



## **VELUX® SUN TUNNEL™ Skylights – Guide Specification**

**VELUX TCC Commercial SUN TUNNEL** skylights are designed for commercial flat or low slope roofing applications that are above spaces that will benefit from daylight to reduce energy loads and improve occupant's performance and comfort. Ideal applications for commercial SUN TUNNEL skylights included schools, retail spaces, and warehouses that require a cost effective daylight solution. The round highly reflective light shaft requires less structural framing than a traditional commercial skylight and can be assembled within minutes versus the days of construction when compared to the traditional framed drywall light shaft. VELUX SUN TUNNEL skylights provide a cost effective method to transfer daylight through the roof for an open ceiling application and greater cost savings can be achieved as run lengths increase for suspended ceiling application.

SUN TUNNEL skylights are frequently a crucial element in energy saving daylighting strategies for LEED-certified or other green building projects.

The TCC SUN TUNNEL skylight is a configurable system that allows the specifier to select only the components required for specific project applications, with adjustable flashing heights, straight and adjustable angle tunnel components, and diffuser options for most applications.

VELUX test facilities ensure that new products comply with regulations and market demands for technical performance. VELUX testing ensures that our products are able to withstand the most difficult climatic conditions to which VELUX products are typically exposed to in the markets where they are sold. Our test procedures include load capacity, air and water tightness in a test chamber and a weather simulator, mechanical tests, impact test results, durability tests, U-factor and solar heat gain tests, burn brand resistance and visual inspection of the surface quality.

Contact **VELUX America Inc.**, Greenwood, SC 29648; [www.VELUXusa.com](http://www.VELUXusa.com); 888-878-3589, [specifications@veluxusa.com](mailto:specifications@veluxusa.com).

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## SECTION 08 62 70 – TUBULAR UNIT SKYLIGHTS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Tubular unit skylight daylighting systems with formed curb counterflashing for mounting on prefabricated roof curbs, for flat and low-slope roofing applications.

#### 1.2 RELATED REQUIREMENTS

Specifier: If retaining optional "Related Sections" article, edit to include sections applicable to Project.

- A. Section 061053 "Miscellaneous Rough Carpentry" for site-built wood roof curbs for tubular unit skylights.
- B. Division 07 roofing section for flashing and roofing terminations at tubular unit skylight curbs.
- C. Section 077200 "Roof Accessories" for manufactured metal roof curbs for tubular unit skylights.
- D. Section 086200 "Unit Skylights" for unit skylights without reflective tubes.
- E. Section 086300 "Metal-Framed Skylights" for aluminum-framed sloped glazing assemblies.
- F. Division 26 electrical sections for conduit and wiring for tubular unit skylight dimmers.

#### 1.3 REFERENCE STANDARDS

Specifier: If retaining optional "References" article, edit to include standards cited in edited Section.

- A. General: Applicable edition of references cited in this Section is current edition published on date of issue of Project specifications, unless otherwise required by building code in force.
- B. American Architectural Manufacturers Association ([www.aama.net](http://www.aama.net)), Window & Door Manufacturers Association ([www.wdma.com](http://www.wdma.com)), Canadian Standards Association ([www.csagroup.org/us/en/services](http://www.csagroup.org/us/en/services))
  - 1. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/ Specification for Windows, Doors, and Skylights (NAFS)
  - 2. CSA A440S1-09 – Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440
  - 3. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems
  - 4. AAMA 2603 – Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum and Panels
- C. ASTM International: [www.astm.org](http://www.astm.org):
  - 1. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  - 2. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
  - 3. ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-supporting plastics in a Horizontal Position

4. ASTM D 2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics
5. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free
6. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials
7. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings
8. ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
9. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
10. ASTM E 408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
11. ASTM E 1651-94(2004) - Standard Test Method for Total Luminous Reflectance Factor by Use of 30/t Integrating-Sphere Geometry
12. ASTM E 1886 - 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
13. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

