



NFRC 102-2023 THERMAL PERFORMANCE
TEST REPORT

Series/Model: Tilt-Turn Window
Type: Dual Action (Tilt Turn)

Rendered To:
Foshan YT Aluminum Co., Ltd.
No. 1 Factory Building, Fumin 3rd Road, Shishan Town, Nanhai District
Foshan , Guangdong 528225, China

QCT Project No.:
QCT-TH-12220.01

Test Date:
5/18/2024

Report Date:
6/12/2024



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Report Date: 06/12/2024
Test Date: 05/17/2024

**NFRC 102-2023 THERMAL PERFORMANCE
TEST REPORT**

Rendered To:

Foshan YT Aluminum Co., Ltd.
No. 1 Factory Building, Fumin 3rd Road, Shishan Town, Nanhai District
Foshan , Guangdong 528225, China

Test Sample Identification:

Series/Model: Tilt-Turn Window

Product Type: Dual Action (Tilt Turn)

Thermal Break: Thermally broken

Thermal Break Material: Polyamide/ Reinforced Nylon

Overall Size: 600mm x 1500mm (23-5/8" x 59")

NFRC Standard Size: 1200mm x 1500mm (47" x 59")

Test Sample Submitted by: Foshan YT Aluminum Co., Ltd.

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 102-2023, *Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems*.

Test Results Summary:

Standardized U-factor (U_{st}):	0.37	Btu/(hr·ft ² ·F)	CTS Method
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Test Sample Description:

Test Date: 05/17/2024

Size Specification:	Frame	Sash
Size (inches)	23-5/8" x 59"	22-3/8" x 50-3/4"
Daylight Opening (inches)	N.A.	16-5/8" x 52"

Construction:	Frame	Sash
Corners	Mitered	Mitered
Fasteners	Keyed	Keyed
Sealant	Yes	Yes

Properties:	Frame	Sash
Material	Aluminum	Aluminum
Exterior Color	Silver	Silver
Exterior Finish	Clear anodized	Clear anodized
Interior Color	Silver	Silver
Interior Finish	Clear anodized	Clear anodized

Spacer:				
Code	Spacer Type	Primary Sealant	Secondary Sealant	Desiccant
ZF-S	Super Spacer Premium	N.A.	Butyl	Yes

Reinforcement Description:	
Location	Material
None	N.A.

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

	Frame	Sash
Glazing Method:	N.A.	Interior

Glazing Information:	
Layer 1	5mm LowE (#2) - 0.197"
Gap 1	Argon 90 - 0.472"
Layer 2	5mm LowE (#4) - 0.197"
Gap 2	Argon 90 - 0.472"
Layer 3	5mm Clear - 0.197"
Gas Fill Method	Two-Probe*

*Stated per Client/Manufacturer

Not Applicable (N.A.)



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Weatherstrip:

Type	Quantity	Location
Bulb gasket	2 rows	Frame perimeter
Bulb gasket	1 row	Sash perimeter

Hardware:

Type	Quantity	Location
DA hardware set	1	Frame

Drainage:

Type	Quantity	Location
None	N.A.	N.A.

Insulation:

Type	Location
Polyethylene foam	Frame perimeter
Polyethylene foam	Sash perimeter



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Measured Test Data:

Heat Flows	Quantity	Units
1. Total Measured Metering Box Input (Q_{total})	433.82	Btu/hr
4. Surround Panel Heat Flow (Q_{sp})	169.47	Btu/hr
2. Surround Panel Thickness	4	inches
3. Surround Panel Conductance (C_{sp})	0.0469	Btu/(hr·ft ² ·F)
5. Metering Box Wall Plus Flanking Loss (Q_{mb+fl})	0.01	Btu/hr
6. EMF vs. Heat Flow Equation (Equivalent Information)	7381.1(EMF)+37.72	
7. Net Test Specimen Heat Flow (Q_s)	264.34	Btu/hr

Areas	Quantity	Units
8. Specimen Projected Area (A_s)	9.68	ft ²
9. Specimen Projected Frame Area (A_f)	3.68	ft ²
10. Specimen Projected Glazing Area (A_g)	6.00	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})	54.32	ft ²

Test Conditions	Quantity	Units
15. Average Metering Room Air Temperature (t_h)	69.80	deg F
16. Average Climate Room Air Temperature (t_c)	-0.40	deg F
17. Average Guard Room Air Temperature (t_g)	75.31	deg F
18. Metering Room Average Relative Humidity	12.50	%
19. Measured Climate Room Wind Velocity (Perpendicular Flow)	16.91	mph
20. Measured Static Pressure Difference Across Test Specimen	-0.01	psf
21. Surround Panel Warm Side Surface Temperature (t_{sp1})	67.11	deg F
22. Surround Panel Cold Side Surface Temperature (t_{sp2})	0.59	deg F

