



## SECTION 08625 (08 62 23)

### TUBULAR DAYLIGHTING DEVICES

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#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Tubular daylighting devices (TDD) and accessories.

##### 1.2 RELATED SECTIONS

- A. Section 06100 (06 10 00) - Wood Framing. Site built wood curbs and nailers.
- B. Section 07310 (07 31 00) - Roof Shingles and Shakes. Flashing of skylight base.
- C. Section 07320 (07 32 00) - Roof Tiles. Flashing of skylight base.
- D. Section 07510 (07 51 00) - Built-Up Bituminous Roofing. Flashing of skylight base.
- E. Section 07520 (07 52 00) - Modified Bituminous Membrane Roofing. Flashing of skylight base.
- F. Section 07530 (07 53 00) - Electrometric Membrane Roofing. Flashing of skylight base.
- G. Section 07540 (07 54 00) - Thermoplastic Membrane Roofing. Flashing of skylight base.
- H. Section 07600 (07 60 00) - Flashing and Sheet Metal. Metal curb flashings.
- I. Section 08620 (08 60 00) - Unit Skylights. Skylights without reflective tube.
- J. Section 08630 (08 63 00) - Metal Framed Skylights.
- K. Section 15810 (23 30 00) - HVAC Air Distribution. Fan vent duct and connections.
- L. Section 16570 (25 50 00) - Integrated Automation Facility Controls. Lighting controllers.
- M. Section 16150 (26 05 00) - Common Work Results Electrical. Power cable, power supply and electrical connections.
- N. Section 16500 (26 09 43) - Lighting Equipment and Controls. Control cable, dimming controls, light bulbs, and lamps.

##### 1.3 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
  1. AAMA/WDMA/CSA 101/I.S.2/A440 - Standard/Specification for Windows, Doors, and Unit Skylights; 2011.

- B. American National Standards Institute (ANSI):
  - 1. ANSI C63.4-2014 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
  
- C. ASTM International (ASTM):
  - 1. ASTM A463/A463M - Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process.
  - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process.
  - 3. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - 4. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - 5. ASTM D635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position.
  - 6. ASTM D1929 - Test Method for Ignition Properties of Plastics.
  - 7. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
  - 8. ASTM F1642 - Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loading.
  - 9. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 10. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.
  - 11. ASTM E283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - 12. ASTM E308 - Standard Practice for Computing the Colors of Objects by Using the CIE System.
  - 13. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors.
  - 14. ASTM E547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain walls by Cyclic Air Pressure Difference.
  - 15. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
  - 16. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricane.
  - 17. ASTM F2912 - Standard Specification for Glazing and Glazing Systems Subject to Airblast Loading.
  
- D. California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1).
  
- E. Code of Federal Regulations (CFR):
  - 1. CFR 47 - Code of Federal Regulations (CFR) Rules and Regulations for FCC, FCC Part 15 - Radio Frequency Devices, Subpart B - Unintentional Radiators, Section 15.107 - Conducted Limits, and 15.109 - Radiated Emission Limits
  
- F. CSA Group (CSA):
  - 1. CSA C22.2 No. 250.0 - Luminaires.
  
- G. European Parliament Directive:
  - 1. Restriction of Hazardous Substances (RoHS) - Directive 2011/65/EU Annex II including amendment (EU) 2015/863 (RoHS 3).

- H. European Standards (EN):
  1. EN 55015:2013+A1:2015 - Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment.
  2. EN 60598-1:2015+A1:2018 - Luminaires. General requirements and tests.
  3. EN 60598-2-2:2012 - Luminaires -- Part 2-2: Particular requirements - Recessed luminaires.
  4. EN 61000-3-2:2014 - Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current less than or equal to 16 A per phase).
  5. EN 61000-3-3:2013 - Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current  $\leq 16$  A per phase and not subject to conditional connection.
  6. EN 61547:2009 - Equipment for general lighting purposes. EMC immunity requirements.
- I. Factory Mutual (FM):
  1. FM Standard 4431 - The Approval Standard for Skylights.
- J. General Services Administration (GSA):
  1. GSA-TS01-2003: Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.
- K. International Building Code (IBC):
  1. IBC Section 1710 - Load Test Procedure for Wind Load Testing on Rooftop Daylight Collecting System - Structural Performance Testing - Devised by ATI PE); 2012.
  2. IBC Section 2606.7.2 - Installation - Diffuser Fall Out Test (Devised by PE); 2012.
- L. International Code Council Evaluation Service, Inc. (ICC-ES):
  1. ICC-ES AC-16 - Acceptance Criteria for Plastic Skylights; 2008.
- M. Florida Building Code (TAS):
  1. TAS 201 - Impact Test Procedures.
  2. TAS 202 - Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure Loading.
  3. TAS 203 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
- N. OSHA 29 CFR - 1910.23 (e)(8) (Guarding Requirements for Skylights); 1926 Subpart M (Fall Protection); 1926.501(b)(4)(i); 1926.501(i)(2); 1926.501(b)(4)(ii).
- O. Unified Facilities Criteria (UFC):
  1. UFC 4-010-01, Change October 2013, DoD Minimum Antiterrorism Standards for Buildings.
- P. Underwriters' Laboratories (UL):
  1. UL 2108 - Low Voltage Lighting Systems.
  2. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Daylight Reflective Tubes: Spectralight Infinity with INFRAREduction Technology combines ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance. Patented spectrally-selective optical surface yields an average total- and specular-reflectance for the Visible Light spectrum (400 nm to 700 nm) providing maximized

