



Report No.: QCT-TH-10591.01-R2

Test Date: 01/16/16

Original Report Date: 1/18/16

Expiration Date: 1/18/21

Revision Date: 5/25/18

NFRC 102-2010 THERMAL PERFORMANCE TEST REPORT

Rendered To:

FreMarq Innovations
8300 Highland Drive
Wausau, WI 54401

Series/Model: Zero Net PW2500
Type: Glazed Wall System (Curtain Wall)



**NFRC 102-2010 THERMAL PERFORMANCE
TEST REPORT**

Rendered To:

FreMarq Innovations
8300 Highland Drive
Wausau, WI 54401

Test Sample Identification:

Series/Model: Zero Net PW2500

Product Type: Glazed Wall System (Curtain Wall)

Thermal Break: Fiberglass

Overall Size: 2000mm x 2000mm (79" x 79")

NFRC Standard Size: 2000mm x 2000mm (79" x 79")

Test Sample Submitted by: FreMarq Innovations

Test Sample Submitted for: Validation for Initial Certification (production line unit) & plant qualification

Test Procedure:

U-factor tests were performed in a Guarded Hot Box in accordance with NFRC 102-2010, *Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems*.

Test Results Summary:

Standardized U-factor (U_{st}): 0.31 Btu/(hr·ft²·F) CTS Method



Test Sample Description:

Size Specification:	Frame	Exterior Sash	Interior Sash
Size (inches) Non-Standard	79" x 79"	N.A.	N.A.
Daylight Opening (inches)	35-3/4" x 75" (2)	N.A.	N.A.

Construction:	Frame	Exterior Sash	Interior Sash
Corners	Square Cut	N.A.	N.A.
Fasteners	Screws	N.A.	N.A.
Sealant	N.A.	N.A.	N.A.

Finish:	Frame	Exterior Sash	Interior Sash
Material	Aluminum	N.A.	N.A.
Exterior Color	Silver	N.A.	N.A.
Exterior Finish	Anodized	N.A.	N.A.
Interior Color	Black	N.A.	N.A.
Interior Finish	Anodized	N.A.	N.A.

Spacer:				
Code	Spacer Type	Primary Sealant	Secondary Sealant	Desiccant
SS-D	Stainless Steel	PIB	Silicone	Yes

Reinforcement Description:	
Location	Material
None.	N.A.

Grid:		
Size	Type	Pattern
None	N.A.	N.A.

Glazing Method:	Frame	Exterior Sash	Interior Sash
	Exterior	N.A.	N.A.

Glazing Information:	
Layer 1	6mm VE2-42 Clear (e= 0.04)
Gap 1	1/2" Argon 90%
Layer 2	6mm Clear
Gap 2	N.A.
Layer 3	N.A.
Gas Fill Method	Single-Probe*

*Stated per Client/Manufacturer

Not Applicable (N.A.)



Measured Test Data:

Heat Flows	Quantity	Units
1. Total Measured Metering Box Input (Q_{total})	1017.18	Btu/hr
2. Surround Panel Thickness	8	inches
3. Surround Panel Conductivity (C_{sp})	0.0238	Btu/(hr·ft ² ·F)
4. Surround Panel Heat Flow (Q_{sp})	33.10	Btu/hr
5. Metering Box Wall Plus Flanking Loss (Q_{mb+fl})	0.03	Btu/hr
6. EMF vs. Heat Flow Equation (Equivalent Information)	4366.5(EMF)+14.277	
7. Test Specimen Heat Flow (Q_s)	984.04	Btu/hr

Areas	Quantity	Units
8 Specimen Projected Area (A_s)	43.34	ft ²
9. Specimen Interior Total (3-D) Surface Area (A_h)	57.03	ft ²
10. Specimen Exterior Total (3-D) Surface Area (A_c)	46.48	ft ²
11. Metering Box Opening Area (A_{mb})	64.00	ft ²
12. Metering Box Baffle Area Warm Side (A_{b1})	58.50	ft ²
13. Climate Room Baffle Area Cold Side (A_{b2})	80.00	ft ²
14. Surround Panel Interior Exposed Area (A_{sp})	20.66	ft ²

Test Conditions	Quantity	Units
15. Metering Room Air Temperature (t_h)	69.80	deg F
16. Climate Room Air Temperature (t_c)	-0.40	deg F
17. Guard Room Air Temperature (t_g)	74.21	deg F
18. Metering Room Average Relative Humidity	23.00	%
18-5. Metering Room Maximum Relative Humidity	23.81	%
18-6. Metering Room Minimum Relative Humidity	22.13	%
19. Climate Room Wind Speed (Perpendicular Flow)	15.15	mph
20. Total Pressure Differential Across Test Specimen	-0.01	psf
23. Surround Panel Warm Side Surface Temperature (t_{sp1})	68.08	deg F
24. Surround Panel Cold Side Surface Temperature (t_{sp2})	0.76	deg F

Thermal Transmittance	Quantity	Units
25. Specimen Thermal Transmittance (U_s)	0.32	Btu/(hr·ft ² ·F)
26. Standardized Thermal Transmittance (U_{ST} (CTS))	0.31	Btu/(hr·ft ² ·F)



Calculated Test Data:

CTS Method	Quantity	Units
27. Test Specimen Room Side Surface Emittance (ϵ_1)	0.84	N.A.
28. Metering Box Baffle Emittance (ϵ_{b1})	0.95	N.A.
29. Equivalent Room Side Surface Temperature (t_1)	54.34	deg F
30. Equivalent Climate Side Surface Temperature (t_2)	3.62	deg F
31. Room Side Baffle Temperature (t_{b1})	68.48	deg F
32. Climate Side Baffle Temperature (t_{b2})	0.31	deg F
33. Room Side Surface Heat Transfer Coefficient (h_h)	1.47	Btu/(hr·ft ² ·F)
34. Climate Side Surface Heat Transfer Coefficient (h_c)	5.65	Btu/(hr·ft ² ·F)
35. Test Specimen Conductance (C_s)	0.4477	Btu/(hr·ft ² ·F)
36. Convection Coefficient (K_c)	0.38	Btu/(hr·ft ² ·F)
37. Room Side Radiative Heat Flow (Q_{r1})	478.73	Btu/hr
38. Room Side Convective Heat Flow (Q_{c1})	505.31	Btu/hr
39. Room Side Radiative Heat Flux (q_{r1})	11.05	Btu/(hr·ft ²)
40. Room Side Convective Heat Flux (q_{c1})	11.66	Btu/(hr·ft ²)
41. Standardized Warm Side Surface Conductance (h_{STh})	1.19	Btu/(hr·ft ² ·F)
42. Standardized Cold Side Surface Conductance (h_{STc})	5.28	Btu/(hr·ft ² ·F)

Test Duration

- The environmental systems were started on
1/15/16 4:56 PM
- The test parameters were considered stable for two consecutive four hour test periods from
1/16/16 3:11 AM to 1/16/16 11:11 AM
- The thermal performance test results were derived from
1/16/16 7:11 AM to 1/16/16 11:11 AM

Glazing Deflection (inches)*:

Left Glazing	Right Glazing	
0.942	0.929	Edge thickness
0.94	0.911	Center thickness upon receipt of specimen in laboratory (after stabilization)
0.937	0.91	Center thickness at laboratory ambient conditions before testing
0.935	0.908	Center thickness width at test conditions

*Deflection determined using glass and gap meter



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References:

The sample was inspected for the formation of frost or condensation, which may influence the surface temperature measurements. The sample showed no evidence of condensation at the conclusion of the test.

A full calibration of the Quast Consulting and Testing, Inc. 'thermal test chamber' in Mosinee, Wisconsin was conducted in 10/28/2015 in accordance with Quast Consulting and Testing, Inc. calibration procedure. A calibration check was performed in 07/26/2015.

"This test method does not include procedures to determine the heat flow due to either air movement through the specimen or solar radiation effects. As consequence, the thermal transmittance results obtained do not reflect performances which are expected from field installations due to not accounting for solar radiation, air leakage effects, and the thermal bridge effects that have the potential to occur due to the specific design and construction of the fenestration system opening. The latter can only be determined by in-situ measurements. Therefore, it is important to recognize that the thermal transmittance results obtained from this test method are for ideal laboratory conditions and should only be used for fenestration product comparisons and as input to thermal performance analyses which also include solar, air leakage and thermal bridge effects."

The test sample was installed in a vertical orientation, the exterior of the specimen was exposed to the cold side. The direction of heat transfer was from the interior (warm side) to the exterior (cold side) of the specimen.

"Rating included in this report are for submittal to an NFRC licensed Inspection Agency (IA) and are not meant to be used for labeling purposes. Only those values identified on a valid Certification Authorization Report (CAR) are to be used for labeling purposes." The rating values were rounded in accordance to the NFRC unit conversions and rounding policy document (NFRC 601-2010).

Quast Consulting and Testing, Inc. is a NFRC accredited testing laboratory and all tests conducted in full compliance with NFRC approved procedures.

The Standardized Thermal Transmittance (Ust) was determined using CTS Method per NFRC 102, Section 8.2.A.

The experimental uncertainty associated for this test was 3.5%.



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Detailed drawings, data files, a copy of this report and other pertinent project documentation will be retained by Quast Consulting and Testing, Inc. for a period of four years from the original test date. At the end of this retention period, such materials shall be discarded without notice and the service life of this report will expire. Results obtained were secured by using the designated testing methods. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. This report is the exclusive property of the client so named herein and represents only the product tested. This report may not be reproduced, except in full, without the written consent of Quast Consulting and Testing, Inc.

This report is not complete without all attachments; see Appendix.

Appendix A: Drawings (16 pages).

A handwritten signature in black ink, appearing to read 'Andrew Tange', is written over a light gray rectangular background.

Test Performed By
Andrew Tange, Test Engineer

A handwritten signature in black ink, appearing to read 'Brian M. Sasman', is written over a light gray rectangular background.

Individual-In-Responsible-Charge
Brian M. Sasman P.E.



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Revision No.	Date	Description
.01	1/18/16	Original report issued.
R1	06/10/16	Issued to FreMarq Innovations
R2	5/25/2018	Revised Product Name

Extrusion List for FreMarq Thermal Test

Drawing has been reviewed to verify compliance with specimen tested.

