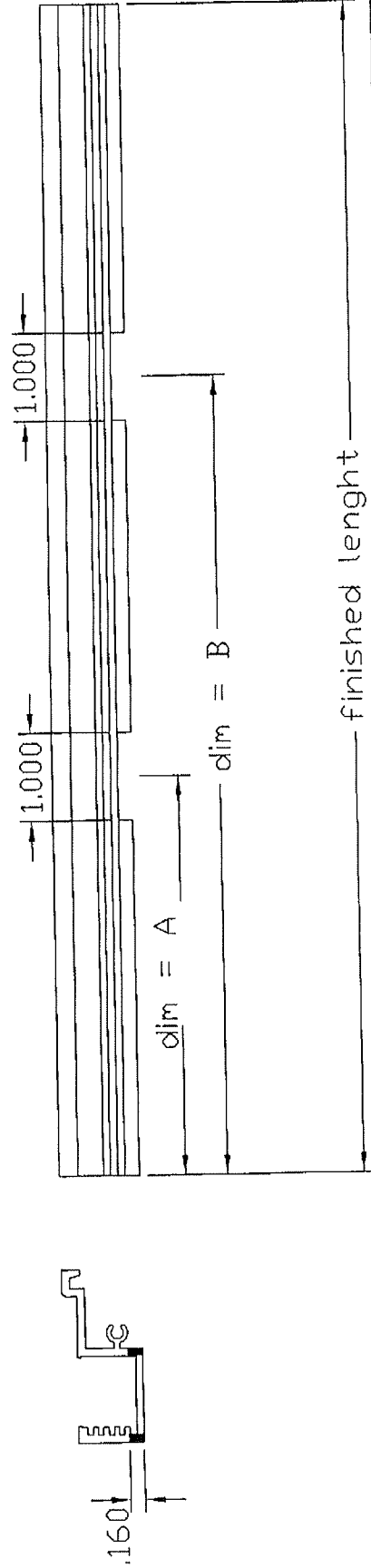
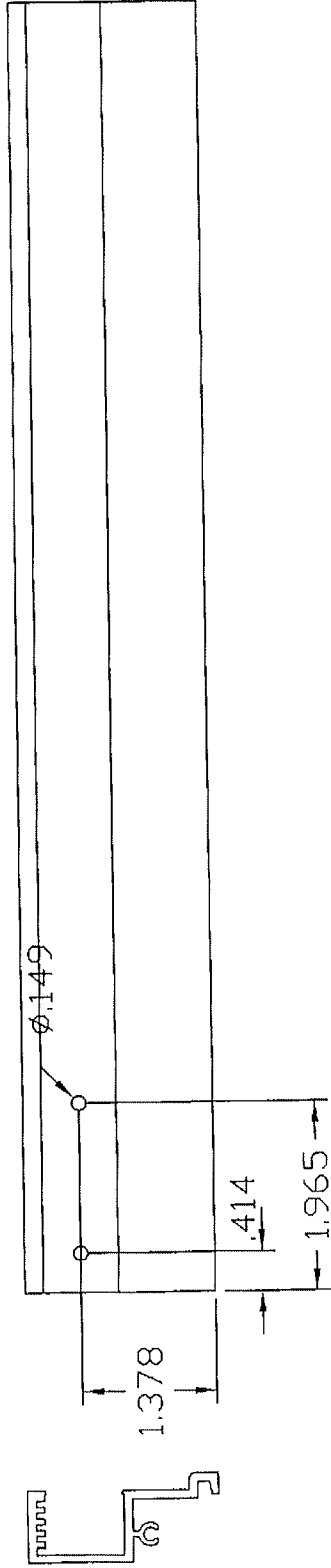
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9-11-12