D. Code of Federal Regulations:

1. 29 CFR 1910.23 (e) (8) - Occupational Safety and Health Standards for Walking-Working Surfaces to Guard Floor and Wall Openings and Holes

E. Illuminating Engineering Society of North America (IESNA): [www.ies.org](http://www.ies.org):

1. IESNA – The Lighting Handbook.

F. National Fenestration Rating Council: [www.nfrccommunity.org](http://www.nfrccommunity.org):

1. NFRC 100 - Procedure for Determining Fenestration Product U-factors
2. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

G. National Fire Protection Association: [www.nfpa.org](http://www.nfpa.org):

1. NFPA 70 - National Electrical Code

H. The Coatings Society (SSPC): [www.sspc.org](http://www.sspc.org):

1. SSPC-SP 12/NACE NO. 5 - Surface Preparation And Cleaning Of Metal

1.4 COORDINATION

[Specifier: Retain option in paragraph below that corresponds to the type of curb used on Project.](#)

- A. Coordinate dimensions, locations, and details of skylight curbs [specified in Section 061053 "Miscellaneous Carpentry"] [specified in Section 077200 "Roof Accessories"] with tubular unit skylight curb cap flashings. Verify requirements for roofing system terminations.

- B. Coordinate tubular unit skylight interior termination locations with structural layout, ceiling grid layouts, and other ceiling-mounted items.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site prior to delivery of tubular unit skylight and installation of roof deck.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For tubular unit skylights. Include standard construction details, product performance characteristics, and material descriptions, dimensions of individual components and profiles, and finishes.
  - 1. Include test reports of qualified independent testing agency or third party certificates verifying compliance with performance requirements.

Specifier: Retain "LEED Submittals" Paragraph when required for Project; this Paragraph stipulates documentation required from Contractor to support cited construction-phase credits.

Review design-phase credits available related to tubular unit skylights, including contribution to IEQ Cr 6.1 Controllability of Systems, IEQ Cr 8.1. Daylighting, EA Cr 1 Energy Optimization, and ID Cr 1 Innovation in Design credits. Consult VELUX representative for detailed support data.

#### B. LEED Submittals:

- 1. Credit MR 4 Recycled Content: Documentation indicating the following:
  - a. Percentages by weight of post-consumer and pre-consumer recycled content.
  - b. Total weight of products provided.
  - c. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: For tubular unit skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.
  - 1. Lighting photometric study indicating compliance with performance requirements in accordance with IESNA. Include layout, spacing criteria and foot-candle report.

Specifier: Retain "Wiring Diagrams" Subparagraph if skylight dimmers are required for Project.

- 2. Wiring Diagrams: For power and control wiring for dimmers.

#### 1.7 INFORMATIONAL SUBMITTALS

Specifier: Retain paragraphs below when Project requirements include compliance with Federal Buy American provisions. VELUX SUN TUNNEL complies with requirement.

- A. Buy American Act Certification: Submit documentation certifying that products comply with provisions of the Buy American Act 41 U.S.C 10a – 10d.
- B. Florida State Product Approval Listing Number: Indicating that products comply with requirements of Florida State Building Code. [www.floridabuilding.org/pr/pr\\_app\\_srch.aspx](http://www.floridabuilding.org/pr/pr_app_srch.aspx)
- C. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data.

1.9 QUALITY ASSURANCE

Specifier: VELUX America, Inc. has been producing skylights in the US for over 30 years and in Europe for an additional 30 years prior to that. VELUX has a reputation among architects and contractors as the most reliably performing skylight in the world.

- A. Manufacturer Qualifications: A qualified manufacturer listed in this Section with minimum 30 years' experience in the US manufacturing similar products in successful use on similar projects and able to provide tubular unit skylights meeting requirements.

Specifier: Retain "Approval of Manufacturers and Comparable Products" Subparagraph if Owner will consider product substitutions.

