Architectural Testing

NFRC U-FACTOR, SHGC, VT, & CONDENSATION RESISTANCE COMPUTER SIMULATION REPORT

Rendered to:
TUBELITE, INC.

SERIES/MODEL:
300ES Curtain Wall (8" System)

Report Number: **C8685.02-116-45**
Report Date: **10/15/13**

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

Architectural Testing

NFRC U-FACTOR, SHGC, VT, & CONDENSATION RESISTANCE
COMPUTER SIMULATION REPORT

Rendered to:
TUBELITE, INC.
4878 Mackinaw Trail
Reed City, Michigan 49677

Report Number:	C8685.02-116-45
Simulation Date:	10/15/13
Report Date:	10/15/13

Project Summary:

Architectural Testing, Inc. was contracted to perform U-Factor, Solar Heat Gain Coefficient, Visible Transmittance, and Condensation Resistance* computer simulations in accordance with the National Fenestration Rating Council (NFRC). The products were evaluated in full compliance with NFRC requirements to the standards listed below.

**NFRC's Condensation Resistance rating is NOT equivalent to a Condensation Resistance Factor (CRF) determined in accordance with AAMA 1503.*

Standards:

NFRC 100-2010:	*Procedure for Determining Fenestration Product U-Factors*
NFRC 200-2010:	*Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence*
NFRC 500-2010:	*Procedure for Determining Fenestration Product Condensation Resistance Values*

Software:

Frame and Edge Modeling:	THERM 6.3.46
Center-of-Glass Modeling:	WINDOW 6.3.74
Total Product Calculations:	WINDOW 6.3.74
Spectral Data Library:	IGDB 31.0

Simulations Specimen Description:

Series/Model:	300ES Curtain Wall (8" System)
Type:	Glazed Wall System, Window Wall
Frame Material:	AT Aluminum w/ Thermal Breaks - All Members
Sash Material:	NA Not Applicable
Standard Size:	2000mm x 2000mm

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Modeling Assumptions/Technical Interpretations:

1) To prevent air infiltration, tape was applied to all interior sash crack locations.
2) This product is available in either a painted or anodized finish. These two finish
3) types were grouped for simulation purposes in accordance with NFRC 100-2010,
4) Section 4.2.1.L. The painted finish was simulated since it is worst case (highest
5) emissivity). The test sample was painted aluminum.
6) The center-line modeling approach was conducted using the horizontal intermediate for
7) the head and sill models, and the vertical intermediate for the jambs. This procedure
8) is outlined in the NFRC Simulation Manual Section 8.10.

Specialty Products Table:

The specialty products method allow the manufacturer to determine the overall product SHGC and VT for any glazing option. The center of glass SHGC and/or VT must be determined using WINDOW 6.3.74. The method gives overall product SHGC and VT indexed on center of glass properties. All values used in the calculations are truncated to six decimal place precision.

	No Dividers	Dividers < 1	Dividers > 1
SHGC0	0.006916	0.010370	0.013611
SHGC1	0.913914	0.811764	0.715933
VT0	0.000000	0.000000	0.000000
VT1	0.906998	0.801394	0.702323

SHGC = SHGC0 + SHGCc (SHGC1 - SHGC0)

VT = VT0 + VTc (VT1 - VT0)

Validation Matrix:

The following products are part of a validation matrix. Only one is required for validation testing.

Product Line	*Report Number*
None	-

Spacer Option Description

	Sealant		
Spacer Type	*Primary*	*Secondary*	*Code*
Aluminum Dual Seal Spacer	Butyl Rubber	Butyl Rubber	A1-D

Grid Option Description

Grid Size	*Grid Type*	*Grid Pattern*
None	-	-

Reinforcement Option Description

Location	*Material*
None	-

Gas Filling Technique Description

Fill Type	*Method*
84.48% Xenon	Single Probe Timed
76.14% Argon	Single Probe Timed
88.47% Argon	Single Probe Timed
78.56% Argon	Single Probe Timed
78.10% Krypton	Single Probe Timed
87.41% Argon	Single Probe Timed
64.98% Argon	Single Probe Timed
74.70% Argon	Single Probe Timed
60.78% Argon	Single Probe Timed
62.43% Argon	Single Probe Timed
86.02% Argon	Single Probe Timed
81.60% Xenon	Single Probe Timed
94.54% Xenon	Evacuated Chamber
76.90% Krypton	Single Probe Timed
71.54% Xenon	Single Probe Timed
76.45% Krypton	Single Probe Timed
66.67% Xenon	Single Probe Timed
82.16% Xenon	Single Probe Timed

Edge-of-Glass Construction

Interior Condition	EPDM Gasket Between Aluminum Frame and Glass
Exterior Condition	EPDM Gasket Between Aluminum Pressure Plate and Glass

Weatherstripping

Type	*Quantity*	*Location*
None	-	-

Frame/Sash Materials Finish

Interior	Painted Aluminum
Exterior	Painted Aluminum

NFRC 100/200/500 Summary Sheet
300ES Curtain Wall (8" System)

ID	Pane Thickness 1	Gap Width 1	Pane Thickness 2	Gap Width 2	Pane Thickness 3	Gap Width 3	Pane Thickness 4	Gap Fill	Low-e (Surface#)	Tint	Spacer	Grid Type
	U-Factor			Solar Heat Gain Coefficient (SHGC) Grids (None / <1 / >=1)					Visible Transmittance (VT) Grids (None / <1 / >=1)		Condensation Resistance	
1	COG=0.4400											
	0.222	0.500	0.225					XEN84		CL	A1-D	N
	U-Factor		**0.49**	**SHGC (N)**				**0.63**	**VT (N)**	**0.67**	**CR**	**44**
2	COG=0.4200											
	0.236	0.500	0.225					ARG76	0.654(#2)	RC	A1-D	N
	U-Factor		**0.47**	**SHGC (N)**				**0.32**	**VT (N)**	**0.29**	**CR**	**44**
3	COG=0.4000											
	0.223	0.500	0.225					ARG88	0.571(#2)	CL	A1-D	N
	U-Factor		**0.46**	**SHGC (N)**				**0.22**	**VT (N)**	**0.15**	**CR**	**45**
4	COG=0.3800											
	0.236	0.500	0.225					ARG79	0.465(#2)	RC	A1-D	N
	U-Factor		**0.44**	**SHGC (N)**				**0.20**	**VT (N)**	**0.13**	**CR**	**46**
5	COG=0.3600											
	0.221	0.500	0.225					KRY78	0.406(#2)	SR	A1-D	N
	U-Factor		**0.42**	**SHGC (N)**				**0.19**	**VT (N)**	**0.16**	**CR**	**47**
6	COG=0.3400											
	0.232	0.500	0.225					ARG87	0.318(#2)	CL	A1-D	N
	U-Factor		**0.41**	**SHGC (N)**				**0.43**	**VT (N)**	**0.51**	**CR**	**48**
7	COG=0.3200											
	0.223	0.500	0.225					ARG65	0.215(#2)	CL	A1-D	N
	U-Factor		**0.39**	**SHGC (N)**				**0.57**	**VT (N)**	**0.67**	**CR**	**49**
8	COG=0.3000											
	0.233	0.500	0.225					ARG75	0.166(#2)	CL	A1-D	N
	U-Factor		**0.37**	**SHGC (N)**				**0.41**	**VT (N)**	**0.48**	**CR**	**49**
9	COG=0.2800											
	0.223	0.500	0.225					ARG61	0.087(#2)	CL	A1-D	N
	U-Factor		**0.36**	**SHGC (N)**				**0.50**	**VT (N)**	**0.69**	**CR**	**50**
10	COG=0.2600											
	0.223	0.500	0.225					ARG62	0.035(#2)	CL	A1-D	N
	U-Factor		**0.34**	**SHGC (N)**				**0.35**	**VT (N)**	**0.64**	**CR**	**51**