BF-61-F01



cut out detail

use @ door stile with gear box/lock box

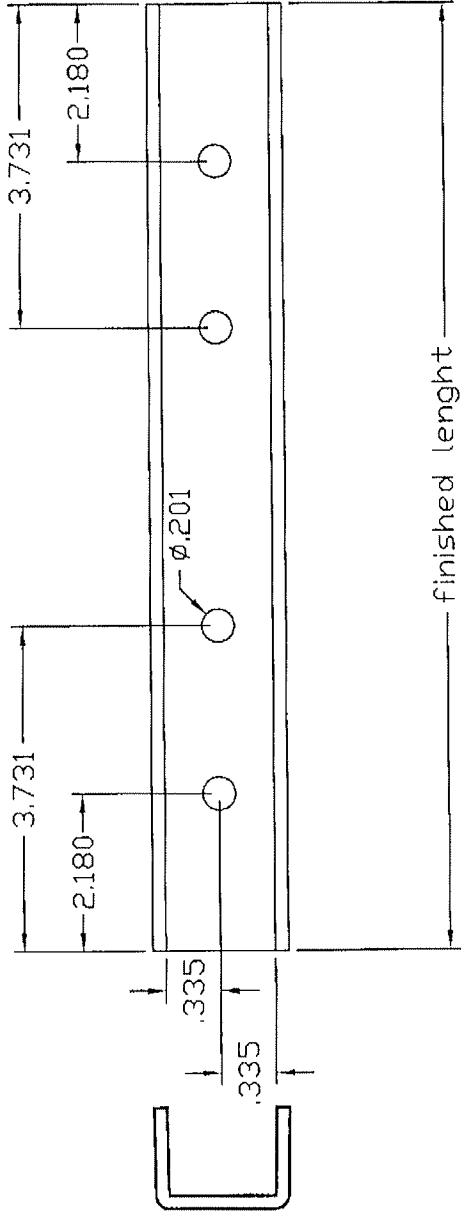


finished length

PRL
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DRAWN FZ
5-15-13

BF-03C-F03



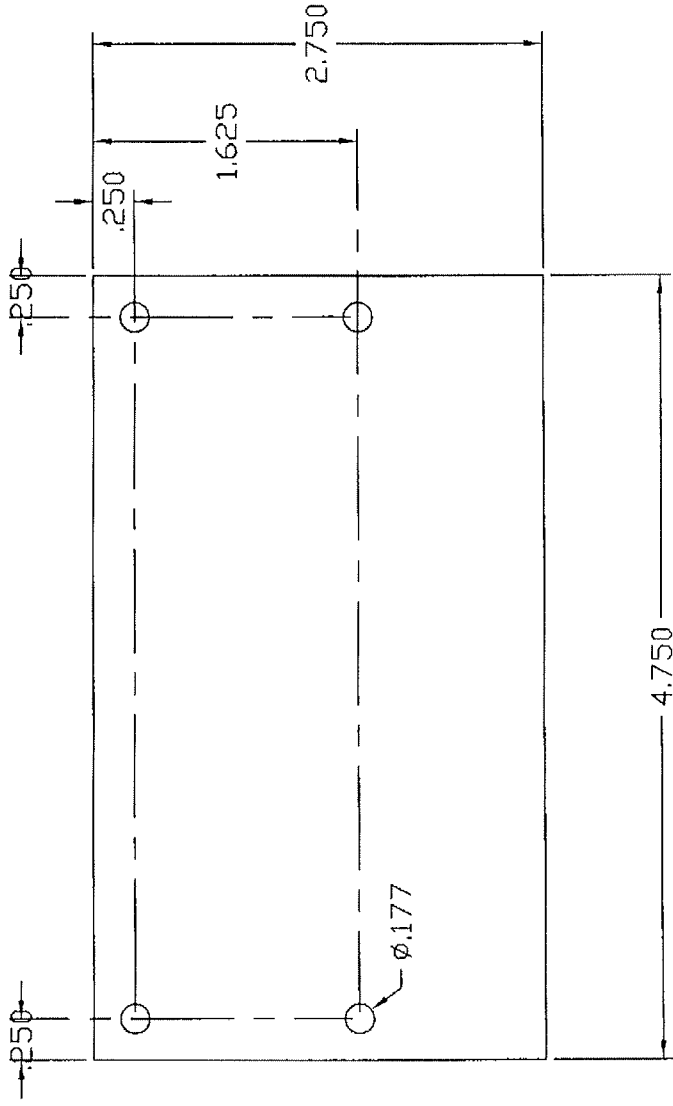
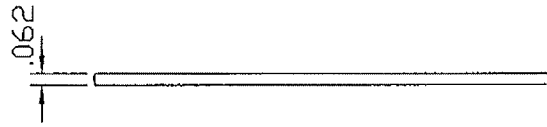
Material: black PVC

sill guide track

PRL
ALUMINUM INC.

