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TEST REPORT # **T1248-2F**

DATE: August 2, 2018

CLIENT: **Artistic Skylight Domes**
255 Regina Road
Woodbridge, Ontario
L4L 8M3
Contact: Nenzio Ferrazzo

SAMPLE ID: Model CU-CF-FF-VE

SAMPLE DESCRIPTION: Aluminum Cold Form Continuous Skylight (Fixed).
Width: 1257 mm (49-1/2″); Length: 3661 mm (144-1/8″); See pages 5 for full description.

SAMPLING PROCEDURES: See page 2 for the sampling procedure.

DATE OF RECEIPT: June 7, 2018

DATE(S) OF TESTING: July 9 to July 23, 2018.

TESTING REQUESTED: **Testing to the mandatory requirements of AAMA/WDMA/CSA 101/I.S.2/A440-17 NAFS - North American Fenestration Standard / Specification for windows, doors and skylights.** As this type of skylight is outside of the scope of the above standard, no product designation can be assigned. However, the test program followed the intent of the standard.

TEST RESULTS: See page 3 for the test results.

CONTENTS: Test report pages 1 through 9, appendix A1 through A14.

TESTING PERFORMED AT: QAI Laboratories Ltd., Toronto.

Tested by: David Wren

Reported by

David Wren
Senior Technician

Reviewed by

Lawrence Gibson
Executive VP

Sampling Plan/Procedures:

One unused, Aluminum Cold Form Continuous Skylight was provided by the client as a typical production sample and examined at the QAI laboratory to determine compliance with the submitted documentation, then tested from July 9 to July 23, 2018 as being representative of the model covered in this report.

Test Conditions:

QAI Laboratories Ltd. (QAI) was retained by Artistic Skylight Domes to perform testing in accordance with the mandatory test requirements of AAMA/WDMA/CSA 101/I.S.2/A440-17 NAFS - North American Fenestration Standard / Specification for windows, doors and skylights on a representative sample of a 1257 mm (49-1/2″) x 3661 mm (144-1/8″) cold form continuous aluminum fixed skylight having acrylic glazing.

This report includes tests performed on a specimen of specific dimensions. Actual product performance may be affected by variations in the products dimensions, assembly details and installation method. The drawings supplied by Artistic Skylight Domes were verified by QAI for the unit tested and are shown in Appendix A.

The test specimen was installed by the client into a simulated wood roof deck test section, complete with curb, as described below. Adhesive-backed closed cell foam gasket tape was applied to the top of the curb around its perimeter (along the inner edge of the curb) prior to the sample installation. The cold form curb frame was complete with a perimeter kerf inserted neoprene bulb with fin weatherstrip along its underside that was positioned adjacent to and to the exterior of the above mentioned closed cell foam gasket. The large silicone cap bead (GE SCS2000 structural silicone) was applied along the cold form curb frame-to-curb joint along the interior once the skylight was installed. The skylight curb frame was fastened to the side of the curb using #10 x 2″ long hex-head self-drilling tek screws (Master Gripper MDP #JS1000) complete with a neoprene washer bonded to a flat stainless steel washer. There were four fasteners per end on nominal 330 mm (13″) centres, and nine fasteners per long side on nominal 432 mm (17″) centres.

The simulated wood roof deck test section measured nominally 2464 mm (97″) wide and 4865 mm (191-1/2″) long. It was fabricated from 2x6 SPF wood framing sheathed with 15.9 mm (5/8″) plywood. A centrally located curb was fastened to the deck surface and underlying framing, and was fabricated from doubled-up 2x8 SPF lumber. The inside of the curb was open to below, the opening measuring 1089 mm (42-7/8″) wide by 3486 mm (137-1/4″) long. The underlying framing of the deck section consisted of a 2x6 perimeter frame, two doubled-up 2x6 members (orientated parallel to the ends of the skylight) spanning two opposing long sides of the perimeter frame. These doubled up 2x6 members being centrally located, spaced 3496 mm (137-5/8″) apart. Two doubled-up 2x6 members (parallel to the long edges of the skylight) spanned the above mentioned 2x6 members, and were centrally located and spaced 1089 mm (42-7/8″) apart. These doubled-up 2x6's were aligned with, and supported, the above mentioned curb. The plywood sheathing was further supported by 2x6 members spanning the long doubled-up 2x6 members and the parallel adjacent perimeter 2x6 members, seven per long side nominally 406 mm (16″) apart on centre. They were positioned between the doubled up 2x6 members that were parallel to the ends of the skylight. The deck surface was further supported by two 2x6 members at each end, 1134 mm (44-5/8″) apart on centre, parallel to the long edge of the deck, and spanning the doubled-up 2x6 members parallel to the ends of the skylight and the adjacent parallel perimeter frame member. The deck surface and curb were covered with an impermeable self-adhered membrane, the membrane covering the top and sides of the deck, continuing up the sides of the curb and wrapping around the top edge of the curb. The roof deck test section was supported on legs, the surface of the deck nominally 1220 mm (48″) from the floor.

