



Report No.: QCT-TH-10591.01-CRF-R2

Test Date: 1/16/2016

Original Report Date: 1/18/16

Expiration Date: 1/18/21

Revision Date: 5/25/18

AAMA 1503-09 THERMAL PERFORMANCE TEST REPORT

Rendered To:

FreMarq Innovations

8300 Highland Drive

Wausau, WI 54401

Series/Model: Zero Net PW2500

QUAST CONSULTING AND TESTING, INC.

Exterior Façade/Fenestration Consulting Testing

1055 Indianhead Drive • Mosinee, WI 54455-0241 • Phone: 715-693-TEST (8378) • Fax: 715-693-0689 www.qct-usa.com



AAMA 1503-09 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")

Test Sample Submitted by: FreMarq Innovations

Test Procedure:

The condensation resistance factor (CRF) and thermal transmittance (U) were determined in accordance with AAMA 1503-09, *Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections*.

Test Results Summary:

	Quantity	Unit
Thermal Trasmittance Due to Conducton (U_c):	0.32	Btu/(hr·ft ² ·F)
Condensation Resistance Factor - Frame (CRF _f):	82	
Condensation Resistance Factor - Glass (CRF _g):	72	
Overall CRF Number	72	



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.

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

Screen:	Frame	Exterior Sash	Interior Sash
None	N.A.	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*
Desiccant	Yes

*Stated per Client/Manufacturer
Not Applicable (N.A.)



Test Data	Quantity	Units
Warm Side Ambient Air Temperature (T_h)	69.80	deg F
Cold Side Ambient Air Temperature (T_c)	-0.40	deg F
Average of 14 Pre-Specified Frame Temperatures (FT_p)	57.38	deg F
Average of 4 Coldest Thermocouples (FT_c)	51.23	deg F
$[(FT_p - FT_r) / (FT_p - (T_c + 10))] \times 0.40 =$ Weighting Factor = W	0.090744	N.A.
$FT_p(1-W) + W(FT_r) =$ Frame Temperature (FT)	56.82	deg F
Average Glass Temperature (GT)	50.06	deg F
Condensation Resistance Factor - Glass $CRF_g = (GT - T_c) / (T_h - T_c) \times 100$	72	
Condensation Resistance Factor - Frame $CRF_f = (FT - T_c) / (T_h - T_c) \times 100$	82	

Test Duration

- The environmental systems were started on:
1/15/2016 16:56
- The test parameters were considered stable for two consecutive four hour test periods from:
1/16/2016 3:11 to 1/16/2016 11:11
- The thermal performance test results were derived from:
1/16/2016 7:11 to 1/16/2016 11:11

Glazing Deflection (inches)*:

Left Glazing	Right Glazing	
0.94	0.93	Edge gap width
0.94	0.91	Center gap width upon receipt of specimen (after stabilization)
0.94	0.91	Center gap width at laboratory ambient conditions before testing
0.94	0.91	Center gap width at test conditions

*Deflection determined using a digital glass and air space meter in accordance with AAMA 1503-09, Section 9.3.5.



CRF Measured Data

Pre-Specified Thermocouples - Frame

1	52.1
2	54.1
3	53.4
4	61.3
5	61.5
6	61.3
7	60.1
8	60.1
9	60.3
10	57.2
11	57.2
12	53.2
13	61.6
14	57.9
FT _p	57.4

Pre-Specified Thermocouples - Glass

15	38.2
16	56.2
17	48.7
18	49.0
19	58.5
20	49.8
GT	50.1

Cold Point Thermocouples

	FTr 3; 49.65
	FTr 5; 51.06
	FTr 8; 51.32
	FT _p 11; 51.938
FT _c	51.2
W	0.090744
FT	56.8



Report No.: QCT-TH-10591.01-CRF-R2

Page 6 of 8
Revision Date: 5/25/18

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.

Prior to testing, the specimen was sealed with silicone on the interior side and checked for air infiltration per AAMA 1503-09, Section 9.3.4.

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.

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



Report No.: QCT-TH-10591.01-CRF-R2

Page 7 of 8
Revision Date: 5/25/18

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: Thermocouple Locations (1)

Appendix B: Drawings (16).

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

Technician

Andrew Tange, Test Engineer

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

Individual-In-Responsible-Charge

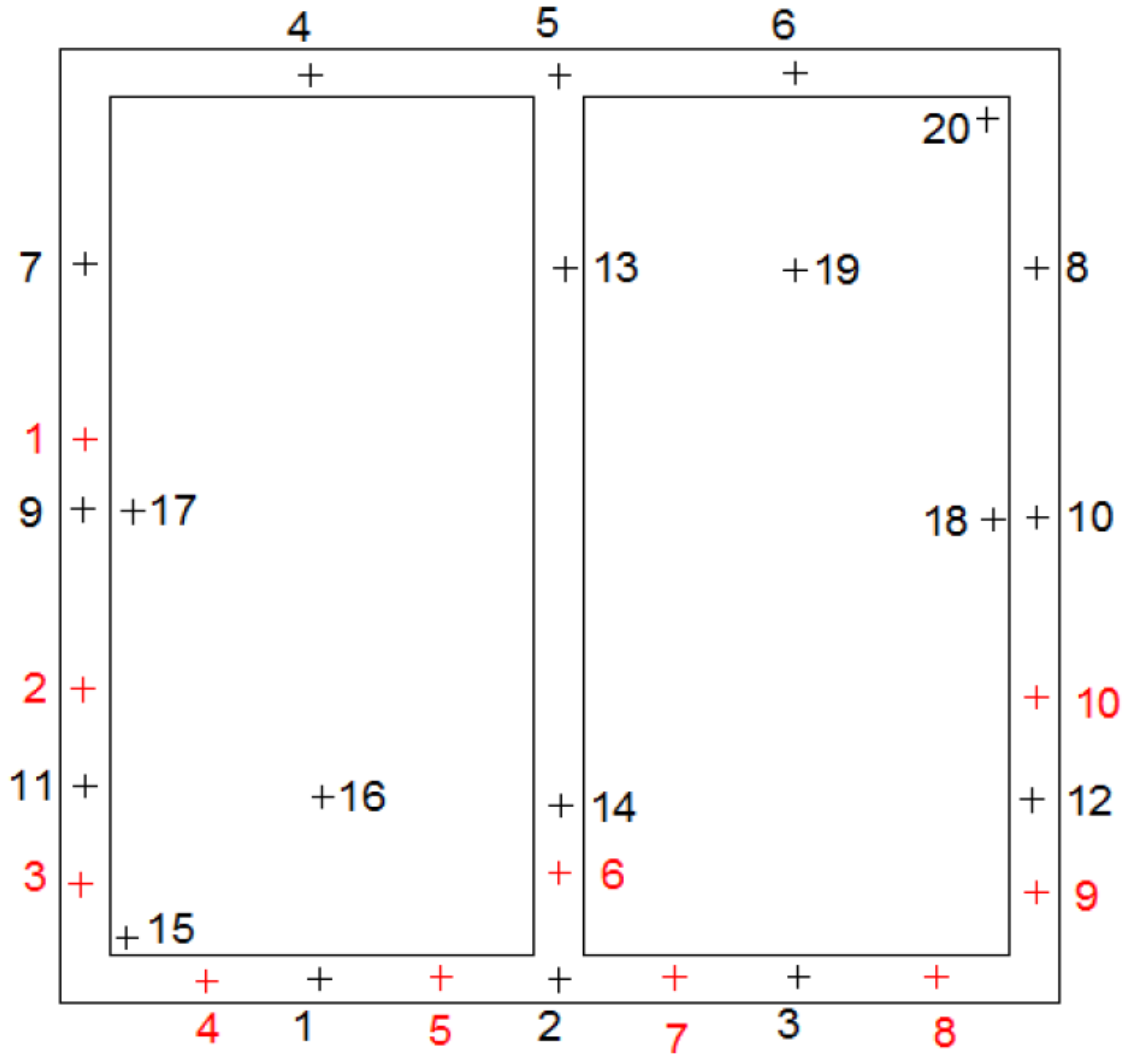


Report No.: QCT-TH-10591.01-CRF-R2

Page 8 of 8
Revision Date: 5/25/18

Revision No.	Date	Description
.01	1/18/16	Original report issued.
R1	06/10/16	Issued to FreMarq Innovations
R2	05/25/18	Revised product name