999VY-11-F03

DRAWN FZ
9-11-12



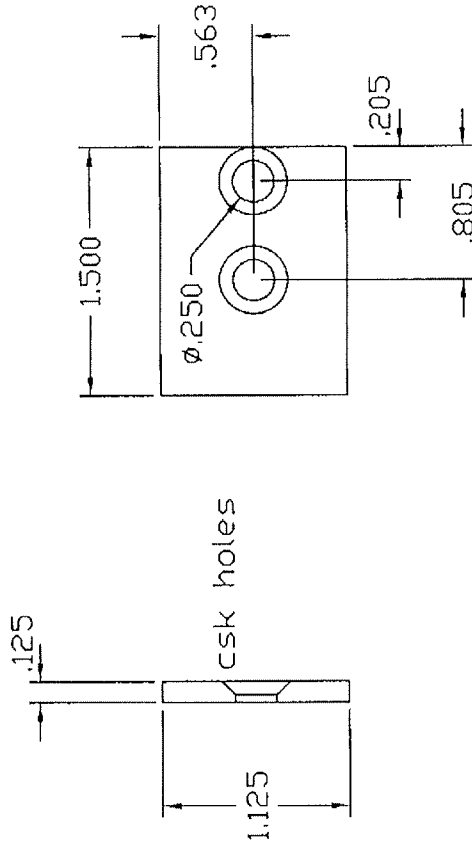
Material: mill finish aluminum

head track end dam

PRL
ALUMINUM INC.

DRAWN FZ
9-11-12

777-02-F01



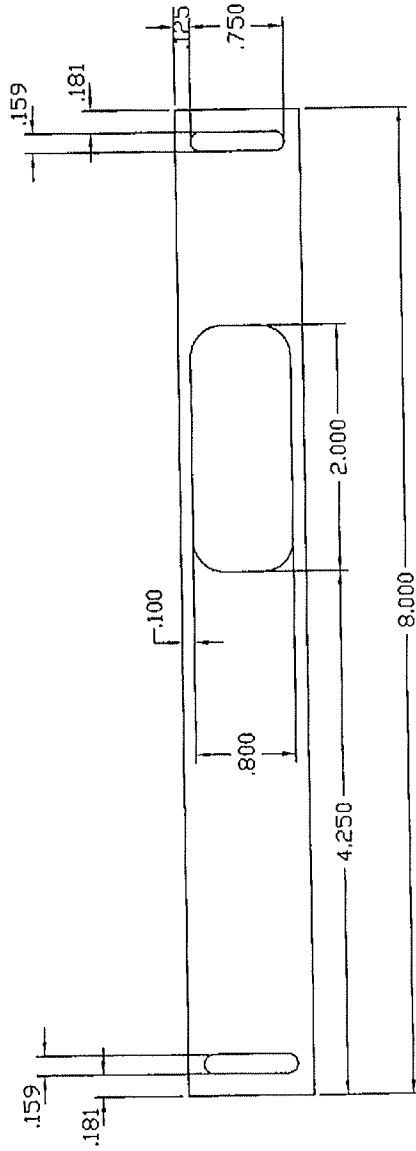
Material: stainless steel

use with BF03-6010 head starter pivot

DRAWN F²
9-11-12

PRL
ALUMINUM INC.