Thermal Transmittance	Quantity	Units
23. Specimen Thermal Transmittance (U_s)	0.39	Btu/(hr·ft ² ·F)
24. Standardized Thermal Transmittance (U_{ST} (CTS))	0.37	Btu/(hr·ft ² ·F)



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Calculated Test Data:

CTS Method	Quantity	Units
25. Room Side Surface Emittance of CTS (ϵ_1)	0.84	N.A.
26. Room Side Surface Emittance of Specimen Frame (ϵ_{fl})	0.80	N.A.
27. Room Side Surface Emittance of Speciment Glazing (ϵ_{gl})	0.84	N.A.
28. Room Side Surface Emittance of Exposed Surround Panel (ϵ_{SP1})	0.90	N.A.
29. Area Weighted Emittance of all Room Side Surfaces (ϵ_{s1})	0.89	N.A.
30. Metering Box Baffle Emittance (ϵ_{b1})	0.95	N.A.
31. Equivalent Room Side Surface Temperature (t_1)	51.30	deg F
32. Equivalent Climate Side Surface Temperature (t_2)	4.86	deg F
33. Room Side Baffle Temperature (t_{b1})	69.17	deg F
34. Climate Side Baffle Temperature (t_{b2})	0.12	deg F
35. Measured Warm Side Surface Conductance(h_h)	1.48	Btu/(hr·ft ² ·F)
36. Measured Climate Side Surface Conductance (h_c)	5.19	Btu/(hr·ft ² ·F)
37. Test Specimen Thermal Conductance (C_s)	0.5881	Btu/(hr·ft ² ·F)
38. Convection Coefficient (K_c)	0.33	Btu/(hr·ft ² ·F)
39. Radiative Test Specimen Heat Flow (Q_{rl})	141.71	Btu/hr
40. Conductive Test Specimen Heat Flow (Q_{cl})	122.63	Btu/hr
41. Radiative Heat Flux of Test Specimen (q_{rl})	14.64	Btu/(hr·ft ²)
42. Convective Heat Flux of Test Specimen(q_{cl})	12.67	Btu/(hr·ft ²)
43. Standardized Warm Side Surface Conductance (h_{STh})	1.28	Btu/(hr·ft ² ·F)
44. Standardized Cold Side Surface Conductance (h_{STc})	5.28	Btu/(hr·ft ² ·F)

Test Duration

- The environmental systems were started on
5/17/24 1:02 PM
- The test parameters were considered stable for two consecutive four hour test periods from
5/17/24 9:37 PM to 5/18/24 5:37 AM
- The thermal performance test results were derived from
5/18/24 1:37 AM to 5/18/24 5:37 AM

Glazing Deflection (inches)*:

D.L.O. 1	D.L.O. 2	
0.000	N.A.	Glass deflection upon arrival
0.000	N.A.	Glass deflection prior to testing
0.039	N.A.	Glass deflection during testing
0.453, 0.453	N.A.	Effective gap width during testing

*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 (QCT-0123) in Mosinee, Wisconsin was conducted in 03/01/2024 in accordance with Quast Consulting and Testing, Inc. calibration procedure. A calibration check was performed in 02/22/2024.

"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, applicable only to the specimen tested, 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. Information that is supplied by the customer can affect the validity of results. "

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 options identified on a valid Certification of Authorization (CA) are to be used for labeling purposes." The rating values were rounded in accordance to the NFRC unit conversions and rounding policy document (NFRC 601-2020).

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

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 <0.6%.



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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 five 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.

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

Appendix A: Drawings (14 pages)