The underside of the test deck was enclosed beneath the curb opening with a chamber fabricated from 2x4 SPF framing and OSB sheathing. The chamber was sealed so that positive and negative test pressures could be applied to it and the associated skylight. The chamber also provided access for observations during the water penetration resistance test.

Product Ratings:

Table 1: Summary of test results

Test Name	AAMA/WDMA/CSA 101/I.S.2/A440-17 NAFS - North American Fenestration Standard / Specification for windows, doors and skylights Result:
Air Leakage Resistance Test (ASTM E283) Test Date and Time: July 17/18 9 am Temperature During Test: 25.0ºC Barometric Pressure During Test: 980 kPa	Pressure differential = 75 Pa Fixed Level Requirement = Max. 0.2 L/s/m^2 (0.04 cfm/ft^2) Infiltration result = 0.152 L/s/m^2 (0.030 cfm/ft^2) - Fixed Level Exfiltration result = 0.183 L/s/m^2 (0.036 cfm/ft^2) - Fixed Level
Water Penetration Resistance Test (ASTM E547) Test Date and Time: July 18/18 1 pm Temperature During Test: 24.5ºC Water Application Rate: 1.492 L/min	Maximum pressure differential = 720 Pa (DP 100 – 15 psf) Observations: No leakage or trapped water.
Uniform Load Deflection Test at Design Pressure (ASTM E330 – Procedure A) Test Date and Time: July 23/18 10:30 am Temperature During Test: 25.0ºC Load Duration (+ve WL): 60 sec. Load Duration (-ve WL): 10 sec. Use of Tape or Film: No Effect of Tape/Film: N/A Inner layer of glazing breached so that outer layer experienced full applied load	Maximum pressure differential = 2880 Pa (DP 60 - 60 psf) Component Measured: Intermediate Pressure Plate Span = 1321 mm (52") Maximum Deflection (+ve WL)= 10.44 mm (0.411") Maximum Residual Deflection (+ve WL) = 0.41 mm (0.016") Maximum Deflection (-ve WL)= -8.26 mm (-0.325") Maximum Residual Deflection (-ve WL) = -0.03 mm (-0.001") Observations: No damage.
Uniform Load Structural Test (ASTM E330 – Procedure A) Test Date and Time: July 24/18 9 am Temperature During Test: 25.5ºC Load Duration (+ve WL): 60 sec. Load Duration (-ve WL): 10 sec. Use of Tape or Film: No Effect of Tape/Film: N/A Inner layer of glazing breached so that outer layer experienced full applied load	Design pressure = 2880 Pa (DP 60) Component Measured: Intermediate Pressure Plate Span = 1321 mm (52") Maximum Pressure Differential (+ve WL)= 5760 Pa (120 psf) Maximum Residual Deflection (+ve WL) = 2.67 mm (0.105") Maximum Pressure Differential (-ve WL)= 4320 Pa (90 psf) Maximum Residual Deflection (-ve WL) = -1.37 mm (-0.054") Observations: No damage. Maximum Allowable Residual Deflection = 3.96 mm (0.156")

Performance Classification: N/A for Skylights
Performance Grade: PG 60
Maximum Size Tested: 1257 mm wide x 3661 mm high (49-1/2" x 144-1/8")
Primary Designator:
N/A- This skylight type is beyond the scope of the standard

Secondary Designator:
Positive Design Pressure (DP) = 2880 Pa (60 psf)
Negative Design Pressure (DP) = -2880 Pa (-60 psf)
Water Penetration Resistance Test Pressure = 720 Pa (15 psf)
Canadian Air Infiltration / Exfiltration = Fixed Level

Note: AAMA/WDMA/CSA 101/I.S.2/A440-17, Clause 9.2.5: The air, water and structural tests were performed on test specimens installed per the method outlined in the test conditions section of this report. The test procedures are designed to test the performance of the test specimen only and are not used to test the performance of the installation, in particular the perimeter sealant joint and the anchoring of the assembly. However, products not installed according to the installation method described in this report may not perform to an equivalent performance level.