NFRC 100/200/500 Summary Sheet
300ES Curtain Wall (8" System)

ID	Pane Thickness 1	Gap Width 1	Pane Thickness 2	Gap Width 2	Pane Thickness 3	Gap Width 3	Pane Thickness 4	Gap Fill	Low-e (Surface#)	Tint	Spacer	Grid Type
	U-Factor			Solar Heat Gain Coefficient (SHGC) Grids (None / <1 / >=1)					Visible Transmittance (VT) Grids (None / <1 / >=1)		Condensation Resistance	
11	COG=0.2400											
	0.223	0.500	0.223					ARG86	0.035(#2) / 0.035(#3)	CL	A1-D	N
	U-Factor		**0.32**	**SHGC (N)**				**0.33**	**VT (N)**	**0.57**	**CR**	**52**
12	COG=0.2200											
	0.223	0.500	0.223					XEN82	0.018(#2) / 0.018(#3)	CL	A1-D	N
	U-Factor		**0.31**	**SHGC (N)**				**0.24**	**VT (N)**	**0.47**	**CR**	**55**
13	COG=0.2000											
	0.223	0.500	0.223					XEN95	0.018(#2) / 0.018(#3)	CL	A1-D	N
	U-Factor		**0.29**	**SHGC (N)**				**0.24**	**VT (N)**	**0.47**	**CR**	**53**
14	COG=0.1800											
	0.223	0.250	0.003	0.250	0.221			KRY77/AIR	0.018(#2) / 0.755(#3) / 0.122(#4) / 0.028(#5)	CL	A1-D	N
	U-Factor		**0.27**	**SHGC (N)**				**0.22**	**VT (N)**	**0.40**	**CR**	**60**
15	COG=0.1600											
	0.223	0.250	0.003	0.250	0.223			XEN72/AIR	0.018(#2) / 0.755(#3) / 0.122(#4) / 0.018(#5)	CL	A1-D	N
	U-Factor		**0.25**	**SHGC (N)**				**0.22**	**VT (N)**	**0.42**	**CR**	**61**
16	COG=0.1400											
	0.223	0.250	0.003	0.250	0.223			KRY76	0.018(#2) / 0.755(#3) / 0.122(#4) / 0.018(#5)	CL	A1-D	N
	U-Factor		**0.23**	**SHGC (N)**				**0.22**	**VT (N)**	**0.42**	**CR**	**61**
17	COG=0.1200											
	0.223	0.250	0.003	0.250	0.223			XEN67	0.018(#2) / 0.755(#3) / 0.122(#4) / 0.018(#5)	CL	A1-D	N
	U-Factor		**0.22**	**SHGC (N)**				**0.22**	**VT (N)**	**0.42**	**CR**	**62**
18	COG=0.1000											
	0.223	0.250	0.003	0.250	0.223			XEN82	0.018(#2) / 0.755(#3) / 0.122(#4) / 0.018(#5)	CL	A1-D	N
	U-Factor		**0.20**	**SHGC (N)**				**0.22**	**VT (N)**	**0.42**	**CR**	**63**

The Condensation Resistance results obtained from this procedure are for controlled laboratory conditions and do not include the effects of air movement through the specimen, solar radiation, and the thermal bridging that may occur due to the specific design and construction of the fenestration system opening.

Ratings values included in this report are for submittals to an NFRC-licensed IA and are not meant to be used directly for labeling purposes. Only those values identified on a valid Certification Authorization Report (CAR) by an NFRC accredited Inspection Agency (IA) are to be used for labeling purposes. The ratings values were rounded in accordance to NFRC 601, NFRC Unit and Measurement Policy.

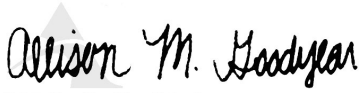
Architectural Testing, Inc. is an NFRC accredited simulation laboratory and all simulations were conducted in full compliance with NFRC approved procedures and specifications. The NFRC procedure requires that the computational results be verified through actual test results.

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. The test record retention end date for this report is October 15, 2017.

Results obtained are simulated values and were secured by using the designated test methods. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to the product simulated. This report may not be reproduced, except in full, without the written approval of Architectural Testing, Inc.

For ARCHITECTURAL TESTING, INC.:

SIMULATED BY:



Allison M. Goodyear
Simulation Technician

REVIEWED BY:

Kristen L. Livelsberger
Senior Simulation Technician
Simulator-In-Responsible-Charge

AMG:amg
C8685.02-116-45

Attachments (pages): This report is complete only when all attachments listed are included.
Appendix A: Drawings and Bills of Material (9)