visible light transmission and less than 25 percent reflectance for Infrared (IR) heat wavelengths (750 nm to 2500 nm) for minimized heat transmission, resulting in a spectrally-selective Total Solar Spectrum (250 nm to 2500 nm) reflectance less than 37 percent, as measured using a Perkin Elmer Lambda 1050 spectrophotometer with a Universal Reflectance Accessory. Color: a\* and b\* (defined by CIE L\*a\*b\* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance with ASTM E308.

B. SKYVAULT M74 DS / OPEN CEILING

1. AAMA/WDMA/CSA 101/IS2/A440, Class CW-PG80, size tested 36 inches by 36 inches (914 mm by 914 mm), Type TDD and Type TDDOC.
  - a. Air Infiltration Test: Single and Dual Glazed Dome (M74 DS Type DP and DPP):
    - 1) Passes Air infiltration; maximum of 0.05 cfm/ft<sup>2</sup> (0.3 L/s/m<sup>2</sup>) when tested according to ICC-ES AC-16, and ASTM E283.
    - 2) Meets or exceeds the air leakage performance levels with a maximum 0.4 cfm/ft<sup>2</sup> when tested in accordance with ASTM E283.
    - 3) Air exfiltration will not exceed 0.4 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E283.
  - b. Water Resistance Test
    - 1) Single and Dual Glazed Dome (M74 DS Type DP and DPP): Passes water resistance; no uncontrolled water leakage with a pressure differential of 12.11 psf (580 Pa) or 15 percent of design pressure and a water spray rate of 5 gallons/hour/sf for 24 minutes when tested in accordance with ICC-ES AC-16, ASTM E547, ASTM E331, and TAS 202.
  - c. Uniform Load Test: All units tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E330.
    - 1) Single and Dual Glazed Dome (Type DP and DPP): Design Pressure plus or minus 80.20 psf (plus or minus 3.84 kPa).
      - a) Passes uniform load test: No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 240.6 psf (11.52 kPa) or Negative Load of 160 psf (7.66 kPa) when tested according to ICC-ES AC-16, and ASTM E330
2. Hurricane Resistance:
  - a. Large Missile Impact test:
    - 1) Single Glazed Dome (Type DP) Passes:
      - a) A minimum of missile level D for Wind Zone 4. No signs of penetration, rupture, or opening when tested in accordance with ASTM E1886 and ASTM E1996.
      - b) No signs of penetration, rupture, or opening when tested in accordance with TAS 201
    - 2) Dual Glazed Dome (Type DPP) Passes:
      - a) No signs of penetration, rupture, or opening when tested in accordance with TAS 201
  - b. Uniform Static Air Pressure Test: Passes Design pressure rating a minimum of plus or minus 80.2 psf (3.84 kPa) when tested in accordance with ASTM E1886, ASTM E1996, and TAS 202
  - c. Air Infiltration Test:
    - 1) Single Glazed Dome (Type DP) Passes:

- a) Air Infiltration a maximum 0.05 cfm/ft<sup>2</sup> at 1.57 psf (25 mph) test pressure when tested in accordance with TAS 202
      - b) Air Infiltration a maximum 0.05 cfm/ft<sup>2</sup> at 6.24 psf (50 mph) test pressure when tested in accordance with TAS 202
    - 2) Dual Glazed Dome (Type DPP) Passes:
      - a) Air Infiltration a maximum 0.04 cfm/ft<sup>2</sup> at 1.57 psf (25 mph) test pressure when tested in accordance with TAS 202
      - b) Air Infiltration, a maximum 0.05 cfm/ft<sup>2</sup> at 6.24 psf (50 mph) test pressure when tested in accordance with TAS 202.
  - d. Water Penetration Test:
    - 1) Single Glazed Dome (Type DP) Passes: No sign of water penetration at 12.11 psf (0.580 kPa) or 15 percent of Design Load when tested in accordance with TAS 202.
    - 2) Dual Glazed Dome (Type DPP) Passes: No sign of water penetration at 12.11 psf (0.580 kPa) or 15 percent of Design Load when tested in accordance with TAS 202.
  - e. Cyclic Wind Pressure Loading:
    - 1) Single Glazed Dome (Type DP): Passes. No signs of failure during the cyclic load test when tested in accordance with ASTM E1886, ASTM E1996, and TAS 203.
    - 2) Dual Glazed Dome (Type DPP): Passes. No signs of failure during the cyclic load test when tested in accordance with ASTM E1886, ASTM E1996, and TAS 203.
3. Wind Load Test:
- a. Daylight Collector System (Type C): Passes: No sign of failure or destruction when a maximum 2.5 times design load is applied laterally to the exposed cylindrical section when tested in accordance with IBC Section 1710 and Florida Building Code Section 1715.3 - Load Test Procedure for Wind Load Testing on Rooftop Daylight Collecting System - Structural Performance Testing - Devised by Architectural Testing Inc. PE.
  - b. Design Load: 69.7 psf.
  - c. Force Coefficients of Chimneys, Tanks, Rooftop Equipment, and Similar Structures according to ASCE/SEI 7-10 Figure 29.5-1
    - 1) Cross Section: Round
    - 2) Type of surface: Moderately smooth
    - 3) Ratio (h/D): 1.4
    - 4) Force coefficient: 0.6
4. Fire Testing:
- a. Fire Rated Roof Assemblies: When used with the Dome Edge Protection Band and mounted on curbs 4 inches high or greater, all domes shall meet the prescriptive fire rating requirements for Class A, B, and C roof assemblies as described in the International Building Code
  - b. Self-Ignition Temperature Testing:
    - 1) Outer Dome Glazing (Type DP and DPP): Self-Ignition Temperature greater than 650 degrees F when tested in accordance with ASTM D1929.
    - 2) Inner Dome Glazing (Type DPP): Self-Ignition Temperature greater than 650 degrees F when tested in accordance with ASTM D1929.
    - 3) Cylinder Collector (Type C): Self-Ignition Temperature greater than 650 degrees F when tested in accordance with ASTM D1929.
    - 4) Diffuser (Type - All M74 DS): Self-Ignition Temperature greater

- than 650 degrees F when tested in accordance with ASTM D1929.
- c. Smoke Density Rating:
    - 1) Outer Dome Glazing (Type DP and DPP):
      - a) Smoke Density Rating no greater than 450 per ASTM E84.
      - b) Smoke Density Rating no greater than 75 per ASTM D2843
    - 2) Inner Dome Glazing (Type DPP): Smoke Density Rating no greater than 75 per ASTM D2843
    - 3) Cylinder Collector (Type C):
      - a) Smoke Density Rating no greater than 450 per ASTM E84
      - b) Smoke Density Rating no greater than 75 per ASTM D2843
    - 4) Light Transmitting Diffuser (Type - All M74 DS): Smoke Density Rating no greater than 75 per ASTM D2843
  - d. Rate of Burn and/or Extent of Burn:
    - 1) Outer Dome Glazing (Type DP and DPP): Minimum CC-1 Classification less than 1 inch (25 mm) extent of burn per ASTM D635
    - 2) Inner Dome Glazing (Type DPP): Minimum CC-2 Classification less than 2.5 inches/min (62 mm/min) rate of burn per ASTM D635.
    - 3) Cylinder Collector (Type C): S Minimum CC-1 Classification less than 1 inch (25 mm) extent of burn per ASTM D635
      - a) Raybender Daylight Lens (Type C): Minimum CC-2 Classification less than 2.5 inches/min (62 mm/min) rate of burn per ASTM D635.
    - 4) Diffuser (Type - All M74 DS): Minimum CC-2 Classification less than 2.5 inches/min (62 mm/min) rate of burn per ASTM D635.
5. FM Certification:
    - a. Spread of Flame: Passes: Class A at 5 in 12. No flame spread when tested in accordance with FM modified version of ASTM E108 Fire Test of Roof Coverings.
    - b. Simulated Hail Resistance (Pre UV Exposure): Passes: No cracking or breaks when tested with nominal 2.0 in. (51 mm) diameter ice ball having a kinetic energy of 26.8 ft-lbs (36.4J)
    - c. Simulated Hail Resistance (Post UV Exposure): Passes: No cracking or breaks when tested with nominal 2.0 in. (51 mm) diameter ice ball having a kinetic energy of 26.8 ft-lbs (36.4J) after no less than 1000 hours of ultraviolet (UV) light exposure.
    - d. Simulated Impact: Passes: No breakage or through openings when a 100 lb (45.5 kg) weight dropped from 4 ft (1.2 m) above highest point of test sample.
    - e. Simulated Wind Uplift: Passes: 195 psf Wind Rating. No separation, breaking or cracking occurred when tested in accordance with FM 4431.
  6. Interior Finish Classification (IBC Section 803):
    - a. Outer Dome Glazing (Type DP and DPP): Class B per ASTM E84
    - b. Cylinder Collector (Type C): Class B per ASTM E84
    - c. Diffuser (Type - All M74 DS): Comply with IBC Section 2606.7.2 (Diffuser Fall Out Test).
  7. Fall Protection Performance
    - a. Passes fall protection test: No penetration of dome or curb cap shall occur when subject to 700 lb (318.2 Kg)/60 second static load test and 700 lb (318.2 Kg)/2-foot (610 mm) impact drop test when tested in

