



Code Compliance Research Report

CCRR-0131

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1. Subject

Solatube Tubular Daylighting Devices

2. Research Scope

2.1 Building Codes:

2009 International Building Code (IBC)

2009 International Residential Code (IRC)

2010 Florida Building Code (FBC) including
High Velocity Hurricane Zones for 160 DS,
290 DS, Smart LED and 750 DS models

2.2 Properties

Structural Performance

Durability (UV, Weathering)

Burning

3. Description

3.1 *Solatube Tubular Daylighting Device*
(TDD) Models recognized by this report are;

The *Solatube Brighten Up® Series* Models 160 DS (10 inch Tube Dia.), 290 DS (14 inch Tube Dia.) daylighting systems.

The *Solatube SolaMaster® Series Models* 330 DS-O, 330 DS-C, 750 DS-O and 750 DS-C are daylighting systems available in a 21 inch tube diameter. The "O" and "C" designation refers to Open (O) and Closed (C) ceiling configurations.

The *Solatube Smart LED System* consists of a 10 inch roof dome assembly and 10 inch reflective tube assembly with a luminaire housing that transitions from a 10 inch to a 14 inch diameter at the ceiling. The *Smart LED System* monitors natural light and utilizes LEDs that come on when daylight is insufficient. See Section 7.3 and Figure 4.

These TDD models consist of three primary assemblies; the roof dome assembly, reflective tube assembly and diffuser assembly. These assemblies are detailed in Figures 1 through 4.

3.1.1 Roof Dome Assembly.

Primary components of the dome assembly are the dome, dome ring or tube ring and flashing.

3.1.1.1 A single dome manufactured from impact resistant acrylic polymer is utilized on Models 160 DS, 290 DS, Smart LED, 330 DS and 750 DS.

3.1.1.2 Models 160 DS, 290 DS, Smart LED and 750 DS utilize an additional inner dome manufactured from impact resistant acrylic polymer or polycarbonate (750 DS) when installation is within the High Velocity Hurricane Zone as defined by the FBC.

3.1.1.3 A dome ring (160 DS, 290 DS & Smart LED) manufactured from impact resistant Acrylic polymer or tube ring (330 DS & 750DS) manufactured from PVC, connects the inner reflective tube, inner reflector, inner dome and outer dome to the flashing.

3.1.1.4 A powder coated steel dome edge protection band is utilized to protect the dome edge on installations on roof assemblies with fire classifications of A, B or C.

3.1.1.5 Powder coated metal flashings are self mounting and are available in pitched and flat configurations. For models 160 DS, 290 DS and Smart LED, the flat configuration is available in both 4 and 6 inch lengths. For models 330 DS and 750 DS, flat configurations in 4, 8 and 11 inch lengths and metal roof flashing are available. Also a support flashing with integral curb cap is available for the 290 DS, 330 DS and 750 DS models.

3.1.2 Reflective Tubes

Reflective tubes and angle adapters have a high reflectance interior tube finish and are manufactured from .015" thick aluminum for 160 DS, 290 DS and Smart LED, and .018" for 330 DS and 750 DS. Two inch wide polymer/foil tape

is utilized at all joints between tube sections and at vertical seams of each tube.

3.1.3 Daylight Dimmer Assembly

A switch operated, electrically driven Daylight Dimmer Assembly is available for installation above the bottom tube on 160 DS, 290 DS, Smart LED and above the round-to-square for 330 DS / 750 DS. The Dimmer Assembly is used to restrict natural light from entering the room. See Section 7.3 and Figure 6.

3.1.4 Light Kit Assembly

Switch operated, electric light kits are available for installation into the bottom tube for the 160 DS and 290 DS models only. The kits contain either an incandescent or fluorescent light bulb. See Section 7.3 and Figure 5.

3.1.5 Diffuser and Decorative Fixture Assembly.

The Diffuser assemblies are either single or dual glazed with acrylic or polycarbonate plastic Diffusers classified as a CC2 plastic material. Diffusers have a flame spread index not exceeding 200 and a smoke development index not exceeding 450 when tested in accordance with ASTM E 84. The Decorative Fixture lenses are comprised of tempered glass.

A dress (trim) ring is mounted over the assembly edge for aesthetic purposes

For models 160 DS, 290 DS and Smart LED the standard diffuser and decorative fixtures (JustFrost, OptiView and Tier Drop) employ a ceiling ring that is manufactured from injection molded impact resistant acrylic and is used to connect the reflective tubing and diffusers or decorative fixtures to the interior room ceiling.

The QuadraFrost and Aurora Glo decorative fixtures employ a fixture mounting ring, in addition to the ceiling ring, that is manufactured from steel and is used to connect the decorative fixture to the interior room ceiling. The ceiling ring is also used to hold the reflective tubing in place.

4. Performance Characteristics

4.1 Models identified in this report have been tested for deflection and structural response under uniform loading in both the positive (inward) and negative (outward) directions in accordance with ICC-ES AC16. The maximum allowable positive and negative design loads for each model size combination, and associated anchoring, are indicated in Table 1.

4.2 Models identified in this report have met the air infiltration and water penetration acceptance criteria identified in ICC-ES AC16 when tested in accordance with Sections 5.3.2 and 5.3.3 of AAMA/WDMA/CSA 101/I.S.2/A440-08.

4.3 Florida Building Code

4.3.1 Models 160 DS, 290 DS, Smart LED, 330 DS and 750 DS have been tested to show compliance with AAMA/WDMA/CSA 101/I.S.2/A440-08 *Standard Specification for Windows, Doors, and Unit Skylights*. Testing was performed by a Miami-Dade County approved testing facility and were signed and sealed by a Professional Engineer with current registration in the state of Florida.

4.3.2 Light Transmitting Plastics forming part of the models identified in this report have been shown to have a self-ignition temperature greater than 650°F when tested in accordance with ASTM D 1929-96(2000e01), A smoke development index less than 450 when tested in accordance with ASTM E 84-07, and a combustibility classification of CC2 when tested in accordance with ASTM D 635-06.