Appendix A: Thermocouple Locaton Diagram





Report No.: QCT-TH-10591.01-CRF-R2

Revision Date: 5/25/18

Appendix B: Drawings

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

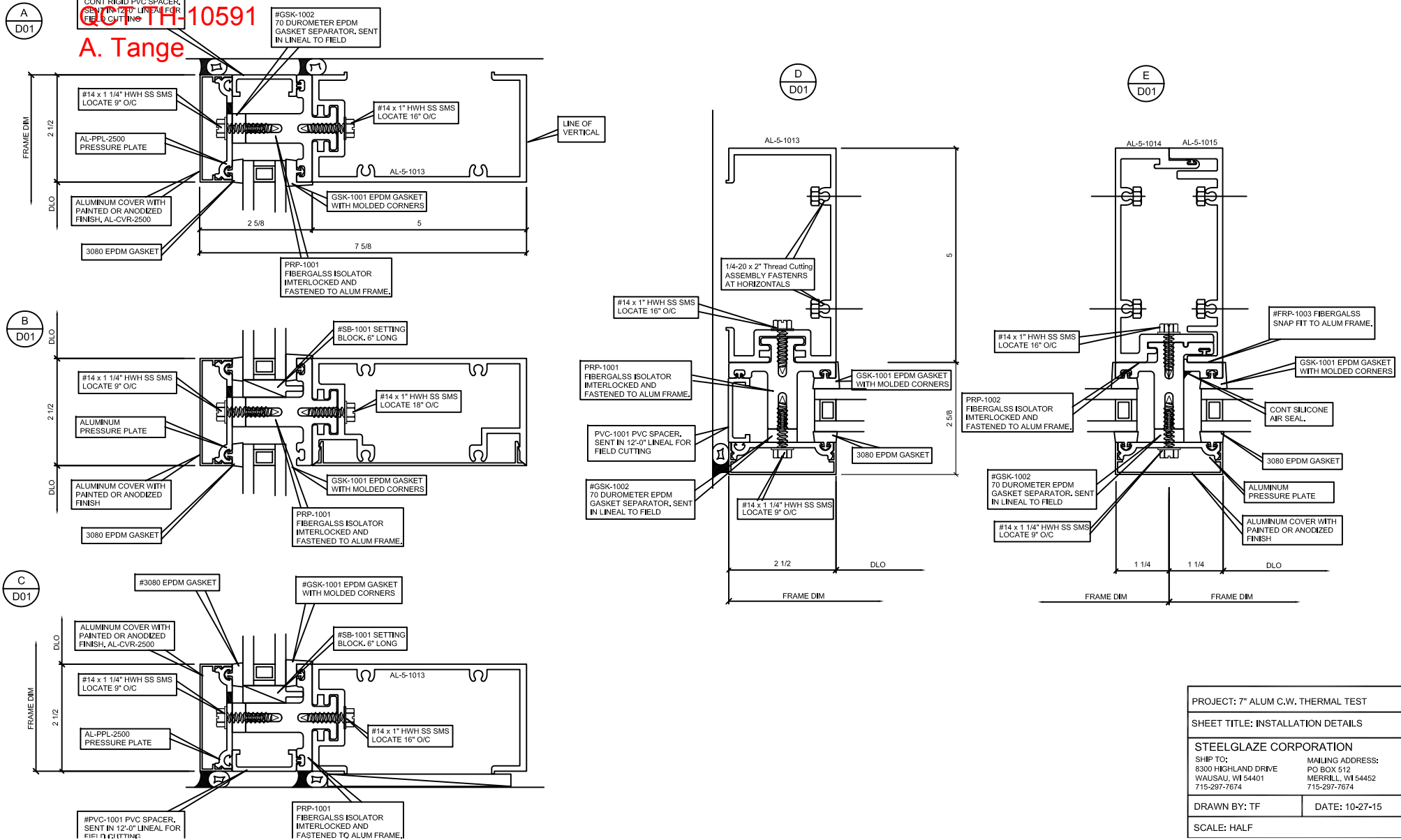
Overall Framing size: 2 1/2" x 7 1/2"

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.

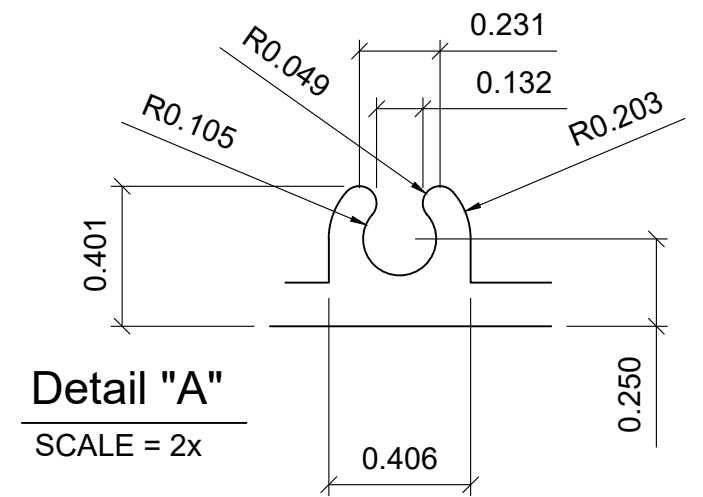
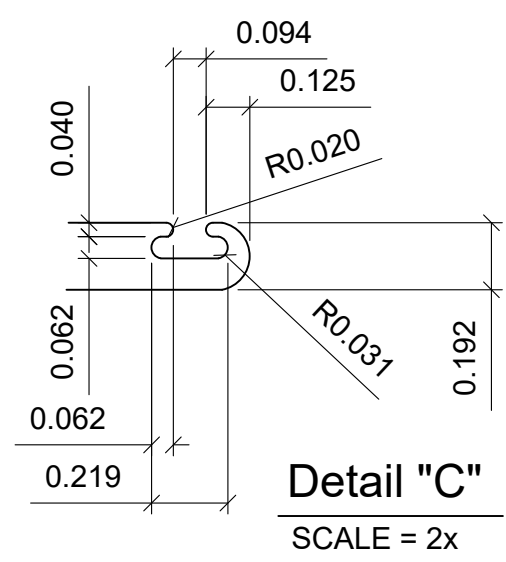
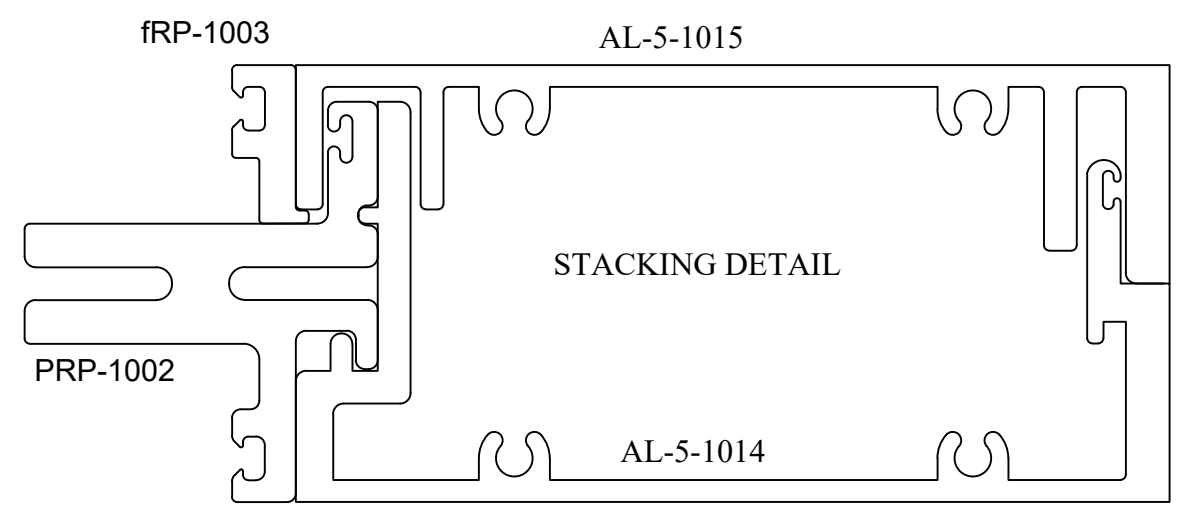
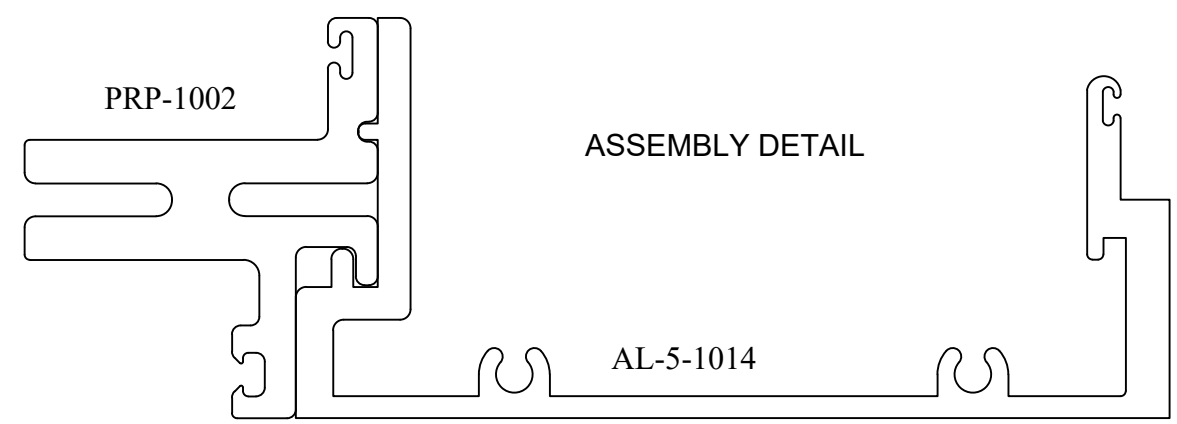
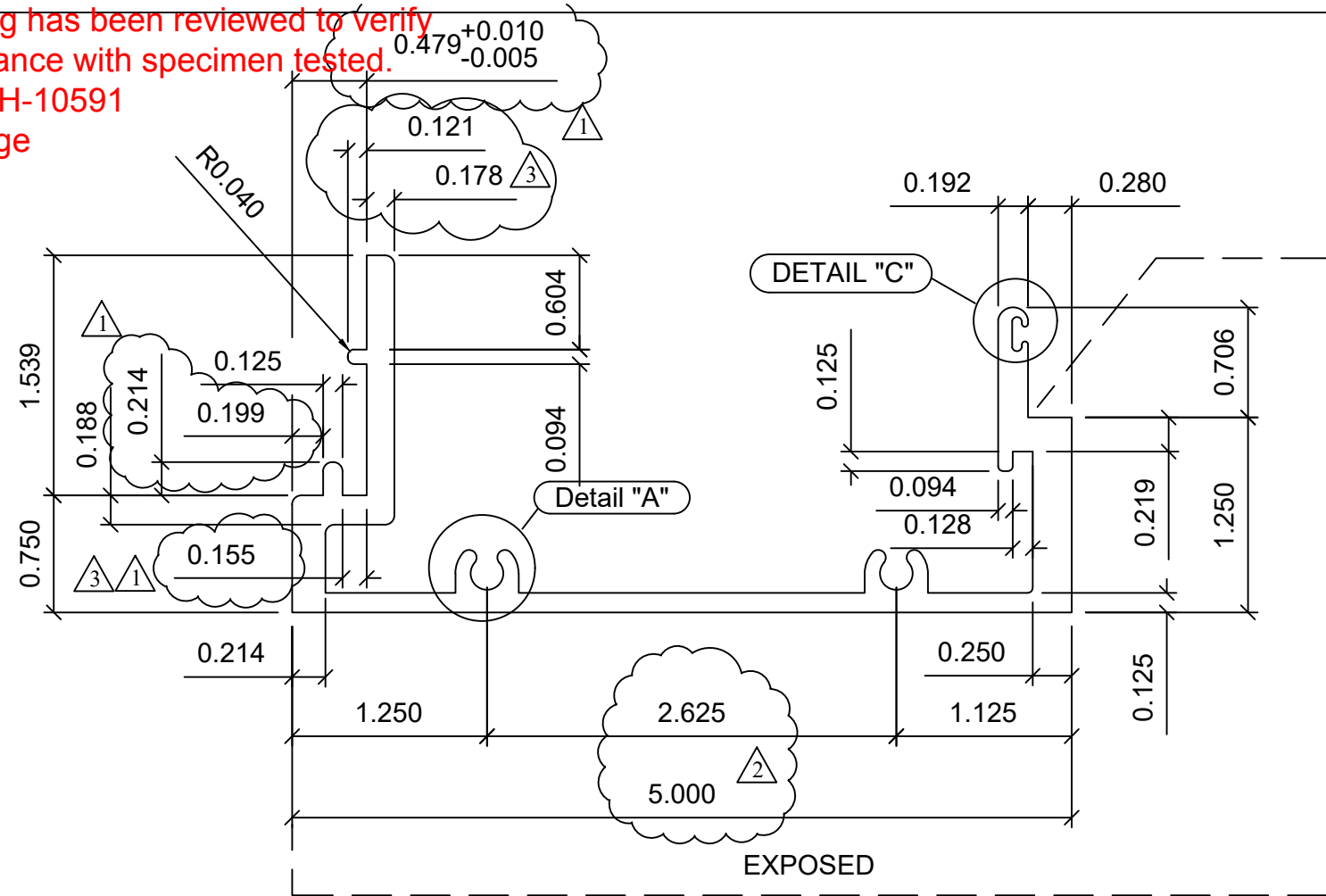
QCT-11-10591