- accordance with OSHA 29 CFR 1926 Subpart M (Fall Protection) 1926.501(b)(4)(i); 1926.501(i)(2); and 1926.501(b)(4)(ii).
- b. Passes fall protection test: California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1)
8. Blast Resistance: ASTM F1642, ASTM F2912, GSA-TS01-2003, and UFC 4-010-01:
- a. Airblast Loading ASTM Hazard Rating: Passes: No Break Rating
  - b. Airblast Loading UFC Level of Protection: Passes High Level of Protection
  - c. Dynamic Overpressure Loading ASTM Hazard Rating: Passes: No Break Rating
  - d. Dynamic Overpressure Loading UFC Level of Protection: Passes High Level of Protection

## 1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Data sheets showing roof dome assembly, flashing base, reflective tubes, diffuser assembly, and accessories.
  - 4. Installation requirements.
- C. Shop Drawings. Submit shop drawings showing layout, profiles, and product components, including rough opening and framing dimensions, anchorage, roof flashings and accessories.
- D. Electrical wiring diagrams and recommendations for power and control wiring.
- E. Verification Samples: As requested by Architect.
- F. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.
- G. Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features:
  - 1. LED Luminaires: Include estimated useful life, calculated based on IES LM-80 test data.
  - 2. To meet LM-80 lifetime projections, LM-80 Max Drive Current must not be exceeded. Lumen maintenance and lifetime predictions are valid for drive current and case temperature conditions used for LM-80 testing as included in the applicable LM-80 test report for these products.
- H. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
  - 1. List of Daylight Credits available for the products specified.
  - 2. Data on Energy Optimization Performance Credits for the products specified.
  - 3. Data on Perimeter and Non-Perimeter Controllability of Systems for use of Daylight Dimmer option with the products specified.
  - 4. Data on potential Innovation in Design Credits which may be available for the innovative use of the products specified.

## 1.6 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** All primary products specified in this section will be supplied by a single manufacturer with a minimum of twenty years experience in the top lighting industry. Secondary products shall be acceptable to the primary manufacturer.
- B. **Installer Qualifications:** All products shall be installed by a single installer with a minimum of five years demonstrated experience, with adequate equipment, skilled workers, and practical experience to meet the project schedule.
- C. **Skylights shall conform with authorities having jurisdiction and be designed to meet design criteria of the project location and the following:**
  - 1. Skylights must be certified by NFRC.
  - 2. Skylights must be Tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
  - 3. Skylights must have Factory Mutual (FM) Approval Class Number 4431.
  - 4. On projects which fall under the jurisdiction of the Florida Building Code, Skylights are required to have a current Florida Building Code (FBC) Number to meet the High Velocity Hurricane Zone (HVHZ) requirements and are required for acceptance of Work specified in this section. Skylight must comply with the jurisdictional code body's submittal data and supporting drawings and documentation. Where the code body's acceptance criteria differs from these specifications regarding components and hardware, the code body's requirements shall govern.
  - 5. Meet or exceed OSHA 200 pound (90 kg) Drop Tests expressed in 29 CFR 1910.23(e)(8)
  - 6. Skylights shall provide minimum 69 psf (3.30 kPa) design load.
- D. **LED Lighting and controls shall be designed to meet criteria of the project, and conform with authorities having jurisdiction, and the following:**
  - 1. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
  - 2. Product Safety Marking, Certifying compliance with:
    - a. UL 1598 - Luminaires
    - b. UL 2108 - Low Voltage Lighting Systems.
    - c. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products
    - d. CSA C22.2 No. 250.0 - Luminaires
  - 3. FCC Rules Part 15
  - 4. California Prop 65:
  - 5. EU RoHS Directive 2011/65EU Annex II and amendment (EU) 2015/863
- E. **Pre-Installation Meeting:** Contractor shall convene a pre-installation meeting on the project site minimum one week before beginning work of this Section. The meeting shall include the Architect or Owner's Representative and representatives of all related trades to:
  - 1. Coordinate between the at least the following trades.
    - a. Roofing to install the flashing, skylight, and LED Light Kit (when specified). Cut holes in roof deck, and flash curb to deck,
    - b. Ensure clear paths for TDD units and coordinate with mechanical so not to interfere with pathways.
    - c. Electrical to wire components and program lighting controls.
  - 2. Verify project requirements and site logistics.
  - 3. Assess integrity of the roofing system and building structure.
  - 4. Review manufacturer's installation instructions and warranty requirements.



## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in a cool dry location protected from the weather and in the manufacturer's original unopened containers until ready for installation.
- B. Store products in manufacturer's unopened packaging until ready for installation.

## 1.8 PROJECT CONDITIONS

- A. Coordinate delivery schedule with the Contractor and project schedule to minimize on site storage.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- C. Store materials in a dry area, protected from freezing, staining, contamination or damage.