4.3.3 High Velocity Hurricane Zones (HVHZ)

Models 160 DS, 290 DS, Smart LED and 750 DS have been additionally tested to show compliance with the requirements of the 2010 Florida Building Code for use in locations designated as High Velocity Hurricane Zones. Testing has shown;

4.3.3.1 Sufficient resistance to windborne debris, as stated in Section 1626 of the Florida Building Code when tested to FBC Test Protocol TAS 201-94.

4.3.3.2 Sufficient resistance to wind forces as determined by Section 1620 of the Florida Building Code when tested to FBC Test Protocol TAS 202-94.

4.3.3.3 Sufficient resistance to cyclic wind pressure loading as determined by Sections 1625, Table 1625.4 and Table 1626 of the Florida Building Code when tested to FBC Test Protocol TAS 203-94

4.3.3.4 Sufficient weathering resistance of plastics with outdoor exposure when tested to ASTM G 155 for a period of 4500 hours and subsequent testing to ASTM D 638.

5. Installation

Installation shall be in accordance with the manufacturer's installation instructions and this report. Where differences occur between this report and the manufacturer's installation instructions, this report shall govern.

5.1 The dome attachment for the 10" 160 DS, 14" 290 DS and Smart LED models is accomplished by attaching the dome ring to the flashing and top tube with four (4) #8x1" truss washer head screws and plastic spacers with a snap fit between the dome and dome ring. See Figure 1 and Figure 4.

5.2 Diffuser assemblies for the 10" 160 DS, 14" 290 DS and Smart LED models are comprised of an acrylic ceiling ring, an acrylic dress ring and dual glazed diffuser. The dress ring is snap fitted or twist secured onto the ceiling ring.

5.3 The Dome attachment for the 21" 330 DS and 750 DS models is accomplished with three (3) #8x1-5/8" washer head sheet metal screws passing through three (3) equally spaced plastic spacers, flashing and into the tube ring. See Figure 2.

5.4 The Dome Assembly for the 21" 330 DS-O and 750 DS-O (Open Ceiling) models utilize a butyl putty seal (referred to as a glazing rope in installation instructions) between the flashing and tube ring. See Figures 2 and 3.

5.5 For the 21" 330 DS-C and 750 DS-C (Closed Ceiling) models, the tube ring should be sealed to the outer face of the top reflector tube with 2" wide polymer/foil tape.

5.6 Diffuser assembly for the 21" 330 DS-O and 750 DS-O (Open Ceiling) models is comprised of an acrylic dress ring and a single glazed diffuser. The assembly is snapped into the four (4) equally spaced slots provided in the end of the extension tube.

5.7 For the 21" 330 DS-C and 750 DS-C (Closed Ceiling) models consist of a square diffuser assembly that connects to the round reflective tube through a square to round transition section.

5.8 Installation for compliance with the IBC and IRC shall be in accordance with IBC Section 2405 and 2610 and, IRC Section R308.6

5.9 Installation for compliance with the FBC shall be in accordance with FBC Section 2405 and 2610.

5.10 For installation on roof assemblies with fire classifications A, B, or C, metal dome edge protective rings shall be installed on the 160 DS, 290 DS, Smart LED, 330 DS and 750 DS models utilizing the 4" flashings. Other flashings noted in Section 3.1.1.5 may be needed in order to maintain the required minimum 4" distance from roof deck to dome edge.

6. Supporting Evidence

6.1 Manufacturer's drawings and installation instructions.

6.2 Reports of testing and engineering analysis in accordance with ICC-ES AC16, *Acceptance Criteria for Plastic Glazed Skylights*, approved April 2011.

6.3 Reports of testing to ASTM D 1929-96(2000e01) *Test Method for determining Ignition Properties of Plastics*.

6.4 Reports of Testing to ASTM E84-07, *Test Method for Surface Burning Characteristics of Building Material* with equivalency to ASTM E84-04.

6.5 Reports of Testing to ASTM D635-06 *Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position* with equivalency to ASTM D635-03.

6.6 Reports of Testing to ASTM G 155 *Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials* and ASTM D638 *Test Method for Tensile Properties of Plastics*.

6.7 A Quality control manual in accordance with ICC-ES AC10, *Acceptance Criteria for Quality Documentation*, approved June 2011.

6.8 Reports of engineering and installation analysis for alternate anchorage signed and sealed by a Professional Engineer registered in the State of Florida.

6.9 Testing for Florida Building Code was performed by a Miami-Dade County approved testing facility (Architectural Testing, Inc. - Fresno, CA) with reports signed and sealed by a Professional Engineer registered in the State of Florida. These reports are;

6.9.1 Reports of testing in accordance with AAMA/WDMA/CSA101/I.S.2/A440-08 "*Standard/Specification for Windows, Doors, and Unit Skylights*", *American Architectural Manufacturers Association, Window and Door Manufacturers Association, and Canadian standards Association*.

6.9.2 Reports of testing to Testing Application Standard (TAS) 201-94 "*Impact Test Procedures*" as required by Section 1626 of the Florida Building Code.

6.9.3 Reports of testing to Testing Application Standard (TAS) 202-94 "*Criteria for Testing Impact & Nonimpact Resistant Building Envelope Components Using Uniform Static Air Pressure*" as required by Section 1620 of the Florida Building Code.

6.9.4 Reports of testing to Testing Application Standard (TAS) 203-94 "*Criteria for Testing Products subject to Cyclic Wind Pressure Loading*" as required by Sections 1625, Table 1625.4 and Table 1626 of the Florida Building Code.

7. Conditions of Use

The *Solatube Tubular Daylighting devices* identified in this report are deemed to comply with the referenced building codes subject to the following conditions:

7.1 Installation shall comply with the manufacturers installation instructions, this report, IBC Section 2405 and 2610, IRC Section R308.6, and FBC Sections 2405 and 2610.