QCT-TH-10591

Overall Framing size: 2 1/2" x 7 1/2"

A. Tange

Part No.	Description	Length	Quantity
AL-5-1013	Head/Sill Frame	35 3/4"	4
AL-5-1013	Jamb Frame	79"	2
AL-5-1014	Male Frame	79"	1
AL-5-1015	Female Frame	79"	1
AL-PPL-2500	Horizontal Pressure Plate	35 3/8"	4
AL-PPL-2500	Vertical Pressure Plate	79"	3
AL-CVR-2500	Horizontal Cover	35 3/4"	4
AL-CVR-2500	Vertical Cover	79"	3

Fiberglass List for FreMarq Thermal Test

Series: Zero-Net PW 2500

Overall Framing size: 2 1/2" x 7 1/2"

Part No.	Description	Length	Quantity
PRP-1001	Fiberglass Thermal Break at Head and Sill	35 3/4"	4
PRP-1001	Fiberglass Thermal Break at Jambs	79"	2
PRP-1002	Fiberglass Thermal Break at Male Vertical	79"	1
PRP-1003	Fiberglass Thermal Break at Female Vertical	79"	1

Misc. Material List for FreMarq Thermal Test

Series: Zero-Net PW 2500

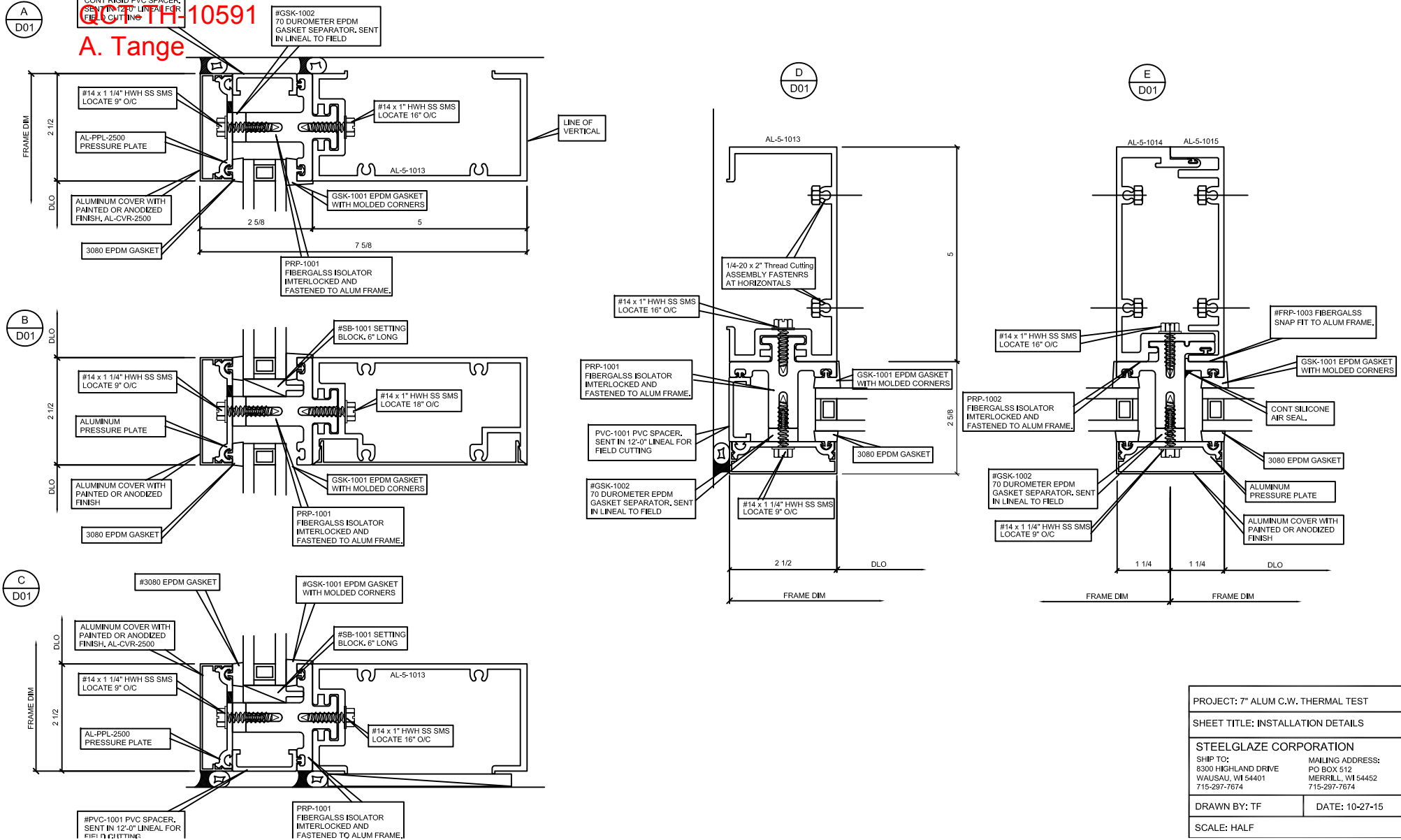
Overall Framing size: 2 1/2" x 7 1/2"

Part No.	Description	Quantity
GSK-1001	Interior EPDM Gasket with molded corners	(2) at 35 3/4" x 74"
GSK-1002	EPDM 70 Durometer frame isolator	35' Lineal Ft.
3080	EPDM 60 Durometer exterior gasket	35' Lineal Ft.
SB-1001	6" long silicone setting block	4
PvVC-1001	PVC perimeter spacer	28 @ 3" long
3998	Weatherstrip at stack	14' Lineal Ft.
FRS-1001	Assembly screws	16
PPS-1001	Pressure plate fastener - #14 x 1 1/4" SS HWH SMS	36
FGS-1001	Fiberglass assembly screw #14 x 1" SS HWH SMS	30

Drawing has been reviewed to verify compliance with specimen tested.

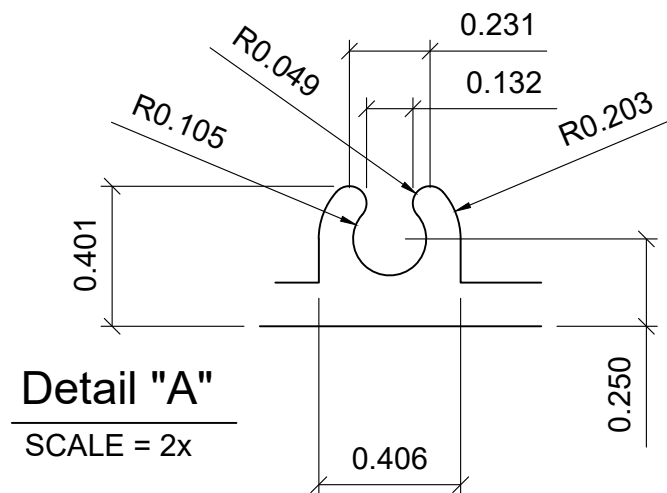
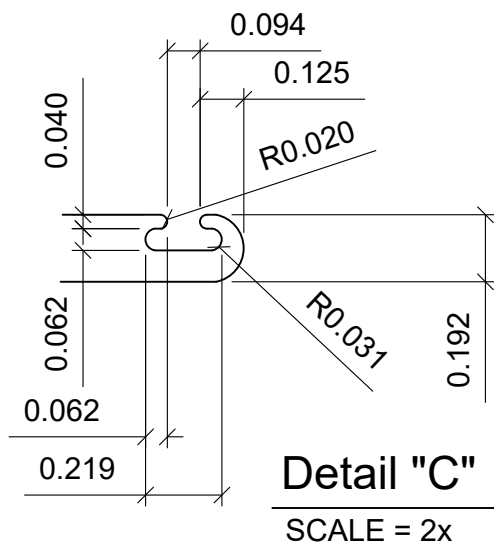
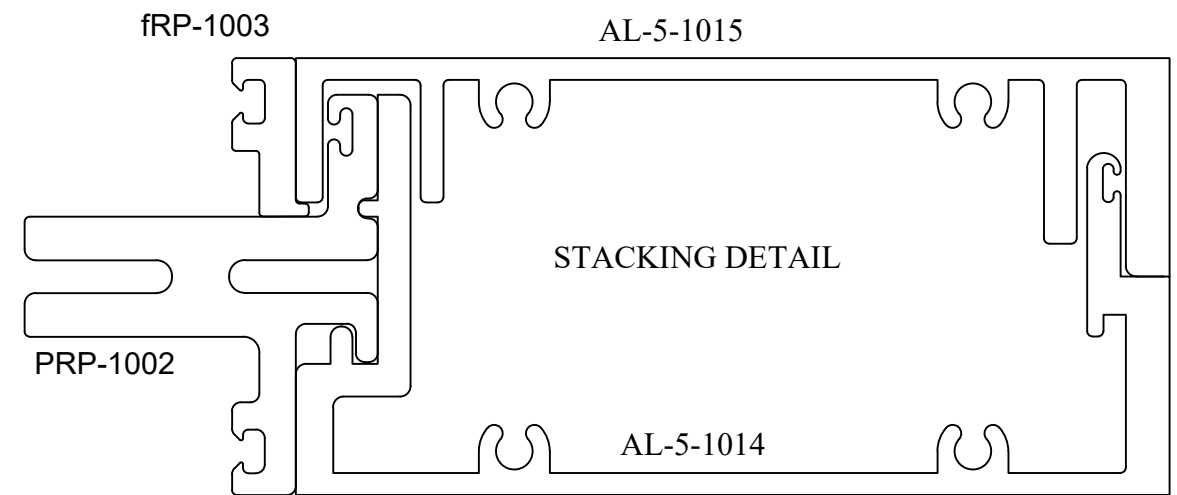
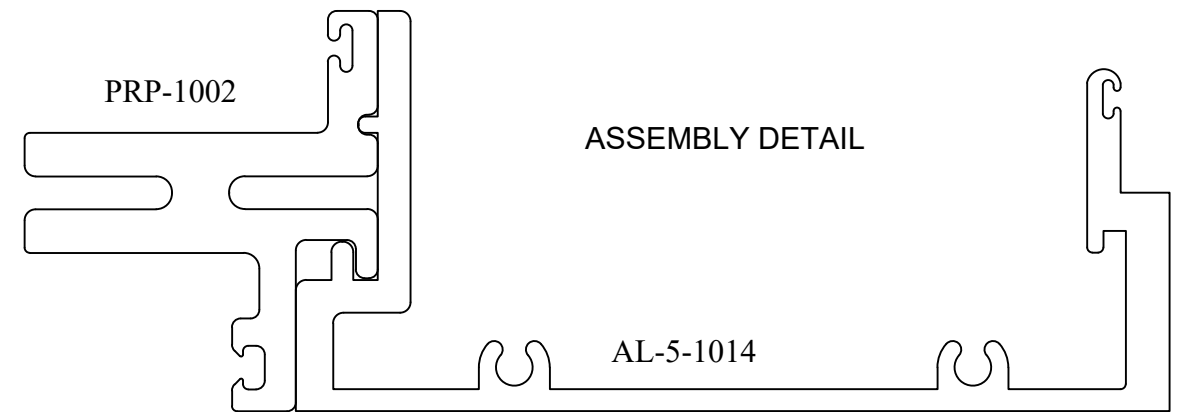
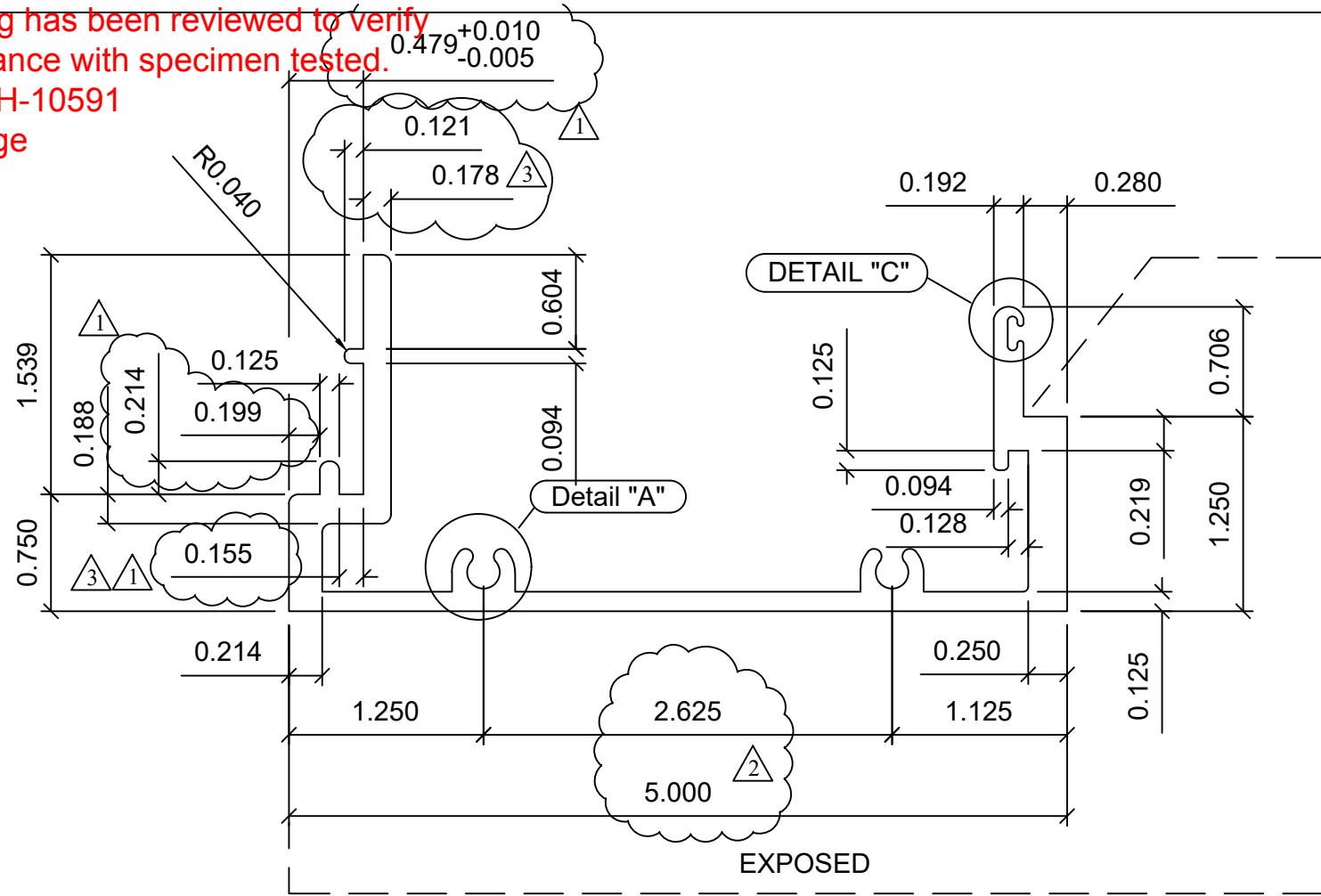
QCT-11-10591