777-01-F01

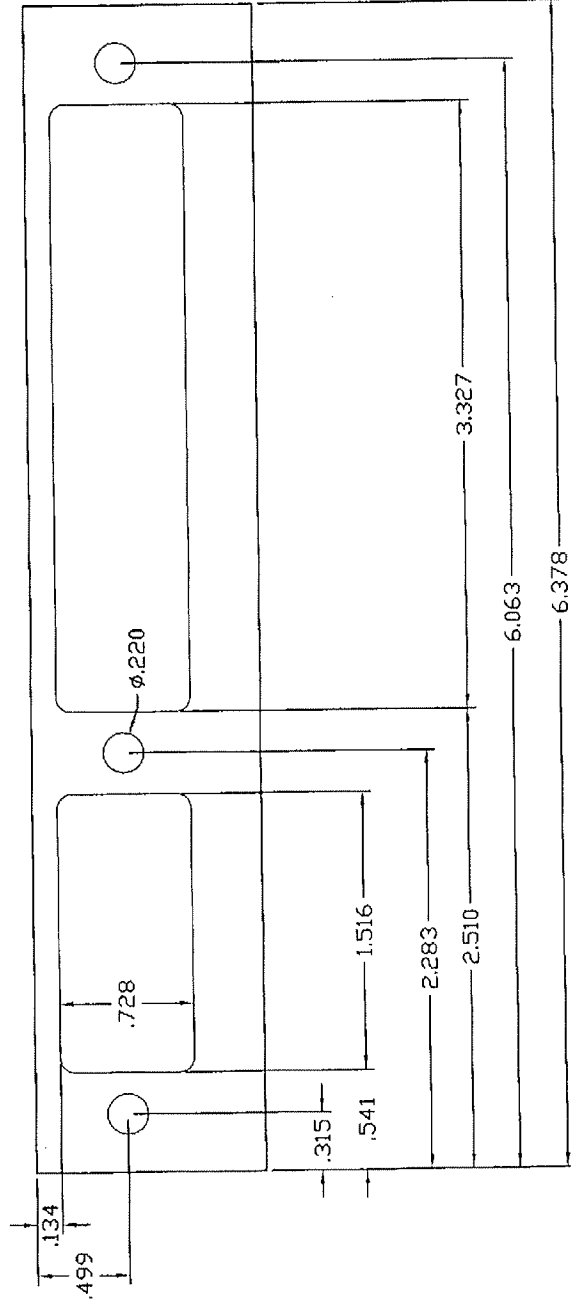
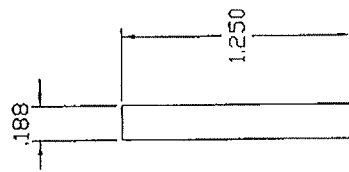


gearbox shim
 material: mill finish aluminum

PRL
 ALUMINUM INC.