7.2 The wind uplift rating recognized in this report (See Table 2) is based on attachment to S-P-F wood curbing (Specific Gravity, $G=0.42$), 5/8" Group 2 Plywood and 22 gauge 33 ksi minimum yield steel deck. Installation on a wood substrate with a lesser specific gravity or lesser thickness may result in a lower wind uplift rating.

7.3 The Smart LED assembly, daylight dimmer, incandescent light and fluorescent light assemblies were only evaluated for effects on performance when TDDs were tested in accordance with ICC-ES AC16. Evaluation of these assemblies for compliance to electrical codes is not part of this report.

7.4 Where required by the building official, engineering calculations and details shall be provided. The calculations shall verify that the anchorage complies with the building code for the type of framing and condition of the supporting construction

7.5 Model 330 DS shall not be installed in High Velocity Hurricane Zones as defined by the Florida Building Code.

7.6 Models 160 DS, 290 DS, Smart LED and 750 DS shall utilize the additional inner dome for use in High Velocity Hurricane Zones as defined by the Florida Building Code.

7.7 All products are manufactured in accordance with the manufacturer's approved quality control system with inspections by Keystone Certifications, Inc. (IAS AA-714).

8. Identification

Solatube Tubular Daylighting devices produced in accordance with this report shall be identified with permanent labeling that includes the following information:

8.1 The manufacturers name and/or logo, address model number and allowable loads

8.2 The plastic dome glazing thickness and classification (CC2)

8.3 The Name or logo of the independent inspection agency, Keystone Certifications, Inc. (IAS AA-714)

8.4 The Architectural Testing Code Compliance Research Report mark and report number (CCRR-0131)

9. Code Compliance Research Report Use

9.1 Approval of building products and/or materials can only be granted by a building official having legal authority in the specific jurisdiction where approval is sought.

9.2 Code Compliance Research Reports shall not be used in any manner that implies an endorsement of the product or manufacturer by Architectural Testing.

9.3 Reference to the Architectural Testing internet web site address at www.ati-es.com is recommended to ascertain the current version and status of this report.

Table 1 – Maximum Allowable Design Loads and Applicable Codes ³

Model No	Dia. (inch)	Dome Thickness (inch)	IBC, IRC		FBC
			Wind Loads (psf)	Snow Load ⁵ (psf)	Wind Loads ⁴ (psf)
160 DS	10	0.125	+70 -60	+150	+70 -70
Smart LED					
290 DS	14	0.125			
330 DS-O ²	21	0.168	+70 -70		
330 DS-C ²	21	0.168			
750 DS-O	21	0.210			
750 DS-C	21	0.210			

¹ Positive (+) loads are directed inward; negative (-) are directed outward.

² Models 330 DS are not approved for use in High Velocity Hurricane Zones as defined by the FBC.

³ All positive design pressures were tested to a safety factor of 2. All negative design pressures were tested to a safety factor of 3.

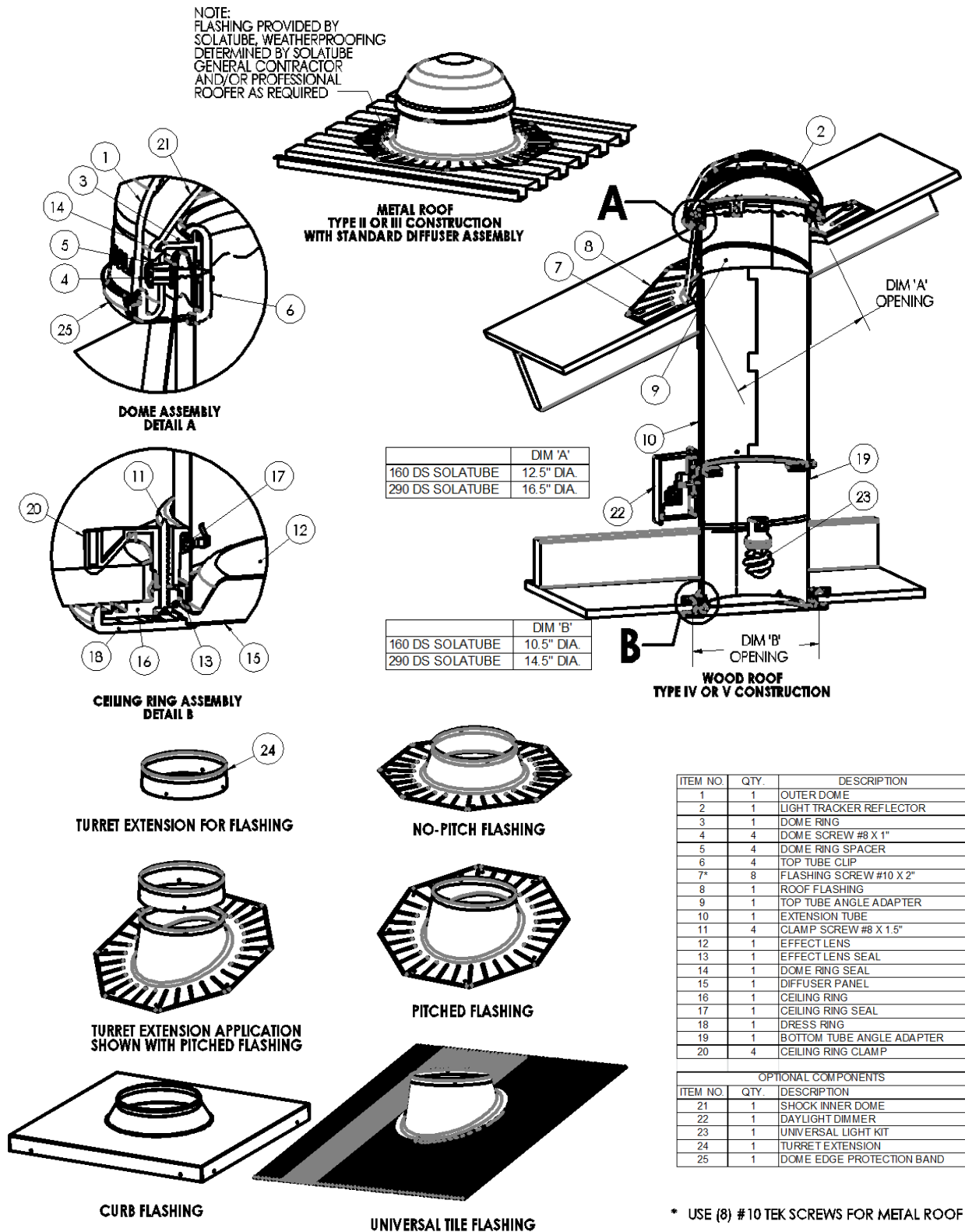
⁴ Values indicated are positive and negative design pressure ratings for use with the FBC.