Kassi Heil

Author
Kassi Heil

Jeff Zibton

Individual-In-Responsible-Charge
& Person Conducting Test
Jeff Zibton



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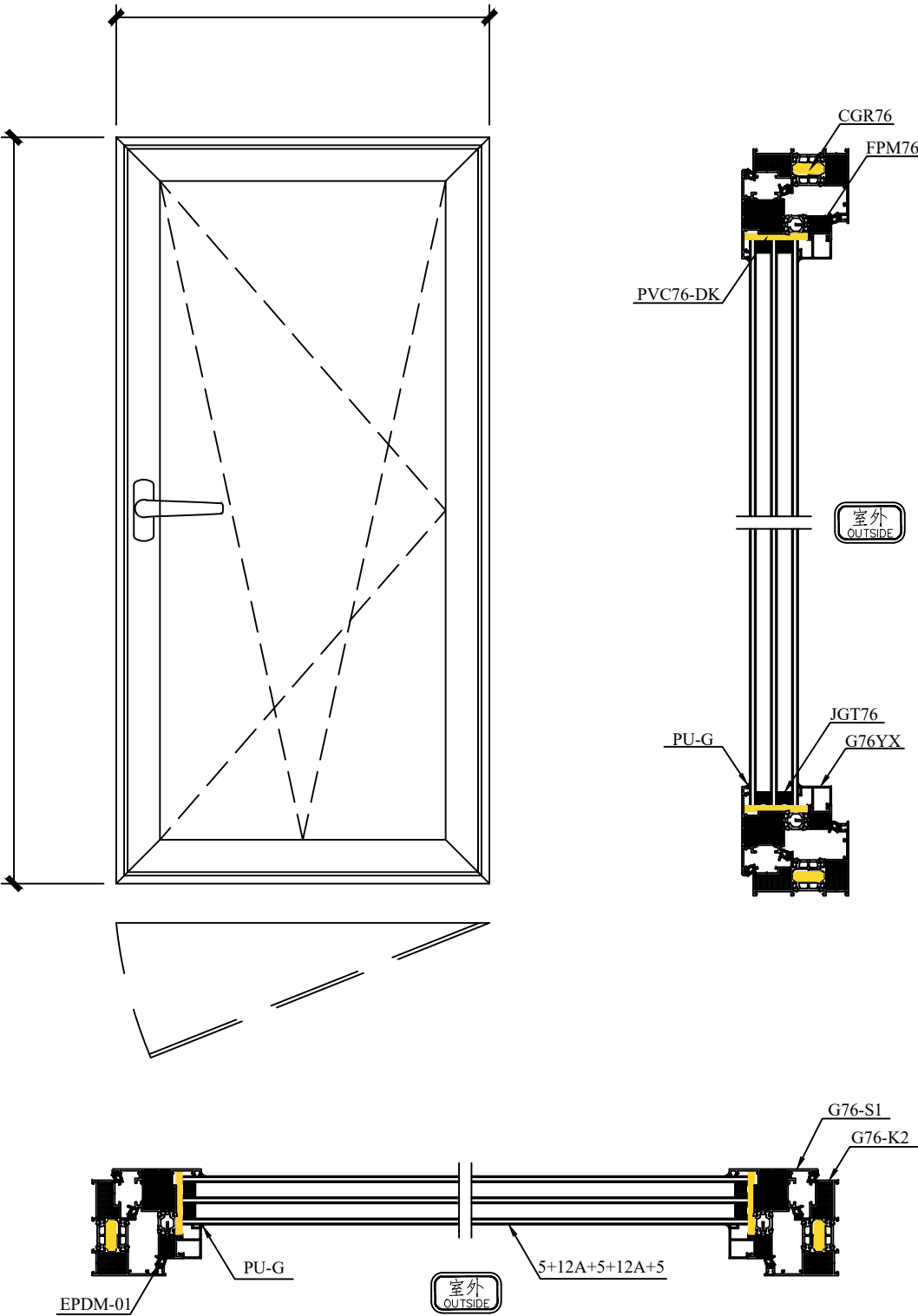
Revision No.	Date	Description
.01	06/12/24	Original report issued.