Description:

Aluminum Cold Form Continuous Skylight		
Frame:	Description:	Extruded aluminum cold form curb frame members (CanArt Drawing titled "COLD FORM CURB FRAME", Proposal No. S-15978 dated 07/08/2005). The curb frame members at the ends included an aluminum angle-shaped extrusion (AFP Part No. AFP 493) fastened across each end using five #8 x 19 mm (3/4") long pan head self-drilling tek screws per end spaced nominally 280 mm (11") apart o/c. This angle-shaped extrusion was orientated with one leg flat and the other leg upstanding and to the rear. The fasteners were positioned adjacent to the front edge of the angle-shaped extrusion, this edge was flush with the outside edge of the underlying curb frame edge, the joint being sealed with a cap bead silicone (GE SCS2000 structural silicone) along its length as well as across the ends. Four curved extruded aluminum frame channels (AFP Part No. AFP 372), one at each end and two intermediate, spanned the long edges of the curb frame and were spaced nominally 1080 mm (42-1/2") apart. The ends of the curved frame channels were secured to the lower leg of the curb frame with two #10 x 19 mm (3/4") long hex head self-drilling tek screws per end complete with a neoprene washer bonded to a flat stainless steel washer. The upper leg of the curb frame was removed at each curved aluminum frame. At the ends, the upstanding leg of the angle-shaped extrusion was fastened the outer side of the curved frame channels using two 3.2 mm (1/8") rivets per end. Extruded aluminum angles, with weatherstrip kerf along one leg, were fastened to the lower leg of the curb frame between the curved frame channels and supported the edges of the glazing. Each angle was secured with a #8 x 19 mm (3/4") long pan head self-drilling tek screw per end. These angles were cut from the above mentioned frame channels (AFP Part No. AFP 372), being the 25.4 mm (1") wide edge portion (see attached drawing). Frame dimensions: Width: 1257 mm (49-1/2″); Length: 3661 mm (144-1/8″).
	Joints:	Curb frame corners were mitred and tack welded on the exterior of the corner, with the inclined portion of the joint fully welded on the exterior and sealed with silicone. On the inside of the corner, both inclined legs were fully welded (the legs that take the thermal breaks) as well as the vertical portion that takes the condensation gutter (the backside of this vertical portion was also sealed with silicone). On the underside the corner was fully welded. See appended photos for corner weld and sealing details.
Thermal Break- Curb Frame:	Description:	Extruded PVC thermal break (Drawing titled "Curb thermal Break") was fitted to the lower leg of the curb frame prior to the installation of the curved frame channels and weatherstrip retaining angles. Along the curb frame at the ends of the skylight, the upper curb frame leg was also fitted with this thermal break.
Thermal Break- End Curved Frame Channels:	Description:	Extruded PVC thermal break (Vinyl Profiles Ltd. Die No. V79-1), modified with the eccentric leg having the co-extruded cup gasket removed. The modified thermal break was fitted to the end curved frame channels with the remaining leg portion of the thermal break hanging over the outer edge of the curved frame channel (at the ends of the thermal break, the complete leg was removed for the last 90 mm (3-1/2")). The thermal break was fastened to the end frame channels using five #8 x 19 mm (3/4″) long pan head self-drilling tek screws per channel, complete with a neoprene washer bonded to a flat stainless steel washer on nominal 305 mm (12") centres. The screws were installed in ports drilled through the upper wall of the thermal break so that the screwheads bore on the lower wall.