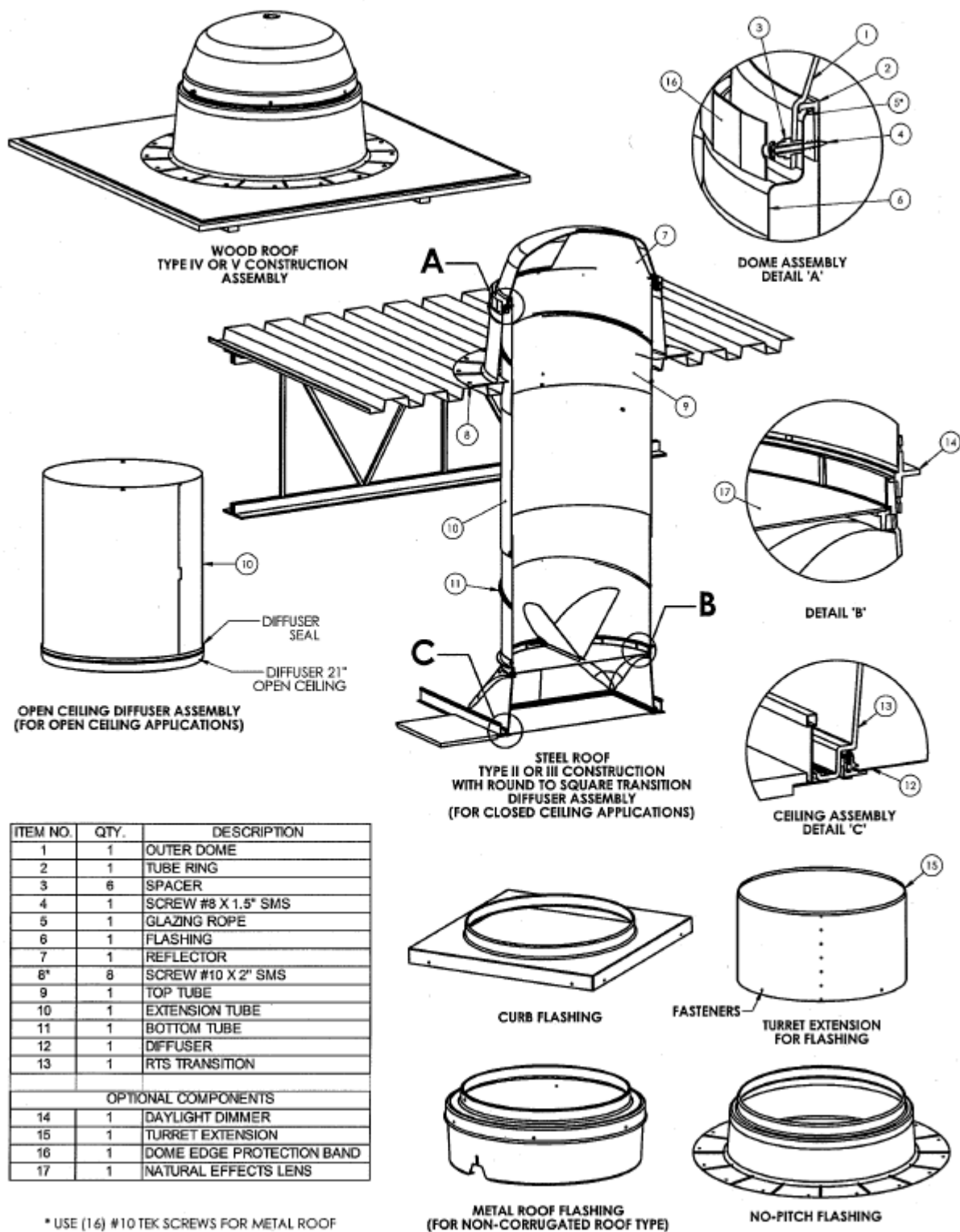
⁵ Allowable design loads for consideration of water penetration are limited to those values indicated under Wind Loads.