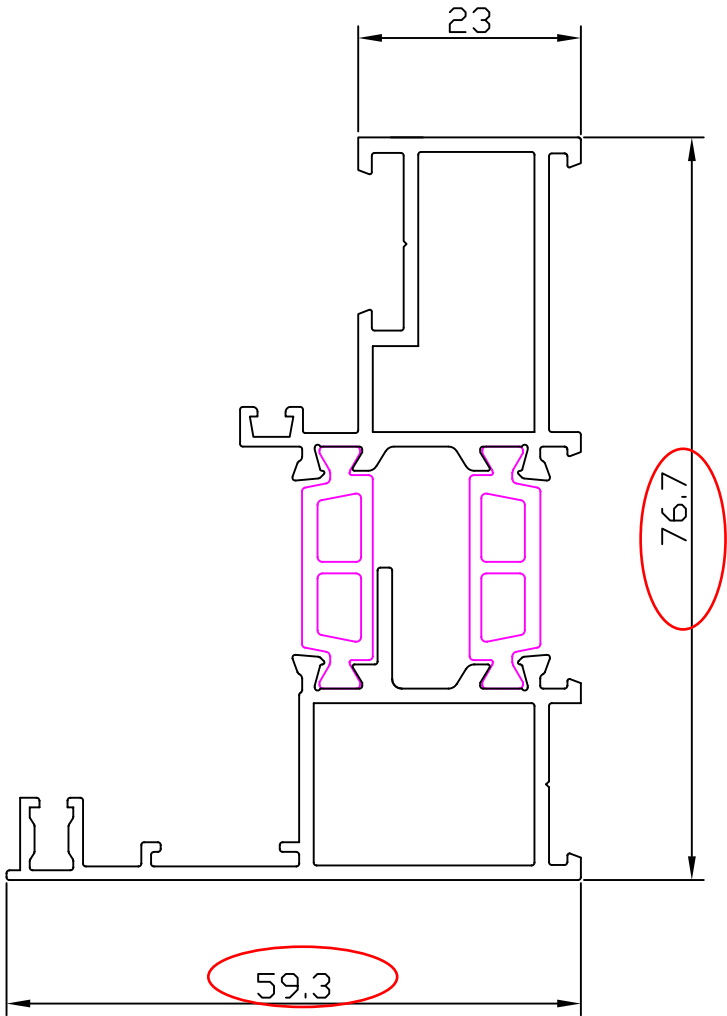
Appendix A: Drawings

平开窗材料清单 (Casement window)

SN	BOM Code	BOM Name		Unit	Quantity
1	G76-S1	窗外框	Window frame	PC	4
2	G76-K2	窗外框	Window frame	PC	4
3	EPDM-01	橡胶密封皮条	EPDM sealing strip	PC	16
4	G3-9-9	Regal条三层玻璃	Tripple glazed glass with Regal spacer	PC	1
5	GR76-25	隔热条	Heat insulation strip	PC	16
6	G76YX	压线	Crimping	PC	4
7	JGT76	Regal间隔条	Regal spacer bar	PC	4
8	PVC76-DK	气凝胶	Aerogel	PC	4
9	CGR76	气凝胶	Aerogel	PC	4
10	FPM76	聚乙烯发泡保温棉	Polyethylene foam insulation cotton	PC	24
11	CZS-17	把手	Handle	PC	1
12	PU-G	“硅宝”胶水	Silicone glue	PC	4



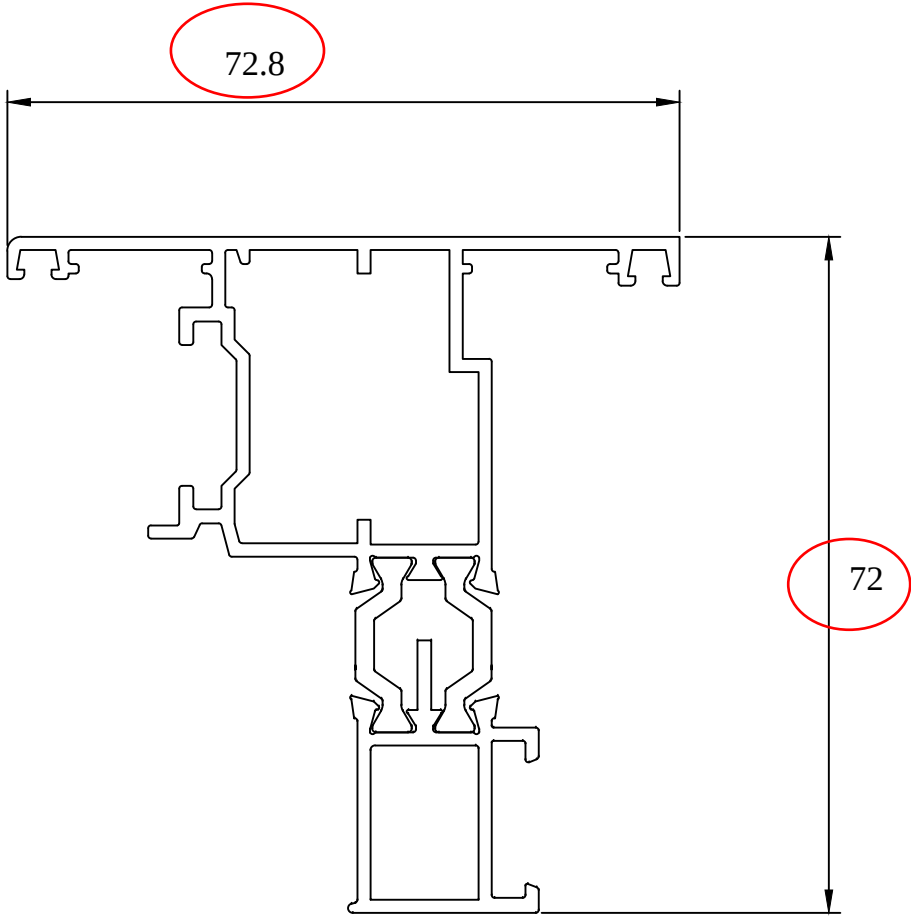
INSIDE



Aluminum Alloy (Painted)