A. Tange



PROJECT: 7" ALUM C.W. THERMAL TEST	
SHEET TITLE: INSTALLATION DETAILS	
STEELGLAZE CORPORATION	
SHIP TO: 8300 HIGHLAND DRIVE WAUSAU, WI 54401 715-297-7674	MAILING ADDRESS: PO BOX 512 MERRILL, WI 54452 715-297-7674
DRAWN BY: TF	DATE: 10-27-15
SCALE: HALF	

Drawing has been reviewed to verify compliance with specimen tested.
 QCT-TH-10591
 A. Tange



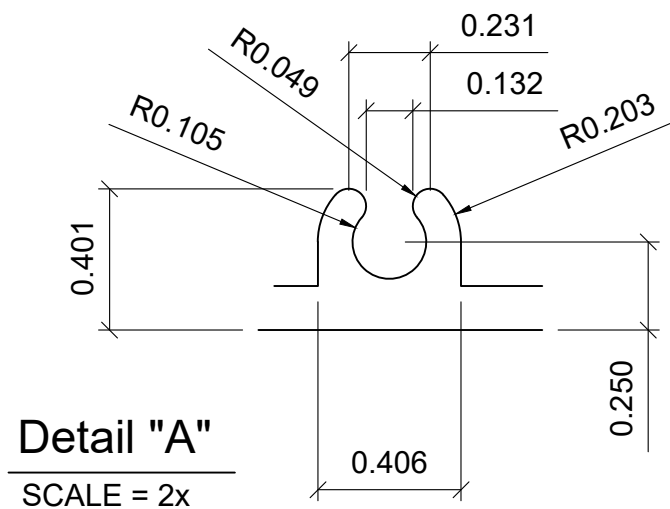
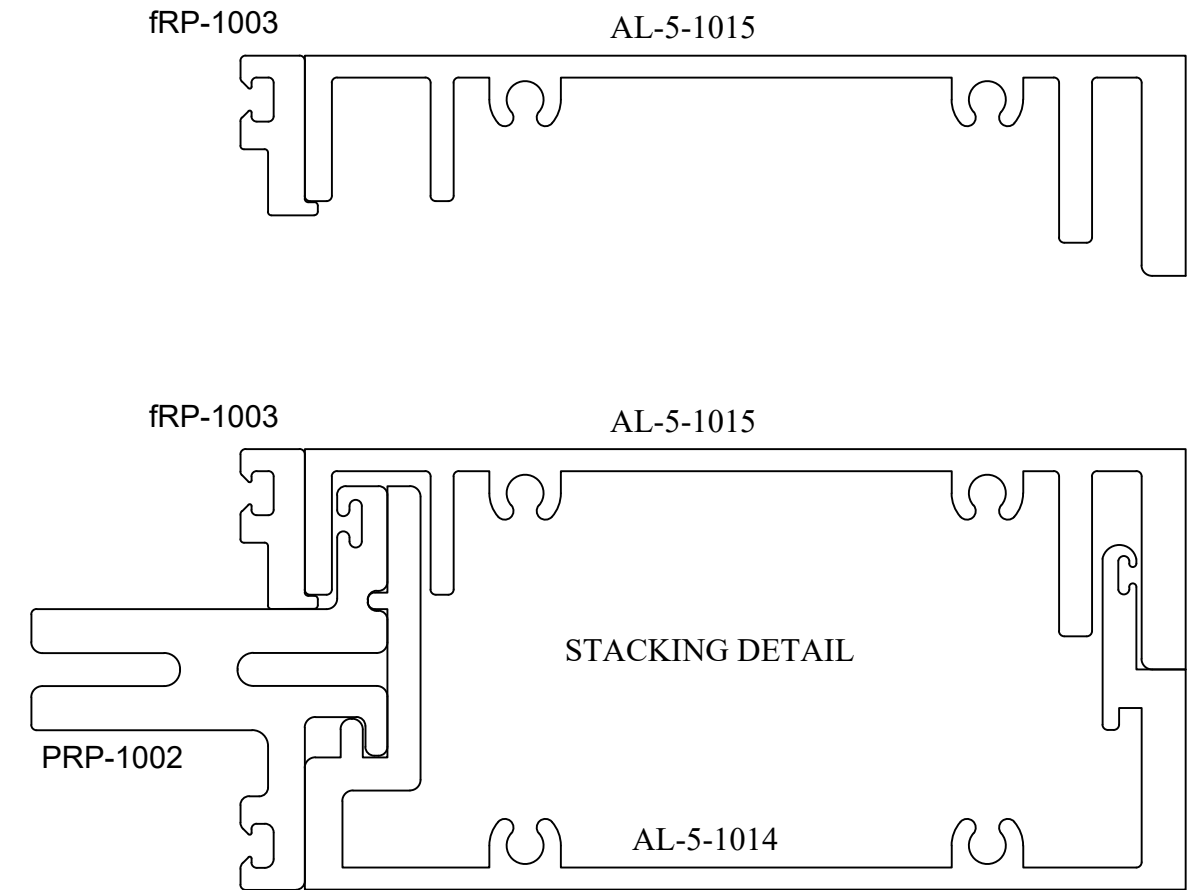
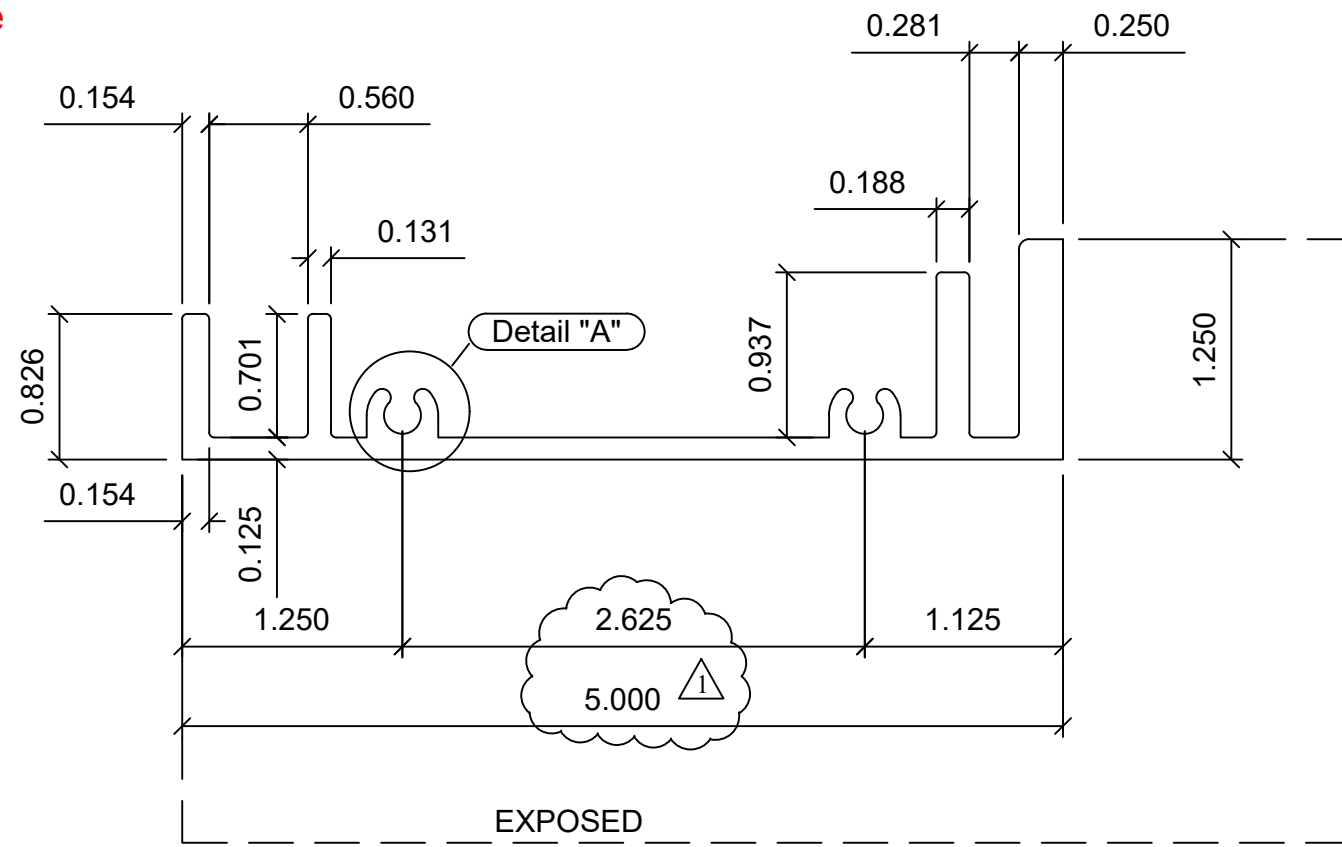
- △ REVD 6-1-16
DECREASED LEG THICKNESS
- △ REVD 10-7-15
INCREASED DEPTH
- △ REVD 9-29-15.