## 1.9 WARRANTY

- A. Daylighting Device: Manufacturer's standard warranty for 10 years.
- B. Electrical Parts: Manufacturer's standard warranty for 5 years, unless otherwise indicated.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Solatube International, Inc.; 2210 Oak Ridge Way, Vista, CA 92081. Tel. Toll Free: 888-765-2882. Tel: (760) 477-1120. Fax: (760) 597-4488. Email: [commsales@solatube.com](mailto:commsales@solatube.com). Web: [www.solatube.com](http://www.solatube.com).
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

### 2.2 TUBULAR DAYLIGHTING DEVICES

- A. Tubular Daylighting Devices General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.
- B. SkyVault Series: Solatube Model M74 DS.
  - 1. Capture Zone:
    - a. Daylight Collector (Type C) with key components consisting of:
      - 1) Collector Dome: Polycarbonate 0.125 inch (3.2 mm) minimum thickness classified as CC1 material; UV inhibiting; (100 percent UVC, 100 percent UVB and 98.8 percent of the range of UVA transmission). Dimensions: 31.5 inches (800 mm) diameter by 6 inches (152 mm) high.
      - 2) Collector Cylinder: Polycarbonate 0.093 inch (2.4 mm) minimum thickness, classified as CC1 material; UV inhibiting, blocks all radiation <380nm: 100 percent UVC, 100 percent UVB and 76 percent of the range of UVA transmission). Dimensions: Dimensions 35.88 inches (911 mm) high by 51.5 inches (1308

- mm) arc length.
- 3) Collector Cylinder Back Panel: Support for collector assembly. Fabricated of corrosion resistant zincaluminum steel sheet CS-B AZ50, conforming to ASTM A792/A792M, with a thickness of 0.0276 inch (0.7 mm). Dimensions: 36 inches (914 mm) high by 48 inches (1219 mm) arc length.
  - 4) Collector Cylinder LightTracker Reflector: Daylight reflector. Aluminum sheet, thickness 0.018 inch (0.5 mm). Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance. Dimensions: 36 inches (914 mm) high by 48 inches (1219 mm) arc length.
  - 5) Micro-replicated Raybender HD Fresnel Lens: Daylight collecting lens. Impact resistant acrylic, 0.020 inch (0.51 mm) thick film with linear prism lens structure, classified as CC2 material. Dimension: 16 inch (406 mm) high by 51.75 inch (1314 mm) arc length.
  - 6) Cylinder Collector Stanchion: "U" shaped support connecting the dome ring to the base cone assembly; (2) each. Fabricated of corrosion resistant galvanized steel sheet (G90), conforming to ASTM A653/A653M, with a thickness of 0.052 inch (1.3 mm). Dimensions: 36 inches (914 mm) high by 0.50 inches (12.7 mm) wide by 0.375 inches (9.5 mm) deep.
  - 7) Base Cone Assembly: Conical shaped support connecting the daylight collection system to the curb-cap of associated TDD unit. Fabricated of corrosion resistant stainless steel (302/304), conforming to ASTM A463/A463M, with a thickness of 0.034 inch (0.86 mm). Dimensions: 35.9 inches (912 mm) major diameter by 30.385 inches (772 mm) minor diameter by 2.28 inches (58 mm) high.
  - 8) Upper seal (M74 DS Type C): Outer Dome, Cylinder Dome, and Back Panel interface. Adhesive backed PU foam "D" profile with water resistant polymeric skin. Dimension: 0.375 inch (9.5 mm) wide by 0.25 inch (6.35 mm) high.
  - 9) Lower seal (M74 DS Type C): Outer Dome and Support Cone interface. Adhesive backed 45 degree angle pile weather-strip. Dimension: 0.670 inch (17 mm) high by 0.27 inch (6.85mm) wide.
- b. Domes:
- 1) Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
    - a) Fasteners: Non-corrosive metal fasteners including non-magnetic stainless steel, zinc plated steel, aluminum, or injection molded nylon.
    - b) Dome Edge Protection Band: For Classified Roof Assemblies. For approved assemblies, curb height (by others or built on site) must be more than 8 inches (203 mm). Galvanized steel. Nominal thickness of 0.039 inch (1 mm).
  - 2) Single Dome Glazing: Type DP.
    - a) Outer Dome Glazing: 0.125 inch (3.2 mm) minimum thickness, vacuum formed polycarbonate classified as CC1 material; UV inhibiting (100 percent UVC, 100 percent UVB and 98.8 percent of the range of UVA transmission).
    - b) Outer Dome Seals: Adhesive Back Closed Cell Foam

