



Product Evaluation Report

Date: December 15, 2011

PTC Report No.: 1971

Report Revision No.: 0

PTC Project No.: 411-1016

Product Mfg.: Solatube International, Inc.
2210 Oak Ridge Way
Vista, CA 92081

Product Name: Impact 160 DS (10") and 290 DS (14") Tubular Daylight Device - HVHZ

Product Category: Sky Lights

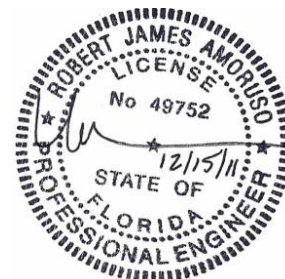
Product Sub-Category: Skylight

Compliance Method: Product Approval Rule 9N-3.005(1)(d) – Product Evaluation Report by a Licensed Professional Engineer

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CERTIFICATE OF INDEPENDENCE

PTC Product Design Group, LLC and Robert J. Amoruso, P.E. do not have, nor will acquire, any financial interest in the company manufacturing or distributing product(s) covered by this Product Evaluation Report. PTC Product Design Group, LLC and Robert J. Amoruso, P.E. do not have, nor will acquire any financial interest in any other entity involved in the approval process or testing of the product(s) covered by this Product Evaluation Report.



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Project Scope

Evaluate Solatube Impact 160 DS (10”) and 290 DS (14”) Tubular Daylight Device for conformance to the 2010 Florida Building Code – Building and Residential Volumes including the High Velocity Hurricane Zone (HVHZ).

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 makes reference 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 9N-3.

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

Applications/Installations outside the Limitations and Conditions of Use of this Product’s Approval

Rule 9N-3.005(1)(e) states “Rational engineering analysis cannot be used in lieu of a standard test required by the Code for approval of products within the scope of the standard, except that project specific approval by the local authorities having jurisdiction in accordance with alternate methods and materials authorized in the Code.” Any modification to this product as evaluated in this report and approved by the Florida Building Commission is outside the scope of this evaluation and will be the responsibility of others. As allowed in Rule 9N-3.005(1)(e), a project specific approval by the local authorities having jurisdiction may be used given an appropriate rational analysis is conducted and deemed acceptable to the local authorities having jurisdiction.

Quality Assurance

This product is manufactured under a quality assurance program audited by an approved Certification and Quality Assurance Entity **Keystone Certifications Inc. (KCI)** as required in Rule 9N-3.005(3). See FBC Organization No. CER1523 and QUA1824 for approval under Rule 9N-3.

Code Conformance – Air, Water and Structural Performance, Impact & Cyclic Loading

Reference 2.a conducted testing to the following standard(s). See Reference 3.b for Code Conformance Evaluation to the 2010 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*

DESIGN PRESSURE LIMITATIONS

- From Reference 2.a
 - Uniform Load Structural Test Pressures where +210/-140 psf.
 - Water Test Pressure of +10.5 psf.
 - Cyclic Wind Loading Pressure of +/-70 psf.
- Apply the following factors to arrive at Design Pressure.
 - A Safety Factor of 2 applied to the Uniform Load Structural Test Pressures to arrive at Design Pressures of +105/-70 psf.
 - A factor of $1/0.15 = 6.67$ applied to the Water Test Pressure arrive at Design Pressures of +70 psf.
- Overall Design Pressure is +/-70 psf.

Code Conformance – Plastics

The 2010 Florida Building Code, Sections 2606.4 & 2612.2 and 2010 Florida Residential Code, Section R4412.1.2 define requirements for Approved Plastics. The following table summarizes plastics testing for applicable components. See Reference 3.b for Code Conformance Evaluation to the 2010 FBC for the testing standards mentioned below. BOM Item No. in parenthesis ().

OUTER DOME (1), DOME RING (3), TOP TUBE CLIP (7) AND INNER DOME (25) testing for High Impact Acrylic PMMA (Poly(methyl methacrylate))					
Attribute	Report Reference	ASTM	Result	Acceptance Criteria	Code Section
Outdoor Exposure	2.b.i	ASTM G155-05a and D638-03	9.25%	+/- 10% difference in tensile strength	2612.2 and R4412.1.2
Rate of Burning	2.b.ii	ASTM D635-06	CC2	CC1 or CC2	2606.4, 2612.2 and R4412.1.2
Self-Ignition Temperature	2.b.iii	ASTM D1929-96	982°F	≥ 650°F	
Smoke Density	2.b.iv	ASTM E84-06	400	≤ 450	
Conclusion: ACCEPTABLE					

OUTER DOME (1), DOME RING (3), TOP TUBE CLIP (7) AND INNER DOME (25) testing for High Impact Acrylic PMMA (Poly(methyl methacrylate))					
Attribute	Report Reference	ASTM	Result	Acceptance Criteria	Code Section
Outdoor Exposure	2.c.i	ASTM G155-00ae1 and D638-03	3.3%	+/- 10% difference in tensile strength	2612.2 and R4412.1.2
Rate of Burning	2.c.ii	ASTM D635-06	CC1	CC1 or CC2	2606.4, 2612.2 and R4412.1.2
Self-Ignition Temperature	2.c.iii	ASTM D1929-96(2001)e1	930°F	≥ 650°F	
Smoke Density	2.c.iv	ASTM D2843-99	5.8	≤ 75	
Conclusion: ACCEPTABLE					

EFFECT LENS (17) testing for PET-GAG (PET-Polyethylene Terephthalate, High Frequency Welding Grade-GAG)					
Attribute	Report Reference	ASTM	Result	Acceptance Criteria	Code Section
Rate of Burning	2.d.ii	ASTM D635-06	CC1	CC1 or CC2	2606.4, 2612.2 and R4412.1.2
Self-Ignition Temperature	2.d.iii	ASTM D1929-96(2001)e1	765°F	≥ 650°F	
Smoke Density	2.d.iv	ASTM E84-09a	95	≤ 450	
Conclusion: ACCEPTABLE					

CEILING RING (16) AND DRESS RING (19) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))					
Attribute	Report Reference	ASTM	Result	Acceptance Criteria	Code Section
Outdoor Exposure	2.e.iv	ASTM G155-05a and D638-03	9.25%	+/- 10% difference in tensile strength	2612.2 and R4412.1.2
Rate of Burning	2.e.i	ASTM D635-06	CC2	CC1 or CC2	2606.4, 2612.2

Self-Ignition Temperature	2.e.ii	ASTM D1929-96	982°F	≥ 650°F	and R4412.1.2
Smoke Density	2.e.iii	ASTM E84-06	400	≤ 450	
Conclusion: ACCEPTABLE					

CEILING RING (16) AND DRESS RING (19) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))					
Attribute	Report Reference	ICC-ES Report	Result	Acceptance Criteria	Code Section
Rate of Burning	2.f.i	ICC-ES RE-1084	CC2	CC1 or CC2	IBC - 2606.4 has same requirements as 2010 FBC 2606.4, 2612.2 and R4412.1.2
Self-Ignition Temperature	2.f.i		Conformance per ICC-ES RE-1084	≥ 650°F	
Smoke Density	2.f.i		≤ 450		
Conclusion: ACCEPTABLE					

DIFFUSER PANEL (18) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))					
Attribute	Report Reference	ASTM	Result	Acceptance Criteria	Code Section
Rate of Burning	2.g.i	ASTM D635-06	CC2	CC1 or CC2	2606.4, 2612.2 and R4412.1.2
Self-Ignition Temperature	2.g.ii	ASTM D1929-96	992°F	≥ 650°F	
Smoke Density	2.g.iii	ASTM E84-06	350	≤ 450	
Conclusion: ACCEPTABLE					

DIFFUSER PANEL (18) testing for Polycarbonate Sheet					
Attribute	Report Reference	ASTM	Result	Acceptance Criteria	Code Section
Rate of Burning	2.h.i	ASTM D635-74	CC2	CC1 or CC2	2606.4, 2612.2 and R4412.1.2
Self-Ignition Temperature	2.h.ii	ASTM D1929-68(1975)	896°F	≥ 650°F	
Smoke Density	2.h.iii	ASTM D2843-93	38	≤ 75	
Conclusion: ACCEPTABLE					

Performance and Testing Standards

Reference 2.a 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*

Reference 2.b, 2.c, 2.d, 2.e, 2.g and 2.h 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 G155-00ae1, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non Metallic Materials*
- 3) ASTM D638-03, *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 2843-99, *Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.*
- 12) ASTM D 2843-93, *Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.*

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

- 1) ICC-ES Report No. ER-1084

References and Supporting Documents

1) Drawings

- a. SOLA0004, Rev. A, dated 12/15/11, *Solatube Impact 160 DS (10") and 290 DS (14") 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. Architectural Testing Inc. Test Report No. 85320.01-301-18, dated 9/08/08, *Solatube Impact 160 DS (10") and 290 DS (14") Tubular Daylight Device testing to TAS 201, TAS 202 and TAS 203.*
- b. OUTER DOME (1), DOME RING (3), TOP TUBE CLIP (7) AND INNER DOME (25) testing for High Impact Acrylic PMMA (Poly(methyl methacrylate))
 - i. Intertek Test Report No. 3143957-004, dated 9/24/08, testing to ASTM G155-05a and D638-08 in accordance with ASTM D2565-99.

- ii. SGS Test Report No. 177:013002-01-R1, dated 6/10/08, testing to ASTM D635-06.
 - iii. SGS Test Report No. 177:013002-02-R1, dated 6/10/08, testing to ASTM D1929-96.
 - iv. SWRI Test Report No. 01.12693.01.139, dated 4/5/07, testing to ASTM E84-06.
- c. OUTER DOME (1), DOME RING (3), TOP TUBE CLIP (7) AND INNER DOME (25) testing for High Impact Acrylic PMMA (Poly(methyl methacrylate))
- i. Architectural Testing Inc. Test Report No. 58735.01-106-18, dated 1/4/07, testing to ASTM G155-00ae1 and D638-03.
 - ii. SGS Test Report No. 177:002666-03, dated 1/2/07, testing to ASTM D635-06.
 - iii. SGS Test Report No. 177:002666-01, dated 1/13/07, testing to ASTM D1929-96(2001)e1.
 - iv. SGS Test Report No. 177:002666-02, dated 1/2/07, testing to ASTM D2843-99.
- d. EFFECT LENS (17), 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.
- e. CEILING RING (16) AND DRESS RING (19) 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.
- f. CEILING RING (16) AND DRESS RING (19) testing for Medium Impact Acrylic PMMA (Poly(methyl methacrylate))
- i. ICC-ES Report No. ER-1084 demonstrates compliance to I-Codes for use in skylight applications. Report No. ER-1084 and 2010 FBC requirements same based on review of documented results.
- g. DIFFUSER PANEL (18) 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.
- h. DIFFUSER PANEL (18) 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.

3) Reports

- a. PTC Report No. 1970, Rev. 0, *Solatube Impact 160 DS (10"), 290 DS (14") and 750 DS (21") Tubular Daylight Device - Anchorage Engineering*, Dated 12/15/11, signed and sealed by Robert J. Amoruso, P.E.
- b. PTC Report No. 1974-1, Rev. 0, *Solatube Impact 160 DS (10") and 290 DS (14") Tubular Daylight Device – Code Compliance Evaluation to the 2010 FBC*, Dated 12/15/11, signed and sealed by Robert J. Amoruso, P.E.

4) 2010 Florida Building Code & 2010 Florida Residential Code

- a. Testing and Labeling Requirements
 - i. Section 1626/R4403.16.1 – Impact Tests (HVHZ – WBDR)
 - ii. Section 1626.1/R4403.16.2 – Large Missile Impact
 - iii. Section 1715.5.2.1.1 – Testing and Labeling of Skylights
 - iv. Section 1715.5.2.1.2 – Skylights and Sloped Glazing
 - v. Section 2411.8 – Sloped Glazing
 - vi. Section 2610/2612.4.5/R4412.1.4.5 – Light-Transmitting Plastic Skylight Glazing
 - vii. Section 2610.2/2612.4.5.1/R4412.1.4.5.1 – Light-Transmitting Plastic Skylight Glazing, Mounting
 - 1. Limitations for installation drawing - outside the HVHZ
 - a. The light-transmitting plastic shall be mounted above the plane of the roof on (a) the TDD’s integral flashing or (b) a Curb constructed in accordance with the requirements for the type of construction classification, but at least 4 inches above the plane of the roof.
 - b. Edges of light-transmitting plastic skylights or domes shall be protected by metal or other approved noncombustible material.
 - c. Integral flashing with light-transmitting plastic edges at least 4 inches above the plane of the roof or Curbs shall not be required for skylights used on roofs having a minimum slope of 3 units vertical in 12 units horizontal (25-percent slope) in occupancies in Group R-3 and on buildings with a non-classified roof covering.
 - d. The metal or noncombustible edge material is not required where non-classified roof coverings are permitted.
 - e. Dome-shaped skylights shall rise above the mounting flange a minimum distance equal to 10 percent of the maximum span of the dome but not less than 3 inches.
 - 2. Limitations for installation drawing - inside the HVHZ
 - a. The light-transmitting plastic shall be mounted above the plane of the roof on (a) the TDD’s integral flashing or (b) a Curb constructed in accordance with the requirements for the type of construction classification, but at least 4 inches above the plane of the roof
 - b. Edges of light-transmitting plastic skylights or domes shall be protected by metal or other approved noncombustible material in Types I, IIB, IV and VB construction.

- c. Dome-shaped skylights shall rise above the mounting flange a minimum distance equal to 10 percent of the maximum span of the dome but not less than 4 inches.
 - b. Product Approval Required
 - i. Section 2410.4/R4410.1.4
 - c. Glazing Requirements
 - i. Section 2405.1/R4410.2.8.1 – Sloped Glazing and Skylights - Scope
 - ii. Section 2405.2/R4410.2.8.2 – Allowable Glazing Materials and Limitations
 - d. Plastics Requirements
 - i. Section 2606.4 – Specifications, Light-transmitting plastics
 - ii. Section 2612.2/R4412.1.2 – Definitions, Approved Plastics