1B14-F01

DRAWN F-2
 9-11-12

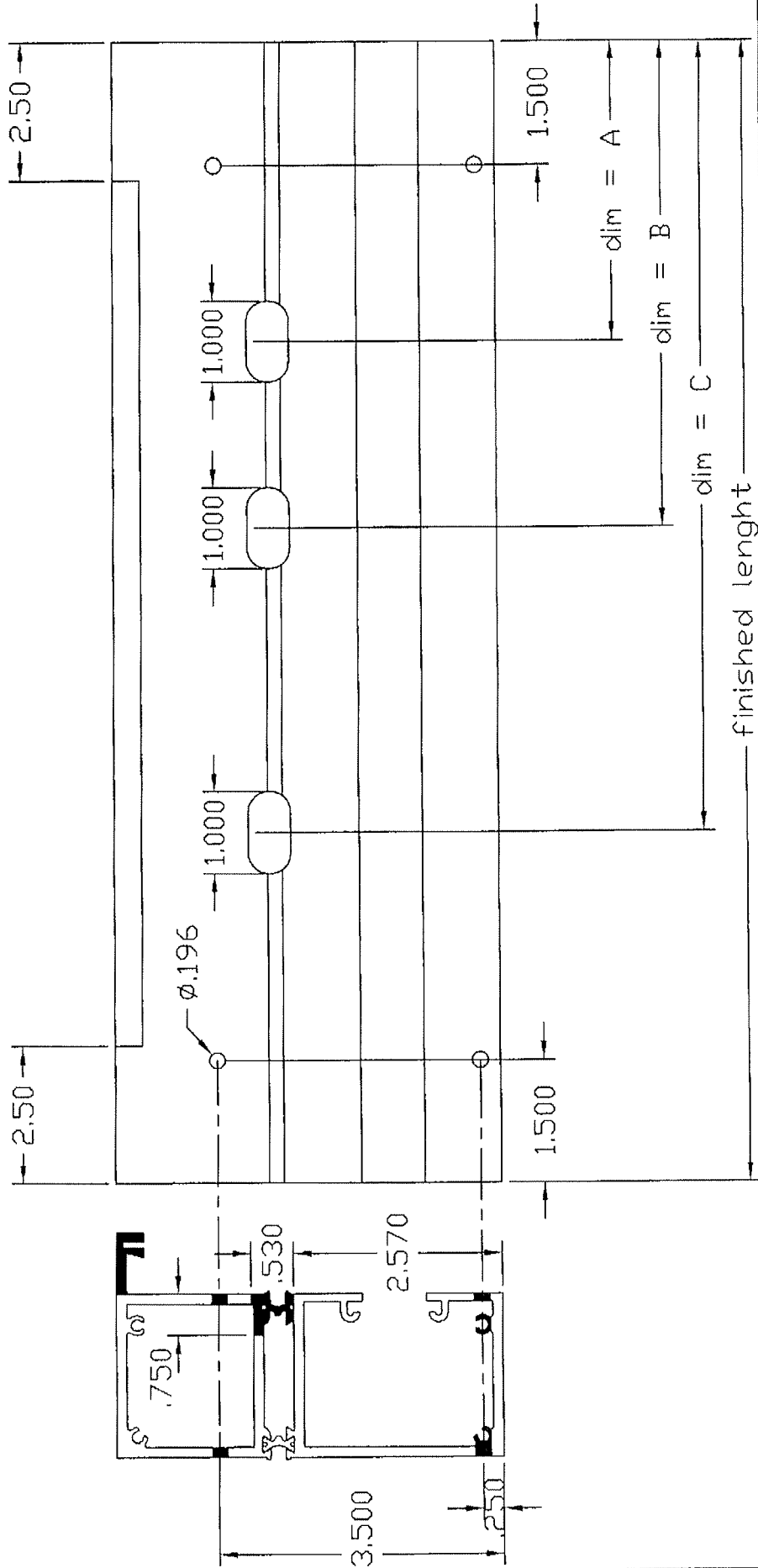


Material: aluminum- black anodize
lock strike shim

DRAWN F-
2-11-12

PRL
ALUMINUM INC.

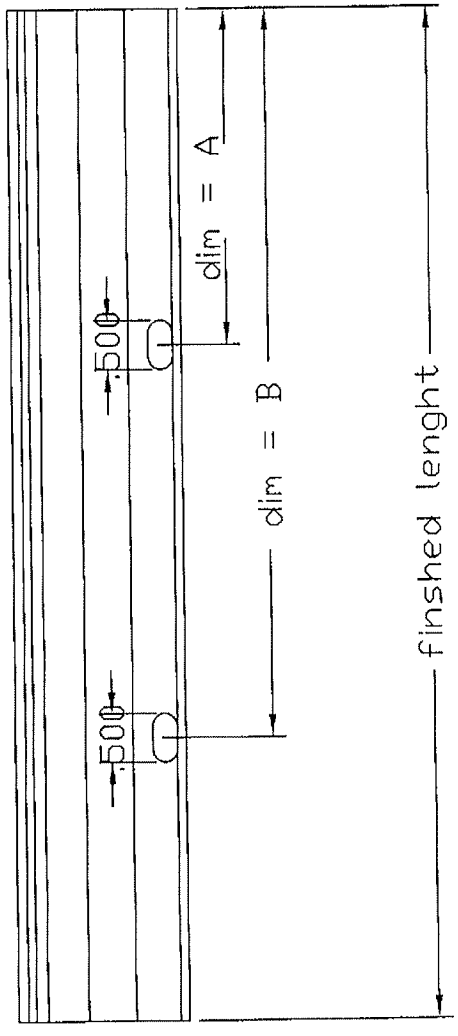
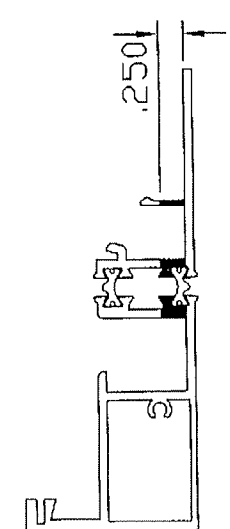
777-05-F01



PRL
ALUMINUM INC.