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

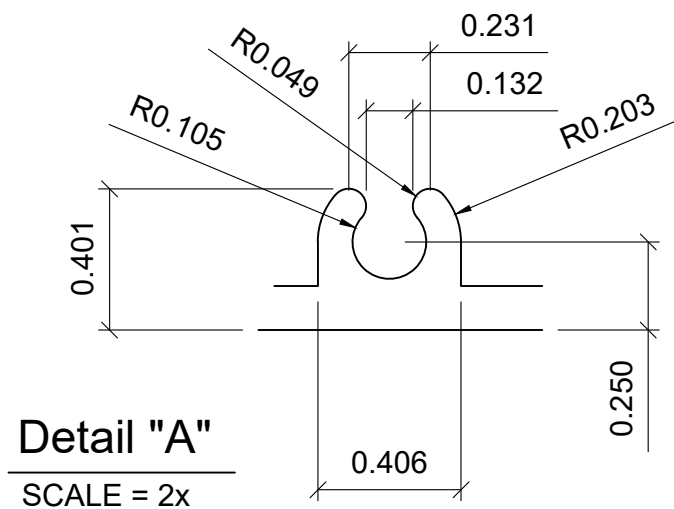
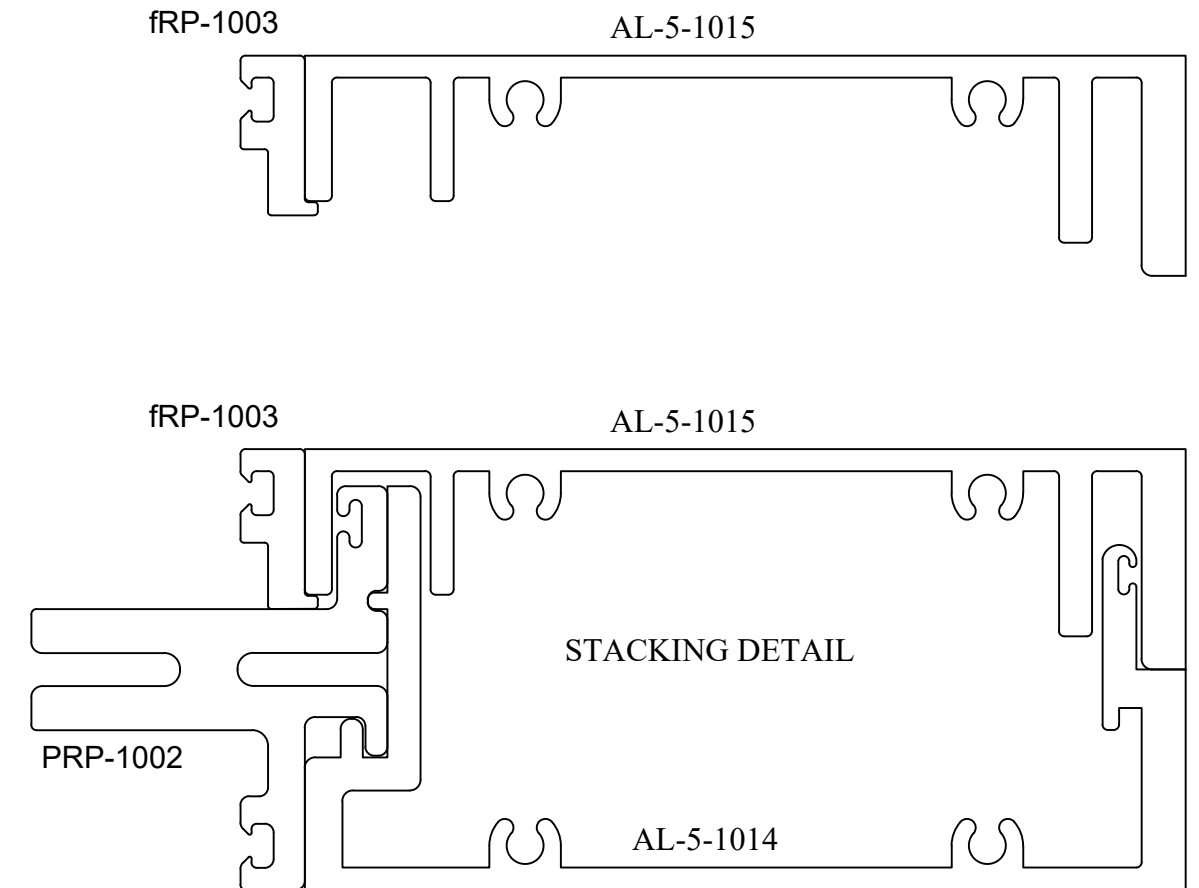
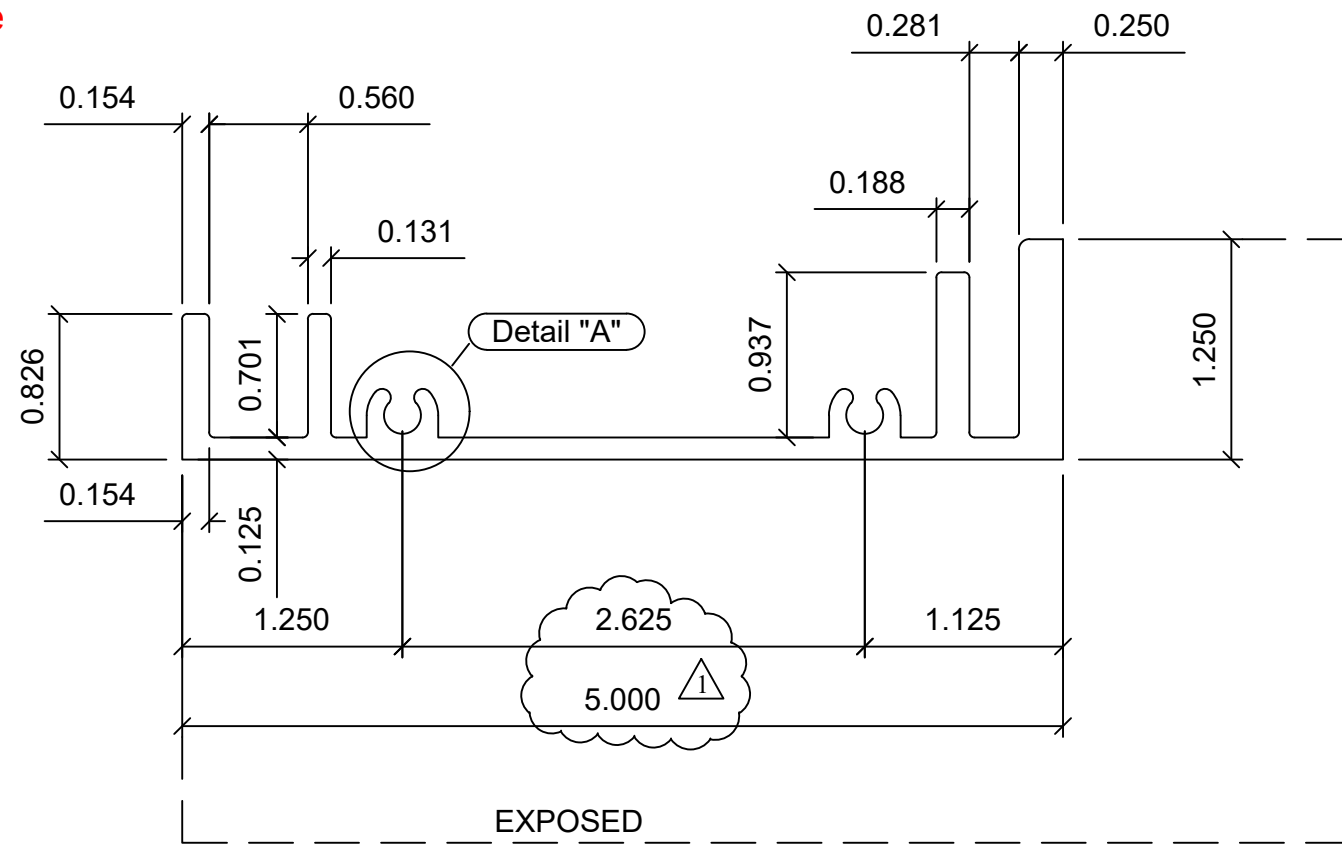


- △ REVD 6-1-16 DECREASED LEG THICKNESS
- △ REVD 10-7-15 INCREASED DEPTH
- △ REVD 9-29-15.