- Seal 0.25 inch (6.3 mm) tall by 0.75 inch (19 mm) wide.
- 3) Dual Dome Glazing: Type DPP.
    - a) Outer Dome Glazing: 0.125 inch (3.2 mm) minimum thickness, vacuum formed polycarbonate classified as CC1 material; UV inhibiting; (100 percent UVC, 100 percent UVB and 98.8 percent of the range of UVA transmission).
    - b) Inner Dome Glazing: 0.040 inch (1 mm) minimum thickness, copolyester (PETG) polyethylene terephthalate with glycol classified as CC2 material.
    - c) Seals:
      - 1) Inner Dome Seal: Adhesive back closed cell foam seal 0.125 inch (3.2 mm) or 0.188 inch (4.8 mm) tall by 0.375 inch (9.5 mm) wide.
      - 2) Dome Assembly Seal: Adhesive backed pile weather-strip, 0.350 inch (8.9 mm) tall by 0.187 inch (4.8 mm) wide.
  - c. Dome Options:
    - 1) Security Guard: Type SG, welded powder coated steel or stainless steel rods 1/8 inch diameter mounted with an 8 inch maximum cross section. Assembly fastened with 1/8 inch diameter blind rivets in 6 locations to Curb-Cap assembly.
  - d. Flashings:
    - 1) Curb Cap Flashing Base: Type FC one piece, seamless, leak-proof flashing, and base support for dome and top of tube and cap flashing. Fabricated of corrosion resistant sheet steel, conforming to ASTM A653/A653M or ASTM A463/A463M or ASTM A792/A792M, with a thickness of 0.0276 inch (0.7 mm) plus or minus .004 inch (.01 mm).
      - a) Base Style: Curb-cap, with inside dimensions of 35.5 inches by 35.5 inches (905 mm by 905 mm) to cover curb specified in Section 07600.
      - b) Insulation: Nominal 1 inch thick thermal isolation pad to reduce thermal conduction between curb-cap and tubing and thermal convection between room air and curb-cap. Rated R-6 ( $^{\circ}\text{F}\cdot\text{ft}^2\cdot\text{hr}/\text{Btu}$ ) Insulation is Polyisocyanurate foam utilizing CFC, HCFC, and HFC free blowing agent. Type-1 Class-1 per ASTM C 1289; Passes UL 1715 (15-minute thermal barrier per IBC 2603.4); Attic ventilation may be required per IBC 1203.2.
      - c) Curb Seal: Includes a double bead of adhesive backed closed cell foam seal 0.188 inch (4.8mm) tall by 0.375 inch (9.5mm) wide to reduce air infiltration.
      - d) Tube Collar: Attached to top of curb-cap section; 0.018 inch (0.45 mm) nominal thickness aluminum conforming to ASTM B 209.
        - 1) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
  - e. Curbs: Metal Insulated Roof Curb: Corrosion resistant 18 Gauge hot-dipped galvanized steel conforming to ASTM A653 G90 with continuous welded seams, integrated base plate for water tightness and extra strength, lined with 1-1/2 inch fiberglass fireproof sound attenuating thermal insulation, factory installed 2 by 2 treated wood nailer secured to top ledge of curb. Curb designed for single-ply

roofing, lightweight fill, or tapered insulation low slope roof types.

- 1) C12 12 inch (305 mm) high Metal insulated curb.
- 2) C14 14 inch (356 mm) high Metal insulated curb.
- 3) C16 16 inch (406 mm) high Metal insulated curb.
- 4) C20 20 inch (508 mm) high Metal insulated curb.
- 5) CXX Metal insulated curb with a custom curb height as determined by the installer.

2. Transfer Zone:

- a. Extension Tubes: Aluminum sheet, thickness 0.018 inch (0.5 mm) conforming to ASTM B 209 with Tab-Lock tube joint structural connection system.
  - 1) Reflective Tubes:
    - a) Reflective 24 inch (610 mm) extension tube, Type EXX or Type EL with total length of run as indicated on the Drawings.
    - b) Belt Alignment Tab aligns Tube Belt on to tube in the correct location.
    - c) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
  - 2) Tab-Lock:
    - a) Tab-Lock captures adjoining tube or tube connector using periodic opposing hooks integrated in the tube perimeter with mating retention detents.
    - b) Hook system allows ease of tube engagement or disengagement for single operator from man-lift or rooftop.
    - c) System intertwines the ends of the adjoining tubes and tube connectors between each Tab-Lock station.
    - d) Intertwining function accepts tubes and connectors of common diameters that reduces light loss up to 2 percent per tube joint relative to tubes with 0.3 inch (7.6 mm) diameter difference.
  - 3) Tube Belt:
    - a) Sheet-metal belt 2 inch (50.8 mm) wide by 28.5 inch (724 mm) nominal diameter by 0.022 inch (0.5 mm) thick CS-B AZ-50 ASTM A792 with 0.10 inch (2.5mm) diameter stainless steel type 302 ASTM A313 torsion spring actuated toggle clamp.
    - b) Retains Tab-Lock tube joint structural connection system; stiffens linear tube assembly; and prevents tube rotation or disengagement under normal use.
    - c) Includes locking tab to prevent unintentional Tube Belt Latch opening due to handling, service, vibration, or normal operation or use.
  - 4) Extension Tube Options:
    - a) Reflective 48 inch extension tube, Type EL 48 inches (1220 mm) long. Use to replace two standard 24-inch (610 mm) extension tubes when long tube runs are required.
    - b) Trim Ring: Type R. Provides a finished appearance to the installation, covering the cut edge of the roof deck penetration in an open ceiling application.
    - c) Thermal Insulation Panel with Integral 24 inches (610 mm) Extension Tube: Type TIP, high-performance dual-glazed, thermally-broken tube insulation system consisting of two acrylic panels, spaced 1.0 inch (25.4 mm) apart, classified CC2 Class C material, 0.110 inch (2.8 mm)