MATERIAL: ALUM ALLOY 6063-T6	
TOLERANCE: INDUSTRY STANDARD	
Perimeter = 22.393	RADIUS: 0.06" UNO
AREA= 1.746	WEIGHT= 2.095 LB/FT

FreMarq Innovations
 PO BOX 512
 MERRILL, WI 54452

TITLE: 5" MALE	
DRAWN BY: TAF	
DATE: 8-20-15	
PART NO.	AL-5-1014

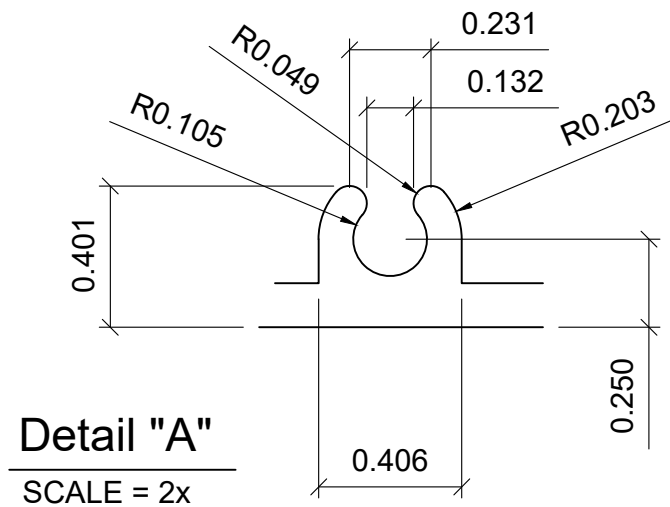
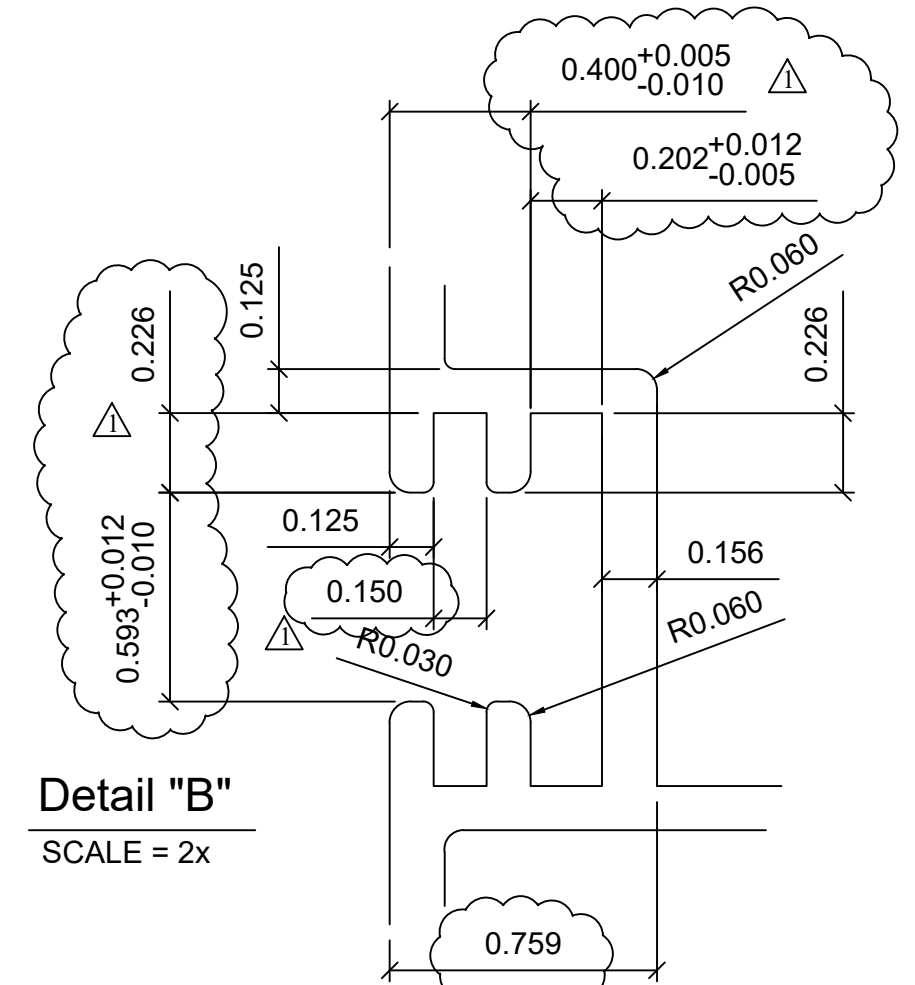
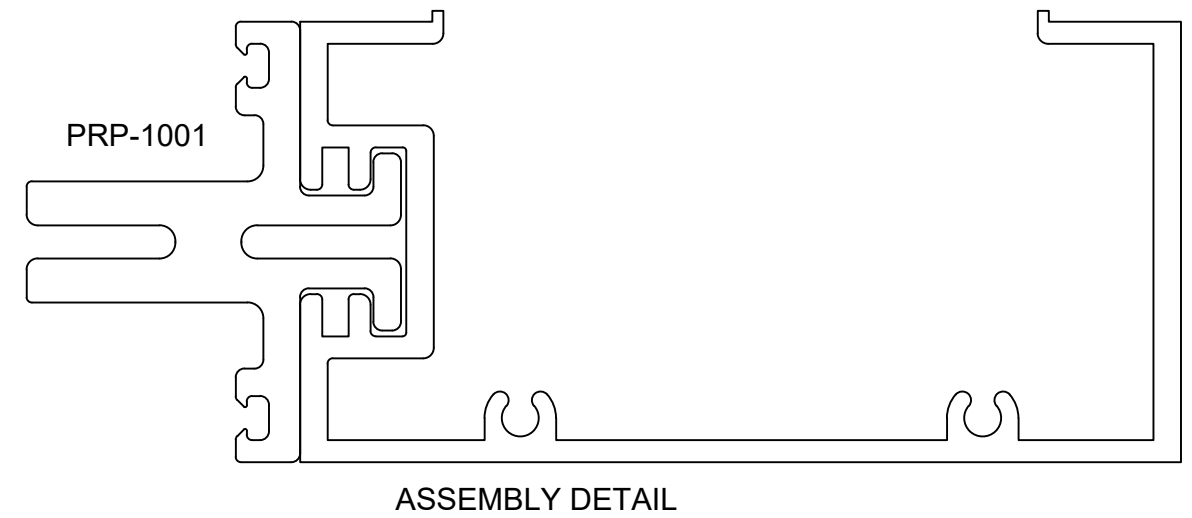
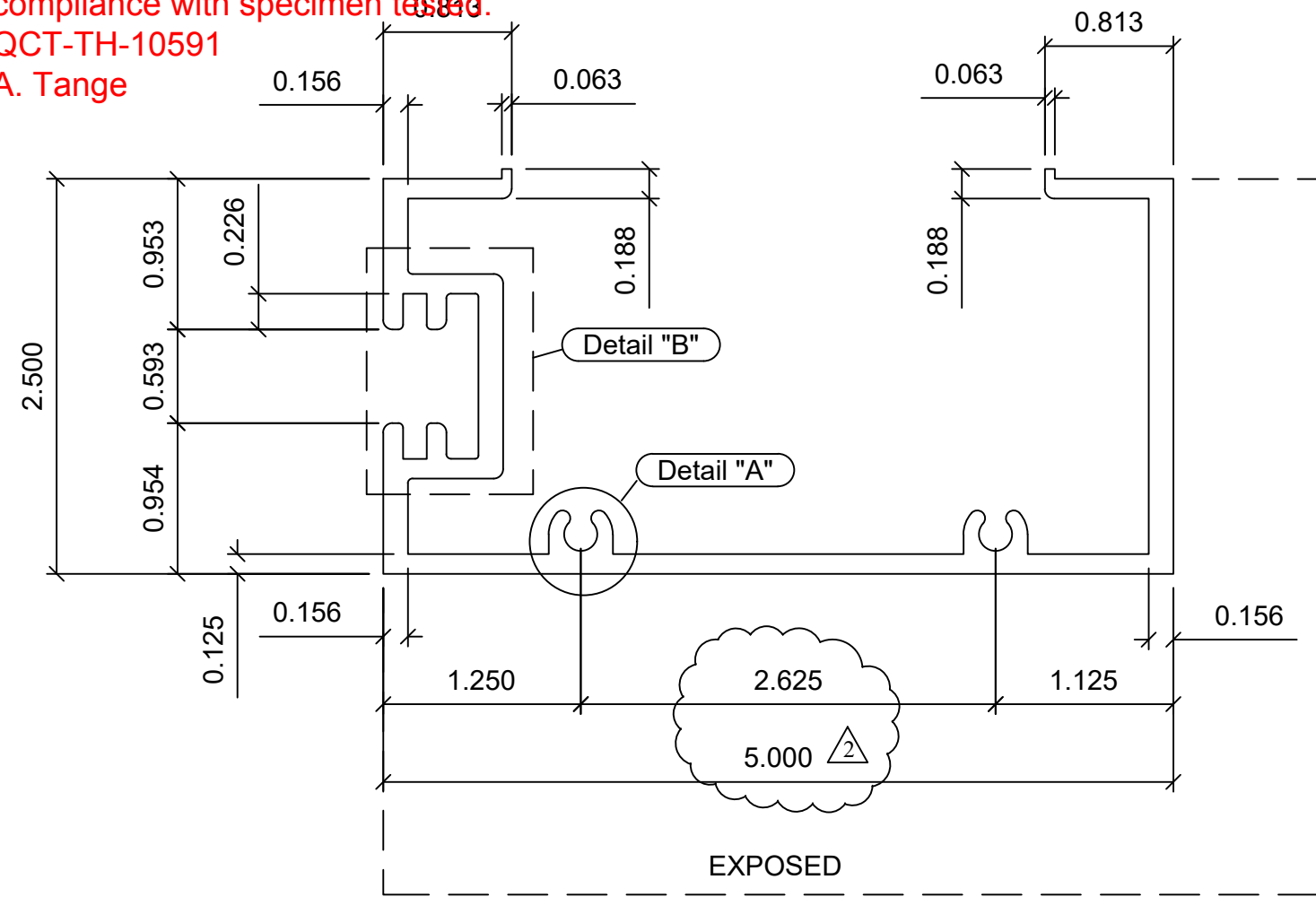
Drawing has been reviewed to verify compliance with specimen tested.
 QCT-TH-10591
 A. Tange