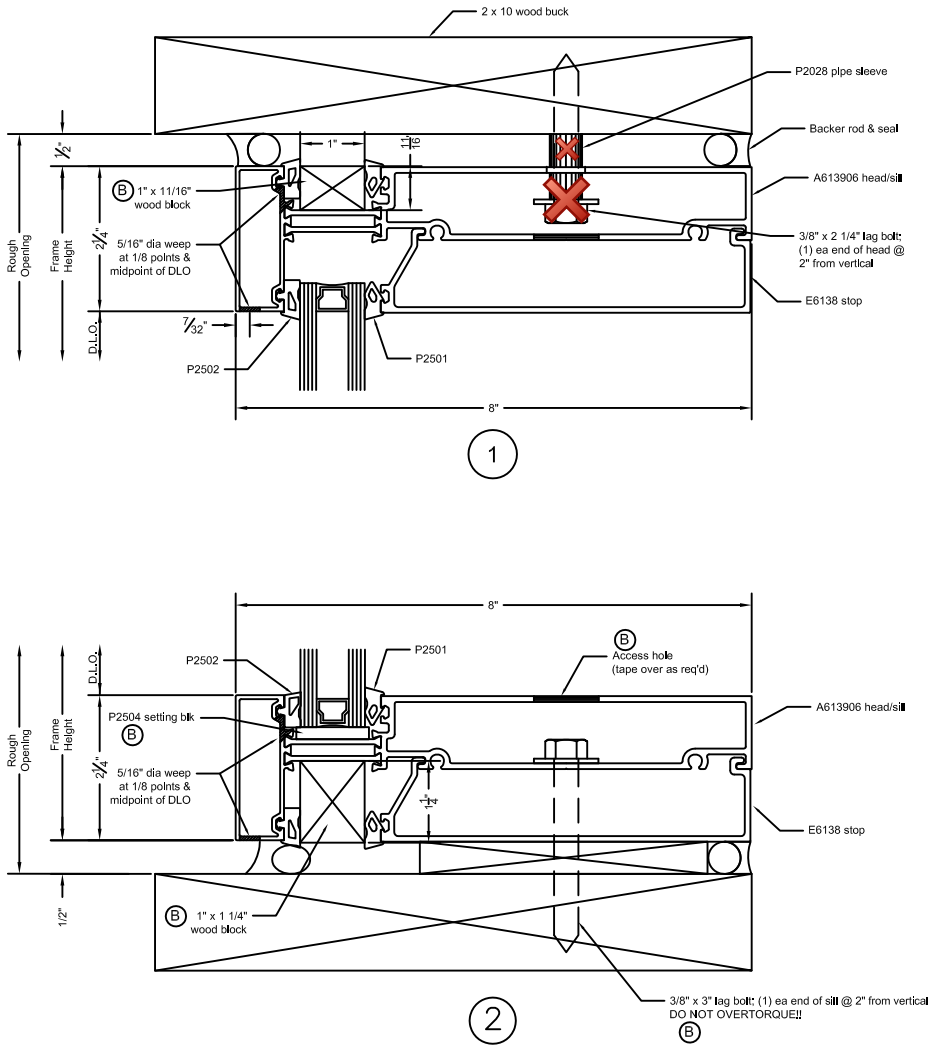
Revision Log

Rev. #	Date	Page(s)	Revision(s)
.02R0	10/15/13	All	Original Report Issue to Tubelite, Inc.

All drawings and Bills of Material used to simulate this product are enclosed in this Appendix

Appendix A

C8685.02-116-45



TUBELITE®
STOREFRONT, CURTAINWALL & ENTRANCES
DEPENDABLE

300 ES THERMAL MOCKUP - 8" SYSTEM
AAMA 507/1503, NFRC 100/200/500, CMAST
ATI - York, PA

DRAWN BY	DRWG DATE	APPV'D BY	DATE APPV'D
G.HALL	05-02-13		
DRWG SCALE: HALF	PRODUCT CODE: 440	SHEET NO.: 2 of 2	REV: B

Architectural Testing

Report #: C8685-116-45
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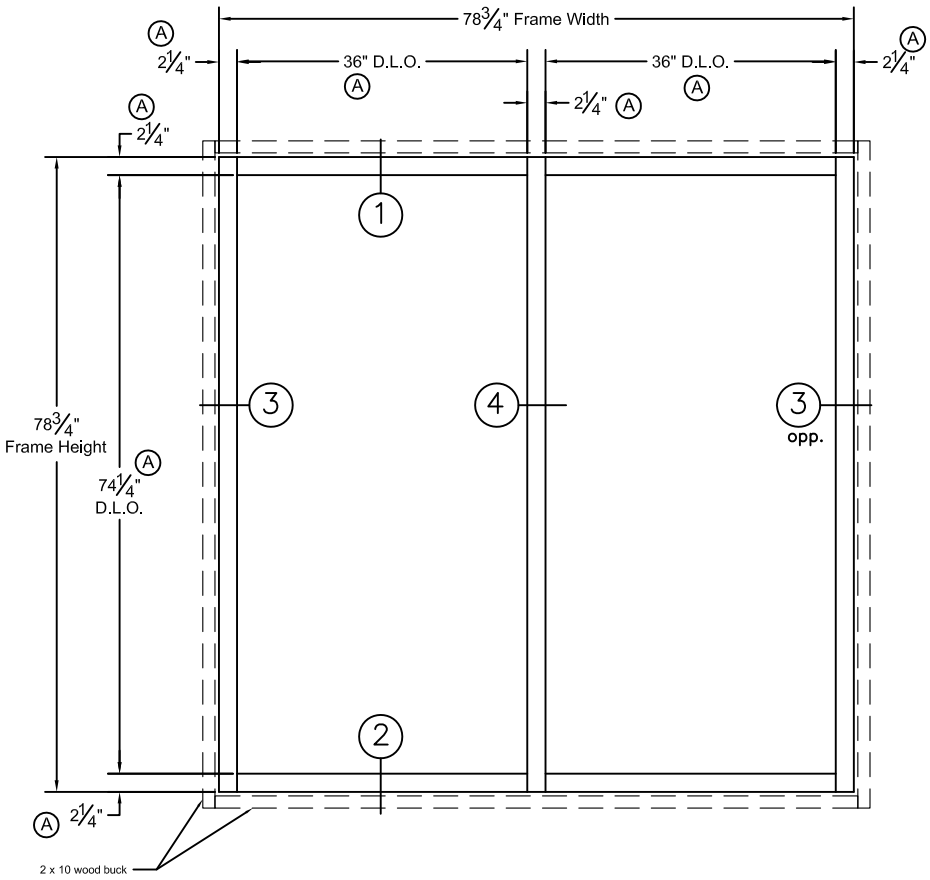
Verified by: Allison M. Goodyear