1. Approval of Manufacturers and Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
  - a. Completed and signed Substitution Request form.
  - b. Product data, including photometric data and independent test data indicating compliance with requirements.
  - c. Sample product warranty.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of tubular unit skylights that fail in materials or workmanship under normal use within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Deterioration of metals, metal finishes, dome, and other materials beyond normal weathering.
    - b. Breakage of glazing.
  2. Warranty Period:
    - a. Tubular Unit Skylight Assembly: 10 years from date of purchase.
    - b. Tunnel Reflective Coating: 20 years from date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products of **VELUX America Inc.**, Greenwood, SC 29648; [www.VELUXusa.com](http://www.VELUXusa.com); (800) 878-3589, [specifications@veluxusa.com](mailto:specifications@veluxusa.com).

Specifier: Retain "Substitutions" Paragraph and select one of two options based upon Project requirements.

- B. Substitutions: [None allowed by Owner] [As permitted under Instructions to Bidders and Section 012500 "Substitution Procedures"].
- C. Source Limitations: Obtain tubular unit skylights through single source from single manufacturer.

## 2.2 TUBULAR DAYLIGHTING DEVICES

- A. System Description: Tubular unit skylight daylighting devices with exterior glazed dome, glazing retainers and gaskets, exterior curb counterflashing assembly with integral adjustable pivot device, reflective tunnel, interior diffuser assemblies, and accessories, as required to meet installation and performance requirements indicated.

- 1. Basis of Design: **VELUX America, Inc, Model TCC Commercial Curb Mount Sun Tunnel Skylight.**

Specifier: **VELUX SUN TUNNEL** 14 inch diameter dome uses low profile geometry. 22 inch diameter dome uses high profile geometry optimized to capture daylight at low solar angles and provide bright evenly distributed lighting levels through peak sun hours.

- B. Roof Dome Assembly: Transparent, UV-resistant dome with flashing base supporting dome, and top of tunnel.
  - 1. Unit Sizes: [14 inch (356 mm)] [and] [22 inch (559 mm)] diameter [as indicated on Drawings].

Specifier: Select second option in "Dome Glazing" Subparagraph below for projects requiring high impact-resistant glazing.

- 2. Dome Glazing: 0.125 inch (3.18 mm) minimum thickness injection molded transparent [impact modified acrylic] [polycarbonate] material; with UV-absorbing additive.
  - 3. Dome Seal: Adhesive-backed foam weatherstrip.

Specifier: **VELUX SunCurve Daylight Directing Device** described below is a component of all 22 inch unit installations and is mounted between the plastic dome and flashing. The SunCurve is designed with triangular-shaped acrylic prisms to refract early morning and late afternoon sunlight directly into the rigid tunnel for increased light output at low sun angles. Prisms along the upper portion of the SunCurve re-reflect a portion of the excess sun light associated with intense mid-day sun levels. The SunCurve is designed to capture more light at low sun angles and therefore to provide more uniform lighting levels throughout the day.

Retain "Daylight Directing Device" Subparagraph below if 22 inch diameter unit is required for Project.

- 4. Daylight Directing Device: 22-inch- (559-mm-) diameter, injection molded, impact modified acrylic prism array configured to direct low-angle sunlight into tunnel and re-reflect high solar heat gain sunlight to exterior.
    - a. Basis of Design: **VELUX America, Inc, VELUX SunCurve Daylight Directing Device.**
- C. Roof Curb Counterflashing: One-piece, formed low slope curb counterflashing suitable for installation on roof curb up to 60 deg. from horizontal.

- 1. Material: Galvanized steel sheet, 0.023-inch/24-ga.- (0.58-mm-) thick.