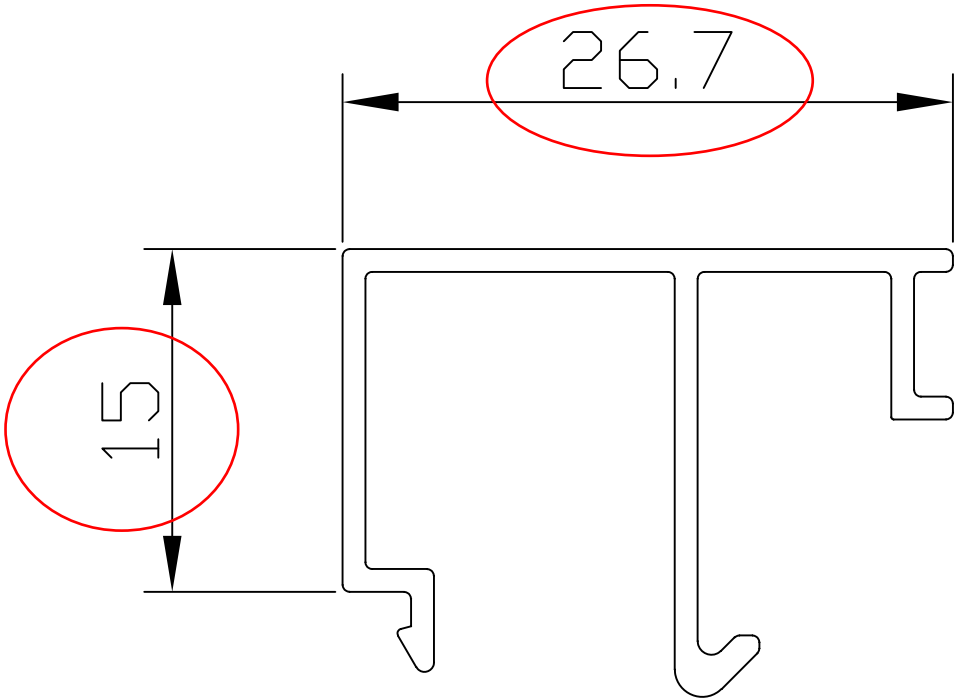
BOM Code	G76-K2
BOM Name	Window frame
比 例	----- 2022 ----- DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER
1 : 1	

INSIDE



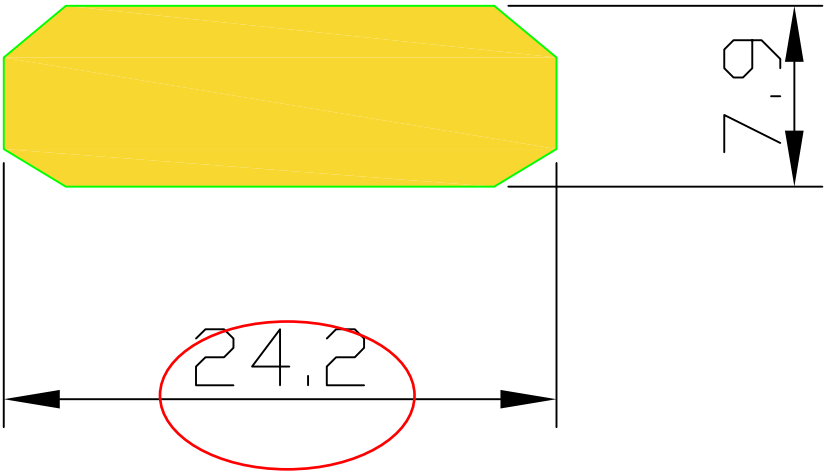
Aluminum Alloy
(Painted)

BOM Code	G76-K2
BOM Name	Casement
比 例	----- 2022 ----- DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER
1 : 1	