Aluminum Cold Form Continuous Skylight (Continued)		
Thermal Break-End Curved Frame Channels (Continued):	Description:	A 24 mm (15/16") wide strip of 19 mm (3/4") plywood, having cuts made across the underside approximately halfway through the strip to allow for curvature of the strip to match that of the curved frame channels, was fastened to each of the above mentioned thermal breaks. Four #8 x 38 mm (1-1/2") long flat head screws on 405 mm (16") to 480 mm (19") centres fastened the each plywood strip to the underlying modified thermal break. The stacked plywood strip and thermal break along the outer edge of the end curved frame channels acted as a support for the pressure plate in place of the acrylic dual glazing and associated gaskets.
Condensation Gutter/Thermal Break- Curb Frame:	Description:	Extruded PVC combination condensation gutter and thermal (Vinyl Profiles Ltd. Die No. V79-1) was fitted to the inside perimeter of the curb frame and secured to it using #8 x 12.7 mm (1/2″) long pan head self-drilling tek screws complete with a neoprene washer bonded to a flat stainless steel washer. There were four fasteners per end located on nominally 330 mm (13″) centres and nine per long side located on nominally 405 mm (16″) to 460 mm (18″) centres The combination condensation gutter and thermal break had the leg with the co-extruded flexible vinyl cup gasket removed at the snap-groove (see above mentioned drawing). Thermal Break dimensions: Width: 1107 mm (43-9/16″), Length: 3508 mm (138-1/8″).
	Joints:	Corners were mitred and thermally welded.
Glazing Method:	Interior (Intermediate detail between skylight ends):	Laid-in glazed on a kerf-inserted rubber gasket (Artistic Drawing titled “SPACER GASKET” un-dated) along the curb frame and curved frame channels (3" channel, AFP Part No. AFP 372), the corners butted together. The gasket wrapped around the inner glazing layer and acted as a spacer for the exterior glazing layer, which was laid on top of the spacer gasket. The corners of the gasket were sealed with silicone between the glazing layers.
	Interior (End Detail):	The inner layer of acrylic was laid-in glazed to the angle-shaped extrusion and the curved frame channel on butyl shim tape (Tremco Polyshim II) measuring 9.5 mm (3/8") in width and 7.1 mm (0.280") in thickness with a 6.4 mm (1/4") diameter shim. Along the angle-shaped extrusion, the inner layer of acrylic was also glazed on a modified rubber gasket (Artistic Drawing titled “SPACER GASKET” un-dated), the kerf spline/cup gasket portion being removed and the gasket adhesively bonded to the upstanding leg of the angle-shaped extrusion using butyl shim tape (Tremco Polyshim II) measuring 9.5 mm (3/8") in width and 3.8 mm (0.150") in thickness with a 3.2 mm (1/8") diameter shim. The outer layer of acrylic was laid-in glazed on the rubber spacer gasket (Artistic Drawing titled “SPACER GASKET” un-dated), mentioned above where the gasket wrapped around the inner glazing layer and acted as a spacer. Along the curved frame channel, the modified spacer gasket mentioned above acted as a spacer for the exterior glazing layer which was laid on top of the spacer gasket. The cut edge of the modified spacer gasket was riveted to the top surface of the thermal break that was fastened to the end curved frame channel using six 3.2 mm (1/8") rivets with washers under their heads, on 230 mm (9") to 250 mm (10") centres. The spacer gasket on the curved frame channel was cut to fit against the spacer gasket along the angle-shaped extrusion, the gasket joints were sealed with silicone between the glazing layers. At each end, the glazing was supported by four neoprene setting blocks spaced nominally 345 mm (13-1/2") apart on centre. The blocks were adhesive backed and were applied to the flat surface of the angle-shaped extrusion. The setting blocks measured 44.5 mm (1-3/4") x 25.4 mm (1") x 4.5 mm (0.175").