△ REVD 10-7-15
 INCREASED DEPTH

MATERIAL: ALUM ALLOY 6063-T6		FreMarq Innovations	TITLE: 4 1/2" FEMALE	
TOLERANCE: INDUSTRY STANDARD			DRAWN BY: TAF	
Perimeter = 18.849		PO BOX 512	DATE: 8-20-15	
RADIUS: 0.03" UNO		MERRILL, WI 54452	PART NO. AL-5-1015	
AREA= 1.407	WEIGHT= 1.688 LB/FT			

Drawing has been reviewed to verify compliance with specimen test QCT-TH-10591
 A. Tange



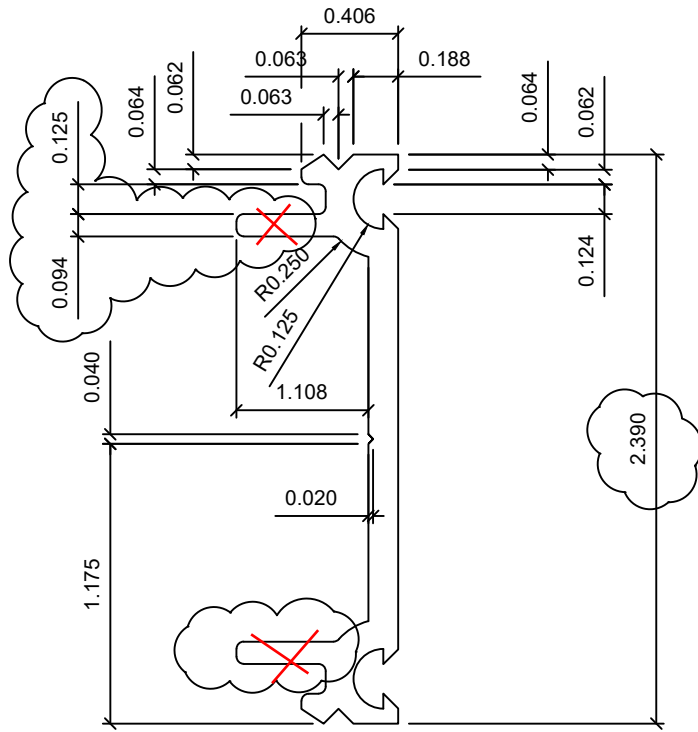
△ REVD 10-7-15 INCREASED DEPTH
 △ REVD 9-29-15.

MATERIAL: ALUM ALLOY 6063-T6	
TOLERANCE: INDUSTRY STANDARD	
Perimeter = 28.366	RADIUS:
AREA = 1.923	WEIGHT = 2.308 LB/FT

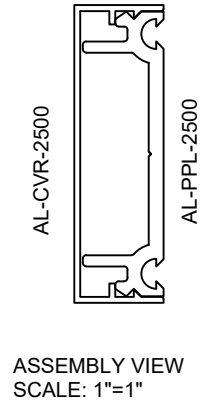
FreMarq Innovations
 PO BOX 512
 MERRILL, WI 54452

TITLE: 5" JAMB	
DRAWN BY: TAF	
DATE: 8-20-15	
PART NO.	AL-5-1013

Drawing has been reviewed to verify compliance with specimen tested.
 QCT-TH-10591
 A. Tange



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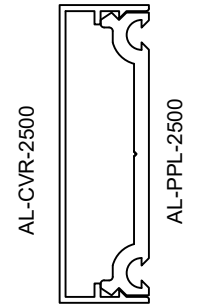
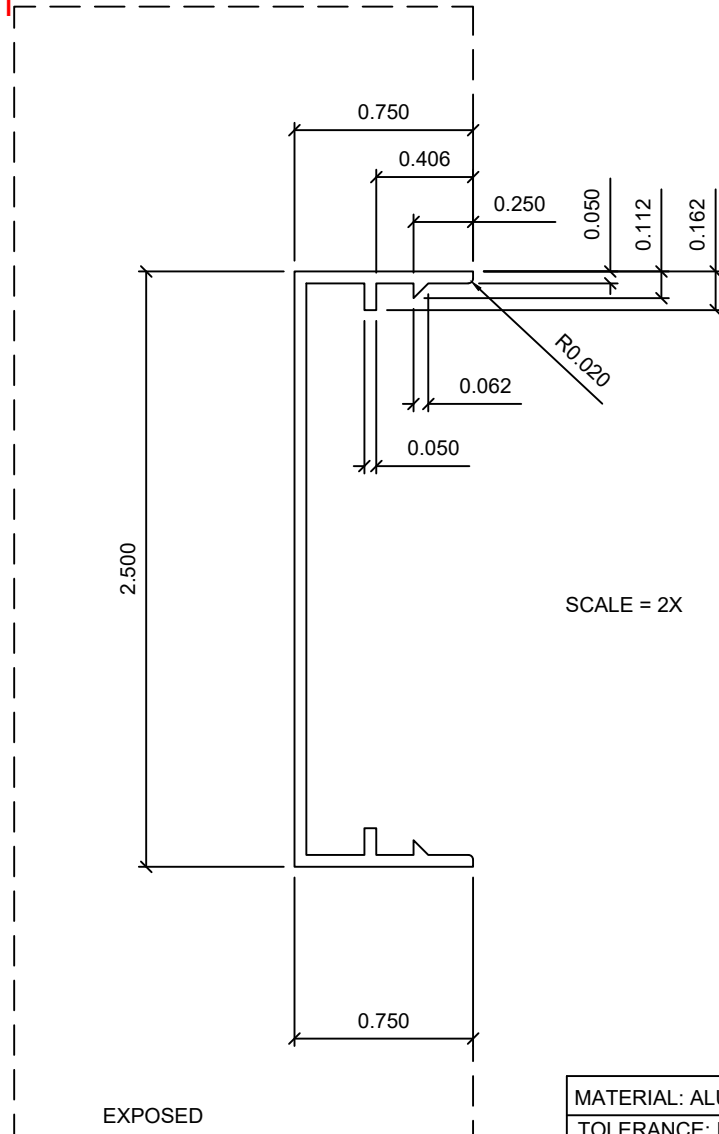


MATERIAL: ALUM ALLOY 6063-T6		STEELGLAZE, LLC	TITLE: 2 1/2" SNAP-ON COVER	
TOLERANCE: INDUSTRY STANDARD			DRAWN BY: TAF	
Perimeter = 8.390	RADIUS: 0.03" UNO	PO BOX 512 MERRILL, WI 54452	DATE: 6-24-14	
AREA= 0.446	WEIGHT= 0.535 LB/FT		PART NO.	AL-PPL-2500

Drawing has been reviewed to verify compliance with specimen tested.

QCT-TH-10591

A. Tange

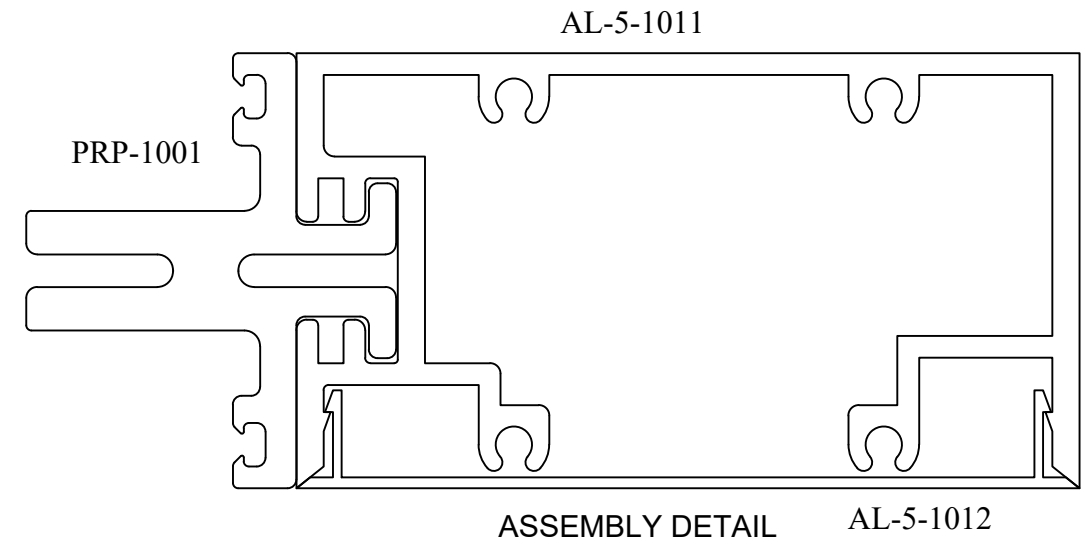
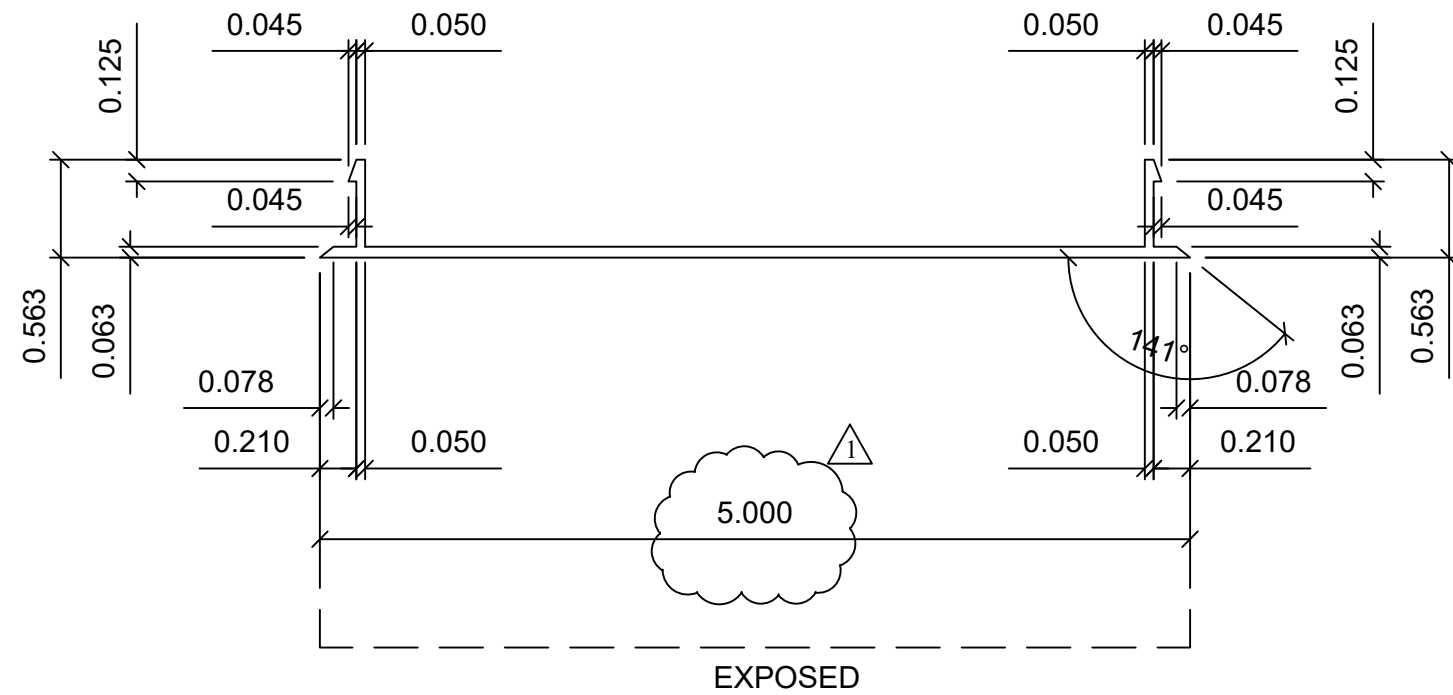