DRAWN Fz
9-11-12

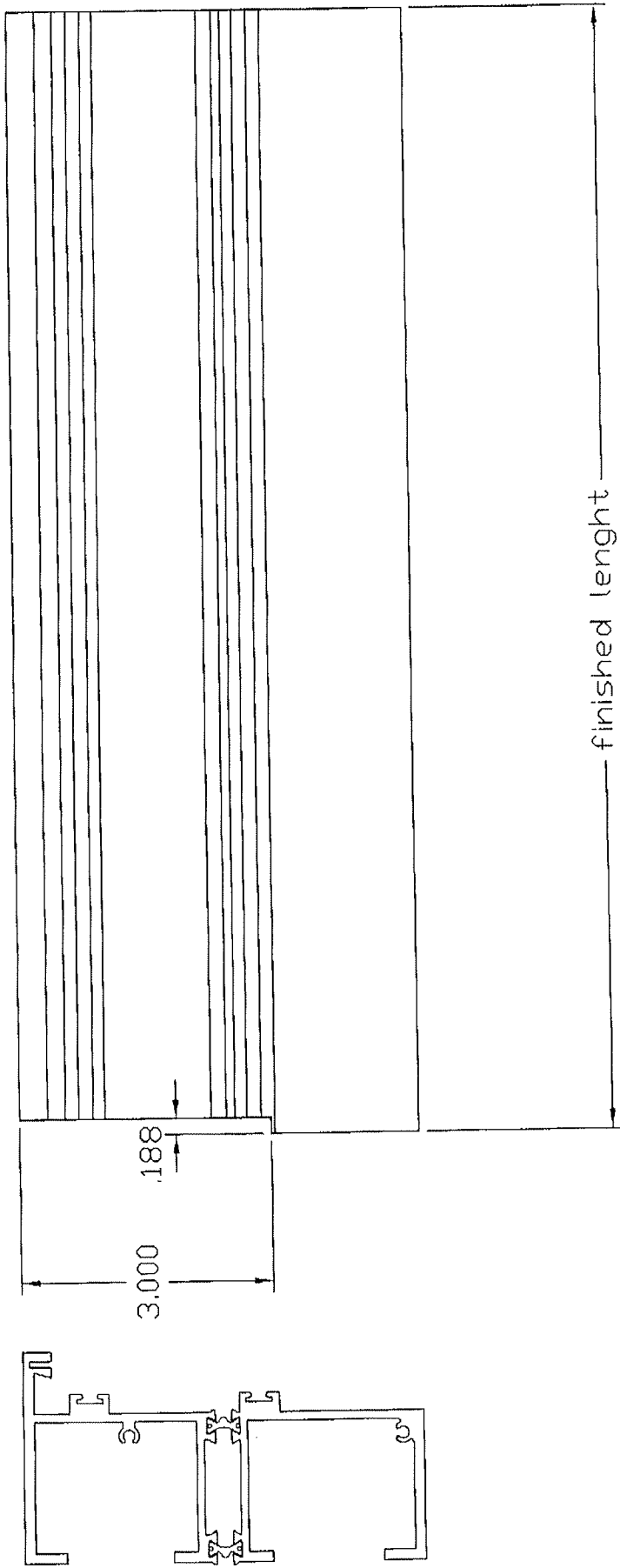
BF-01-F01



PRL
ALUMINUM INC.

DRAWN FZ
5-15-13

BF-03-F03



PRL
ALUMINUM INC.