TEST UNIT ELEVATION
(1) THUS

BILL OF MATERIAL - 300 ES THERMAL TEST

ITEM	QTY	PART NO.	FINISH	DESCRIPTION	SIZE	
1	4 (B)	A613906	CLEAR	HEAD/SILL (B)	36"	(A)
2	4 (B)	E6138	CLEAR	GLASS STOP AT HEAD/SILL (B)	35 31/32"	(A)
~~3~~	~~2~~	~~E6131~~	~~CLEAR~~	~~SILL FILLER~~	~~35 31/32"~~	(B)
~~4~~	~~2~~	~~A613406~~	~~CLEAR~~	~~SILL~~	~~36"~~	(B)
5	3	A613406	CLEAR	VERTICAL & JAMB	78 3/4"	
6	3	E6131	CLEAR	VERTICAL & JAMB FILLER	78 3/4"	
7						
~~8~~	~~4~~	~~P1267~~	~~MILL~~	~~LOCKING LUG~~	~~2"~~	(B)
9	4	P2028	STOCK	PIPE SLEEVE - HEAD ANCHOR	1"	
10						
~~11~~	~~2~~	~~P2500~~	~~STOCK~~	~~POCKET FILLER AT JAMBS~~	~~78 3/4"~~	(B)
~~12~~	~~4~~	~~P2500~~	~~STOCK~~	~~POCKET FILLER AT HEAD/SILL~~	~~35 15/16"~~	(B)
13	4	P2504 (B)	STOCK	SETTING BLOCK (B)	4"	
~~14~~	~~4~~	~~P2505~~	~~STOCK~~	~~SETTING BLOCK~~	~~4"~~	(B)
15	1 ROLL	P2502	STOCK	EXTERIOR SPONGE GASKET	250 FT	
16	1 ROLL	P2501	STOCK	INTERIOR WEDGE GASKET	300 FT	
17	6	P2063	STOCK	DEEP POCKET WATER DAM	---	
18	2	P2507	STOCK	SHALLOW POCKET WATER DAM	---	
19	14	P1094	STOCK	ETHAFOAM CAULK BACKER ROD	---	
20	16	S403	STOCK	1/4-20 X 1" HWH ASSEMBLY SCREW	---	
21						
22	4 (B)	---	STOCK	3/8" X 2 1/4" LAG BOLT @ HEAD	---	
(B) 22A	4	---	STOCK	3/8" X 3" LAG BOLT @ SILL	---	
23	8	---	STOCK	3/8" ID FLAT WASHER	---	
24						
25	2	---	STOCK	2 X 10 BUCK AT JAMBS	82 3/4"	
26	2	---	STOCK	2 X 10 BUCK AT HEAD/SILL	79 3/4"	
27						
28	2	---	---	36 7/8" X 75 1/8" GLASS	---	(A)
				- 1/4" PPG SOLARBAN 70XL #2		
				- 1/2" SPACE, ZF-D TRISEAL SUPER SPACER, 90%	ARGON FILL	
				- 1/4" PPG SUNGATE 500 #3		

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DEPENDABLE

300 ES THERMAL MOCKUP - 8" SYSTEM
AAMA 507/1503, NFRC 100/200/500, CMAST
ATI - York, PA

DRAWN BY	DRWG DATE	APPV'D BY	DATE APPV'D
G.HALL	05-02-13		
DRWG SCALE 1/8 SIZE	PRODUCT CODE 440	SHEET NO. 1 of 2	REV B

Architectural Testing

Report #: C8685-116-45
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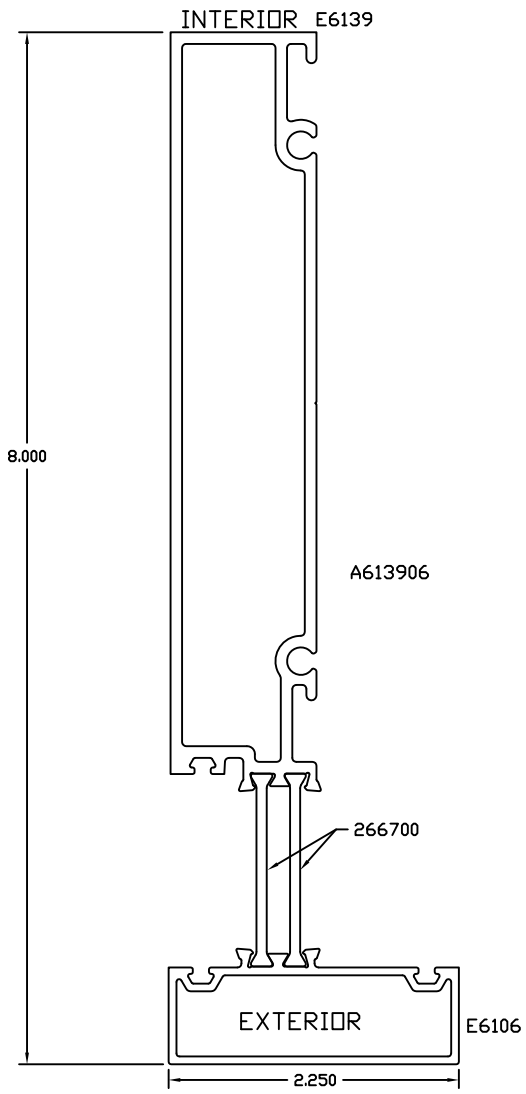
A613906



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▭ DENOTES CRITICAL DIMENSION