- a. Dimensions: Curb-mounted, 21 inches (533 mm) or 31 inches (787 mm) square, as required for skylight unit sizes indicated on Drawings, with 3 inch (76.2 mm) vertical counterflashing lip.
  - b. Finish: Powder coat, gray.
2. Flashing Insulator: Manufacturer's standard closed-cell thermal isolation material affixed to underside of flashing.
  3. Intermediate Ring: High-impact plastic reflective tunnel receiver attached to top of roof curb counterflashing base serving as mounting base for dome assembly and providing a thermal break between counterflashing base and reflective tunnel, configured to channel condensed moisture out of assembly.
    - a. Intermediate Ring Seal: Santoprene O-ring providing weather tight seal with roof curb counterflashing.
    - b. Pivot Ring and Reflective Tunnel Collar: High-impact plastic pivoting socket mounts in intermediate ring and secures to factory-installed tunnel collar; adjustable to allow increased adjustability for proper alignment of tunnel sections.

Retain "Flashing Accessories" Paragraph and accessories required for Project, if any.

D. Flashing Accessories:

1. Manufacturer's standard turret risers, [12 inches (305 mm) high] [36 inch (914 mm) high] [height indicated on Drawings], matching counterflashing metal and finish.
2. Fire Band: Dome edge protection band, as required for installation in fire-resistance-rated roof assemblies; matching counterflashing metal and finish.

E. Reflective Tunnel: Skylight light shaft formed from Class II anodized aluminum sheet, 0.016-inch/26-ga.- (0.41-mm) thick, with silver specular interior finish surface coated with vacuum-evaporated silicone oxide and titanium oxide protective surface that protects the tunnel surface from corrosion and provides a long life of reflection characteristics.

1. Basis of Design: **VELUX America, Inc, Model TTK or ZTR Rigid Reflective Tunnel.**
2. Diameter: As required for indicated skylight unit sizes.
3. Reflectance: 99 percent reflectance when measured in accordance with ASTM E 1651 at 30 degrees from vertical. Total reflectance greater than 98 percent when measured in accordance with ASTM E 1651.
4. Color Rendition, ASTM E 408: As defined by CIE L\*a\*b\* color model, L equal to 99-100, values a\* and b\* shall not exceed +1 or be less than -1.

F. Reflective Tunnel Components: Provide components indicated and as required for installation based upon roof, ceiling, and structural member configuration, skylight and diffuser locations indicated on Drawings, and manufacturer's recommendations, selected from the following:

1. Rigid Tunnel Extensions: Reflective extension tube, lengths as required for application.
2. Universal Reflective Elbows: Reflective angle adaptors adjustable to 45 degrees, 0.023-inch/24-ga. (0.58 mm) thick, and mounted at the top, middle, or bottom of reflective tunnel assemblies as required for application.

Specifier: **VELUX Flexi-Loc Fasteners** are engineered to enable extremely accurate and fast tool-free assembly of the reflective tunnel on the job site, ensuring compliant daylighting performance and precluding in-service disturbance of the reflective tunnel.

3. Reflective Tunnel Fastening System: Manufacturer's recommended fastening devices consisting of spring tempered stainless steel pull clip mechanical fasteners allowing tunnel vertical and horizontal joints to be secured without the use of screws or tools, used in conjunction with pre-located punched holes in tunnel sections, that allow for a tight naturally-occurring tapered mating of interconnecting tunnel sections and elbows.

- a. Basis of Design: **VELUX America, Inc, Flexi-Loc Fasteners.**

- G. Reflective Tunnel Accessories: Provide accessories indicated and as required for installation based upon roof, ceiling, and structural member configuration, skylight and diffuser locations indicated on Drawings, and manufacturer's recommendations, selected from the following:

1. Rotating Couplers: Rotating adaptors allowing coupling of two elbows to create 90 degree transition of tunnels using fastening system connections with rotating joint enabling alignment of tunnel sections.

Specifier: The **VELUX Commercial Energy Kit** is an innovative solution to increasing skylight energy efficiency while reducing potential for condensation within tubular unit skylights. The 14 inch Energy Kit also includes a heat shield plate that attaches to the inside of the dome to reduce solar heat intensity of high sun angles. Retain paragraph on heat shield if 14 inch size unit is used.

2. Commercial Energy Kit: Two clear diffusers mounted in airtight Santoprene gasketing system inserted in a round polymer housing that provides a thermal break and installs in line with building envelope insulation to isolate tunnel from exterior temperatures. Kit is affixed to tunnel with manufacturer's spring lock fasteners.