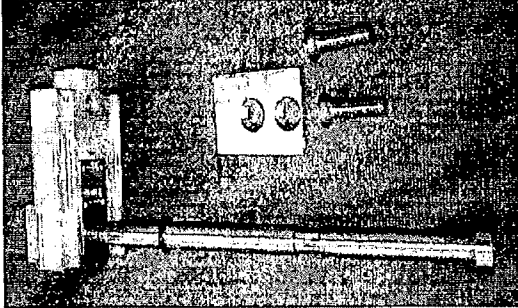
DRAWN **F²**

6-12-13

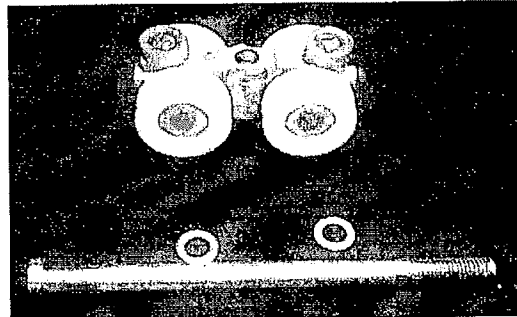
BF-04-F13

PRL Bi-Fold Hardware

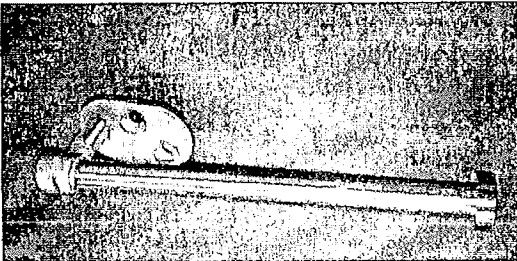
BFH-01 top jamb starter pivot



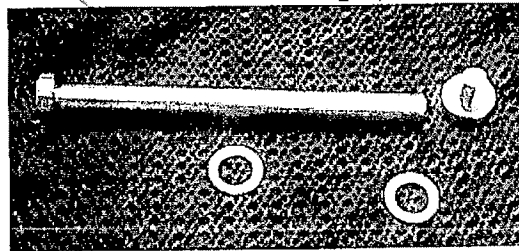
BFH-04 intermediate roller assembly



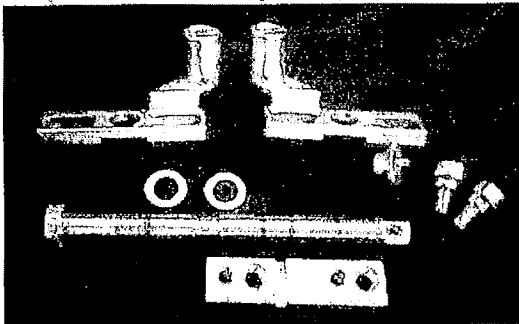
BFH-02 intermediate jamb pivot (when used)



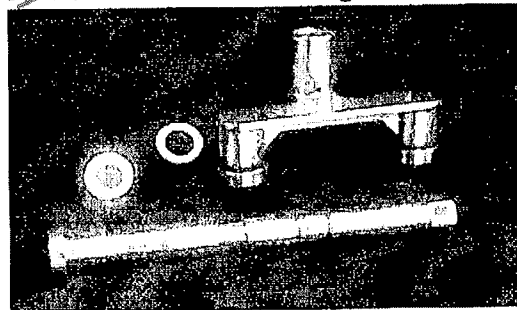
BFH-05 intermediate hinge pin



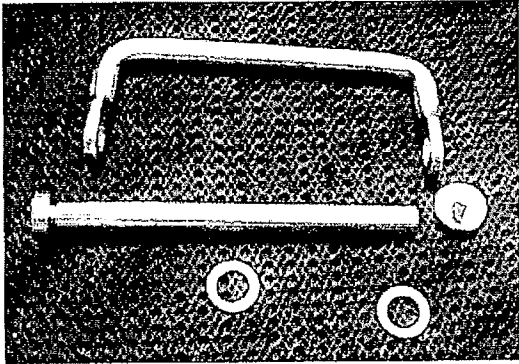
BFH-03 bottom sill jamb pivot



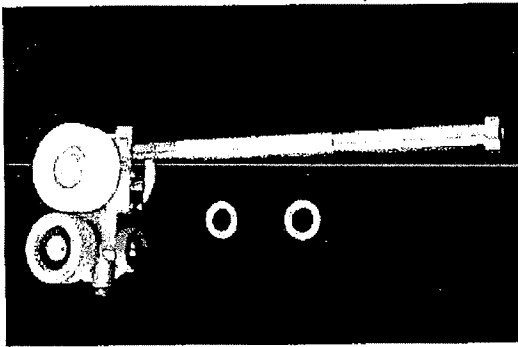
BFH-06 intermediate sill guide



BFH-07 intermediate hinge pin and pull handle



BFH-08 Half roller assembly



BFH-09 Half sill guide assembly

