Product Evaluation Report

Date:	August 2, 2023
PTC Report No.:	2664-PER
Report Revision No.:	2
PTC Project No.:	422-0615
Product Mfg.:	Solatube International, Inc. 2210 Oak Ridge Way Vista, CA 92081
Product Name:	Impact 290 DS Low Profile Tubular Daylight Device - HVHZ
Product Category:	Sky Lights
Product Sub-Category:	Skylight
Compliance Method:	Product Approval Rule 61G20-3.005(1)(a) – Certification
Prepared By:	Robert J. Amoruso, P.E. Florida P.E. License Number 49752 PTC Product Design Group, LLC FBPE Certification of Authorization No. 25935

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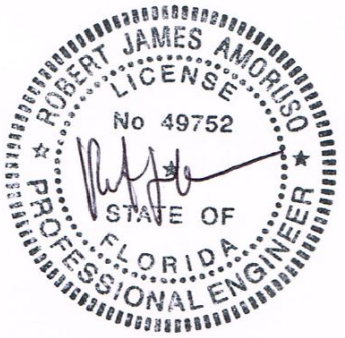

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Evaluated by:
Robert J. Amoruso, P.E.
Florida P.E. License Number 49752

Project Scope

Evaluate Solatube Impact 290 DS Low Profile Tubular Daylight Device for conformance to the 8th Edition (2023) Florida Building Code – Building and Residential Volumes including the High Velocity Hurricane Zone (HVHZ). This include the 8th Edition (2023) Florida Building Code. Prepare the following:

- Product Installation Details/Drawings (Reference 1)
- Installation Anchorage Evaluation (Reference 3)
- Product Evaluation Report (this report)

Description of Product – Installation Requirements

See Reference 1 for a description of the product, its installation and other pertinent data related to its approved use.

Limitations and Conditions of Use

This product evaluation report contains or refers to specifications, technical details, and installation details and/or methods that pertain to the proper use and/or installation of the product specified herein. Specific limitations and conditions of its use including but not limited to the following are contained in Reference 1 and are the subject of Product Approval in accordance with the State of Florida Product Approval Rule 61G20-3.

- Design Pressure Rating (psf)
- Installation substrate requirements.
- Installation anchor requirements.
- Installation restrictions.
- Product description.
- Product components.

Code Conformance – Performance Testing

Reference 2.a conducted testing to the following standard(s). See Reference 3.b for Code Conformance Evaluation to the Current Edition FBC for these testing standards.

1) TAS 201-94 - *Impact Test Procedures*
2) TAS 202-94 - *Criteria for Testing Impact & Nonimpact Resistant Building Envelope Components Using Uniform Static Air Pressure*
3) TAS 203-94 - *Criteria for Testing Products Subject to Cyclic Wind Pressure Loading*
4) ASTM E1886-13a, Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
5) ASTM E1996-14a, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

6) AAMA/WDMA/CSA 101/1.S.2/A440-08

Performance testing was conducted in the following tests.

- Intertek Test Report No. J2410.02-303-44, dated 1/30/20 (Revision), TAS 201, TAS 202, TAS 203, ASTM E1886 and ASTM E1996 testing on low profile glass skylight, tubular daylight device, signed and sealed by Tyler Westerling, FL P.E. No. 72012.
    - This report covered the full testing required of TAS 201, TAS 202, TAS 203 to demonstrate compliance with High Velocity Zone.
    - This report also demonstrated compliance to ASTM E1886 and ASTM E1996.
- Intertek Test Report No. J2410.01-303-44, dated 4/9/20 (Revision), AAMA/WDMA/CSA 101/1.S.2/A440-08 testing on low profile glass skylight, tubular daylight device.
    - This report also demonstrated compliance to AAMA/WDMA/CSA 101/1.S.2/A440-08.

Certification by Keystone Certification Inc. based on the above testing as follows; broken down by Florida Product Approval Number.

- FL32178.1
    - CAR & Product ID Number: 110 - 129.0
        - Referenced Standard: PA/TAS 201/202/203
        - Test Report No: ATI-J2410.02-303-44-R1
        - 3/8" Lami Glass + 1/8" Acrylic
    - HVHZ: Yes, Outside HVHZ: Yes, Impact: Yes
- FL32178.2
    - CAR & Product ID Number: 110 - 128.0
        - Referenced Standard: AAMA/WDMA/CSA 101/IS2/A440-08
        - Test Report No: ATI-J2410.01-303-44-R3
        - 3/8" Lami Glass + 1/8" Acrylic
    - CAR & Product ID Number: 110 - 206.0
        - Referenced Standard: ASTM E1886-13a/E1996-14a
        - Test Report No: ATI-J2410.01-303-44-R3/ATI-J2410.02-303-44-R1
        - 3/8" Lami Glass + 1/8" Acrylic
    - HVHZ: No, Outside HVHZ: Yes, Impact: Yes
- FL32178.3
    - CAR & Product ID Number: 110 - 127.0
        - Referenced Standard: AAMA/WDMA/CSA 101/IS2/A440-08
        - Test Report No: ATI-J2410.01-303-44-R3
        - 5/32" Temp Mono Glass + 1/8" Acrylic
    - HVHZ: No, Outside HVHZ: Yes, Impact: No