- a. Provide semi-transparent heat shield plate fastened with screws to the inside of the dome to reduce solar heat gain associated with high sun angles for **14 inch (356 mm)** units.

- b. Basis of Design: **VELUX America, Inc, Commercial Energy Kit Model ZTC.**

## 2.3 DIFFUSERS

Specifier: Retain one or more of three "Diffuser Assemblies" Paragraphs below based upon one or more diffuser assembly types required for Project.

- A. Round Diffuser Assemblies for Exposed Structure Applications: Round diffuser attached directly to bottom of tunnel, with high visible light transmittance lens, airtight seals, and white polycarbonate trim ring.

1. Basis of Design: **VELUX America, Inc, Round Diffuser Model TOC.**
  2. Size: As required for skylight sizes indicated.
  3. Lens Type: [Prismatic lens, minimum 92 percent visible light transmittance] [Frosted lens, minimum 92 percent visible light transmittance] [Fresnel lens with concentric honeycomb parabolic light-diffusing prisms].

- B. Square Diffuser Assemblies for Suspended and Hard Ceiling Applications: Round-to-square transition box with white diffuse internal coating attached directly to bottom of tunnel and fitted to standard suspended ceiling grid or hard ceiling, with hinged, white painted extruded



aluminum diffuser frame with high visible light transmittance lens, seals, and white metal ceiling trim.

1. Basis of Design: **VELUX America, Inc, Square Diffuser Model TTC.**
2. Size: As required for skylight sizes indicated, and coordinated with nominal 24 by 24 inch (610 by 610 mm) ceiling grid size.
3. [Round-to-Round Adapter: Where required to adapt 14 inch tunnel to square diffuser assembly.]

Specifier: Retain second option in "Curvilinear Ceiling Adapter Assembly" Subparagraph below when required for Project fire-rated ceiling assembly requirements.

4. Curvilinear Ceiling Adapter Assembly: [Injection-molded copolymer] [Plenum-rated Kynar PVDF thermoplastic].
  5. Lens Type: [Prismatic lens, minimum 92 percent visible light transmittance] [Frosted lens, minimum 92 percent visible light transmittance] [Fresnel lens with concentric honeycomb parabolic light-diffusing prisms supported by clear lens, 92 percent visible light transmittance].
- C. Round Diffuser Assemblies for Finished Ceiling Applications: Round ceiling diffuser assembly attached directly to bottom of tunnel, dual high visible light transmittance lenses with insulating airspace, airtight seals, and paintable white acrylic trim ring.
1. Basis of Design: **VELUX America, Inc, Round Diffuser Model THC.**
  2. Size: As required for skylight sizes indicated.
  3. Lens Type: [Prismatic lens, minimum 92 percent visible light transmittance] [Frosted lens, minimum 92 percent visible light transmittance] [Fresnel lens with concentric honeycomb parabolic light-diffusing prisms].

## 2.4 ACCESSORIES

Specifier: Retain "Daylight Controller" Paragraph and show locations for daylight controllers on Drawings if required for Project.

- A. Daylight Controller: Local daylight control with reflective variable positioning paddle mounted in rigid housing. Provide for units in which daylight controllers are indicated.
1. Basis of Design: **VELUX America, Inc, Daylight Controller Model ZTP.**

Specifier: Retain second option in "Housing" Subparagraph below when required for Project fire-rated ceiling assembly requirements.

1. Housing: [Injection-molded copolymer] [Plenum-rated Kynar PVDF thermoplastic].
  2. Daylight Dimmer: Electro-mechanically-actuated daylight valve with 24 VDC input voltage providing adjustable daylight output between 2 and 100 percent.
  3. Daylight Controller and Switch: Combination power supply and DP/DT switch, 110-277VAC input and 24 VDC output, capable of operating up to ten daylight dimmer units. Switching allows reflective paddle to stop at any location between fully open and fully closed positions.
- B. Security Bar: Single 304 stainless steel bar installed across diameter of tunnel collar section, and security fasteners for fastening dome to assembly.