Aluminum Cold Form Continuous Skylight (Continued)		
Glazing Method (Continued):	Exterior:	Extruded aluminum retainer frame (CanArt Drawing titled "COLD FORM CURB FRAME", Proposal No. S-15979 dated 06/29/2005) was fitted to the curb frame on the exterior, and fastened to the sides of the curb frame using #10 x 38 mm (1-1/2″) long hex head self-drilling tek screws complete with a neoprene washer bonded to a flat stainless steel washer. There were seventeen fasteners per side and six per end, located nominally 230mm (8-1/2″) o/c. The corners of the aluminum retainer frame were mitred and fully welded. Each section of curved glazing was also retained by three 'Z'-shaped clips per long edge, spaced 430 mm (17") to 460 mm (18") apart o/c, each fastened to the curb frame with one #8 x 12.7 mm (1/2") long pan head self-drilling tek screw. These brackets were brake-formed from 1.29 mm (0.050") thick aluminum and measured nominally 76 mm (3") wide with a 25 mm (1") leg at the glazing, a 22 mm (7/8") leg at the curb frame, and 19.8 mm (0.780"") high to underside of glazing leg. 76 mm (3") wide curved extruded aluminum pressure plates (AFP Part No. AFP 381) were fitted to each of the intermediate mullions and retained using 1/4"-20 x 51 mm (2") long stainless steel hex-head bolts complete with a neoprene washer bonded to a flat stainless steel washer. There were nine fasteners per pressure plate located on nominal 152 mm (6") centres. The intermediate pressure plates were complete with two kerf-inserted santoprene gaskets (Drawing titled "Santoprene Cup Gasket Die No. V-76", un-dated). The end pressure plates were modified versions of those above, where a curved section of 38 mm (1-1/2") x 38 mm (1-1/2") extruded aluminum angle was tack welded along one edge, making the pressure plate 111 mm (4-3/8") wide overall, the leg of the angle orientated downwards acting as a glazing leg. Butyl shim tape (Tremco Polyshim II) measuring 9.5 mm (3/8") in width and 3.8 mm (0.150") in thickness with a 3.2 mm (1/8") diameter shim was sandwiched between the exterior glazing and the above mentioned glazing leg. The tack welds were along the underside of the pressure plates, with the exposed joint along the top side of the pressure plate being sealed with a cap bead of silicone. There were nine tack welds, nominally 19 mm (3/4") long spaced nominally 150 mm (6") apart o/c. The pressure plates on the end mullions had one (inboard) of the above mentioned gaskets.
Glazing:	Description:	Two 5.1 mm (0.200″) thick acrylic sheets, 12.7 mm (1/2″) apart with the aforementioned spacer gasket sandwiched in between.
Drainage:	Condensation Gutter/Thermal Break:	None
	Curb Frame:	Two 4.8 mm (3/16") diameter holes along each curb frame end, 114 mm (4-1/2") o/c inboard of the adjacent curb frame corner, and two along each long side at the intermediate curved frame channels, drained the lower leg surface to the retainer frame cavity.
	Retainer Frame:	Two 3.6 mm (9/64") diameter holes along each retainer frame end member, 76 mm (3") o/c inboard of the adjacent retainer frame corner, and one along each long side of the retainer frame at the centre, drained the retainer frame cavity to the exterior.
Additional Sealant Applied Following Assembly (GE SCS2000 Structural Silicone	Retainer Frame:	The lower edge of the retainer frame was sealed to the underlying curb frame with a full perimeter cap bead. The upper edge of the retainer frame was sealed to the exterior glazing layer with a full perimeter cap bead, including across the ends of the pressure plates. Angle-shaped extrusion across ends of curb frame sealed to exterior layer of end glazing with a cap bead

Aluminum Cold Form Continuous Skylight (Continued)		
Additional Sealant Applied Following Assembly (GE SCS2000 Structural Silicone (Continued)	End Pressure Plates:	Inboard edge of end pressure plates sealed to exterior layer of curved glazing from end to end with cap bead, continuous to retainer frame cap bead. Down-turned edge of welded-on angle (aforementioned glazing leg) sealed to exterior layer of glazing at end with full cap bead, cap bead continued across angle-shaped extrusion across ends of curb frame
	Intermediate Pressure Plates:	Edges of pressure plates sealed to exterior layer of glazing from retainer frame cap bead continuing up edges of pressure plate for approximately 200 mm (8").

MODIFICATIONS:

- Frame weeps added, eight to curb frame and six to retainer frame.
- Retainer frame sealed with cap bead of structural silicone to underlying curb frame about perimeter, and to glazing and ends of pressure plates.
- Curb frame sealed to curb about inside perimeter with a large cap bead of structural silicone.
- Intermediate pressure plates sealed to glazing from end to 200 mm (8") up from end.
- End glazing sealed to frame members and pressure plates with cap bead of structural silicone

CONCLUSION:

QAI Laboratories Ltd., with lab facilities located in Toronto, Ontario, performed testing in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-17 NAFS - North American Fenestration Standard / Specification for windows, doors and skylights on a representative sample of an Artistic Skylight Domes Model CU-CF-FF-VE Aluminum Cold Form Continuous Skylight (Fixed). As this type of skylight is outside the scope of the aforementioned standard, no product designation could be assigned. The skylight described and tested here-in achieved the ratings based on the intent of the standard.

Test results in this report may not be reproducible in the field. Test results relate only to those products tested.

See Table 1 for a summary of test results and window ratings. The sample tested was found to comply with the applicable requirements and obtained test results as reported in Table 1 of this report.

Report Revision History

Date	Revision	Change Description	Initials
August 2, 2018	0	Original Report	DW

Photos

Test Sample Setup

Curb Frame Corner Weld Details