MATERIAL: ALUM ALLOY 6063-T6		TITLE: 5" MALE	
TOLERANCE: INDUSTRY STANDARD		DRAWN BY: TAF	
Perimeter = 22.393	RADIUS: 0.06" UNO	DATE: 8-20-15	
AREA= 1.746	WEIGHT= 2.095 LB/FT	PART NO.	AL-5-1014

FreMarq Innovations
 PO BOX 512
 MERRILL, WI 54452

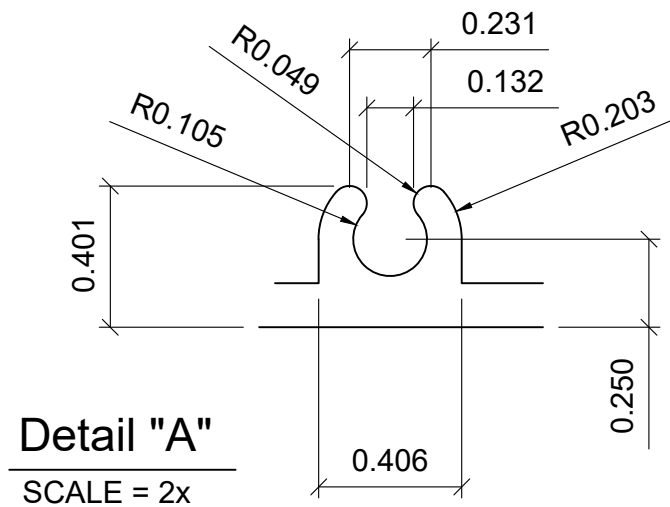
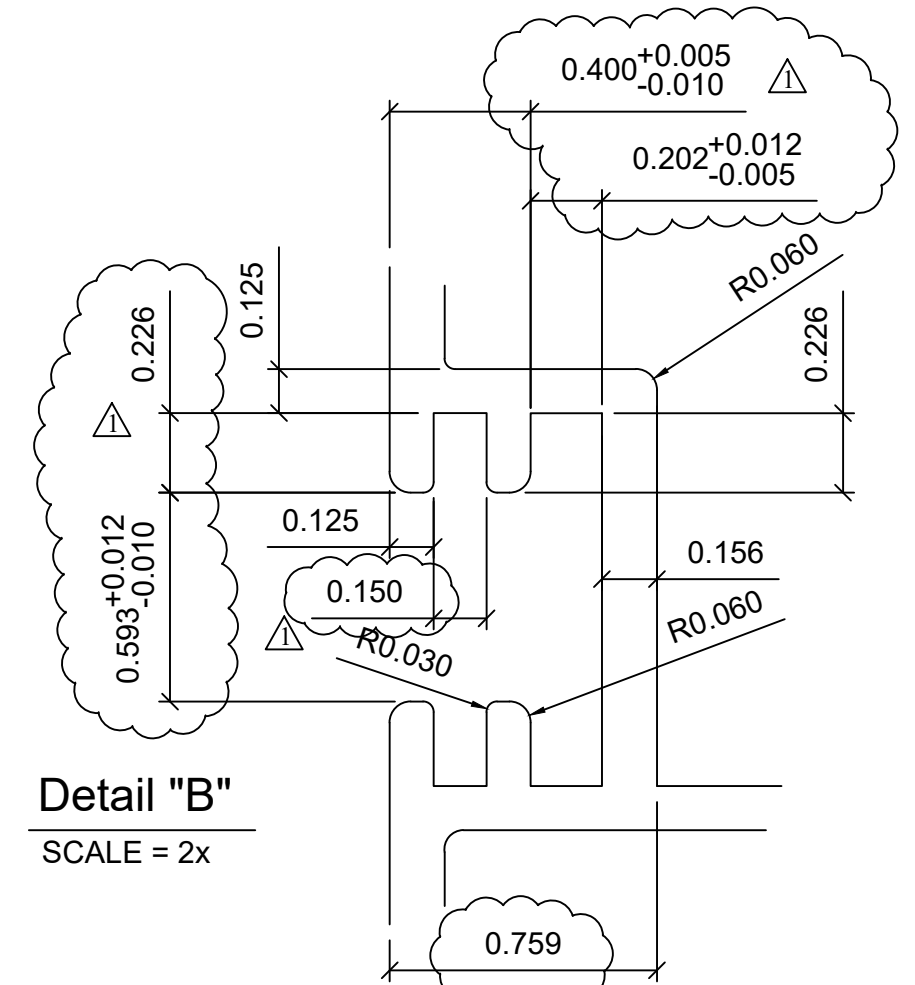
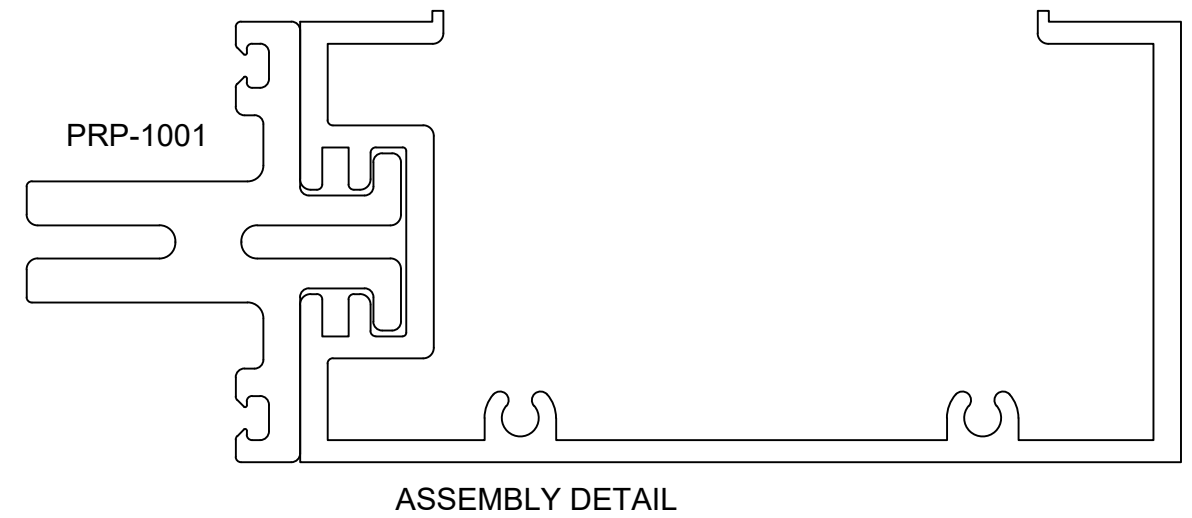
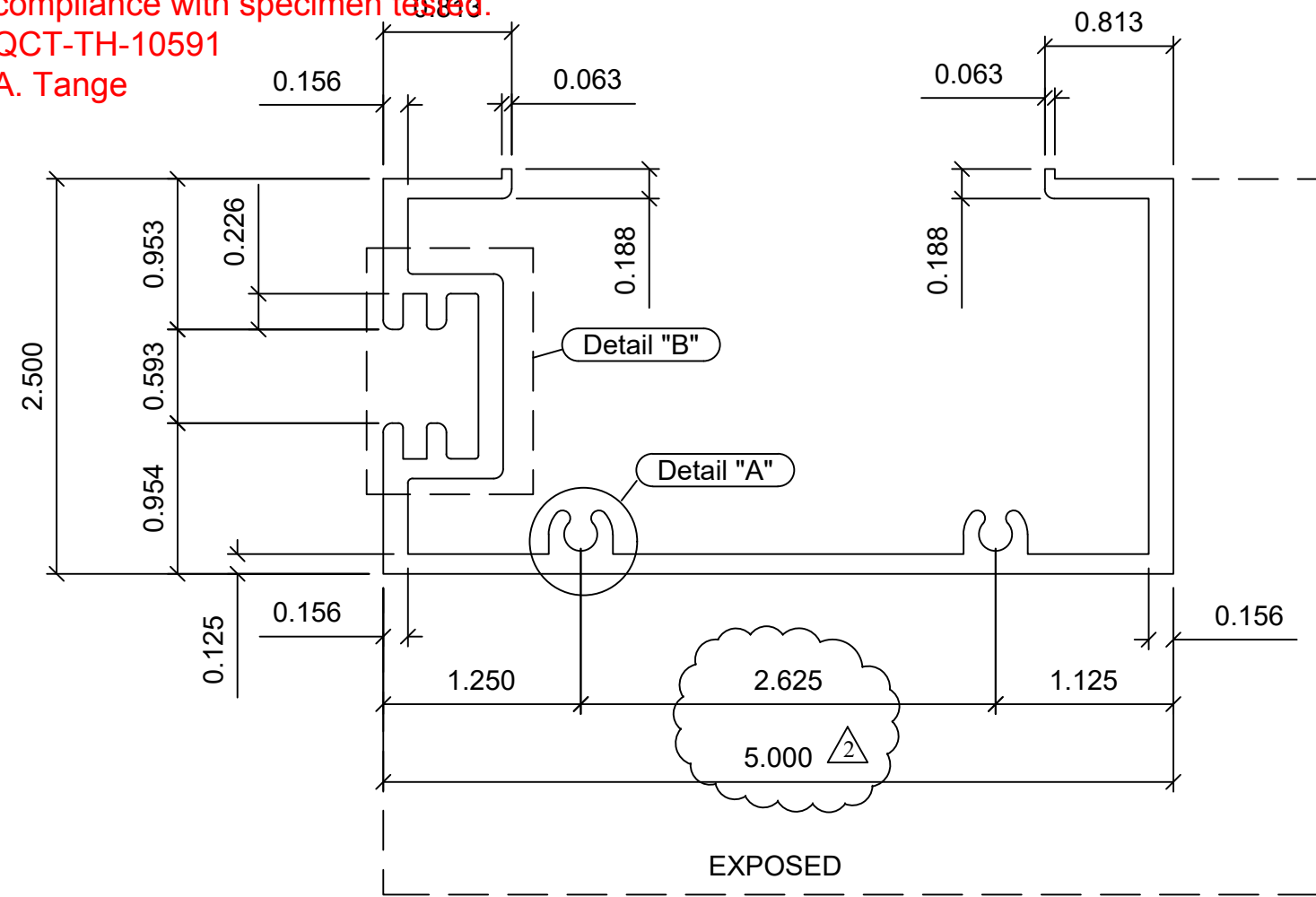
Drawing has been reviewed to verify compliance with specimen tested.
 QCT-TH-10591
 A. Tange