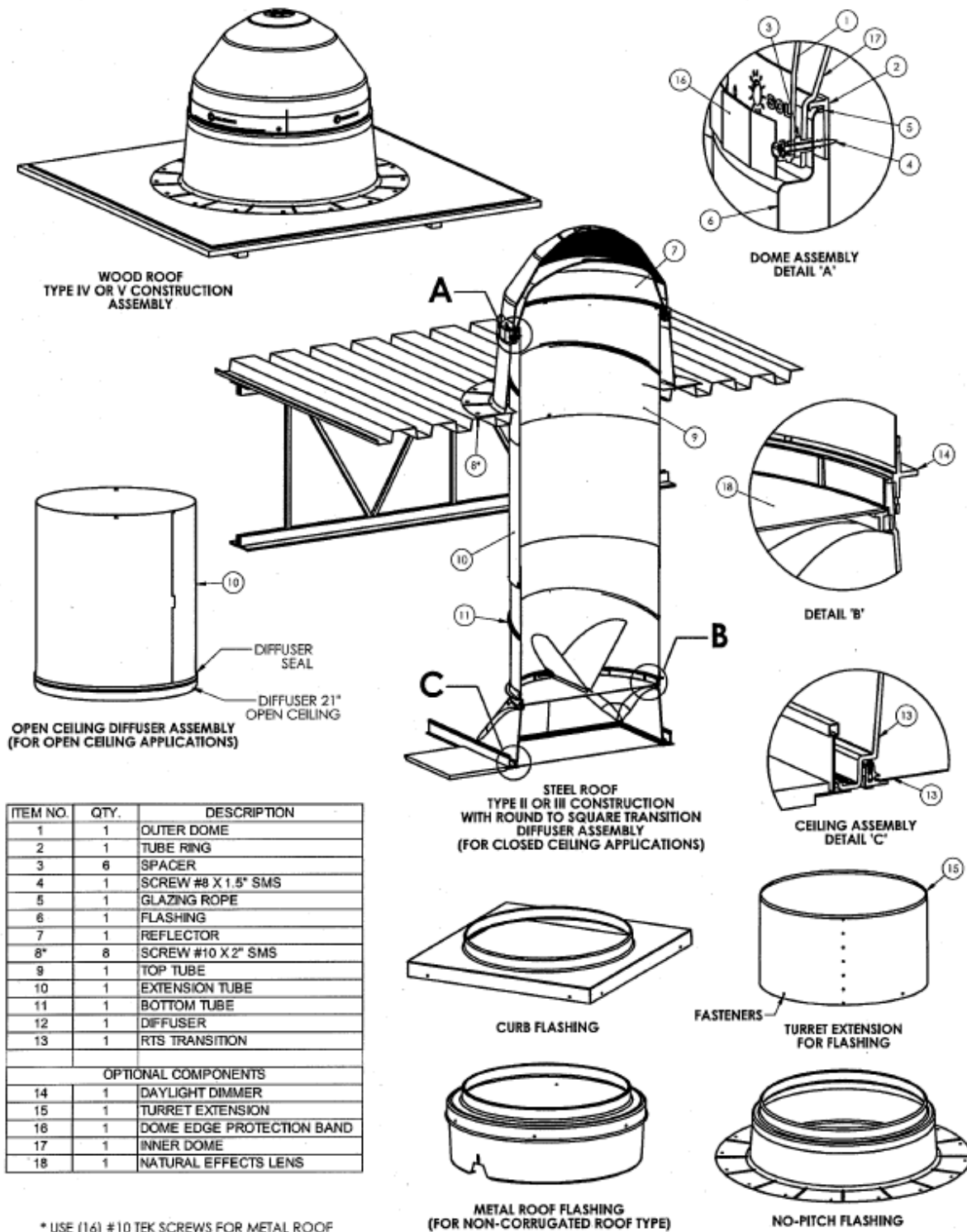
Table 2
Anchorage Descriptions for Recognized Wind Uplift Design Pressures

Model #s	Anchorage	Substrate	Anchor Description and Quantity
160 DS 290 DS Smart LED	Metal Flange to wood curb	SPF (S.G.≥ .42) wood curb	Qty 8 #10 x 2" Screw
	Metal Flange to wood deck	5/8" Type 2 Plywood	Qty 8 #10 x 2" Screw
	Metal Flange to Metal Deck	22 gauge steel 33ksi Min Yield	Qty 8 #10 TEKS
330 DS-O ¹ 330 DS-C ¹ 750 DS-O 750 DS-C	Metal Flange to wood curb	SPF (S.G.≥ .42) wood curb	Qty 16 #10 x 2" Screw
	Metal Flange to wood deck	5/8" Type 2 Plywood	Qty 16 #10 x 2" Screw
	Metal Flange to Metal Deck	22 gauge steel 33ksi Min Yield	Qty 16 #10 TEKS
	Alum Flange to Metal Deck (Non-Corrugated Roof Type)	26 gauge steel Roof Deck	Qty 16 4.8mm Zinc-Coated Steel Rivets

¹Models 330 DS are not approved for use in High Velocity Hurricane Zones as defined by the FBC.