REV	DATE	DESCRIPTION	INTL
	02/19/10	RELEASED FOR PRODUCTION	CRH

TUBELITE DEPENDABLE

3056 WALKER RIDGE NW, SUITE G
WALKER, MICHIGAN 49544

ASSEMBLED HORIZONTAL MULLION
ES300 CURTAINWALL-INSIDE SET
8" DEPTH SYSTEM

DRAWN BY	DRWG DATE	APPV'D BY	DATE APPV'D	REV
CRH	1/06/10			
DRWG SCALE: FULL	PRODUCT CODE: A613906			

Architectural Testing

Report #: C8685-116-45
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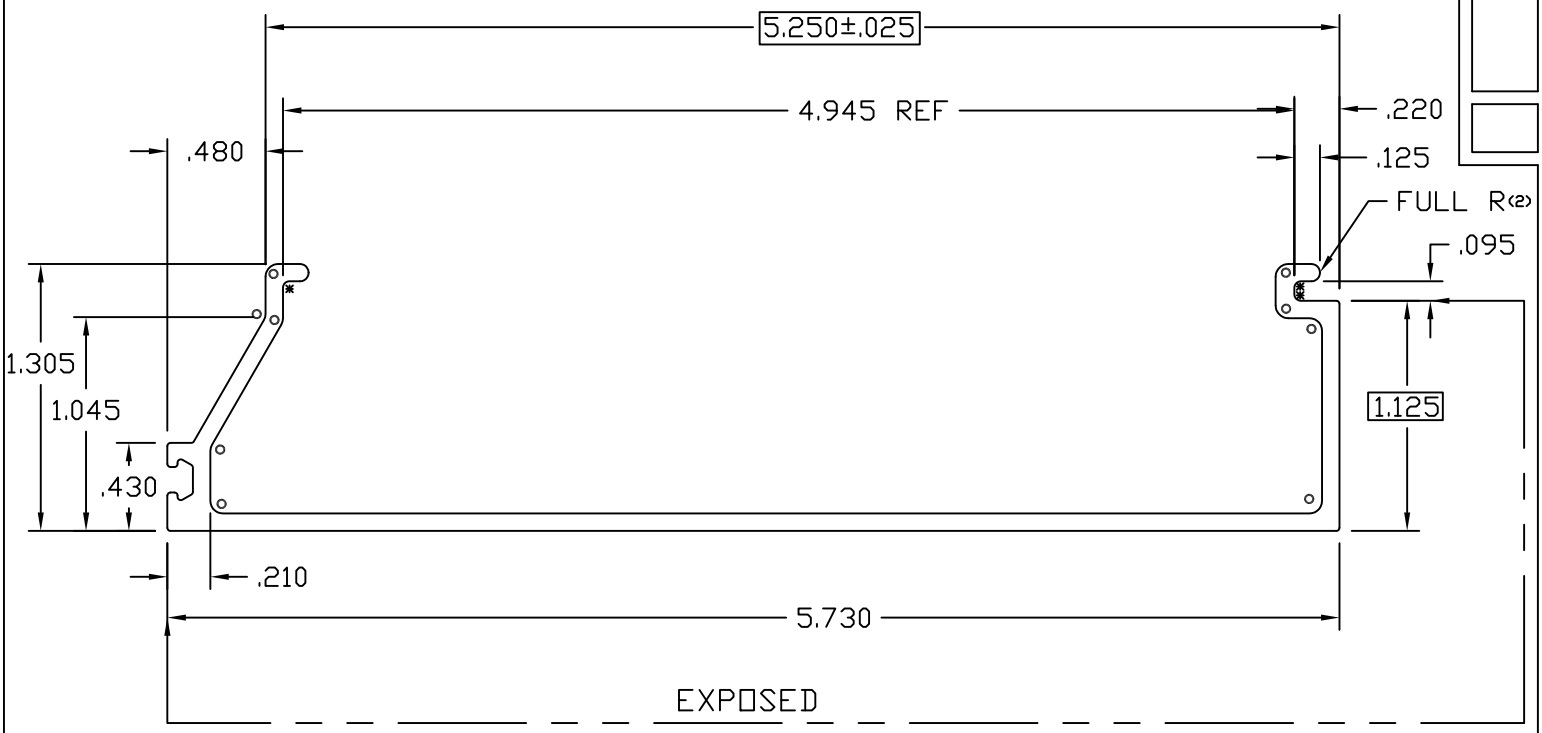
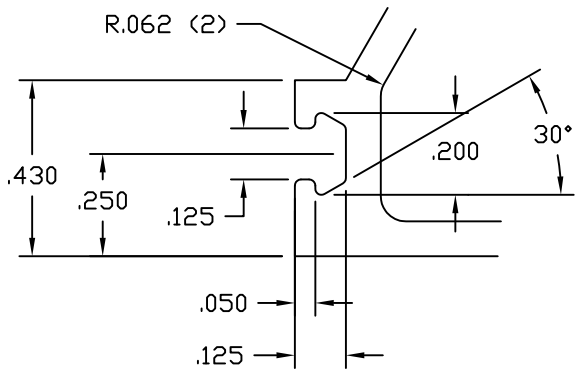
E6138



FULL SIZE



DETAIL 'A'
TWO TIMES SIZE

USE WITH E6329
∘ INDICATES .062R

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ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS NOTED

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DEPENDABLE
LEADERS IN ECO-EFFICIENT STOREFRONT, CURTAINWALL AND ENTRANCE SYSTEMS

3056 WALKER RIDGE NW, SUITE G
WALKER, MICHIGAN 49544

REV	DATE	DESCRIPTION	INTL
	XX/XX/XX	XXXXXXXXXXXXXXTOOLING ACCT#4327300000.7020.770	CRH

WALL THK. .085	SECTION CLASS S	MAT'L 6063-T5	RATIO 72:1
PERIMETER OUT (TOTAL) 17.689		AREA .767	WGT/FT .902
FACTOR 20	CIRCLE SIZE 5.839		INFILL VOLUME N/A

RXX 2.079	SXX 1.157	IXX 3.316	CXX 2.865
RYY .400	SYY .121	IYY .123	CYY 1.014

GLASS STOP
8" 300ES SYSTEM

DRAWN BY CRH	DRWG DATE 01/06/10	APPV'D BY	DATE APPV'D
DWG SCALE NOTED	PRODUCT CODE E6138		REV

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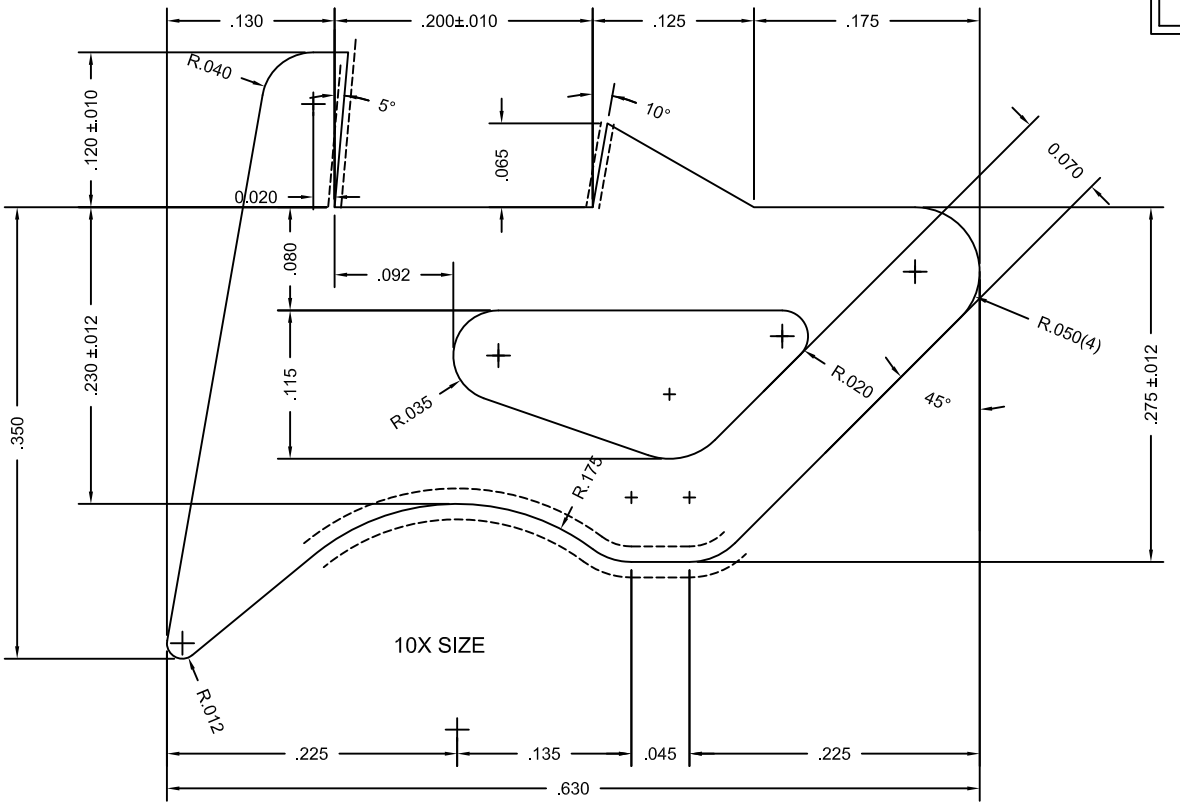
P2501