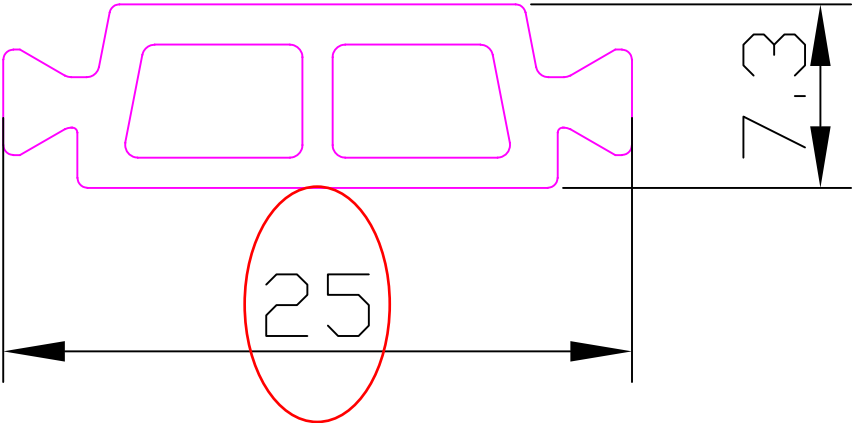


Aluminum Alloy (Painted)

BOM Code	G76YX
BOM Name	Crimping
比 例	----- 2022 ----- DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER
1 : 1	

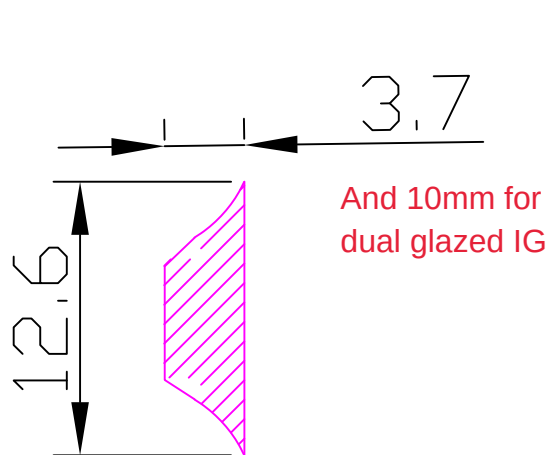


BOM Code	CGR76
BOM Name	Aerogel
比 例	----- 2022 ----- DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER
1 : 1	

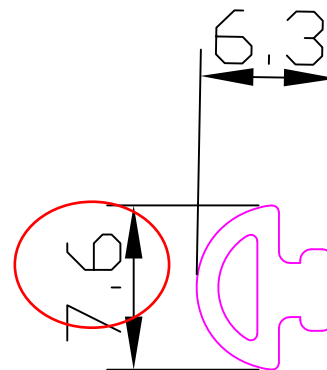


Polyamide 6.6 with 25% glass fiber

BOM Code	GR76-25
BOM Name	Heat insulation strip
比 例	----- 2022 ----- DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER
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PU-G



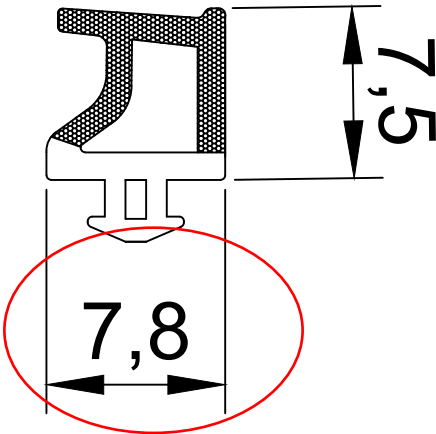
EPDM-01

EPDM

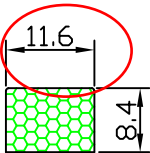
----- 2022 -----

型号;FH652

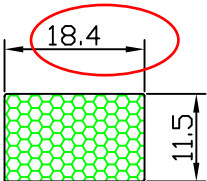
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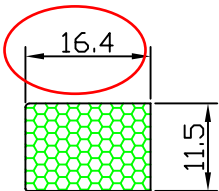
EPDM



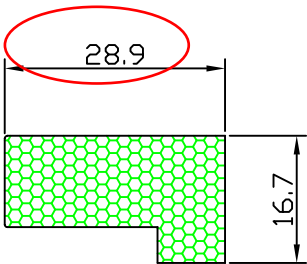
BOM Code	FPM76-004
BOM Name	Polyethylene foam insulation cotton
比例	2022
1 : 1	DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER



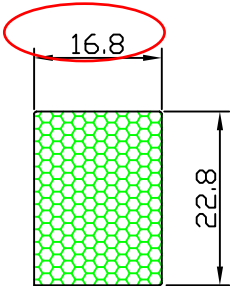
BOM Code	FPM76-005
BOM Name	Polyethylene foam insulation cotton
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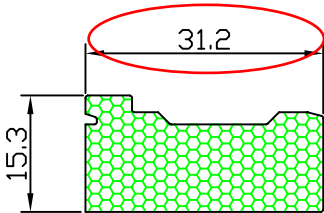
BOM Code	FPM76-006
BOM Name	Polyethylene foam insulation cotton
比例	2022
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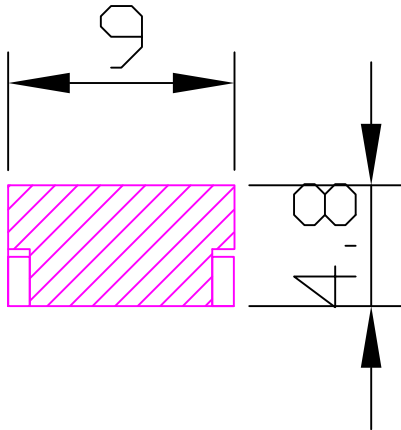
BOM Code	FPM76-001
BOM Name	Polyethylene foam insulation cotton
比例	2022
1 : 1	DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER



BOM Code	FPM76-002
BOM Name	Polyethylene foam insulation cotton
比例	2022
1 : 1	DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER



BOM Code	FPM76-003
BOM Name	Polyethylene foam insulation cotton
比例	2022
1 : 1	DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER



BOM Code	JGT76-001
BOM Name	Quanex spacer bar
比 例	----- 2022 ----- DOORS & WINDOWS SYSTEM SOLUTION SUPPLIER
1 : 1	

building products

Insulating Glass Systems

Super Spacer® Premium Plus

Enhanced

Super Spacer® Premium Plus is a flexible, silicone foam spacer that provides the maximum in perimeter insulation for sealed glazing units. Desiccant-filled with pre-applied side adhesive, the structural foam product significantly simplifies insulating glass (IG) production.



Basic Use

Super Spacer is a dual seal insulating glass spacer system that uses a high-performance acrylic adhesive for its structural seal and is backed with a proprietary multi-layer moisture vapor seal.

Featuring a vapor barrier backing, the spacer must be used in combination with conventional IG sealants.

Colors

Super Spacer Premium is available in Black, Aluminum, Grey and Almond.

Composition

Silicone foam base with desiccant pre-fill.

Desiccant Fill

3A molecular-sieve; 47% minimum by weight.

Continuous Packaged Length

For regular insulating glass production, Super Spacer Premium Plus is supplied on reels with the continuous packaged length varying depending on the spacer width.

Protective Packaging

To provide desiccant protection, the reels are sealed in moisture-proof foil bags. The reels are then shipped in recyclable cardboard boxes.

Performance	Norm
Thermal conductivity 0.127 W/m°K	ASTM C 518
Gas / Moisture vapor barrier WVTR < 0.020 gm/m ² /day Oxygen < 0.009 cc/m ² /day	ASTM F 1249 ASTM D 3985
Primary structural seal Acrylic adhesive	
Fogging No fog in visual area.	ASTM E 2190 EN 1279 - 6 CAN/CGSB 12.8
Gas Retention Pass with hot-melt butyl or curative butyl	EN 1279 - 3
I.G. Durability Pass with hot-melt butyl or curative butyl	ASTM E 2190 EN 1279 - 2

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- Superior silicone foam insulation
 - Low thermal conductivity
 - Substantially reduced perimeter condensation
 - Typical overall 0.2 W/m²K (0.04 BTU/h-ft²-°F) U-factor window improvement (vs. aluminum)
 - Excellent UV resistance
 - Extreme temperature performance
 - Fast dew-point drop
 - Superior compression-set resistance
 - Excellent color stability
 - Enhanced sound dampening

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- Continuous vapor barrier at corners
 - No chemical fogging
 - High desiccant content
 - Same spacer material and edge-seal technology as the proven Premium Plus product.

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- Outer hot-melt butyl sealant for enhanced gas retention
 - Inner structural acrylic side adhesive
 - Immediate unit handling
 - No cold flow or spacer/seal migration problems

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- Fast application
 - Elimination of desiccant filling
 - No corner key assembly
 - Simplified production of shaped units
 - Limited equipment investment
 - High-volume production with reduced labor force

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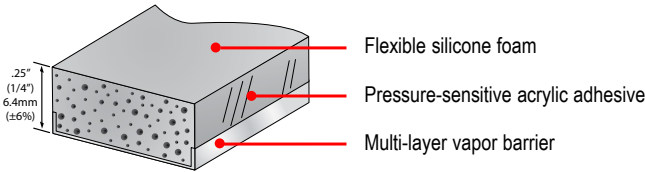
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- Black, Aluminum, Grey or Almond colors
 - Smooth matte surface finish
 - No surface blistering or bubbling
 - Straight-line application with sharp 90° corners