ASSEMBLY VIEW
SCALE: 1"=1"

SCALE = 2X

MATERIAL: ALUM ALLOY 6063-T6		FreMarq Innovations PO BOX 512 MERRILL, WI 54452	TITLE: 2 1/2" SNAP-ON COVER	
TOLERANCE: INDUSTRY STANDARD			DRAWN BY: TAF	
Perimeter = 8.506	RADIUS: 0.03" UNO	DATE: 6-24-14		
AREA= 0.210	WEIGHT= 0.252 LB/FT	PART NO.	AL-CVR-2500	

Drawing has been reviewed to verify compliance with specimen tested.
 QCT-TH-10591
 A. Tange



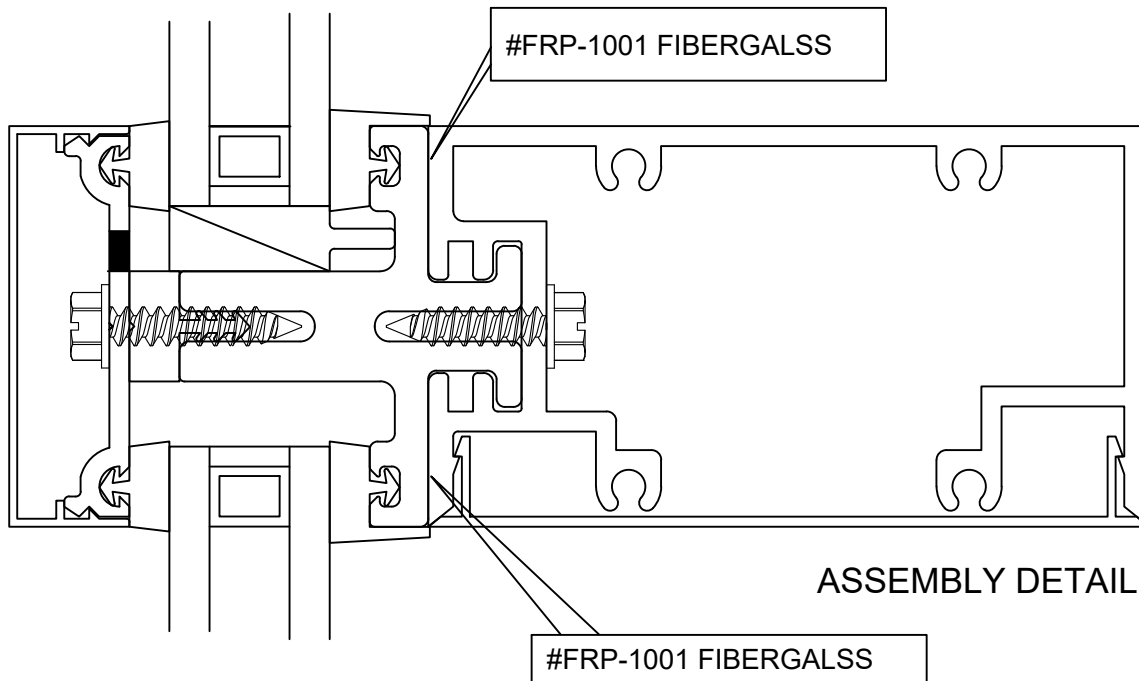
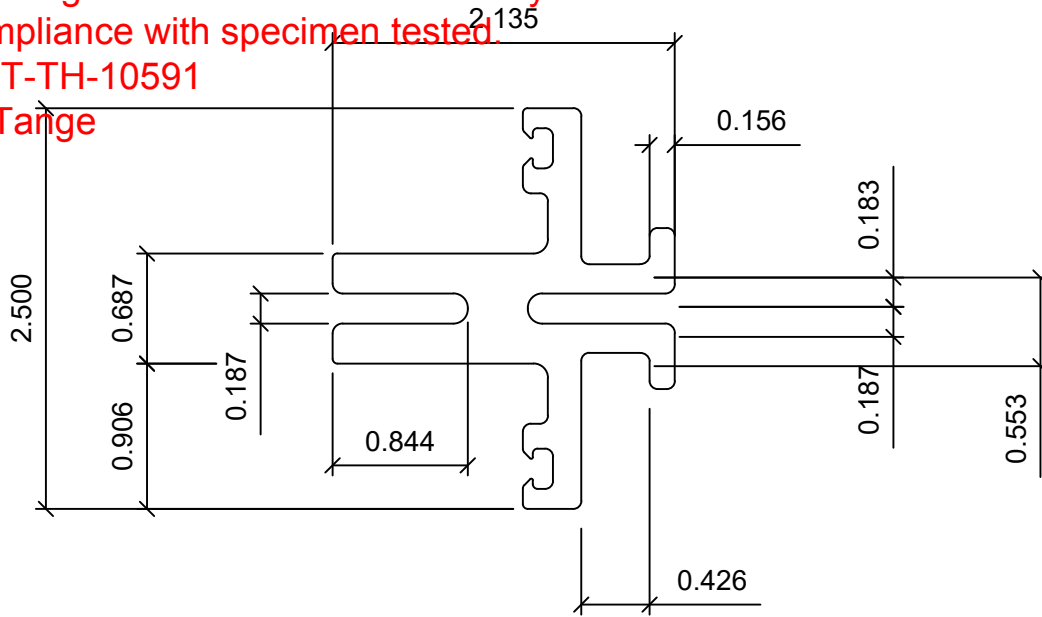
△ REVD 10-7-15
 INCREASED DEPTH

MATERIAL: ALUM ALLOY 6063-T6		FreMarq Innovations PO BOX 512 MERRILL, WI 54452	TITLE: 5" HORIZ. COVER	
TOLERANCE: INDUSTRY STANDARD			DRAWN BY: TAF	
Perimeter = 12.15	RADIUS:	DATE: 6-24-14		
AREA= 0.363	WEIGHT= 0.436 LB/FT	PART NO.	AL-5-1012	

Drawing has been reviewed to verify compliance with specimen tested.

QCT-TH-10591

A. Tange



2 REVD 9-24-15. ADDED DIMENSIONS

1 REVD 9-23-15. INCREASED DEPTH & THICKNESS

Baydur PUL-2500

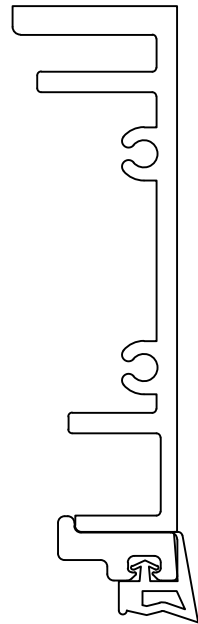
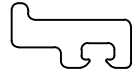
AREA = 1.600 SQ.IN.

PART NO. PRP-1001

Drawing has been reviewed to verify compliance with specimen tested.