ACTUAL SIZE



70±5 SHORE "A" DURO
BLACK EPDM
TRELLEBORG PART 2690-02 W/LUBE

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DENOTES CRITICAL DIMENSION

REV	DATE	DESCRIPTION	INTL

TUBELITE
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LEADERS IN ECO-EFFICIENT STOREFRONT, CURTAINWALL AND ENTRANCE SYSTEMS

3056 WALKER RIDGE NW, SUITE G
WALKER, MICHIGAN 49544

WEDGE GASKET
300ES CURTAINWALL

DRAWN BY	DRWG DATE	APPV'D BY	DATE APPV'D
SRD	09/15/08		

DRWG SCALE	PRODUCT CODE	REV
NOTED	P2501	

Architectural Testing

Report #: C8685-116-45
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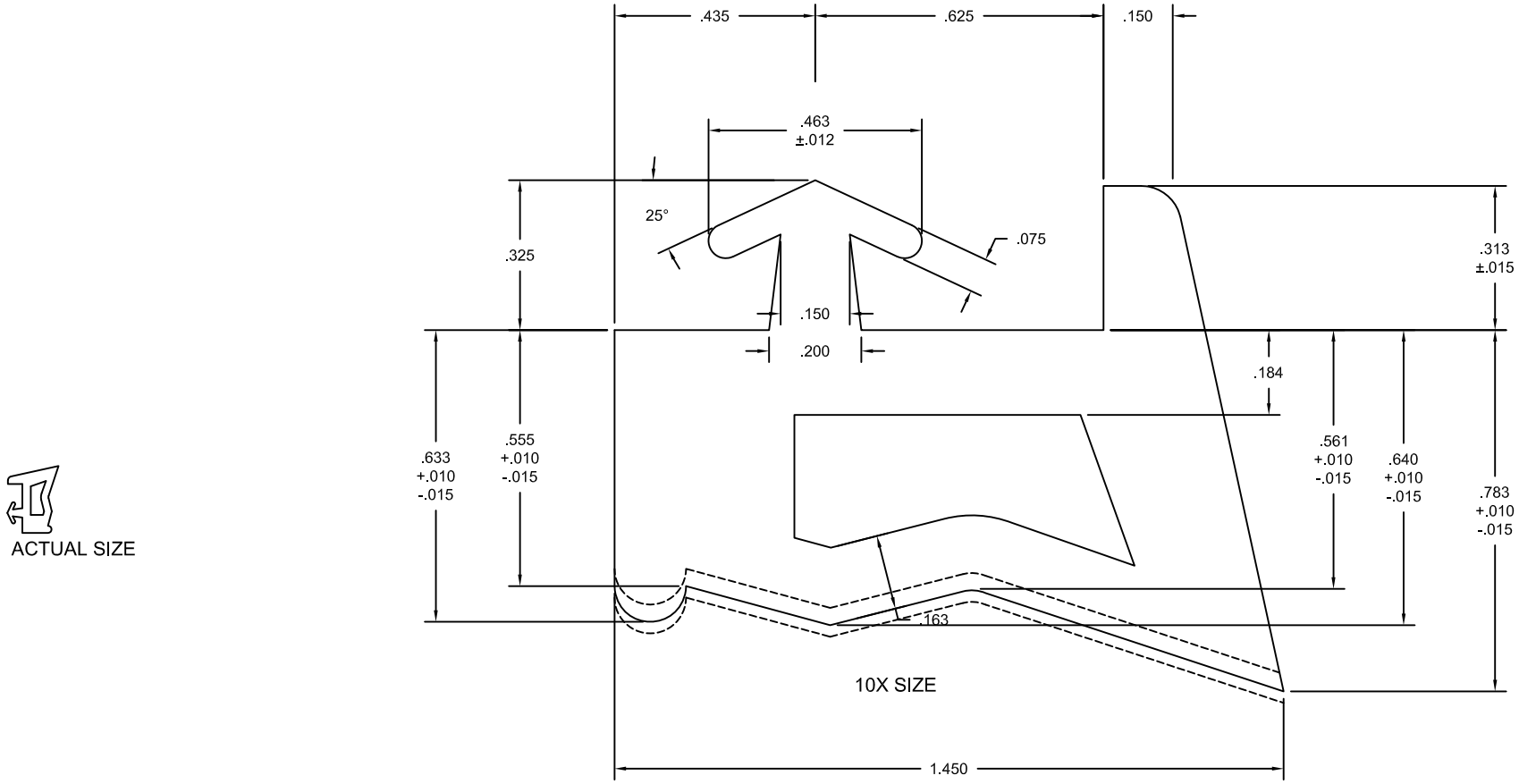
P2502



ACTUAL SIZE

60±5 SHORE "A" DURO
BLACK EPDM
TRELLEBORG PART 4416-02-00

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OTHERWISE NOTED

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DENOTES CRITICAL DIMENSION

REV	DATE	DESCRIPTION	INTL

TUBELITE
DEPENDABLE
LEADERS IN ECO-EFFICIENT STOREFRONT, CURTAINWALL AND ENTRANCE SYSTEMS

3056 WALKER RIDGE NW, SUITE G
WALKER, MICHIGAN 49544

SPONGE GASKET
300ES CURTAINWALL

DRAWN BY	DRWG DATE	APPV'D BY	DATE APPV'D
SRD	09/15/08		

DRWG SCALE	PRODUCT CODE	REV
Noted	P2502	

Architectural Testing

Report #: C8685-116-45
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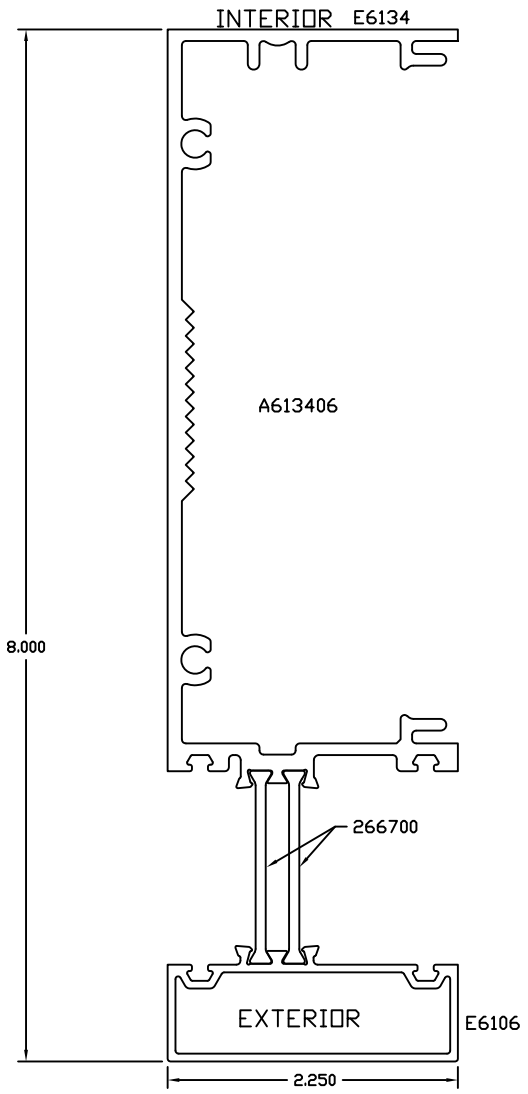
A613406