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Width mm	Width inches	Meter/ Reel	Feet/ Reel	Meter/ Auto Reel	Feet/ Auto Reel
3.2 mm	.125"	457	1500	N/A	N/A
4.8 mm	.188"	457	1500	1372	4500
6.4 mm	.250"	335	1100	1006	3300
7.9 mm	.313"	305	1100	914	3000
9.5 mm	.375"	274	900	823	2700
11.1 mm	.438"	244	800	731	2400
12.7 mm	.500"	213	700	640	2100
14.3 mm	.563"	190	625	571	1875
15.9 mm	.625"	175	575	526	1725
17.5 mm	.688"	152	500	N/A	N/A
19.1 mm	.750"	152	500	457	1500
20 mm*	.787"	122	400	N/A	N/A

* All even metric sizes are not available in North American market.

Note: Nominal sizes larger than 0.375" (3/8") have a tolerance of +/- 3% for the width (airspace) and +/- 6% for the height (thickness).
For nominal sizes 0.375" (3/8") and lower the tolerance is +/- 0.010" on the width (airspace) and +/- 6% for the height (thickness).

Note: All metric dimension equivalent sizes are for reference only.

Quanex's Quality Management System is certified to ISO 9001 by Smithers Quality Assessments

Rev. #	Revisions Made	Rev. Date
2	Changed U-value to U-factor per Grant Muller	2/24/17

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800 Cochran Avenue

Cambridge, OH 43725

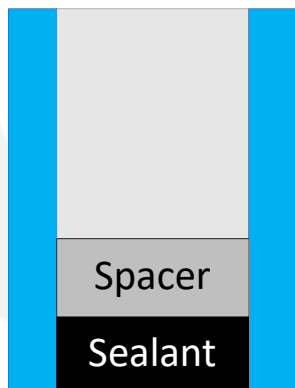
T 800-233-4383

F 740-439-0121

www.quanex.com

Super Spacer® Thermal Modeling Instructions

Please use the information below when modeling Quanex Super Spacer® for thermal performance.



Modeling Steps (THERM):

1. Sum the sealant depth and the appropriate spacer height;
2. Import a glazing system with the **Spacer Height** set to the sum from step 1;
3. Use the **Rectangle** tool to draw the sealant box:
 - a. Box bottom should be flush with the lower glass edge;
 - b. Box height is according to the actual sealant depth;
4. Use the **Fill Void** tool to create the spacer box; make sure to select the proper material.

Spacer Type	Spacer Height	Material Name in NFRC 101	Listed K _{EFF}
Standard	3/16" [4.8 mm]	Super Spacer Standard (EPDM)	0.179 W/m·K
Premium	3/16" [4.8 mm]	Super Spacer S2 Premium	0.115 W/m·K
Premium Plus	1/4" [6.4 mm]	Super Spacer S2 Premium Plus	0.127 W/m·K
Triseal	0.287" [7.3 mm]	Super Spacer Triseal / T-Spacer	0.141 W/m·K
T-Spacer	0.287" [7.3 mm]	Super Spacer Triseal / T-Spacer	0.141 W/m·K

Notes:

1. All Super Spacers are modeled using the 2-box method, using effective conductivity (K_{EFF}) values for the spacers, and the appropriate conductivity for the sealant. This includes the various T-spacers: the PIB is not drawn separately.
2. Listed K_{EFF} values are taken from NFRC 101, but may not be current. If there is a disparity between the values above and those in NFRC 101, use the NFRC values.
3. By default, Super Spacer is sized in 1/16" increments, but some non-standard sizes are available. Always verify actual size with the IG manufacturer before modeling.
4. Default sealant depths¹ for the rectangular (i.e. not T-spacer/Triseal) spacers are:
 - a. 3/16" for hot melt butyl, a.k.a. "Butyl rubber (isobutene, solid/hot melt)";
 - b. 1/4" for other organic sealants (silicone is not used with rectangular spacers);
 - c. Always verify actual sealant depth with the IG manufacturer before modeling;
5. Default sealant for the T-spacer and Triseal products is 1/4" silicone.¹ However, both the material and depth can vary according to the requirements of individual projects, so always verify both with the IG manufacturer before modeling.

¹ Note that default sealant specifications are for thermal modeling only; they are not recommendations for IG manufacture. For more information, see Quanex technical bulletin RDQ0024: *Secondary Sealant use with Super Spacer Systems*.

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