$\triangle 1$ REVD 10-7-15
 INCREASED DEPTH

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

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



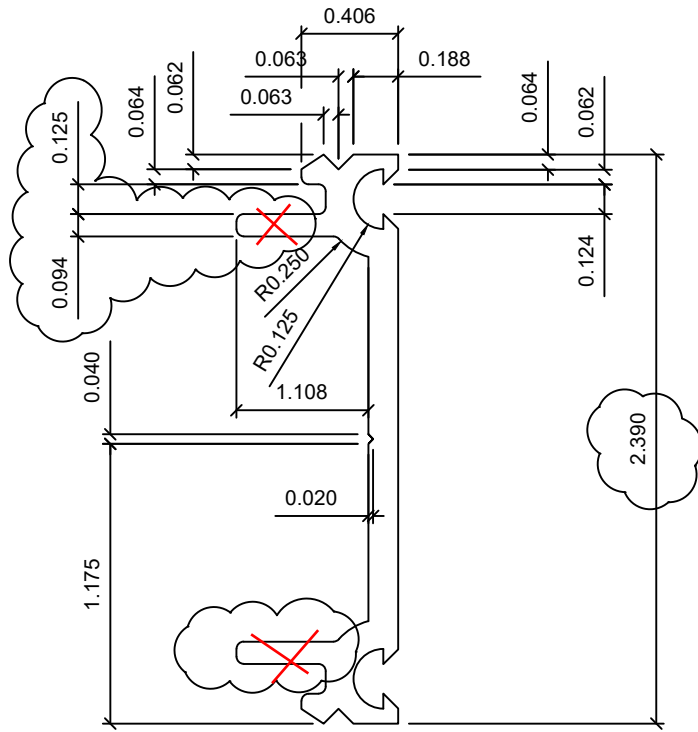
$\triangle 2$ REVD 10-7-15 INCREASED DEPTH
 $\triangle 1$ REVD 9-29-15.

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

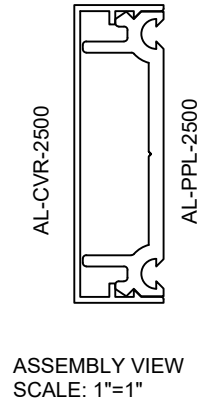
FreMarq Innovations
 PO BOX 512
 MERRILL, WI 54452

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



SCALE = 2X

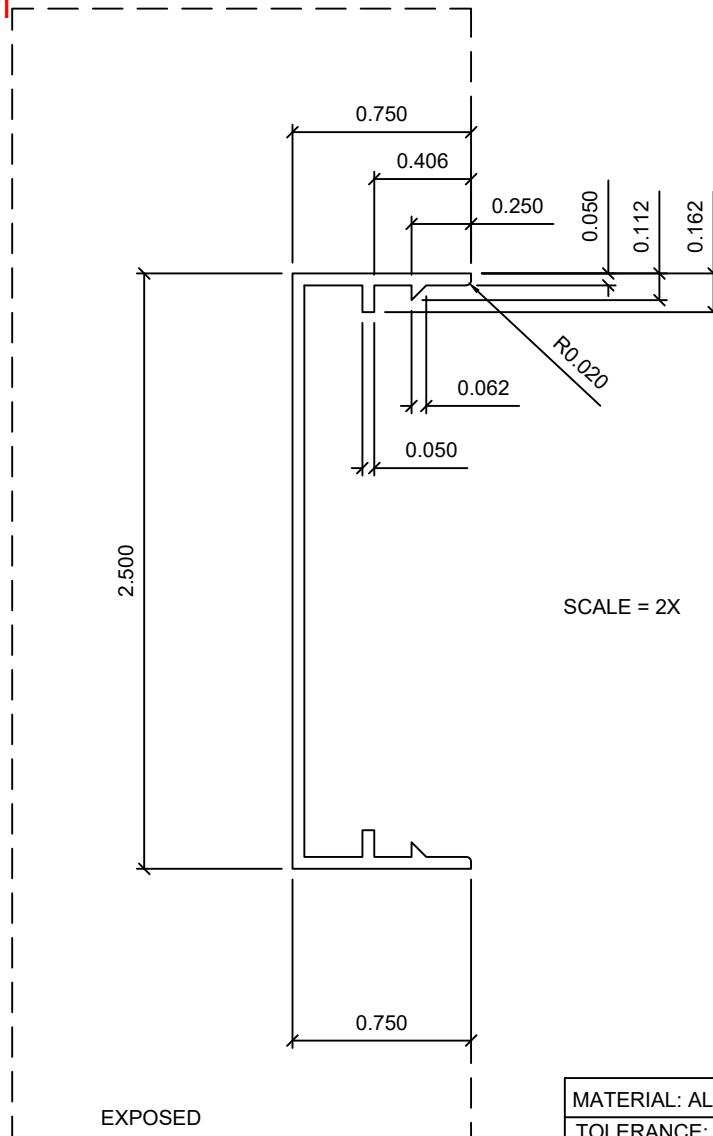


MATERIAL: ALUM ALLOY 6063-T6		STEELGLAZE, LLC	TITLE: 2 1/2" SNAP-ON COVER	
TOLERANCE: INDUSTRY STANDARD			DRAWN BY: TAF	
Perimeter = 8.390	RADIUS: 0.03" UNO	PO BOX 512 MERRILL, WI 54452	DATE: 6-24-14	
AREA= 0.446	WEIGHT= 0.535 LB/FT		PART NO.	AL-PPL-2500

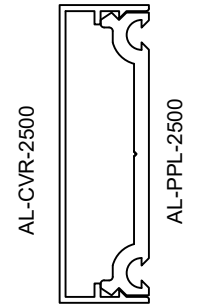
Drawing has been reviewed to verify compliance with specimen tested.

QCT-TH-10591

A. Tange



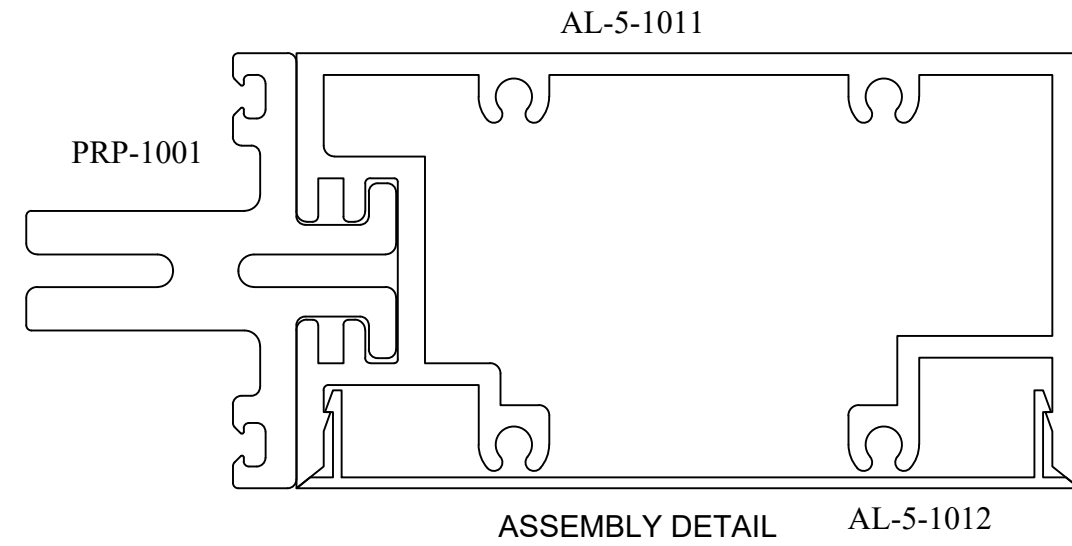
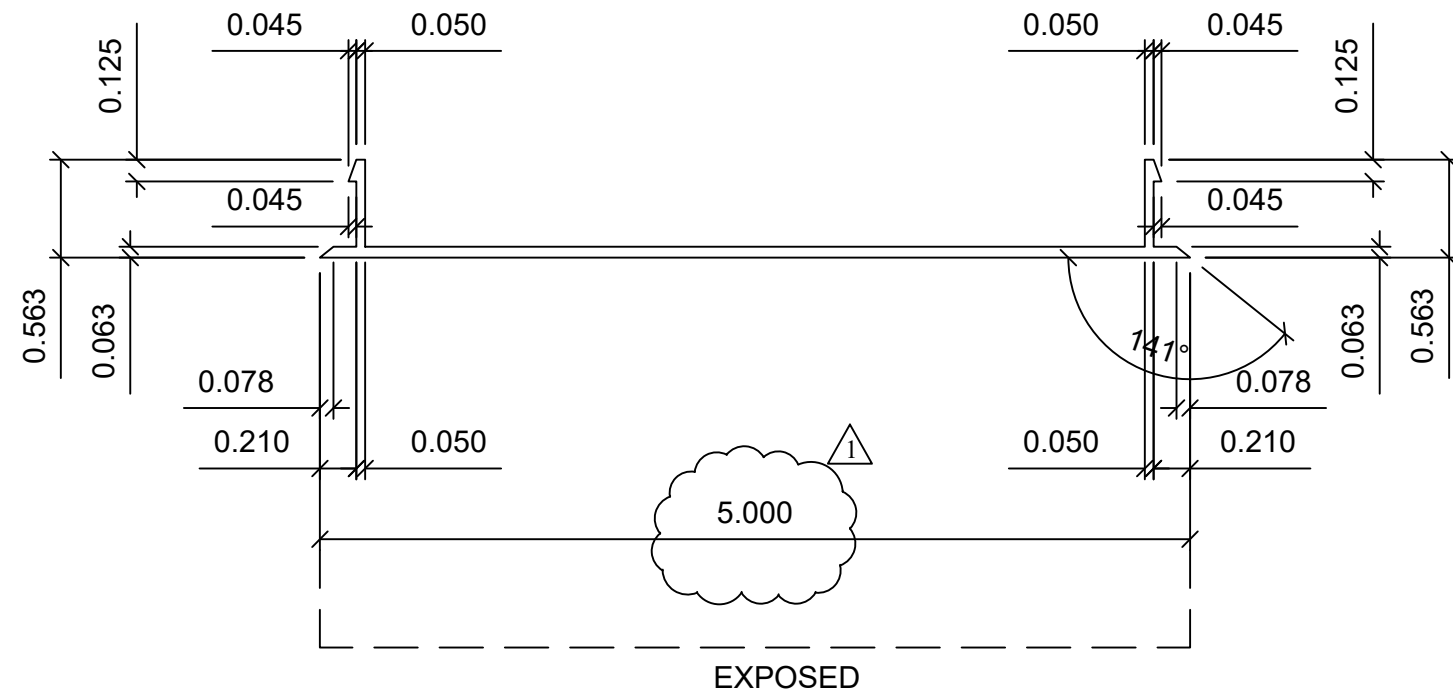
SCALE = 2X