thick, housed in a polyethylene terephthalate glycol-modified (PETG) or acrylonitrile butadiene styrene (ABS) band classified as CC2 material 0.060 inch (1.5 mm) thick by 1.75 inch (44.5 mm) high with Spectralight Infinity high reflectance specular finish interior surface, and assembled with stainless steel disk spacers 0.0197 inch (0.5 mm) thick and aluminum rivets 0.13 inch (3.2 mm) fastened periodically around the perimeter. Dual-glazed Panel assembly integrated with a 12 inch (305 mm) Upper, and a 12 inch (305 mm) Lower Transition Tube made of Spectralight Infinity with INFRAREduction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance to form a nominal 24.9 inch (633 mm) tube assembly with integrated Tab-Lock connections.

3. Delivery Zone:

- a. Daylight Dimmer - 0 to 10 V Dimmer Control: Provide electrical actuator controller, auxiliary switches, and cable as specified in Section 25 50 00; Common Work Results Electrical Section 26 05 00; and Lighting Equipment and Controls Section 26 50 00.
  - 1) Low Voltage Daylight Dimmer, Type D1, is an Electro-mechanically actuated daylight valve; 0-10 V Control, Class-2, UL Listed. Low voltage Daylight Dimmer, an electrical actuator provides for programmable (0 to 10VDC) scene-based dimming control for daylight output between 0.5 and 100 percent, auxiliary 12VDC dimming control for daylight output between 2 and 100 percent, or auxiliary ON/OFF control. Input voltage: 24VAC at 50 or 60 Hz. Daylight Dimmer assembly integrated with a 12 inch (305 mm) Upper, and a 12 inch (305 mm) Lower Transition Tube made of Spectralight Infinity with INFRAREduction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance to form a nominal 24.9 inch (633 mm) tube assembly with integrated Tab-Lock connections.
    - a) Programmable (0 to 10VDC) Control: requires an electrical actuator lighting controller or building automation controller capable of producing a signal between 0 and +10 VDC (Min 50mA) to incrementally modulate up to 50 daisy chained Daylight Dimmers (Current Sinking) between fully closed at 0 to 1 volts to fully open at 9 to 10 volts.
    - b) Requires CL-2 (Min), 18 AWG, stranded copper, two conductor, twisted cable from lighting controller to first dimmer and interconnecting between subsequent dimmers.
    - c) Auxiliary 12VDC Dimming Control: Requires 12VDC Dimming Switch (Current Sourcing; 12VDC power supply not required).
      - 1) Requires CL-2 (Min), 22 AWG, stranded, three conductor, twisted cable from switch to first dimmer and CL-2 (Min), 18 AWG, stranded copper, two conductor, twisted cable; interconnecting subsequent dimmers.
    - d) Auxiliary ON/OFF Control: requires commercial or residential single pole electric light switch.
      - 1) Requires CL-2 (Min), 22 AWG, stranded, three conductor, twisted cable from switch to first dimmer

- and CL-2 (Min), 18 AWG, stranded copper, two conductor, twisted cable; interconnecting subsequent dimmers.
- 2) Power can be transformed from line voltage through use of a UL Listed Class-2, 24VAC Transformer.
- b. Bottom Assembly:
- 1) Base Diffuser Assemblies for Tubes Not Penetrating Ceilings (Open Ceiling): Type B, Solatube Model M74 DS-O. 28.5 inch (724 mm) diameter diffuser attached directly to bottom of tube.
    - a) Diffuser Collar: Attached to diffuser lens; 0.018 inch (0.45 mm) nominal thickness aluminum.
      - 1) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
      - 2) Color:  $a^*$  and  $b^*$  (defined by CIE  $L^*a^*b^*$  color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance with ASTM E308.
    - b) Diffuser Belt:
      - 1) Sheet-metal belt 2 inch (50.8 mm) wide by 28.5 inch (724 mm) nominal diameter by 0.022 inch (0.5 mm) thick CS-B AZ-50 ASTM A792 with 0.10 inch (2.5 mm) diameter stainless steel Type 302 ASTM A313 torsion spring actuated toggle clamp.
      - 2) Retains Tab-Lock tube joint structural connection system; stiffens linear tube assembly; and prevents tube rotation or disengagement under normal use.
      - 3) Includes locking tab to prevent unintentional Latch opening due to handling, service, vibration, or normal operation or use.
  - 2) Amplifier Assembly for Tubes Not Penetrating Ceilings (Open Ceiling): Type A, 36 inch (914 mm) diameter amplifier diffuser assembly attached directly to bottom of tube.
    - a) Amplifier: Conical shaped assembly 23.7 inches (602 mm) tall, 28.5 inches (724 mm) upper diameter, and 36 inches (914 mm) lower diameter.
      - 1) Amplifier collimates incident light. Light reflects off 2 successively angled facets designed to mix the light to reduce glare and to correct the incident angle by 15 degrees and 25 degrees successively thereby improving the transmission efficiency through the diffuser lens by reducing retro-reflection due to first surface refraction and concentrating the distribution of light by reducing the cone of illumination relative to the incident angle correction.
      - 2) Assembly comprised of 3 multifaceted segments to be joined together with 15 - 0.125 Inch (3 mm) rivets.
      - 3) Tube Connect Slots at upper perimeter receive 6 Tab-Lock Hook features from adjoining tube for mechanical tube engagement.
      - 4) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.