- C. High Security Bars: Double 304 stainless steel bars installed perpendicular to each other across diameter of tunnel collar section, and security fasteners for fastening dome to assembly and flashing to curb.
- D. Suspension Wire: 12-ga., galvanized steel wire.

## 2.5 PERFORMANCE REQUIREMENTS

- A. Unit Skylight Standard, 14 inch (356 mm) Unit: AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS-11 or previous):

Specifier: Retain first four Subparagraphs below and delete following four Subparagraphs for IBC 2012 and 2015 code requirements; verify requirements of authorities having jurisdiction.

1. Performance Grade (Primary Designator): TDDCC/TDDOC-PG150.
2. Design Pressure (DP): +300/-150 psf (+14.4/-7.2 kPa).
3. Water Test Pressure: 15 psf (0.72 kPa) with no leakage at 5 gallons per minute spray rate.
4. Air Leakage Rate: 0.30 cfm/ft<sup>2</sup> maximum.

Specifier: Delete first four Subparagraphs above and retain first four Subparagraphs below for IBC 2009 and NBC code requirements, including CSA A440S1-09; verify requirements of authorities having jurisdiction.

5. Performance Class and Grade (Primary Designator) CW-PG110.
6. Design Pressure (DP): +200/-110 psf (+9.58/-5.27 kPa).
7. Water Test Pressure: 15 psf (0.72 kPa) with no leakage at 5 gallons per minute spray rate.
8. Canadian Air Infiltration/Exfiltration Rating: A2. (1.5 L/s/m<sup>2</sup> maximum)

- B. Unit Skylight Standard, 22 inch (559 mm) Unit: AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS-11 or previous):

Specifier: Retain first four Subparagraphs below and delete following four Subparagraphs for IBC 2012 and 2015 code requirements; verify requirements of authorities having jurisdiction.

1. Performance Grade (Primary Designator): TDDCC/TDDOC-PG130.
2. Design Pressure (DP): +300/-130 psf (+14.4/-6.22 kPa).
3. Water Test Pressure: 15 psf (0.72 kPa) with no leakage at 5 gallons per minute spray rate.
4. Air Leakage Rate: 0.30 cfm/ft<sup>2</sup> maximum

Specifier: Delete first four Subparagraphs above and retain first four Subparagraphs below for IBC 2009 and NBC code requirements, including CSA A440S1-09; verify requirements of authorities having jurisdiction.

5. Performance Class and Grade (Primary Designator): CW-PG100.
6. Design Pressure (DP): +200/-100 psf (+9.58/-4.79 kPa).
7. Water Test Pressure: 15 psf (0.72 kPa) with no leakage at 5 gallons per minute spray rate.
8. Canadian Air Infiltration/Exfiltration Rating: A2 (1.5 L/s/m<sup>2</sup> maximum).

- C. Daylighting: Provide daylighting photometric performance comparable to basis of design product at layout indicated, based upon daylighting profile of March 21, 9:00 am local time, at Project location by simulation in accordance with IESNA guidelines.
- D. Air Infiltration: Maximum air leakage through unit of **0.30 cfm/sq. ft. (1.5 L/s/sq. m)** of fixed area as determined according to ASTM E 283 at a static-air-pressure differential of **1.57 lbf/sq. ft. (75Pa.)**
- E. Water Penetration under Static Pressure: No evidence of water penetration through unit when tested according to ASTM E 331 at a static-air-pressure differential of **15 lbf/sq. ft. (720 Pa).**

Specifier: Retain "Windborne Debris Resistance" Paragraph if required by authorities having jurisdiction. Select optional polycarbonate glazing when retaining this Paragraph.