ASSEMBLY VIEW
SCALE: 1"=1"

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



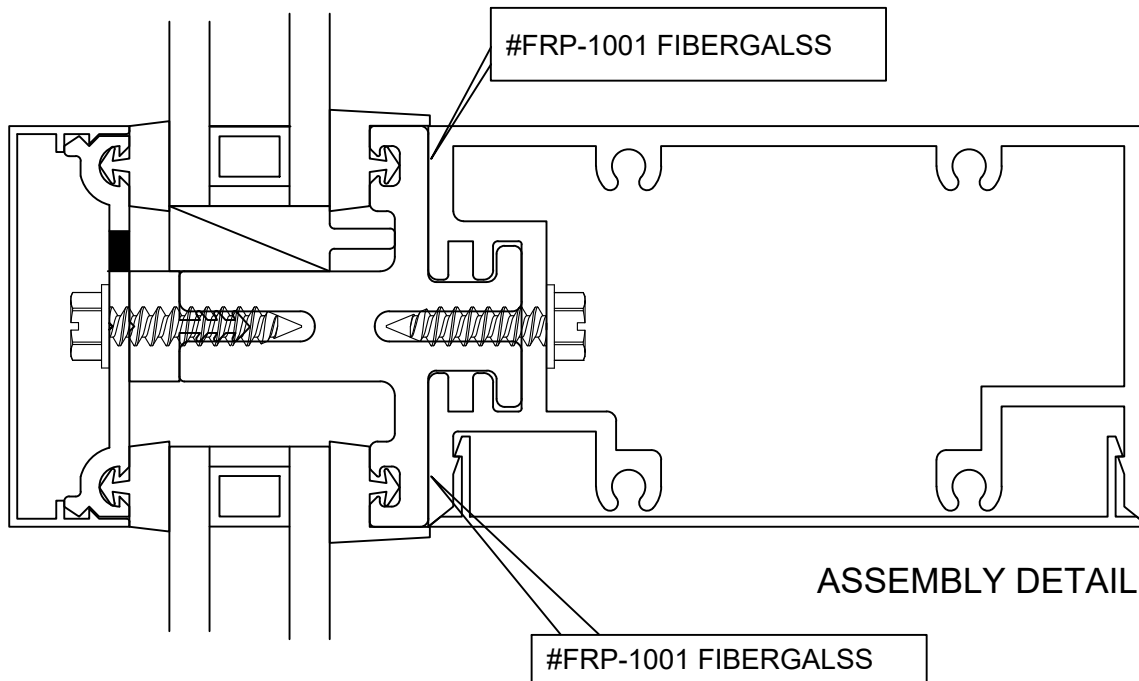
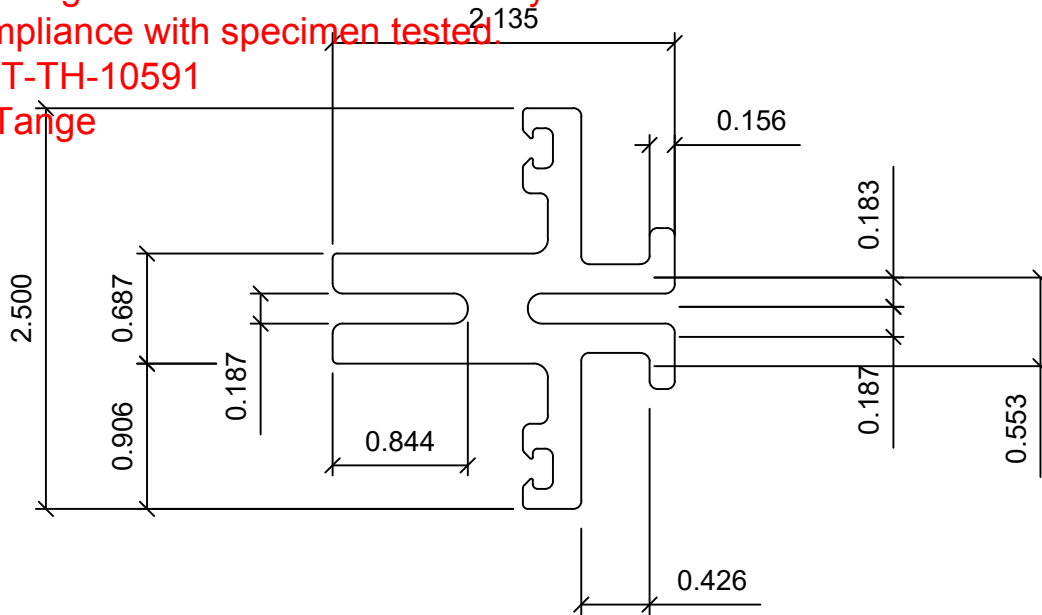
△ REVD 10-7-15
 INCREASED DEPTH

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

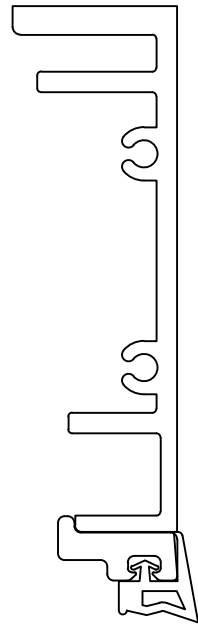
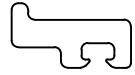
AREA = 1.600 SQ.IN.

PART NO. PRP-1001

Drawing has been reviewed to verify compliance with specimen tested.