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DENOTES CRITICAL DIMENSION

REV	DATE	DESCRIPTION	INTL
	02/19/10	RELEASED FOR PRODUCTION	CRH

TUBELITE DEPENDABLE

3056 WALKER RIDGE NW, SUITE G
WALKER, MICHIGAN 49544

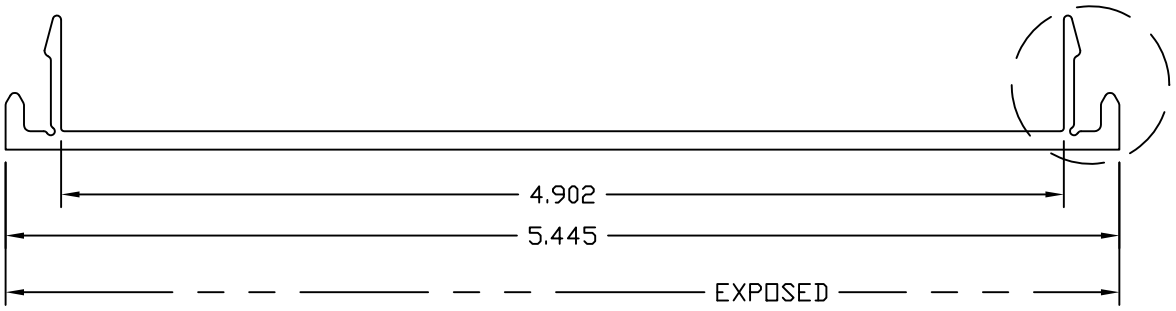
ASSEMBLED JAMB
ES300 CURTAINWALL-INSIDE SET
8" DEPTH SYSTEM

DRAWN BY	DRWG DATE	APPV'D BY	DATE APPV'D	REV
CRH	1/06/10			
DRWG SCALE: FULL	PRODUCT CODE: A613406			

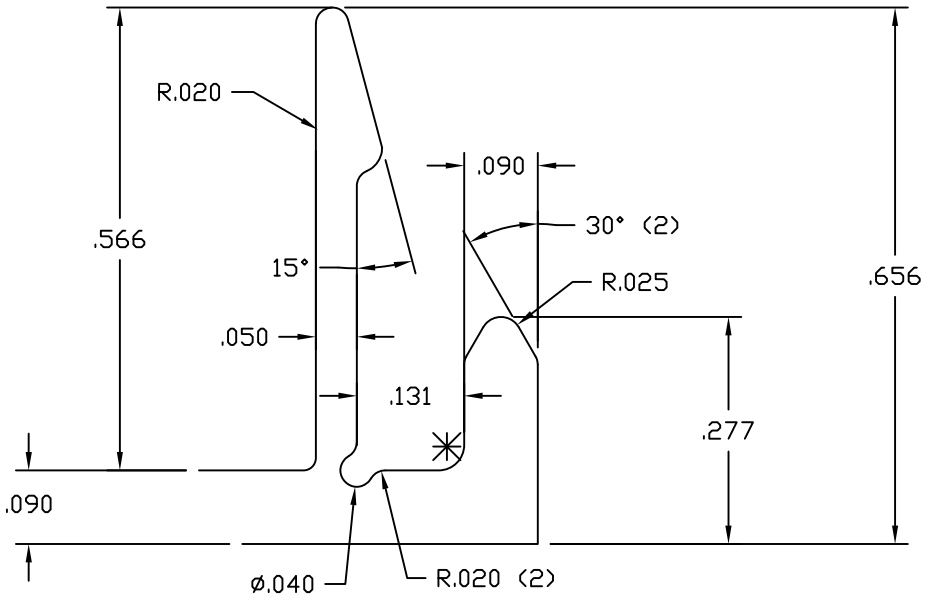
Architectural Testing

Report #: C8685-116-45
Date: 09/12/13
Verified by: Allison M. Goodyear

E6131



FULL SIZE



DETAIL 'A'
FOUR TIMES SIZE

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ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY UNLESS NOTED

ALL UNSPECIFIED RADII .015

✳ INDICATES .031 RADIUS

▭ DENOTES CRITICAL DIMENSION

ALL DIES PROPERTY OF TUBELITE

TUBELITE®
DEPENDABLE
LEADERS IN ECO-EFFICIENT STOREFRONT, CURTAINWALL AND ENTRANCE SYSTEMS

3056 WALKER RIDGE NW, SUITE G
WALKER, MICHIGAN 49544

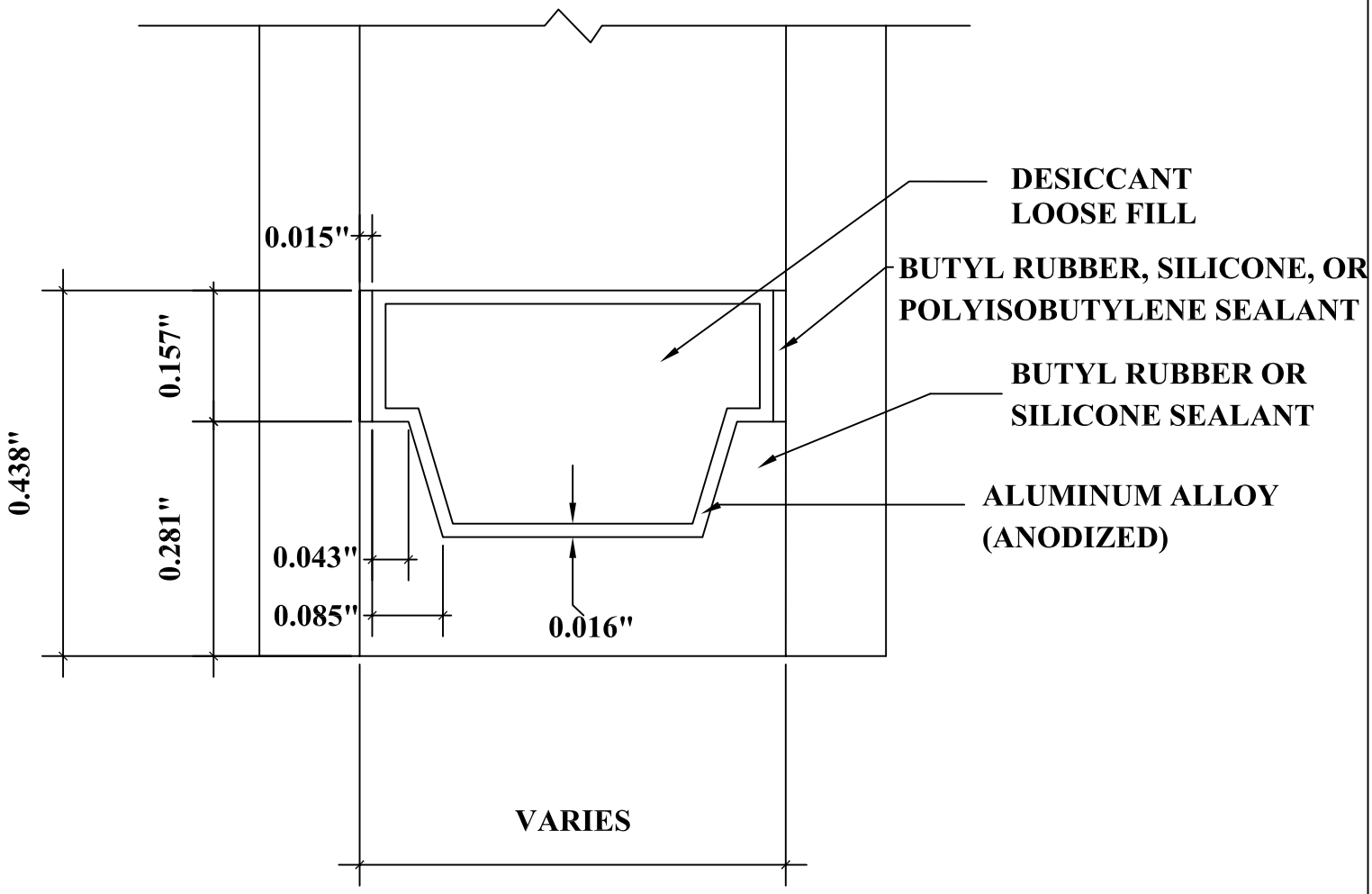
REV	DATE	DESCRIPTION	INTL
	XX/XX/XX	XXXXXXXXXXXXXXXXTOOLING ACCT#4327300000.7020.770	CRH

WALL THK. .090	SECTION CLASS S	MAT'L 6063-T5	RATIO 95:1
PERIMETER OUT (TOTAL) 14.015		AREA .580	WGT/FT .682
FACTOR 21	CIRCLE SIZE 5.449	INFILL VOLUME N/A	

RXX 1.759	SXX .658	IXX 1.792	CXX 2.722
RYY .119	SYY .014	IYY .008	CYY .569

POCKET CLOSURE
8" 300ES SYSTEM

DRAWN BY CRH	DRWG DATE 01/06/10	APPV'D BY	DATE APPV'D
DWG SCALE NOTED	PRODUCT CODE E6131		REV

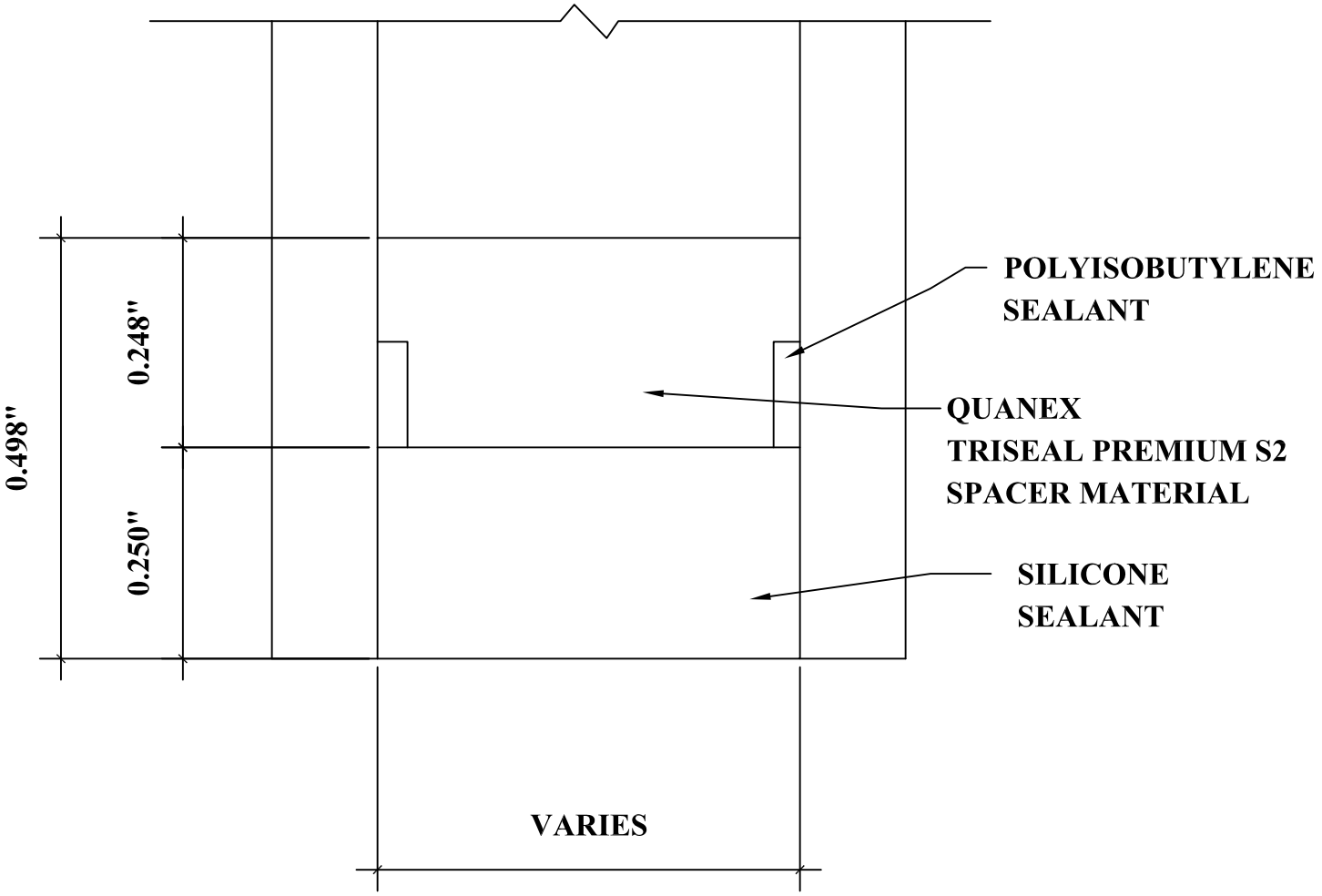


DETAIL FOR THERMAL MODELING OF
ALUMINUM SPACER (A1-D)

VALIDATION SPACER

Architectural Testing

Report #: C8685-116-45
Date: 09/12/13
Verified by: Allison M. Goodyear



DETAIL FOR THERMAL MODELING OF
QUANEX SUPER SPACER T-SPACER PREMIUM (ZF-D)