QCT-TH-10591

A. Tange



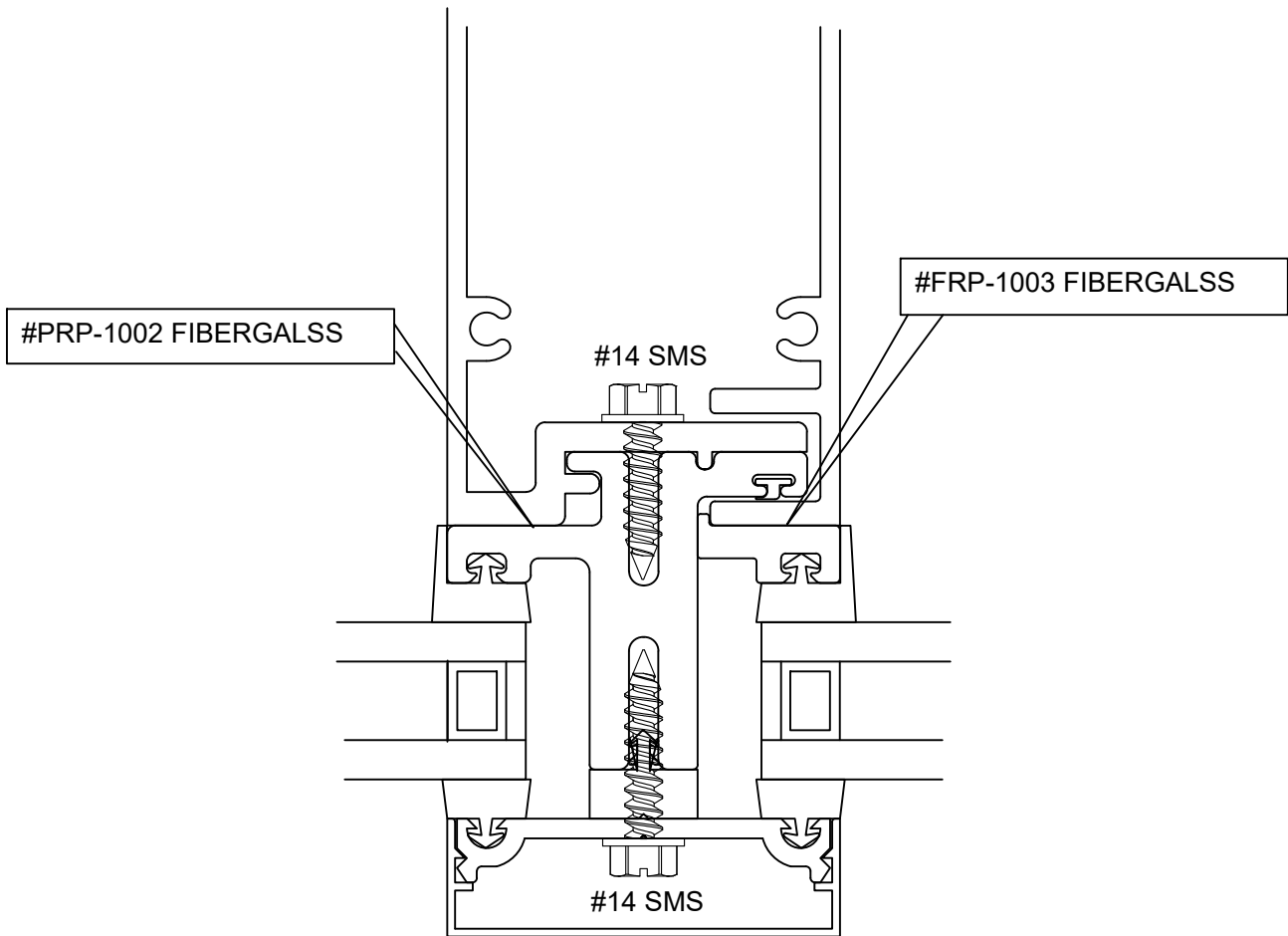
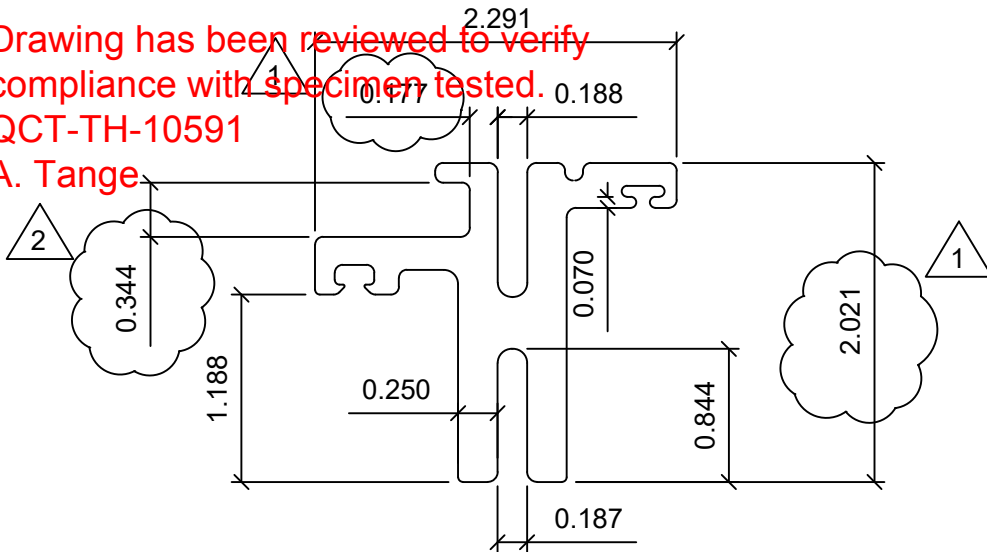
ASSEMBLY DETAIL

AREA = 0.246 SQ.IN.

PART NO. PRP-1003

Drawing has been reviewed to verify compliance with specimen tested.
 QCT-TH-10591

A. Tange



ASSEMBLY DETAIL

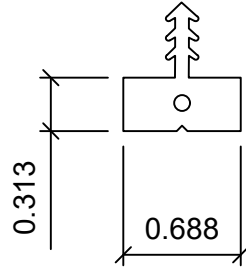
2 REVD 9-24-15. ADDED DIMENSIONS

1 REVD 9-23-15. INCREASED DEPTH & THICKNESS

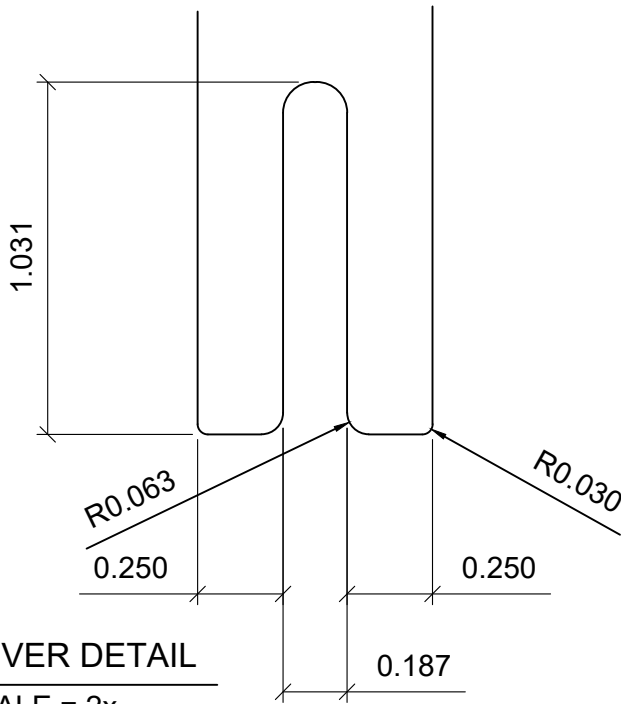
AREA = 1.462 SQ.IN.
PART NO. PRP-1002

Drawing has been reviewed to verify compliance with specimen tested.
 PART DESCRIPTION: ISOLATOR GASKET
 MATERIAL: 80 DUROMETER EPDM
 DESIGN FOR 0.313" GAP
 QCT# 10591

A. Tange



FULL SIZE DETAIL



RECEIVER DETAIL

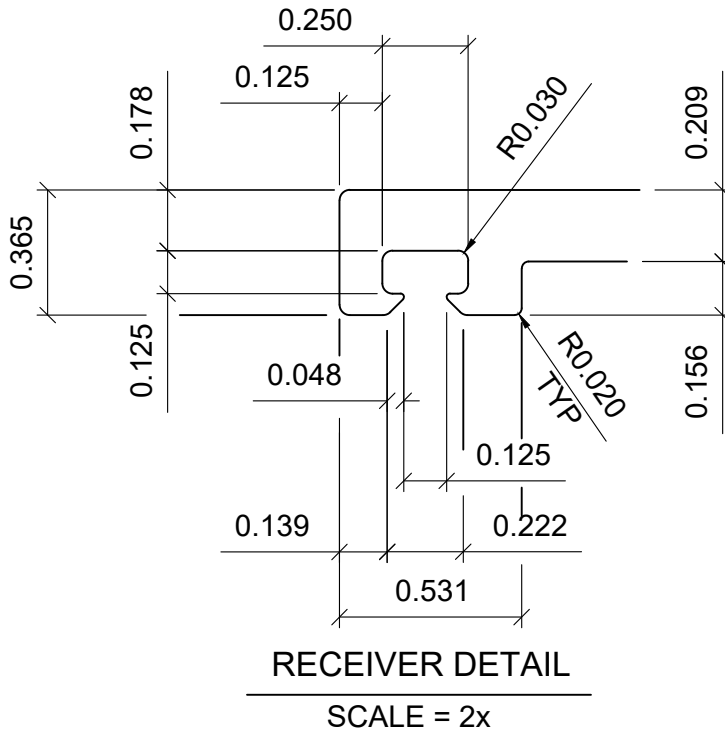
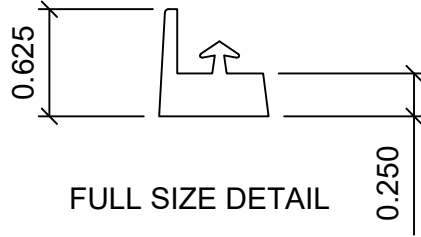
SCALE = 2x

MATERIAL: .See Note Above		FreMarq Innovations	TITLE: 5/16" ISOLATOR	
TOLERANCE: INDUSTRY STANDARD			DRAWN BY: TAF	
Perimeter =	RADIUS:	MAILING: PO BOX 512 MERRILL, WI 54452		DATE: 3-14-17
AREA=	WEIGHT=	SHIP TO: 8300 HIGHLAND DR. WAUSAU, WI 54401		PART NO. GSK-1002

PART DESCRIPTION: INTERIOR PRESET GASKET
 MATERIAL: 304L STAINLESS STEEL
 DESIGN FOR 0.250" GAP AND WELDED CORNER CAPABILITIES

Drawing has been reviewed to verify compliance with specimen tested.
 QCT-PP-10591

A. Tange



MATERIAL: .See Note Above		FreMarq Innovations	TITLE: 1/4" INTERIOR GASKET	
TOLERANCE: INDUSTRY STANDARD			DRAWN BY: TAF	
Perimeter =	RADIUS:	MAILING: PO BOX 512 MERRILL, WI 54452 SHIP TO: 8300 HIGHLAND DR. WAUSAU, WI 54401	DATE: 9-15-14	
AREA=	WEIGHT=		PART NO.	GSK-1001

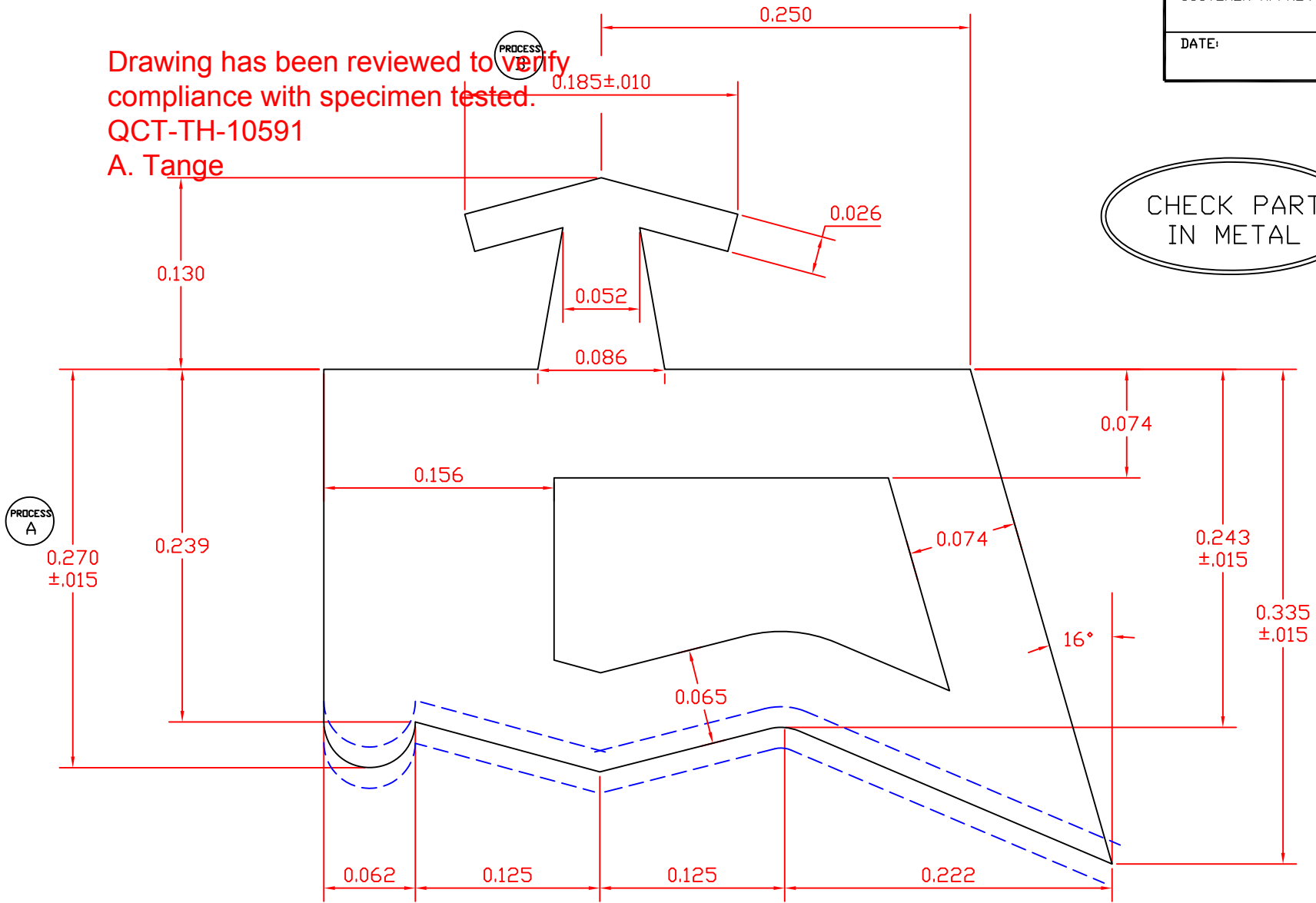
CUSTOMER APPROVAL:
DATE:

Drawing has been reviewed to verify compliance with specimen tested.

QCT-TH-10591


A. Tange

CHECK PART IN METAL



3080-04-01 CASCADE LABELS

ACTUAL SIZE

		EXTRUDED POLYMERS FOR GLAZING, INC. 1205 Danner Drive Aurora, Ohio 44202 (330) 995-9725 fax (330) 995-9734	
EPG PART NUMBER	3080-04-00	DATE	5-24-00
CUSTOMER PART NUMBER	.250FC .250DC .000 TL	SCALE	10X
COMPOUND NUMBER	260555	AREA	.115
DIE NUMBER	3080	FILE	30800400
		DRAWN BY	MRG

RMA Class		2
above	up to	Precision
0.000	0.060	+/- .010
0.060	0.100	+/- .010
0.100	0.160	+/- .016
0.160	0.250	+/- .020
0.250	0.390	+/- .030
0.390	0.630	+/- .031
0.630	0.980	+/- .039
0.980	1.570	+/- .051
1.570	2.480	+/- .063
2.480	3.940	+/- .079

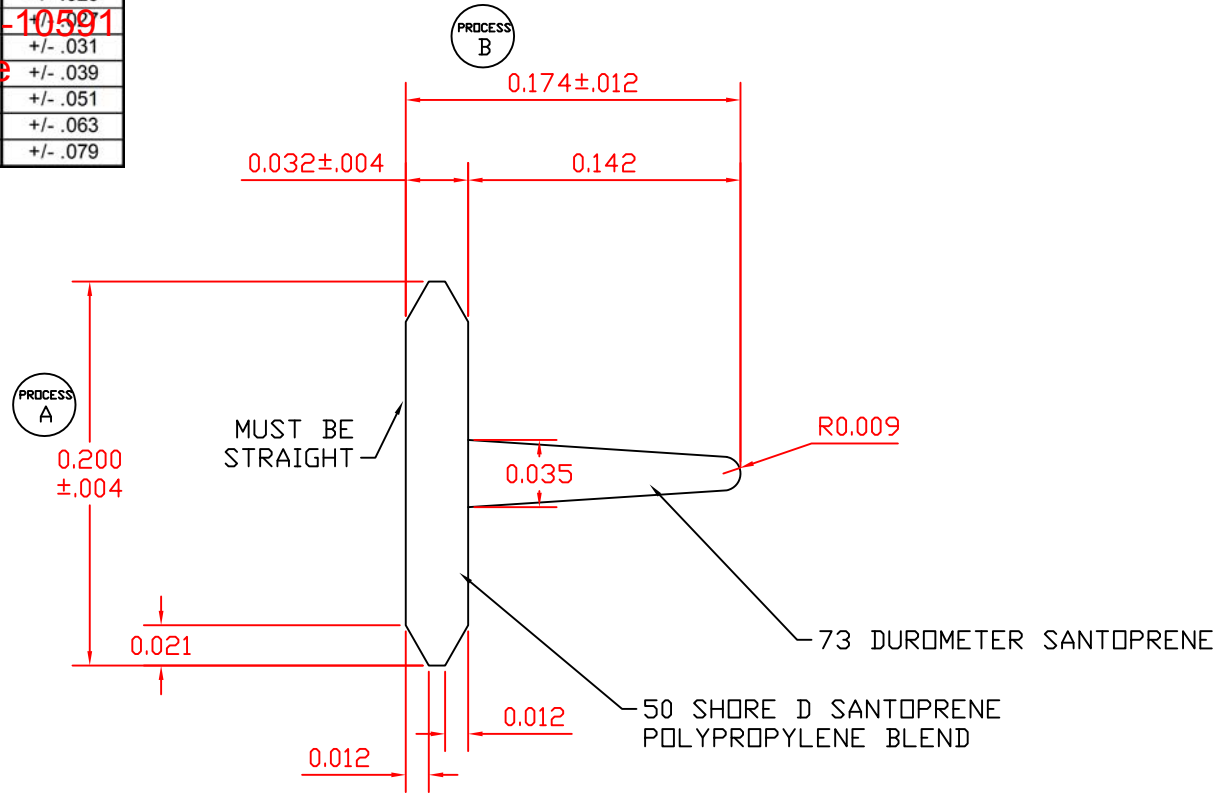
Drawing has been reviewed to verify compliance with specimen tested.

OCT 11-10-99

A. Tange

CUSTOMER APPROVAL:


DATE:



3998-01-02 U/M BOX (3,000 FT)

ACTUAL SIZE

ALL TOLERANCES ARE RMA CLASS II UNLESS OTHERWISE NOTED

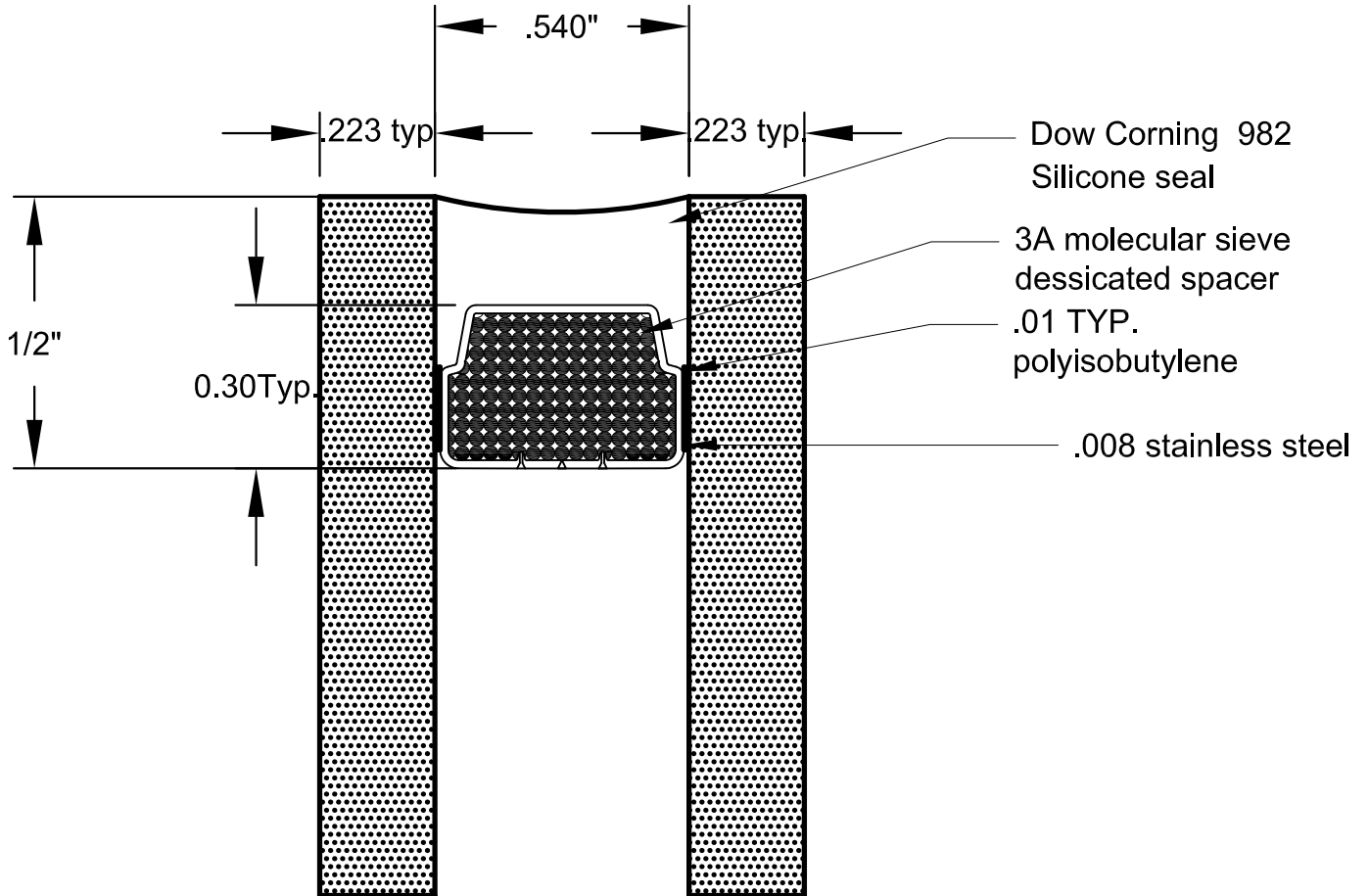


EXTRUDED POLYMERS FOR GLAZING, INC.
 1780 MILLER PARKWAY
 STREETSBD RD OHIO 44241
 (330) 995-9725 FAX (330) 995-9734

EPG PART NUMBER 3998-01-01		DATE 3-21-05
CUSTOMER PART NUMBER		SCALE 10X
COMPOUND NUMBER		AREA .007/.004
DIE NUMBER 3998	FILE 39980100	DRAWN BY MRG

Drawing has been reviewed to verify compliance with specimen tested.
 QCT-TH-10591
 A. Tange

Typical
 1" Insulating Unit
 Stainless steel



REV.	DATE	REVISED BY	DESCRIPTION

BASE AS VIEWED FROM EXTERIOR (surface #1)

DRAWN BY: _____ DATE DRAWN: _____

BLOCK SIZE: _____ LINE#: _____ DRAWING#: _____ OPTI#: _____
(JOB # - TAG)

CUSTOMER / Job Name: _____ CNC#: _____

Cat. #: _____