QCT-TH-10591

A. Tange



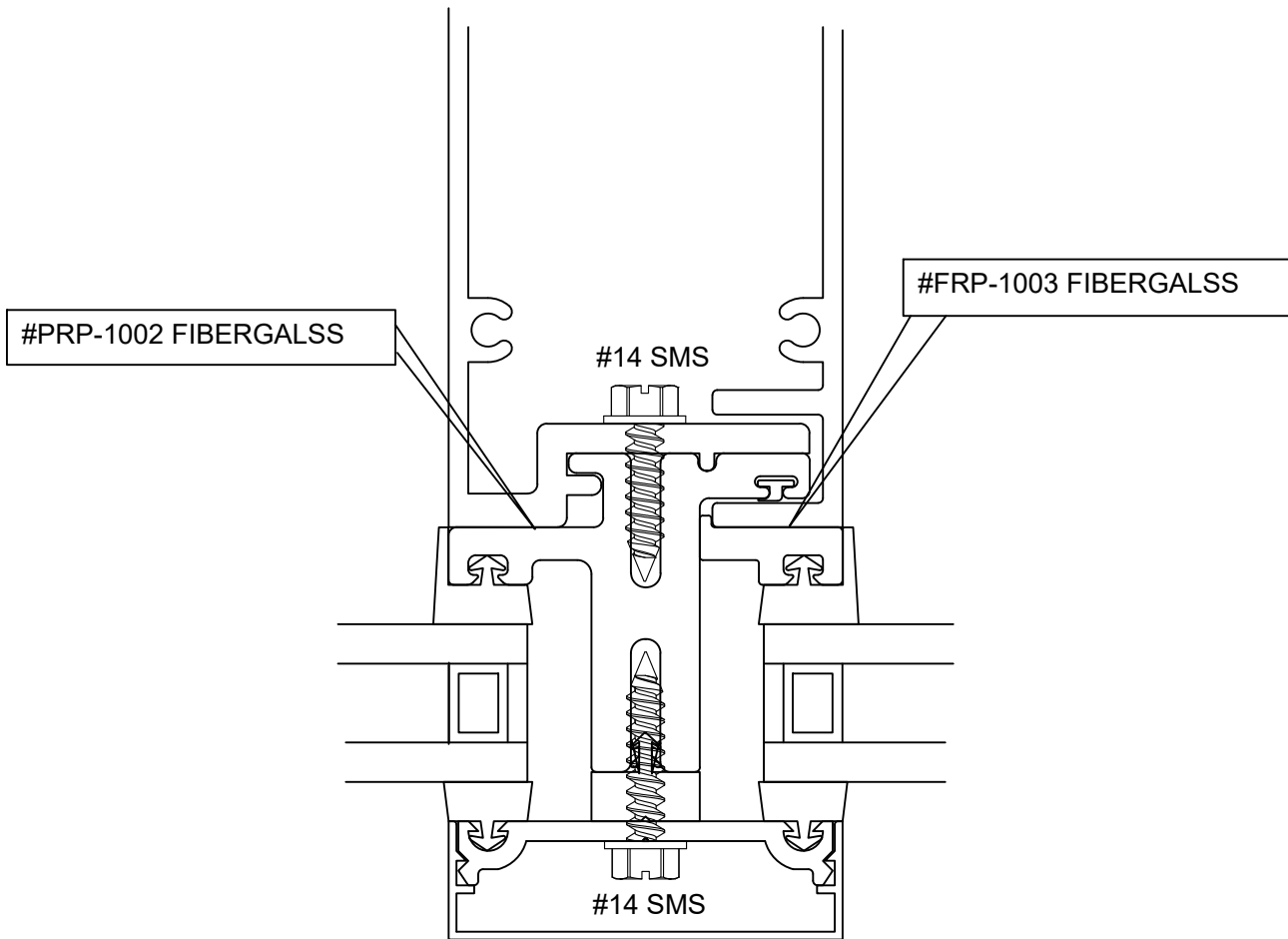
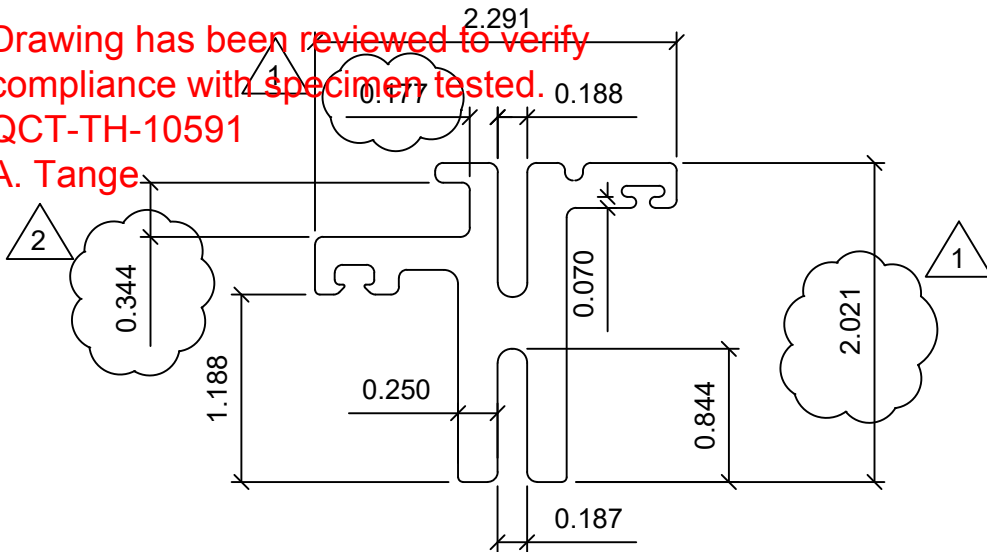
ASSEMBLY DETAIL

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

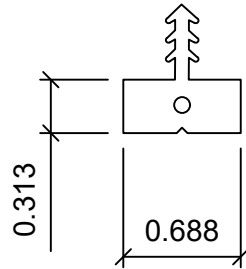
△ 2 REVD 9-24-15. ADDED DIMENSIONS

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

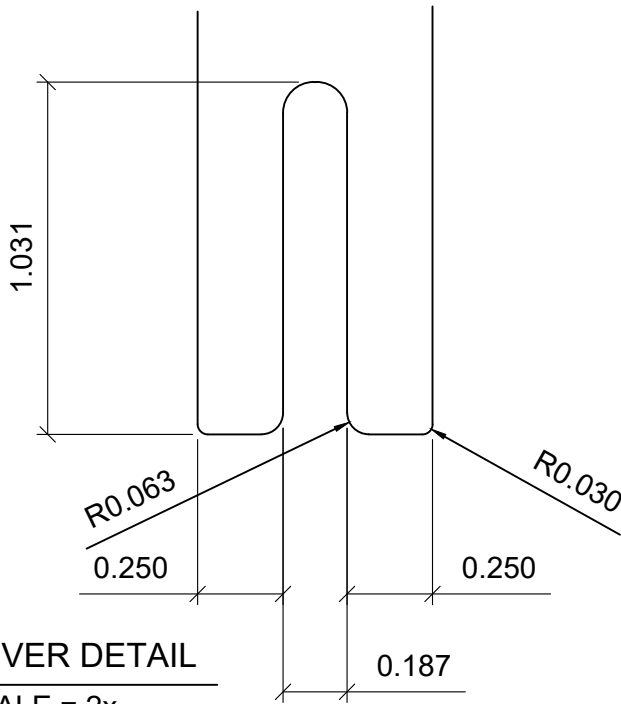
AREA = 1.462 SQ.IN.
PART NO. PRP-1002

PART DESCRIPTION: ISOLATOR GASKET
 MATERIAL: 80 DUROMETER EPDM
 DESIGN FOR: 3/16" GAP
 QCT# 10591

A. Tange



FULL SIZE DETAIL



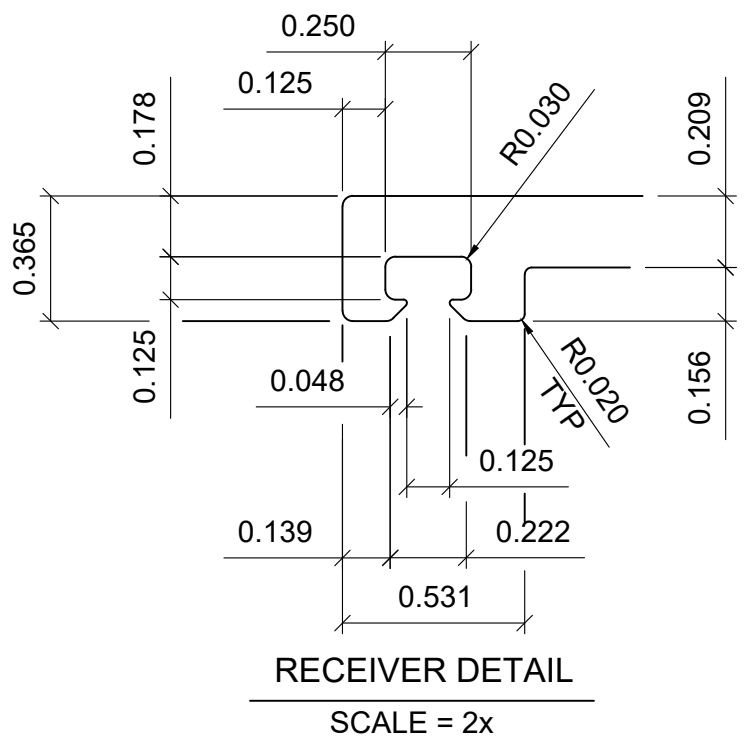
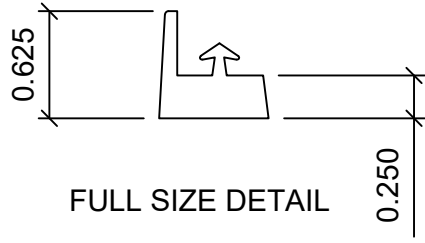
RECEIVER DETAIL

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: 304 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		DATE: 9-15-14
AREA=	WEIGHT=	SHIP TO: 8300 HIGHLAND DR. WAUSAU, WI 54401		PART NO. GSK-1001