The Impact HVHZ product tested in ATI-J2410.02-303-44-R1 to TAS 201/202/203 (CAR 110-129) also covers the impact testing of the Non-HVHZ product (CAR 110-206) using the same glazing.

The Impact Non-HVHZ product tested in ATI-J2410.01-303-44-R3 to AAMA/WDMA/CSA 101/IS2/A440-08 (CAR 110-128) and tested in ATI-J2410.02-303-44-R1 to ASTM E1886-13a/E1996-14a (CAR 110-206) using the same glazing.

The Non-Impact Non-HVHZ product tested in ATI-J2410.01-303-44-R3 to AAMA/WDMA/CSA 101/IS2/A440-08 (CAR 110-127).

DESIGN PRESSURE LIMITATIONS

From Reference 2.a

  - Uniform Load Structural Test Pressures were +300/-300 psf.
  - Water Test Pressure of +15 psf.
  - Cyclic Wind Loading Pressure of +/-100 psf.
- Apply the following factors to arrive at Design Pressure.
  - Safety Factor of 2 applied to the Uniform Load Structural Test Pressures to arrive at Design Pressures of +150/-150 psf.
  - A factor of 1/0.15 = 6.67 applied to the Water Test Pressure arrive at Design Pressures of +100 psf (i.e., 15 x 6.67 = 15/.15)
- Overall Design Pressure is +/-100 psf.

Code Conformance – Plastics

The Current Edition Florida Building Code, Chapter 26 define requirements for Approved Plastics. The following table summarizes plastics testing for applicable components. See Reference 3.b for Code Conformance Evaluation to the Current Edition FBC for the testing standards mentioned below. BOM Item No. in parenthesis refer to drawing number SOLA0016 unless otherwise indicated.

EFFECT LENS (21) testing for PET-GAG (PET-Polyethylene Terephthalate, High Frequency Welding Grade-GAG)					
Attribute	**Report Reference**	**ASTM**	**Result**	**Acceptance Criteria**	
Rate of Burning	2.b.ii	ASTM D635-06	CC1	CC1 or CC2	
Self-Ignition Temperature	2.b.iii	ASTM D1929-96(2001)e1	765°F	$\geq$ 650°F	
Smoke Density	2.b.iv	ASTM E84-09a	95	$\leq$ 450	
Conclusion: ACCEPTABLE					

CEILING RING (24) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))					
Attribute	**Report Reference**	**ASTM**	**Result**	**Acceptance Criteria**	
Outdoor Exposure	2.c.iv	ASTM G155-05a and D638-03	9.25%	+/- 10% difference in tensile strength	
Rate of Burning	2.c.i	ASTM D635-06	CC2	CC1 or CC2	
Self-Ignition Temperature	2.c.ii	ASTM D1929-96	982°F	≥ 650°F	
Smoke Density	2.c.iii	ASTM E84-06	400	≤ 450	
Conclusion: ACCEPTABLE					

CEILING RING (20) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))					
Attribute	**Report Reference**	**ICC-ES Report**	**Result**	**Acceptance Criteria**	**Comment**
Rate of Burning	2.d.i & 2.d.ii	ICC-ES ESR-1653	CC2	CC1 or CC2	IBC - 2606 has same requirements as Current Edition FBC , Chapter 26
Self-Ignition Temperature	2.d.i & 2.d.ii		Conformance per ICC-ES ESR-1653	≥ 650°F	
Smoke Density	2.d.i & 2.d.ii			≤ 450	
Conclusion: ACCEPTABLE					

DIFFUSER PANEL (22) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))					
Attribute	**Report Reference**	**ASTM**	**Result**	**Acceptance Criteria**	
Rate of Burning	2.e.i	ASTM D635-06	CC2	CC1 or CC2	
Self-Ignition Temperature	2.e.ii	ASTM D1929-96	992°F	≥ 650°F	
Smoke Density	2.e.iii	ASTM E84-06	350	≤ 450	
Conclusion: ACCEPTABLE					

DIFFUSER PANEL (22) testing for Polycarbonate Sheet					
Attribute	**Report Reference**	**ASTM**	**Result**	**Acceptance Criteria**	
Rate of Burning	2.f.i	ASTM D635-74	CC2	CC1 or CC2	
Self-Ignition Temperature	2.f.ii	ASTM D1929-68(1975)	896°F	≥ 650°F	
Smoke Density	2.f.iii	ASTM D2843-93	38	≤ 75	
Conclusion: ACCEPTABLE					

ACRYLIC LENS AND TRIM RING (Various – BOM – Optional Diffusers) testing for Acrylic					
Attribute	**Report Reference**	**ASTM**	**Result**	**Acceptance Criteria**	
Rate of Burning	2.g.i	ASTM D635-14	CC2	CC1 or CC2	
Self-Ignition Temperature	2.g.i	ASTM D1929-16	878°F	≥ 650°F	
Smoke Density	2.g.i	ASTM D2843-16	13.4	≤ 75	
Conclusion: ACCEPTABLE					

Additional Plastic and/or Foam Plastic Components – Manufacturer Data Sheet

DWG BOM	STI MATERIAL P/N	COMPONENT P/N	COMPONENT	MATERIAL	MATERIAL MFR. P/N	MATERIAL MFR	MATERIAL SUPPLIER	TEST AND RESULTS	TEST STANDARD
1	890010	411190	SASH	ASA (Acrylonitrile styrene acrylate)	Luran S 757G	INEOS STYROLUTION GROUP	Entec Polymers	HB Rating for flammability of polymeric materials used for parts in devices and appliances.	UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (like ASTM E84), Rated HB
2	890010	411210	SASH CLIP (NOT SHOWN)	ASA (Acrylonitrile styrene acrylate)	Luran S 757G	INEOS STYROLUTION GROUP	Entec Polymers	HB Rating for flammability of polymeric materials used for parts in devices and appliances.	UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (like ASTM E84), Rated HB
4	890010	411060	CONNECTOR FLANGE	ASA (Acrylonitrile styrene acrylate)	Luran S 757G	INEOS STYROLUTION GROUP	Entec Polymers	HB Rating for flammability of polymeric materials used for parts in devices and appliances.	UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (like ASTM E84), Rated HB

5	890001	411460	RAYBENDER LENS	PMMA (polymethyl methacrylate)	ZK5BR (EXP-273 9V913) UV	EVONIK Cyro	Roehm America	HB Rating for flammability of polymeric materials used for parts in devices and appliances.	UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (like ASTM E84), Rated HB
8	N/A	600325	SEAL	EPDM FOAM	F-03011	Armacel	Smalley & Company	HF-1 Rating for flammability of polymeric materials used for parts in devices and appliances.	UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (like ASTM E84), Rated HF
9	600018	600045	BUG AND DUST BARRIER (NOT SHOWN)	PU FOAM	N/A	N/A	McMaster Carr	Passed for smoke generated and the combustibility of air filter units.	UL 900, Standard for Air Filter Units, Passed
23	890002	410715	DRESS RING 290 DS	PMMA (polymethyl methacrylate)	ZK5BR	EVONIK Cyro	Roehm America	HB Rating for flammability of polymeric materials used for parts in devices and appliances.	UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (like ASTM E84), Rated HB

26	990955-008	420610	DRESS RING SEAL 290 DS	PE FOAM	Volara	Voltek	Reilly Foam	Flame Spread Index: 5, Smoke Developed Index: 75.	ASTM E84
29	890040	420270	INSULATION PANEL CLIP	PC	Lexan 143R-111	Sabic	Nexeo Solutions	HB Rating for flammability of polymeric materials used for parts in devices and appliances.	UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (like ASTM E84), Rated HB

The above components listed in the BOM and manufactured from Plastic or Foam Plastic have had flammability characteristics tested using alternate UL procedures (see list above). These test protocols meet/exceed Florida Building Code requirements.

Test results meet/exceed Florida Building Code requirements.

Performance and Testing Standards

Reference 2.a.i conducted air, water and structural testing including impact and cyclic loading to the following standard(s).

1) TAS 201-94 - *Impact Test Procedures*
2) TAS 202-94 - *Criteria for Testing Impact & Nonimpact Resistant Building Envelope Components Using Uniform Static Air Pressure*
3) TAS 203-94 - *Criteria for Testing Products Subject to Cyclic Wind Pressure Loading*
4) ASTM E1886-13a, Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
5) ASTM E1996-14a, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

Reference 2.a.ii conducted air, water, and structural testing to the following standard(s).

1) AAMA/WDMA/CSA 101/1.S.2/A440-08

Reference 2.b, 2.c, 2.d, 2.e, 2.g, 2.h and 2.i conducted plastics testing to the following standard(s).

1) ASTM G155-05a, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
2) ASTM D638-03, Standard Test Method for Tensile Properties of Plastics
3) ASTM D638-08, Standard Test Method for Tensile Properties of Plastics
4) ASTM D635-06, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
5) ASTM D635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
6) ASTM D1929-96 (2001)e1, Standard Test Method for Determining Ignition Temperature of Plastics.
7) ASTM D1929-96, Standard Test Method for Determining Ignition Temperature of Plastics.
8) ASTM D1929-68(1975), Standard Test Method for Determining Ignition Temperature of Plastics.
9) ASTM E84-06, Standard Test Method for Surface Burning Characteristics of Building Materials
10) ASTM E84-09a, Standard Test Method for Surface Burning Characteristics of Building Materials
11) ASTM D 2843-93, Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
12) ASTM D635-14, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
13) ASTM D1929-16, Standard Test Method for Determining Ignition Temperature of Plastics
14) ASTM D2843-16, Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics
15) ASTM D2565-99, Standard Practice for Xenon Arc Exposure of Plastics Intended for Outdoor Applications

Reference 2.d recorded ICC/FBC conforming plastics testing in the following evaluation reports.

1) ICC-ES Report No. ER-1084
2) ICC-ES Report No. ESR-1653

References and Supporting Documents

1) Drawings

    a. SOLA0016, dated 11/9/20, signed and sealed by Robert J. Amoruso, PE, *Solatube Impact 290 DS Low Profile Tubular Daylight Device – Installation Anchorage Details.*

2) Testing (note that References 2.b thru 2.h have the BOM Item description and (Item No.) shown.

    a. Performance Testing:
        i. Intertek Test Report No. J2410.02-303-44, dated 1/30/20 (Revision), TAS 201, TAS 202, TAS 203, ASTM E1886 and ASTM E1996 testing on low profile glass skylight, tubular daylight device, signed and sealed by Tyler Westerling, FL P.E. No. 72012.
        ii. Intertek Test Report No. J2410.01-303-44, dated 4/9/20 (Revision), AAMA/WDMA/CSA 101/1.S.2/A440-08 testing on low profile glass skylight, tubular daylight device.

    b. EFFECT LENS (21), PET-GAG (PET – Polyethylene Terephthalate, High Frequency Welding Grade - GAG) testing
        i. SGS Test Report No. 2138368-1, dated 8/27/10, testing to ASTM D635-06.
        ii. SGS Test Report No. 2138368-3, dated 2/2/10, testing to ASTM D1929-96(2001)e1.
        iii. SGS Test Report No. 2138368-2, dated 8/31/10, testing to ASTM E84-09a.

    c. CEILING RING (24) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))
        i. SGS Test Report No. 177:013002-01-R1, dated 6/10/08, testing to ASTM D635-06.
        ii. SGS Test Report No. 177:013002-02-R1, dated 6/10/08, testing to ASTM D1929-96.
        iii. SWRI Test Report No. 01.12693.01.139, dated 4/5/07, testing to ASTM E84-06.
        iv. Intertek Test Report No. 3143957-004, dated 9/24/08, testing to ASTM G155-05a and D638-08 in accordance with ASTM D2565-99.

    d. CEILING RING (20) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))
        i. ICC-ES Report No. ESR-1653 demonstrates compliance to I-Codes for use in skylight applications. Report No. ESR-1653 and Current Edition FBC requirements same based on review of documented results.

    e. DIFFUSER PANEL (22) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))
        i. SGS Test Report No. 177:013002-03-R1, dated 6/10/08, testing to ASTM D635-06.
        ii. SGS Test Report No. 177:013002-04-R1, dated 6/10/08, testing to ASTM D1929-96.
        iii. SWRI Test Report No. 01.13536.01.060, dated 1/30/08, testing to ASTM E84-06.

    f. DIFFUSER PANEL (2) testing for Polycarbonate

i. SGS Test Report No. 153367-2, dated 4/2/01, testing to ASTM D635-74.
ii. SGS Test Report No. 153367-1, dated 4/2/01, testing to ASTM D1929-68(1975).
iii. SGS Test Report No. 153367-3, dated 4/2/01, testing to ASTM D2843-93.

g. Acrylic Lens and Trim Ring (Various in BOM of Optional Diffusers) testing for Acrylic Material
   i. Intertek/ATI Test Report No. G3786.01-106-24, dated 4/28/17 for Huashuaite Clear Acrylic Sheet Material, testing to ASTM D635-14, ASTM D1929-16 and ASTM D2843-16

3) Reports
   a. Engineering Analysis: Anchorage and product verification has been substantiated by calculation (Calc-2664) prepared, signed, and sealed by Robert J. Amoruso, P.E. in accordance with the 8th Edition (2023) Florida Building Code.