Figure 1 - 160 DS & 290 DS Solatube with Details


Figure 2 - 330 DS Solatube with Details


Figure 3 - 750 DS Solatube with Details

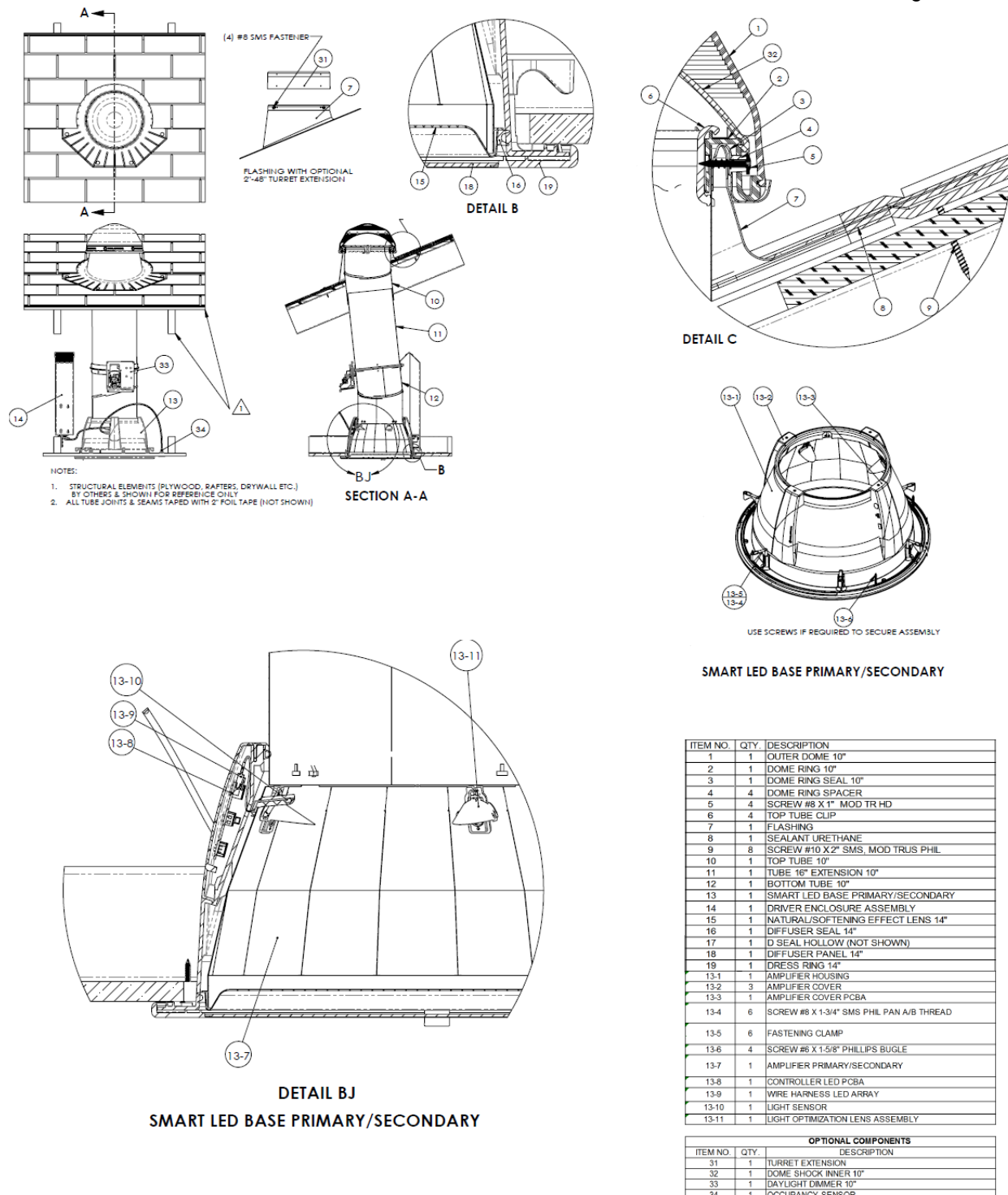


Figure 4 - Solatube Smart LED with Details

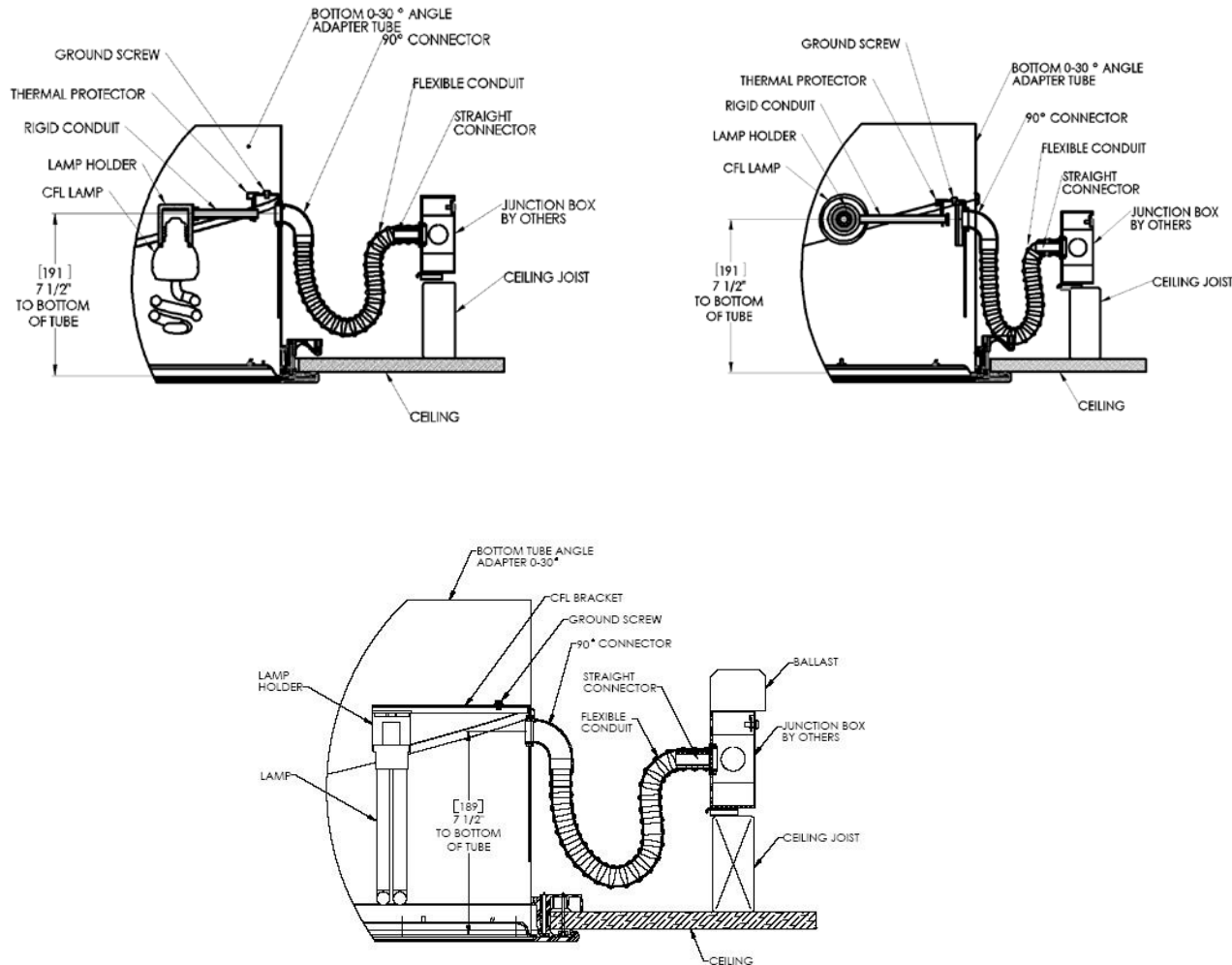
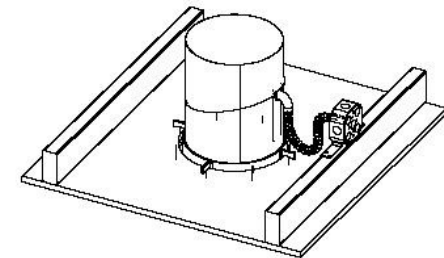


Figure 5- Typical Solatube Light Kit Assembly



Notes:

- 1) Evaluation of these Light Fixtures for compliance to applicable electrical codes is not part of this report.

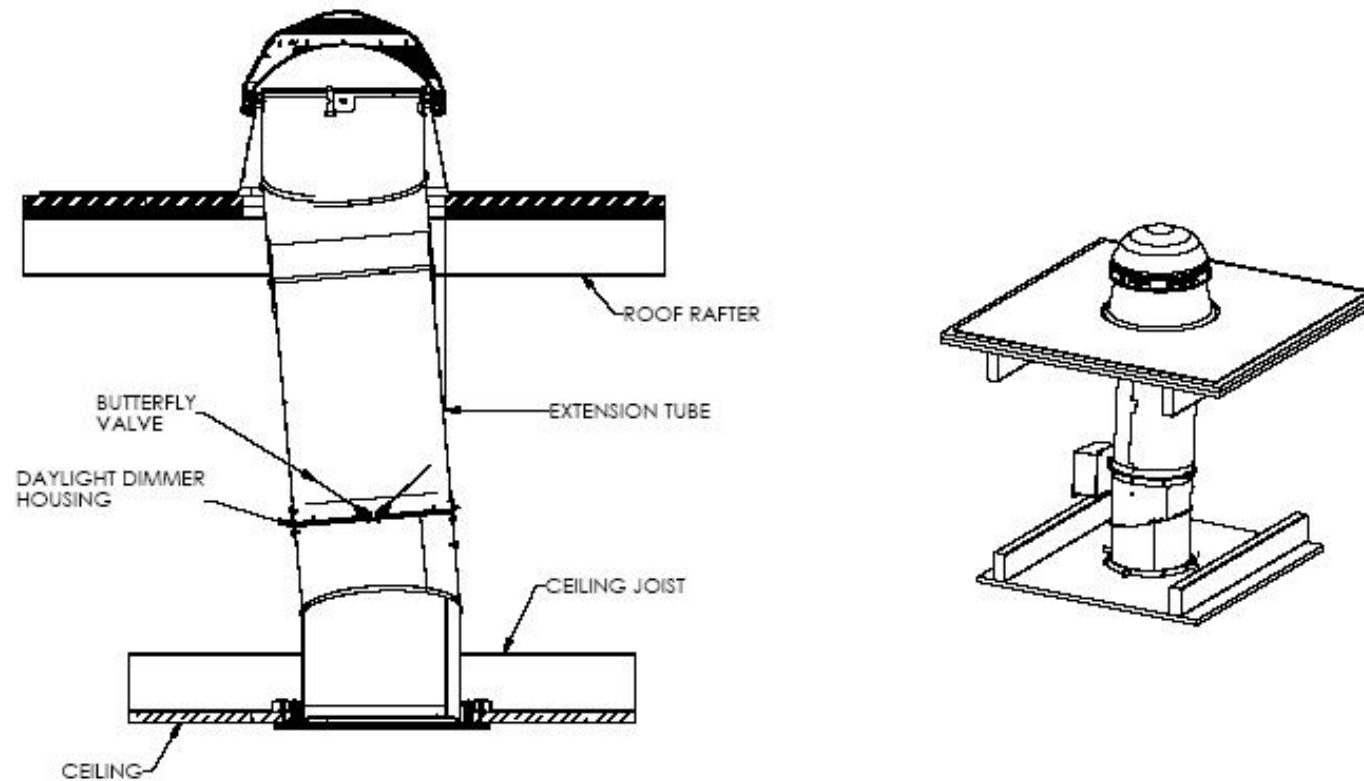
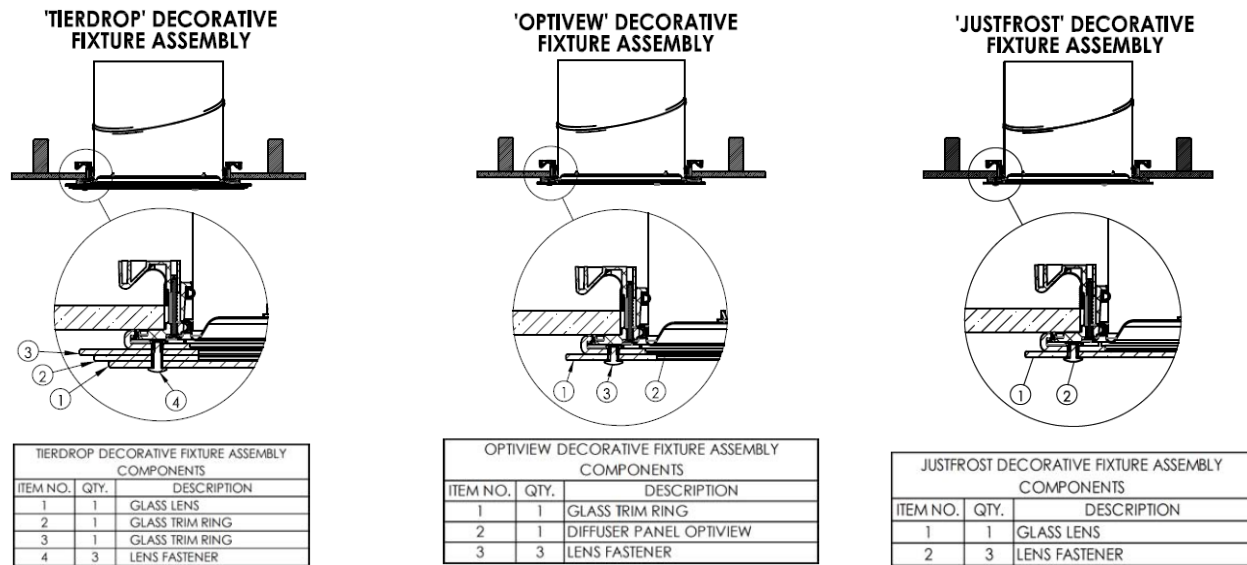
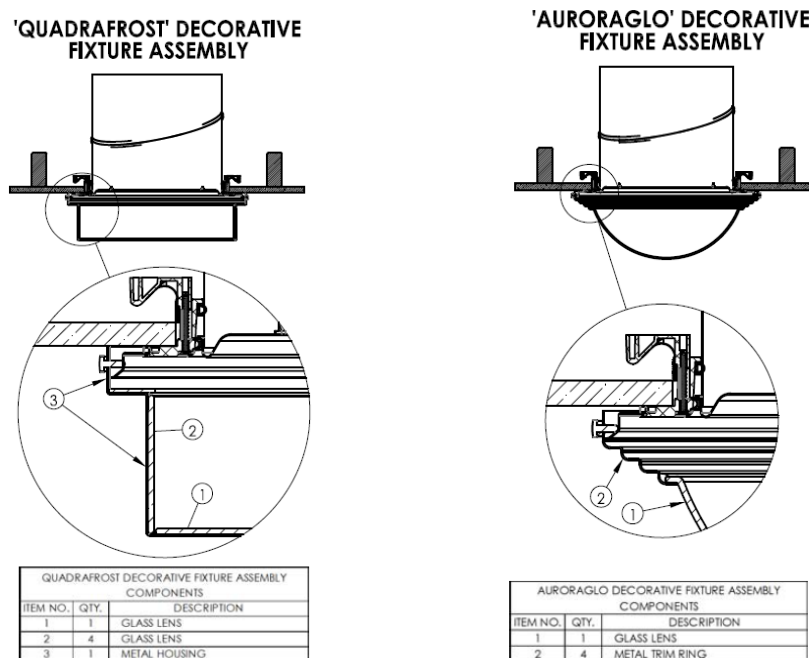