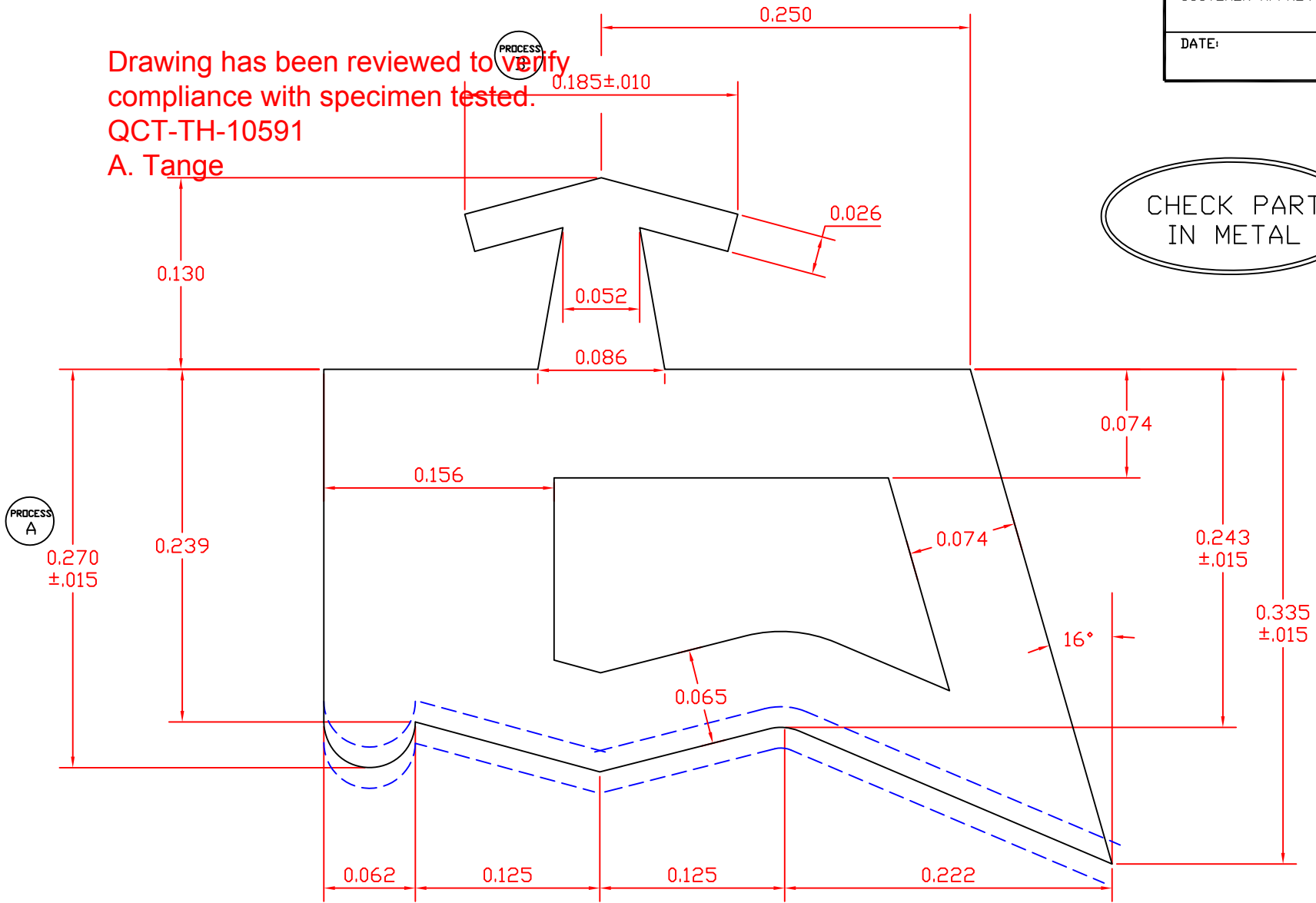
CUSTOMER APPROVAL:
DATE:

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

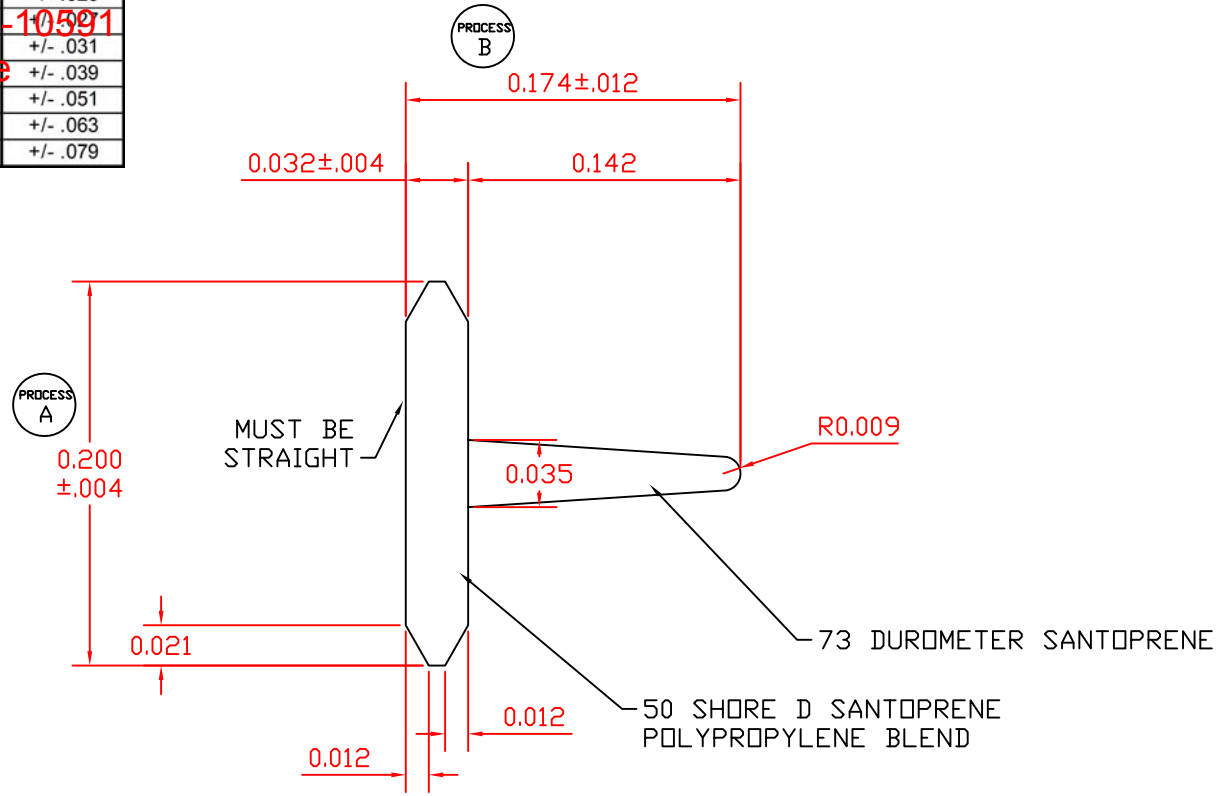
Drawing has been reviewed to verify compliance with specimen tested.

OCT 11-10-99

A. Tange

CUSTOMER APPROVAL:


DATE:



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

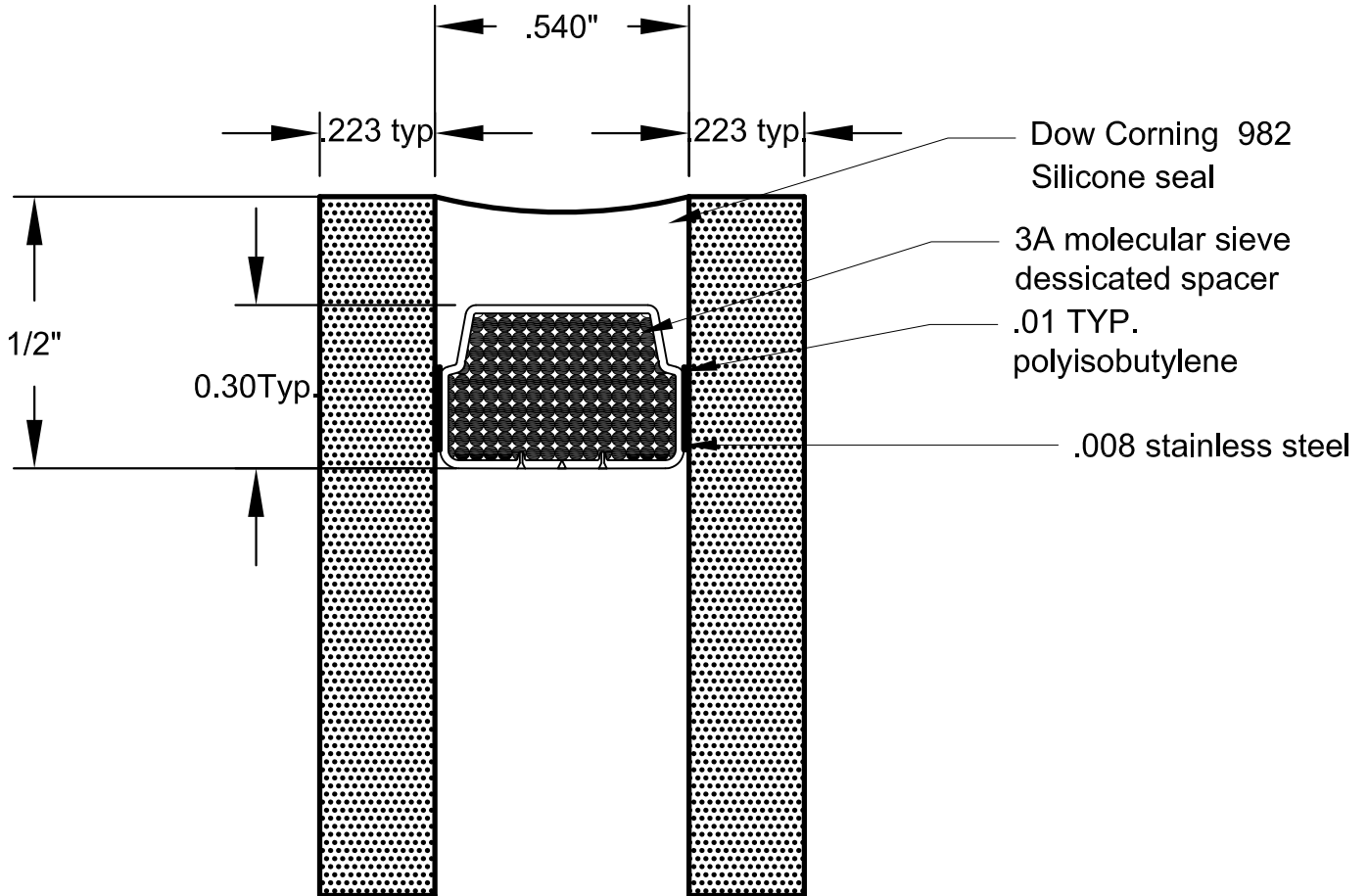
ACTUAL SIZE

ALL TOLERANCES ARE RMA CLASS II UNLESS OTHERWISE NOTED

 EXTRUDED POLYMERS FOR GLAZING, INC. 1780 MILLER PARKWAY STREETSBORO OHIO 44241 (330) 995-9725 FAX (330) 995-9734		
		EPG PART NUMBER 3998-01-01
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. #: _____