- F. Windborne-Debris Resistance: Provide tubular unit skylights capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed representative of those specified, according to ASTM E 1886 and ASTM E 1996.
  - 1. Missile Level C, Wind Zone 3 requirements, and +50/-50 psf cycle pressure minimum.
- G. Surface-Burning Characteristics of Plastic Glazing: Provide plastic glazing meeting NAFS and identical to specimens tested for fire-exposure behavior in accordance with test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Self-Ignition Temperature: **650 deg F (345 deg. C)** or more for plastic glazing in thickness indicated when tested per ASTM D 1929.
  - 2. Smoke-Production Characteristics: Comply with either requirement below:
    - a. Smoke-Developed Index: 450 or less when tested per ASTM E 84 on plastic glazing in manner indicated for application.
    - b. Smoke Density: 75 or less when tested per ASTM D 2843 on plastic glazing in thickness indicated for application.
  - 3. Burning Characteristics: Tested and labeled in accordance with ASTM D 635.
    - a. Plastic Glazing for Domes: [Polycarbonate Class CC1] [Acrylic Class CC2].
- H. Fire Ratings for Roof Assemblies with Fire Classifications: Tubular unit skylight with dome edge protection band tested in accordance with ASTM E 108 and listed as passing Burning Brand test with target classification of Class B
- I. Energy Performance with Energy Kit Installed:
  - 1. Thermal Transmittance: NFRC 100 maximum U-factor:
    - a. **14 inch (356 mm)** Units: **0.55 Btu/hr\*ft<sup>2</sup>\*deg F (3.12 W/m<sup>2</sup>\*deg C).**
    - b. **22 inch (559 mm)** Units: **0.43 Btu/hr\*ft<sup>2</sup>\*deg F (2.44 W/m<sup>2</sup>\*deg C).**
  - 2. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum SHGC:

- a. 14 inch (356 mm) Units: 0.28.
- b. 22 inch (559 mm) Units: 0.22.

Specifier: Retain "Electrical Components" Paragraph below if retaining requirement for dimmer.

- J. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- K. Fall Protection Standard Compliance: 29 CFR 1910.23: Passed.

## 2.6 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel or forming steel.
- B. Aluminum Sheet: Flat sheet complying with ASTM B 209/B 209M.
- C. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers, formulated for 15-mil dry film thickness per coating.
- D. Joint Sealants: As specified in Section 079200 "Joint Sealants."
- E. Mastic Sealants: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- F. Roofing Cement: ASTM D 4586, asbestos free, designed for trowel application or other adhesive compatible with roofing system.

## 2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Galvanized Steel Sheet:
  - 1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
    - a. Color and Gloss: Neutral gray.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Proceed with tubular unit skylight installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install tubular unit skylights in accordance with manufacturer's written instructions and approved shop drawings. Coordinate installation of units with installation of substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that finished installation is weather tight.
  - 1. Anchor tubular unit skylights securely to supporting substrates.
  - 2. For horizontal installation, install tubular unit skylights true to line and without distortion.
  - 3. For sloped roof installation, install tubular unit skylights on curbs specified in another section with tops of curbs parallel to finished roof slope.
- B. Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation recommended in writing by tubular unit skylight manufacturer.
- C. Install tubular unit skylight curb counter flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.

### 3.3 FIELD QUALITY CONTROL

Specifier: Retain option in "Testing Agency" Paragraph below assigning responsibility for testing agency, if required.

- A. Testing Agency: [Owner will engage] [Engage] testing agency to perform tests and inspections.
  - 1. Test for water leaks according to AAMA 501.2 after installation and curing of sealants but prior to installation of interior finishes.
  - 2. Perform test for total area of each tubular unit skylight.
- B. Work will be considered defective if it does not pass tests and inspections.
- C. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.4 CLEANING AND PROTECTION

- A. Clean exposed tubular unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Replace glazing that has been damaged during construction period.
- C. Dimmer Assemblies: Test and adjust dimmer assemblies for proper operation.

- D. Protect tubular unit skylight surfaces from contact with contaminating substances resulting from construction operations.

END OF SECTION