Figure 6- Typical Solatube Daylight Dimmer Assembly

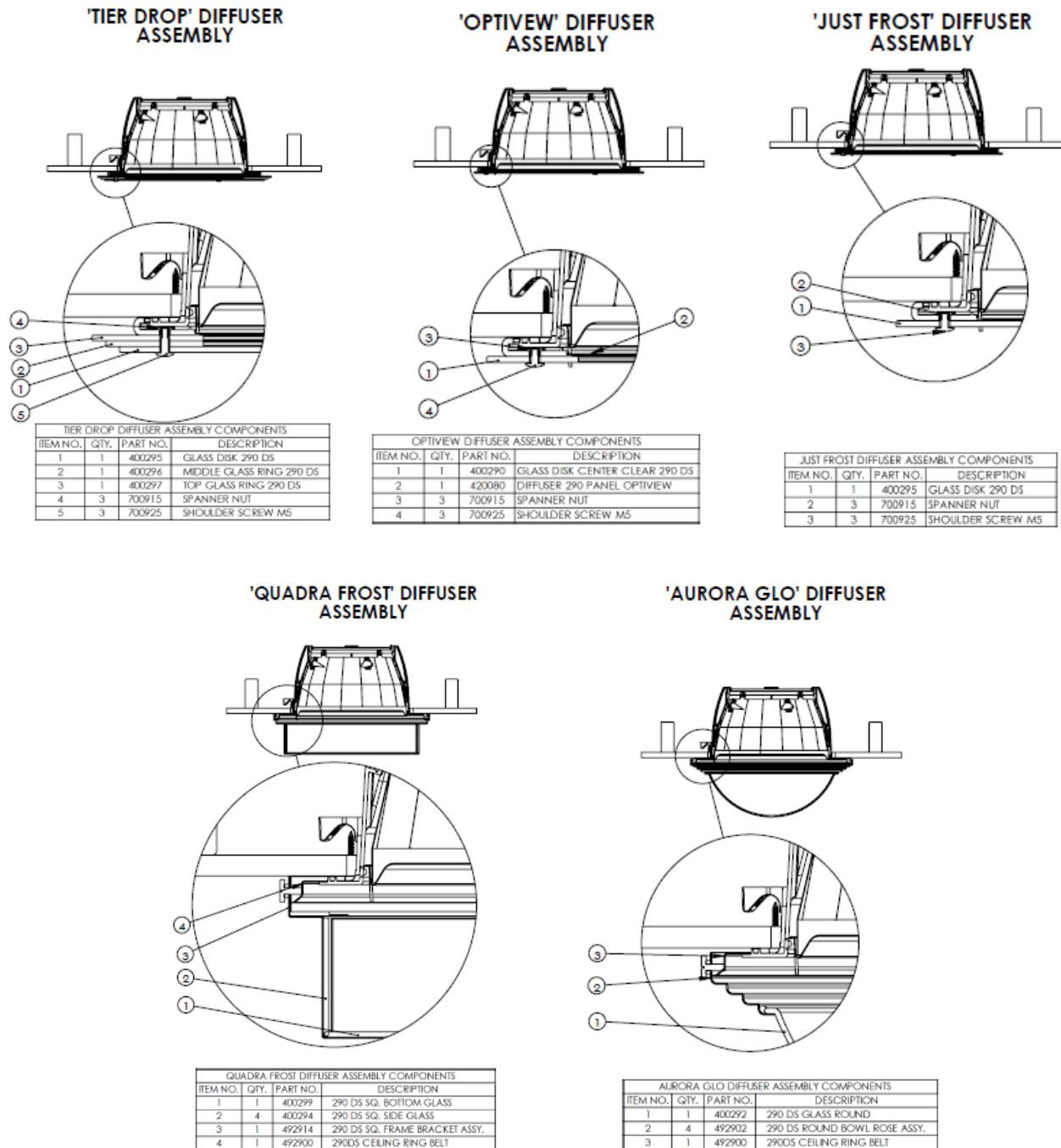


160 DS and 290 DS Decorative Fixture Options



290 DS Decorative Fixture Options

Figure 7 – 160 & 290 DS Glass Distractions


Figure 8 – Smart LED Glass Distractions