- 5) Color:  $a^*$  and  $b^*$  (defined by CIE  $L^*a^*b^*$  color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance with ASTM E308.
- b) Amplifier Diffuser Belt:
  - 1) Sheet-metal belt 2 inch (50.8 mm) wide by 36 inch (914mm) nominal diameter by 0.022 inch (0.5 mm) thick CS-B AZ-50 ASTM A792 with 0.10 inch (2.5 mm) diameter stainless steel Type 302 ASTM A313 torsion spring actuated toggle clamp.
  - 2) Retains Tab-Lock tube joint structural connection system; stiffens linear tube assembly; and prevents tube rotation or disengagement under normal use.
  - 3) Includes locking tab to prevent unintentional Latch opening due to handling, service, vibration, or normal operation or use.
- 3) Diffuser Lens:
  - a) Lens: Type L2, Prismatic lens designed to maximize light output and diffusion. Visible Light Transmission shall be greater than 90 percent at 0.100 inch (2.5 mm) thick. Classified as CC2.
  - b) Diffuser Collar: Attached to diffuser lens; 0.018 inch (0.45 mm) nominal thickness aluminum.
    - 1) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
  - c) Diffuser Seal: "L" shaped EPDM closed cell foam, , 0.86 inch (21.8 mm) wide by 1.37 inch (34.8mm) tall by 0.16 inch (4.1 mm) thick to minimize condensation and bug, dirt, and air infiltration per ASTM E283.
  - d) Diffuser Band: Stainless steel diffuser band, 0.25 inch (6.4 mm) wide by 0.020 inch (0.5 mm) thick stainless steel Type 201 ASTM A666, for enhanced seal performance and protection.
- 4) Options/Accessories
  - a) Optional Low-voltage Transformer: Solatube Remote Transformer, Type T20, is a 20VA, 24VAC, 50/60HZ, UL Listed, UL Category XOKV7, CE Marked, Class-2 Transformer with cover plate mounting system configured for easy field assembly onto standard 4.06 inch by 4.06 inch (103 mm by 103 mm) square junction box: Inherently Limited, Primary: 120VAC, 208VAC, 240VAC, and 277VAC.
  - b) Optional Low-voltage Transformer: Solatube Remote Transformer, Type TR96, is a 96VA, 24VAC, 50/60HZ, UL Listed, UL Category XOKV7, CE Marked, Class-2 Transformer with cover plate mounting system configured for easy field assembly onto standard 4.06 inch by 4.06 inch (103 mm by 103 mm) square junction box: Inherently Limited, Primary: 120VAC, 240VAC, 277VAC and 480VAC.
  - c) Switch: Type S1, is a Low-voltage 0-10V Class 2 control switch (white) required to operate 0-10V Daylight Dimmer. Note: only one switch is required per set of up to 50 synchronously controlled dimmers. For use with 0-10V

Daylight Dimmer, Type D1, only.

## 2.3 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.
- C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions.
- C. If substrate and rough opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Coordinate requirements for power supply, conduit, and wiring.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Coordinate installation with substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing to ensure that each element of the Work performs properly, and that finished installation is weather tight.
  - 1. Install flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.
  - 2. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.
  - 3. Coordinate attachment and seal of perimeter air and vapor barrier material.
- C. Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, provide permanent separation as recommended by manufacturer
- D. Align device free of warp or twist, maintain dimensional tolerances.
- E. Inspect installation to verify secure and proper mounting. Test each fixture to verify operation, control functions, and performance. Correct deficiencies.



### 3.4 FIELD QUALITY CONTROL

- A. Provide independent testing and inspection as specified in Section 01 45 23. Inspect installation to verify secure and proper mounting.
  - 1. Test for water leaks in accordance with AAMA 502 after installation and curing of sealants but prior to installation if interior finishes.
  - 2. Perform test for total area of each unit skylight.
  - 3. Notify the Architect and the Contractor of any failed tests.

### 3.5 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

### 3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION