SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

## PART 1 - GENERAL

### 1.0 RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01-Specification sections, apply to work of this section.

### 1.1 SUMMARY:

Section Includes:

Aluminum-framed entrances and storefront work of the following types:

Entrance door and frame to replace existing exterior vestibule door.
Exterior storefront framing to replace existing exterior vestibule framing as required to accommodate work of this Contract.

All sealant work within aluminum door and storefront framing systems as specified in Section 07 92 00.

Related Sections:

Joint Sealers: Section 07 92 00
Glazed Aluminum Curtain Wall: Section 08 44 13
Door Hardware: Section 08 71 00
Glazing: Section 08 80 00

### 1.2 SYSTEM PERFORMANCE:

General:

Provide exterior entrance and storefront assemblies that have been designed and fabricated to comply with requirements for system performance characteristics listed below as demonstrated by testing manufacturer's corresponding stock systems according to test methods designated.

Thermal Movement:

Provide systems capable of withstanding thermal movements resulting from metal surface temperature range of 180° F. without buckling, failure of joint seals, undue stress on structural elements, excess loads on fasteners, reduction of performance, stress on glass or other detrimental effects.

Wind Loading:

Provide assemblies capable of withstanding uniform test pressure of 30 psf inward and outward when tested in accordance with ASTM E330. Design pressure to be based on a ground ultimate wind speed of 160 MPH (3 second gust), Exposure C, Risk Category III per IBC requirements.

Deflection:

Normal to Plane of Wall: Limit mullion deflection to l/175, or flexure limit of glass with full recovery of glazing materials, nor more than 1", whichever is less.

Parallel to Plane of Wall: At test pressures equal to 1.5 times specified wind loading, deflection of any member with full dead load shall not exceed that which will reduce glass bite below 75% of design dimensions nor reduce edge clearances by more than 1/8". The clearance between member and door or window shall be at least 1/16".

Weather Resistance:

Provide framing system and assemblies meeting the following requirements (based on a minimum test size of 15'-0" wide by 9'-0" high):

Air Infiltration at Framing: Not more than 0.06 cfm per sq. ft. of fixed area (excluding operable door edges), at inward pressure differential of 6.24 psf, tested in accordance with ASTM E283.

Air Infiltration at Door: Not more than 1.0 cfm per sq. ft. air infiltration of area measured at a pressure differential of 1.57 psf per ASTM E283.

Water Penetration: Provide entrance and storefront systems that do not show evidence of water leakage through fixed glazing and frame areas when tested according to ASTM E331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7 "Minimum Design Loads for Buildings and Other Structures", but not less than 10 psf.

Water leakage is defined as uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and a gutter that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

Thermally Broken Construction: Provide systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance. Fabricate thermally broken construction to comply with AAMA 505 "Dry Shrinkage and Composite Performance Thermal Cycling Test Procedure" and AAMA TIR-A8 "Structural Performance of Poured or Debridged Framing Systems".

Thermal Performance:

Perform thermal tests in accordance with NFRC 102 and AAMA 1503, or provide finite element computer thermal modeling and calculations per NFRC 100 or AAMA 507, using DOE/LBL THERM 5.2 and WINDOWS 5.2 software.

Condensation Resistance Factor (CRF): Provide aluminum curtain wall system with condensation resistance factor (CRF) of not less than 68 for the frame and not less than 68 for the glass when tested in accordance with AAMA 1503.1 (based on a minimum test size of 5'-6" wide by 7'-6" high) glazed with 1" insulating glass unit comprised of standard, non-coated 0.25" glass, 0.5" air space, 0.25" glass design.

Field Conditions: Supplied assemblies will not exhibit condensation under project conditions.

Thermal Transmission Coefficient (u-value) Due to Conduction: Not greater than 0.38 for fixed framing and not greater than 0.73 for door.

Solar Heat Gain Coefficient (SHGC): Not more than 0.38 for the overall storefront vision area and adjacent framing.

1.3 SUBMITTALS:

Product Data:

Submit manufacturer's product specifications, technical product data, standard details, and installation recommendations for each type of entrance and storefront product required. Include the following information:

- Fabrication methods.
- Finishing.
- Hardware.
- Accessories.
- Maintenance and cleaning.

Shop Drawings:

Submit shop drawings for the fabrication and installation of aluminum door and frames and associated components of the work. Include wall elevations at 0.25" scale or larger, and detail sections of every typical composite member. Show anchors, joint system, expansion provisions and other components not included in manufacturer's standard data. Include glazing details.

Test Reports:

Submit test reports indicating products to be furnished under the work of this section have been tested as specified herein and meet specified performance requirements for air infiltration, water resistance, structural performance (including wind loading) and thermal performance.

Approval Letter:

Submit manufacturer's letter approving proposed product for application indicated.

Calculations:

Submit thermal movement calculations for frames indicating adequacy of system, including framing members, connections and all other affected components to meet thermal movement requirements specified herein.

Hardware Schedule:

Submit complete hardware schedule organized into sets based on hardware specified. Coordinate hardware with door, frames and related work to ensure proper size, thickness, hand, function, and finish. Include item name, name of manufacturer and complete designations of every item required for each door opening.

1.4 QUALITY ASSURANCE:

Manufacturer's Qualifications:

Provide entrance and storefront produced by a single manufacturer with 5 years of continuous successful in-service performance in the fabrication of assemblies of the type and quality required.

Installer's Qualifications:

Entrance and storefront shall be installed by a firm where work has resulted in construction with successful in-service performance in the installation of systems similar to those required. Installer must have been engaged in installing entrance and storefront systems in the State of Colorado under the same name for at least 24 months prior to bid opening.

Single Source Responsibility:

Provide entrance and storefront produced by a single manufacturer capable of showing prior production of units similar to those required.

Sizes and Profiles:

The details shown are based upon standard details by one manufacturer. It is intended that similar details by other manufacturers will be acceptable, provided they comply with the strength and profile requirements, and are acceptable to the Architect.

Standards:

Comply with the requirements and recommendations in applicable specifications and standards by NAAMM, AAMA, and AA, including the terminology definitions, except to the extent more stringent requirements are indicated.

1.5 DELIVERY, STORAGE AND HANDLING:

Deliver aluminum entrance and storefront components in the manufacturer's original protective packaging.

Store aluminum components in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.

Stack framing components in a manner that will prevent bending and avoid damage.

1.6 PROJECT/SITE CONDITIONS:

Field Measurements:

Wherever possible, take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work. Where necessary, coordinate fabrication and installation tolerances when field measurements might delay work.

1.7 WARRANTY:

Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance and storefront systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

Structural failures including, but not limited to, excessive deflection.

Deterioration of metals, metal finishes, and other materials beyond normal weathering.

Failure of operating components to function normally.

Failure of door corners.

Warranty Period: 2 years from the date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

Provide entrance and storefront materials by one of the following:

EFCO, Inc.
Kawneer Company, Inc.
Oldcastle
Tubelite Division of Indal
Vistawall Architectural Products

### 2.2 MATERIALS:

Aluminum:

Provide alloy and temper recommended by the manufacturer for strength, corrosion resistance and application of the required finish; comply with ASTM B221 for extrusions, B209 for sheet or plate, and B211 for bars, rods and wire.

Minimum Recycled Content: 60% by weight.

Steel Reinforcement:

ASTM A36 for structural shapes, plates, and bars, A611 for cold rolled sheet and strip, or A570 for hot rolled sheet and strip.

Minimum Recycled Content: 30% by weight.

Glazing Accessories:

Provide metal stops and elastomeric glazing gaskets to comply with performance requirements specified and as required for framing and door systems furnished. Make provisions for glazing with glass thicknesses indicated.

Fasteners:

Aluminum, non-magnetic stainless steel or other non-corrosive metal fasteners compatible with items being fastened. For exposed fasteners (if any), provide Phillips flat-head screws with finish matching the item fastened.

Do not use exposed fasteners except where unavoidable for the assembly of units, and unavoidable for the application of hardware. Provide only concealed screws in glazing stops.

Where fasteners screw-anchor into aluminum less than 0.125" thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.

Brackets and Reinforcement:

Where feasible, provide high-strength aluminum brackets and reinforcements; otherwise provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A123.

Expansion Anchor Devices:

Lead-shield or toothed-steel, drilled-in, expansion bolt anchors.

Bituminous Coatings:

Cold-applied asphalt mastic complying with ASTM D1187, Type I, or SSPC-Paint 12, compounded for 30 mil thickness per coat.

VOC Content: Not more than 100 grams per liter in accordance with Section 01 81 16.

Compression Weatherstripping:

Provide manufacturer's standard replaceable weatherstripping of molded neoprene, ASTM D2000 or PVC, ASTM D2287.

VOC Content: Not more than 7 percent VOCs by weight in accordance with Section 01 81 16.

Sliding Weatherstripping:

Provide manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon or aluminum strip backing, AAMA 701.2.

VOC Content: Not more than 7 percent VOCs by weight in accordance with Section 01 81 16.

Sealants and Gaskets:

Provide sealants and gaskets within the framing system required in the fabrication, assembly and installation of the work, which are recommended by the manufacturer and will remain permanently elastic, non-shrinking, and weather proof.

VOC Content for Sealants: Not more than 4 percent VOCs by weight in accordance with Section 01 81 16.

Compressible foam joint fillers, polyester polyurethane foam impregnated with neoprene rubber or acrylic ester styrene copolymer manufactured using chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) is not acceptable.

Joint sealers and accessories formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure), fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, or their components are not acceptable.

Do not use joint sealers containing the following:

Mercury.
Butyl rubber.
Neoprene.
SBR (styrene butadiene rubber).
Nitrile.

Shoes:

Where storefront framing rests directly on concrete slabs, provide concealed stainless steel shoes anchored to the concrete which will allow for attachment of framing system as indicated.

2.3 COMPONENTS:

Framing:

Provide entire system including anchors, connectors, accessories and trim for flush glazing with glass centered in the framing, TriFab 451UT by Kawneer or equal by listed manufacturers.

Provide system fabricated with 2" face profile and 4.5" depth as shown on the drawings or equivalent similar dimensions by listed manufacturer.

Systems using compression fitting caps or plastic clips are not acceptable.

Fabricate system for glazing with 1" insulating glass units.

Equip exterior locations with enhanced thermal barrier to eliminate continuity of metal from interior to exterior and to achieve required thermal performance.

Fabricate system to drain water entering joints, condensation occurring in glazing channels or migrating moisture occurring within system, to exterior.

System to accommodate, without damage to system or components, or deterioration of perimeter seal, movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; and deflection of structural support framing.

Include 1.5" deflection track at heads of aluminum storefront framing system.

Stile and Rail Door:

Provide tubular frame members, fabricated with mechanical joints using inserted heavy reinforcing plates and concealed tie-rods or j-bolts.

Provide thermally broken wide stile door AA 425 Thermal Entrances by Kawneer or equal by listed manufacturer, with full weatherstripping and with the following dimensions:

Thickness: 2.25".
Stiles: 4.25".
Top Rail: 4.25".
Bottom Rail: 10".

Fabricate door for glazing with 1" insulating glass units.

Hardware:

Provide hardware as specified in Section 08 71 00.

Coordinate requirements for security systems with work performed by the Owner. See Section 01 10 00 for additional information about work performed by the Owner.

2.4 FABRICATION:

Hardware: Cut, reinforce, drill and tap frame and door as required to receive hardware, except do not drill and tap for surface-mounted items until the time of installation at the project site. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

Install all hardware, except surface-mounted hardware, at the fabrication plant. Remove only as required for final finishing operations, and for delivery and installation of the work at the project site.

Welding: Comply with AWS recommendations; grind exposed welds smooth and restore mechanical finish.

Perform welding behind finished surfaces in a manner to minimize distortion and discoloration.

Install reinforcing as required for hardware and necessary for performance requirements; sag resistance and rigidity.

Separate dissimilar metals with bituminous paint or other separator that will prevent corrosion. Do not use coatings containing lead.

Maintain accurate relation of planes and angles, with hairline fit of contacting members.

Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.

Weatherstripping: Provide compression weatherstripping against fixed stops for door. At other edges provide sliding weatherstripping retained in adjustable strip mortised into door edge.

2.5 FINISHES:

Anodized Finishes:

Natural Anodized Finish: NAAMM AA-M12C22A31, Class II (minimum thickness of 0.4 mils), clear anodic coating.

Field Touch-Up Paint:

Manufacturer's recommended touch-up paint compatible with and matching appearance of shop finish and complying with the following environmental limitations.

VOC Content: Not more than 50 grams per liter for flat coatings and not more than 100 grams per liter for non-flat coatings in accordance with Section 01 81 16.

PART 3 - EXECUTION

3.1 INSTALLATION:

General:

Comply with manufacturer's specifications and recommendations for installation.

Set units plumb, level and true to line, without warp or rack of frames, door or panels. Anchor securely in place.

Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

Zinc or cadmium plate steel anchors and other unexposed fasteners.

Paint dissimilar metals where drainage from them passes over aluminum.

Paint aluminum surfaces in contact with mortar, concrete or other masonry with bituminous paint.

Paint wood and similar absorptive material in contact with aluminum and exposed to the elements or subject to wetting, with bituminous paint. Seal joints between the materials with sealants.

Drill and tap frame and door and apply surface-mounted hardware items, complying with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

Set sill members and other members in a bed of compound as shown, or with joint fillers or gaskets as shown to provide weathertight and watertight construction.

Refer to Section 07 92 00 for sealants to be installed after installation of door and frames.

Refer to Section 08 80 00 for installation of glass shown to be "Glazed" into door and frames.

Remove burrs from all cut lines. Fabricate corner joints flush, mitered, rigid, and weatherproof. Provide hairline joints at any seams. Protruding screws and sharp unfinished edges are prohibited.

Construction Tolerances:

Install aluminum entrance and storefront to comply with the following:

Variation from Plane: Do not exceed 1/8" in 12' of length or 1/4" in any total length.

Offset from Alignment: Do not exceed 1/16" from true alignment between two identical members abutting end to end in line.

Diagonal Measurements: Do not exceed 1/8" difference between measurements.

Offset at Corners: Do not exceed 1/32" out-of-plane offset of framing at corners.

## 3.2 ADJUSTING, CLEANING AND PROTECTION:

Adjust operating hardware to function properly, without binding, and to prevent tight fit at contact points and weatherstripping.

Clean completed system, inside and out, promptly after erection and installation of glass and sealants. Remove excess glazing and joint sealants, dirt, and other substances from aluminum surfaces.

Protection:

Refer to Section 01 50 00.

END OF SECTION 08 41 13

SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALL

## PART 1 - GENERAL

### 1.0 RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01-Specification sections, apply to work of this section.

### 1.1 SUMMARY:

Section Includes:

Curtain wall work as shown on the drawings for:

Stick-type framing systems; exterior exposed structural glazing gaskets, interior exposed metal framing.

The primary components of curtain wall work include:

Non-load bearing wall framing system.
Punched window frames.
Glass panels set in window wall framing.
Sills and similar items shown as window wall work.
Associated sealants, caulking, joint fillers, gaskets, and flashings.
Anchorage system, shims and support brackets.

Related Sections:

Joint Sealants: Section 07 92 00
Aluminum-Framed Entrances and Storefronts: Section 08 41 13
Glazing: Section 08 80 00

### 1.2 PERFORMANCE REQUIREMENTS:

Delegated Design:

Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Colorado, using performance requirements and design criteria indicated.

Engineer the connections to the structure so that connections are made to the structure only at the locations identified in the structural drawings.

Detail fabrication and assembly of curtain wall systems.

Include design calculations and analysis data.

Structural Performance:

Load-Bearing Strength (Wind Resistance): Provide manufacturer's stock system, adapted to application indicated, which has been tested in accordance with ASTM E330 to withstand at least the following loadings:

Uniform pressure of 30 psf inward and outward, but not less than required per the International Building Code (2018 Edition) with an ultimate wind speed of 160 MPH (3 second gust), Risk Category III, Exposure C.

Design, engineer, fabricate and install the glazed aluminum curtain wall system to withstand the effects of wind load acting inward and outward, normal to the plane of the wall, when tested in accordance with ASTM E330, with no material failures or permanent deformation of structural members at required design loads.

Deflections and Thermal Movements:

Provide manufacturer's stock products and system which are capable of withstanding building movements without damage to the system or components or deterioration of perimeter seals, movement within and between system and perimeter framing components, dynamic loading and release of load, and accommodating deflections within the following provisions or limitations:

Deflection under design load shall not exceed L/175 for spans less than 162" but not more than 1/2".

Deflection under design load shall not exceed L/240 +1/4" for spans greater than 162" but not more than 1/2".

Parallel-to-wall deflections not exceeding 75% of glass edge clearances.

Thermal movements resulting from ambient temperature range of 120° F., which may cause window wall framing range of 180° F.

Uniform Load Structural Test:

Specimen to be tested at 1.5 x design test pressure, both positive and negative, acting normal to plane of wall in accordance with ASTM E330.

No glass breakage; permanent damage to fasteners or anchors; or permanent deformation of any main frame member in excess of 0.2% of its clear span.

Leakage Resistance, Water and Air:

Provide manufacturer's standard window wall system which has been tested to demonstrate permanent resistance to leakages per the AAMA "Metal Curtainwall Manual" as follows:

Test Mock-Up Size: 23'-0" wide by 19'-0" high with 1" insulating glass vision lights, 0.25" thick spandrel glass lights, and a vertical splice joint at all vertical mullions under the horizontal at mid-point span.

Air Infiltration at Fixed Glass: Not more than 0.06 cfm per sq. ft. air infiltration of fixed areas measured at a pressure differential of 6.24 psf per ASTM E283.

Water Resistance (Static): No uncontrolled leakage at 15 psf pressure differential with a water rate of 5 gallons per hour per square foot when tested in accordance with ASTM E331.

Water Resistance (Dynamic): No leakage at an air pressure differential of 15 psf with a water rate of 5 gallons per hour per square foot when tested in accordance with AAMA 501.1.

Thermal Performance:

Perform thermal tests in accordance with NFRC 102 and AAMA 1503, or provide finite element computer thermal modeling and calculations per NFRC 100 or AAMA 507, using DOE/LBL THERM 5.2 and WINDOWS 5.2 software.

Condensation Resistance Factor (CRF): Provide aluminum curtain wall system with condensation resistance factor (CRF) of not less than 71 for the frame and not less than 67 for the glass.

Thermal Transmission Coefficient (u-value) Due to Conduction: Not greater than 0.38.

Field Conditions: Supplied assemblies will not exhibit condensation under project conditions.

Solar Heat Gain Coefficient (SHGC): Not more than 0.38 for the overall curtain wall vision area and adjacent framing.

Sealant Performance:

Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.

Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

Structural-Sealant Joints: Designed to produce tensile or shear stress of less than 20 psi.

## 1.3 SUBMITTALS:

Product Data:

Submit manufacturer's product data on system, including both published data and supplementary data for project, and including certified test reports where required. Submit manufacturer's fabrication specifications and installation instructions, including erection and glazing.

Shop Drawings:

Submit shop drawings showing adaptation of manufacturer's standard system to project; include elevations at 0.5" scale and details at 3" scale, to show dimensioning, members, anchorage system, interface with building construction and glazing. Show section moduli of wind-load-bearing members, and calculations for stresses and deflections under design loading.

Shop drawings must be prepared wholly by the curtain wall manufacturer, or a qualified engineering services firm under the direction of the manufacturer. Shop drawings for pre-engineered configurations may be prepared by authorized installers.

Include stamp of professional engineer responsible for the design of the system.

Test Reports/Design Engineering Calculations:

Submit test reports indicating products to be furnished under the work of this section have been tested as specified herein and meet specified performance requirements for air infiltration, water resistance, structural performance (including wind loading) and thermal performance.

Approval Letter:

Submit manufacturer's letter approving proposed product for application indicated.

Calculations:

Submit thermal movement calculations for frames indicating adequacy of system, including framing members, connections and all other affected components to meet thermal movement requirements specified herein.

Submit structural calculations prepared by a registered engineer in the State of Colorado and bearing his original stamp and signature for review purposes. Calculations shall indicate adequacy of systems to meet the uniform and structural load requirements. Design engineer shall size and locate any internal steel reinforcing required within framing members to meet system design criteria. As a minimum, calculations shall include all formulas used including:

Deviation of loadings (magnitude and type).
Dimensioned drawings of frames (sizes and configurations).
Other formulas used to generate results of calculations.

1.4 QUALITY ASSURANCE:

Manufacturer's Qualifications:

Provide curtain wall produced by a single manufacturer with successful in-service performance in the fabrication of assemblies of the type and quality required.

Installer:

A firm with not less than 5 years successful experience in erection of stock window wall systems similar to systems required for this project. Submit evidence of such qualifications including a listing of five projects of similar type and scope, dollar value of installed system for each project, general contractor for the projects and suppliers for the projects. Include evidence of ability to provide performance and payment bond for this scope of work.

Single Source Responsibility:

Provide curtain wall produced by a single manufacturer capable of showing prior production of units similar to those required.

Standards:

Comply with applicable provisions of "Metal Curtain Wall, Window, Storefront and Entrance Guide Specifications Manual" by AAMA.

Drawings:

Drawings are based on one basis-of-design manufacturer's standard window wall system. Another standard system of a similar and equivalent nature will be acceptable when difference do not materially detract from design concept or intended performances, as judged solely by Architect.

Pre-Installation Conference:

Comply with the requirements of Section 01 31 19.

1.5 DELIVERY, STORAGE AND HANDLING:

Deliver aluminum curtain wall components in the manufacturer's original protective packaging.

Store aluminum components in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.

Stack framing components in a manner that will prevent bending and avoid damage.

1.6 PROJECT/SITE CONDITIONS:

Field Measurements:

Wherever possible, take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work. Where necessary, coordinate fabrication and installation tolerances when field measurements might delay work.

1.7 WARRANTY:

Manufacturer's Warranty:

Submit a written warranty, executed by the curtainwall manufacturer, for a period of 10 years from the date of Substantial Completion, against defective materials or workmanship, including substantial non-compliance with applicable specification requirements and industry standards, which result in premature failure of the curtainwall, finish or parts (outside of normal wear).

In the event that curtainwall or components are found defective, manufacturer will repair or provide replacements without charge at manufacturer's option.

Warranty for all components must be direct from the manufacturer (non pass-through) and non pro-rated for the entire term.

"Defective" is defined to include abnormal deterioration, aging or weathering, glass breakage, failure of operational parts to function normally, deterioration or discoloration of finishes, and failure of system to meet performance requirements including structural and infiltration.

Installer's Warranty:

Submit a written warranty, executed by the curtainwall Installer, for a period of 5 years from the date of Substantial Completion, against defective materials or workmanship, including substantial non-compliance with applicable specification requirements, which result in premature failure.

In the event that installation of curtainwall or components is found to be defective, installer will repair or provide replacements without charge at the installer's option.

Repairs and Replacements:

Repairs or replacements required because of acts of God exceeding performance requirements, vandalism, inadequate maintenance, alterations, failure of structure supporting window wall work, or other causes beyond Manufacturer's/Fabricator's/Installer's/Contractor's control, as judged by Architect, shall be completed by Contractor/Installer and paid for by Owner at prevailing rates. Warranty and enforcement shall not deprive Owner of other available actions, right or remedies.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

EFCO, Inc.
Kawneer Company, Inc.
Oldcastle
Tubelite Architectural Products
Vistawall Architectural Products

### 2.2 MATERIALS AND COMPONENTS:

Aluminum Members:

Provide members (extrusions, formed members, sheet and plate) of alloy, temper and thicknesses recommended by manufacturer to comply with requirements; ASTM B221 for extrusions, ASTM B209 for sheet/plate.

Minimum Recycled Content: 60% by weight.

Structural Glazing Gaskets for Butt Glazed System:

Manufacturer's standard configuration of lock-strip gaskets, complying with applicable provisions of ASTM C542 and C716; black.

Bituminous Paint:

Cold-applied asphalt mastic complying with ASTM D1187, Type I, or SSPC-Paint 12, compounded for 30 mil thickness per coat.

VOC Content: Not more than 100 grams per liter in accordance with Section 01 81 16.

Glass and Glazing:

Specified in Section 08 80 00. Glazing to be provided by curtain wall Installer.

Framing System Gaskets and Joint Fillers:

Manufacturer's standard permanent type, depending on joint movement and sealing requirements (sliding joints, compression, joint translation, or non-moving joints).

Brackets and Reinforcements:

Manufacturer's standard high-strength aluminum units where feasible; otherwise, non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A386. Provide non-staining, non-ferrous shims for installation and alignment of window wall work.

Provide integral concealed steel reinforcement as required to meet specified performance requirements.

Provide all steel angles, embed plates, support brackets and anchorage devices required to attach window system to structure. Coordinate all embeds and anchorage devices with masonry Installer.

Concealed Flashing:

Dead-soft stainless steel, 26 gage, type selected by manufacturer for compatibility.

Fasteners and Accessories:

Manufacturer's standard with exposed portions matching finish of window wall system. Provide slip-joint linings of sheets, pads, shims, or washers of fluorocarbon resin, or similar material recommended by manufacturer at joints where movement must be accommodated.

Where fasteners anchor into aluminum less than 0.125" thick, provide non-corrosive pressed-in splined grommet nuts or other type reinforcement to receive fastener threads.

Concrete/Masonry Inserts:

Cast iron or malleable iron complying with ASTM A386.

Miscellaneous Items:

Furnish any additional miscellaneous items associated with aluminum curtain wall system as detailed on the drawings and where indicated that finish is to match finish of curtain wall system.

Sealants:

Sealants and backup rods at joints within the work described as specified in Section 07 92 00. Sealants to be provided by curtain wall Installer.

VOC Content: Not more than 4 percent VOCs by weight in accordance with Section 01 81 16.

Compressible foam joint fillers, polyester polyurethane foam impregnated with neoprene rubber or acrylic ester styrene copolymer manufactured using chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) is not acceptable.

Joint sealers and accessories formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure), fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, or their components are not acceptable.

Do not use joint sealers containing the following:

Mercury.
Butyl rubber.
Neoprene.
SBR (styrene butadiene rubber).
Nitrile.

2.3 FABRICATION:

General:

Fabricate window wall system at manufacturer's shop to greatest extent possible, and prior to application of finish. Conceal fasteners unless otherwise indicated. Make provisions to weep penetrating water and condensation to exterior.

Fabricate aluminum window sills from extruded or rolled aluminum shapes in profiles as indicated.

Welding: Comply with AWS recommendations; grind exposed welds smooth and restore mechanical finish.

Perform welding behind finished surfaces in a manner to minimize distortion and discoloration.

Install reinforcing as necessary for performance requirements; sag resistance and rigidity.

Separate dissimilar metals with bituminous paint or other separator that will prevent corrosion. Do not use coatings containing lead.

Maintain accurate relation of planes and angles, with hairline fit of contacting members.

Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.

Aluminum Curtain Wall System:

Provide complete system No. 1600UT Wall System$^2$ by Kawneer or approved equal by listed manufacturers.

Frame Width: 2.5".

Frame Depth: 6".

Caps: Manufacturer's standard aluminum pressure plate.

Aluminum and Structural Gasket System:

Individual-member erection system with interior mullions of aluminum and exterior of structural gaskets (no aluminum mullions exposed on exterior for vertical mullions) and exposed exterior horizontal mullions, glazed from exterior.

Include window sill extension and integral finished end caps for full length of ribbon window opening in single section. Where window projects beyond interior wall line, close opening at ends of run by folding aluminum plate to form hairline seams. Separate end cap pieces are not acceptable.

2.4 FINISHES:

Anodized Aluminum Finishes:

Natural Anodized Finish: NAAMM AA-M32C21A31, Class II (0.4 mils), natural aluminum color.

Field Touch-Up Paint:

Manufacturer's recommended touch-up paint compatible with and matching appearance of shop finish and complying with the following environmental limitations.

VOC Content: Not more than 50 grams per liter for flat coatings and not more than 100 grams per liter for non-flat coatings in accordance with Section 01 81 16.

## PART 3 - EXECUTION

### 3.0 EXAMINATION:

Refer to Section 01 73 00 for examination of substrate and job conditions.

Verify structural framing, supporting members and related work for adequacy and compliance with tolerances specified.

Start of this work constitutes acceptance of substrates as suitable for satisfactory performance of work of this section.

### 3.1 INSTALLATION/ERECTION:

Comply with manufacturer's instructions for protection, handling and installation of fabricated curtain wall components, with particular care and attention to preservation of applied finishes. Discard or remove and replace damaged members.

Comply with manufacturer's instructions for protection, handling and installation of fabricated window wall components, with particular attention and care in preservation of applied finishes. Discard or remove and replace damaged members.

Anchor components securely in place in manner required, shimming and allowing for required movements, and provide separators and isolators to prevent corrosion and electrolytic deterioration, and to prevent "freeze-up" of moving joints.

Erection Tolerances:

Limit variations from plumb and level to 0.125" in 10' vertically, 0.125" in 20' horizontally, 0.25" in 40' either direction. Limit variations from theoretical location to 0.375" for any member at any location. Limit offsets in theoretical end-to-end and edge-to-edge alignments to 1/16" for flush surfaces not more than 2" apart and including surfaces not more than 0.25" out-of-flush, 0.125" for surfaces more than 2" apart or out-of-flush by more than 0.25".

Sills:

Set sill members and other members in a bed of compound as shown, or with joint fillers or gaskets as shown to provide weathertight construction. Anchor sills to framing members with premanufactured clips.

Glazing:

Conform to Section 08 80 00.

Sealants:

Install sealants and backup rods conforming to Section 07 92 00.

3.2 CLEANING, ADJUSTING AND PROTECTION:

Clean completed system, inside and out, promptly after erection and installation of glass and sealants (allow for nominal cure of liquid sealants). Window wall Installer shall advise Contractor of proper and adequate protection and cleaning procedures during remainder of construction period, so that system will be without damage and deterioration at time of acceptance.

Remove any excess lubricant.

Advise the Contractor of protective measures necessary to prevent damages to curtain wall system and its finishes beyond normal weathering.

Final cleaning is specified under Section 01 74 23.

END OF SECTION 08 44 13

SECTION 08 62 23
TUBULAR SKYLIGHT UNITS

## PART 1 - GENERAL

### 1.0 RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01-Specification sections, apply to work of this section.

### 1.1 SUMMARY:

Section Includes:

Tubular skylight units consisting of roof dome, reflective tube, and diffuser assembly; configurations as indicated on the drawings.

Related Sections:

Thermoplastic Membrane Roofing: Section 07 54 00
Sheet Metal Flashing and Trim: Section 07 62 00
Joint Sealants: Section 07 92 00

### 1.2 PERFORMANCE REQUIREMENTS:

Provide completed tubular skylight assemblies capable of meeting the following performance requirements:

Air Infiltration Test: Not more than 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E283.

Water Resistance Test: No uncontrolled water leakage at 10.5 psf pressure differential with water rate of 5 gallons/hour/sf when tested in accordance with ASTM E547.

Thermal Performance: Perform thermal tests in accordance with NFRC 102 and AAMA 1503, or provide finite element computer thermal modeling and calculations per NFRC 100 or AAMA 507, using DOE/LBL THERM 5.2 and WINDOWS 5.2 software or as required to comply with the City of Boulder Energy Conservation Code.

Thermal Transmission Coefficient (u-value) Due to Conduction: Not greater than 0.475.

Solar Heat Gain Coefficient (SHGC): Not more than 0.38 for the overall tubular skylight vision area and adjacent framing.

Uniform Load Test:

No breakage, permanent damage to fasteners, hardware parts, or damage to make system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf or Negative Load of 60 psf in accordance with ICBO/ICC AC-16 Section A, or Negative Load of 70 psf if tested per ICBO/ICC AC-16 Section B.

Test all units with a safety factor of 3 for positive pressure and a safety factor of 2 for negative pressure, acting normal to plane of roof in accordance with ASTM E330.

Fire Testing:

When used with the Dome Edge Protection Band, provide domes which meet fire rating requirements as described in the 2006 International Building Code.

Self-Ignition Temperature: Greater than 650° F per ASTM D1929.

Smoke Density: Not greater than 450 (Class C) per ASTM E84 in way intended for use.

Rate of Burn and/or Extent: Maximum burning rate of 2.5 inches/min, Classification CC-2 per IBC, when tested in accordance with ASTM D635.

Rate of Burn and/or Extent: Maximum burn extent of 1 inch, Classification CC-1 per IBC, when tested in accordance with ASTM D635.

1.3 SUBMITTALS:

Product Data:

Submit manufacturer's drawings, specifications, preparation instructions, storage and handling requirements and installation instructions for each type of tubular skylight unit required including all related accessories. Include data substantiating that products comply with the requirements.

Shop Drawings:

Submit shop drawings detailing installation, profiles and layout of tubular skylight units. Include details of curbs, flashing, anchorage, accessories, tubular runs, diffusers, adjacent construction and similar items.

Test Reports:

Submit independent testing agency or evaluation service reports verifying compliance with specified performance requirements.

1.4 QUALITY ASSURANCE:

Standards:

Provide manufacturer's standard products except as otherwise indicated and comply with applicable recommendations and details of the "Architectural Sheet Metal Manual" by SMACNA for custom fabricated work.

Manufacturer Qualifications:

Engaged in manufacture of tubular skylight units for a minimum of 15 years.

1.5 DELIVERY, STORAGE AND HANDLING:

Store products in manufacturer's unopened packaging until ready for installation.

Store and dispose of solvent-based materials and materials used with solvent-based materials in accordance with requirements of the City of Boulder.

1.6 PROJECT/SITE CONDITIONS:

Coordinate the installation of tubular skylight units with roofing and flashing so that the best possible integration of work is achieved, resulting in permanent, waterproof construction.

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.

1.7 WARRANTY:

Submit manufacturer's standard warranty covering materials and workmanship for the following periods:

Daylighting Device: 10 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

Provide tubular skylights manufactured by Solatube, 2210 Oakridge Way, Vista, California 92083, (760) 597-4400 (no substitutions).

2.2 LARGE TUBULAR SKYLIGHT UNITS:

Provide transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and diffuser assembly, transferring sunlight to interior spaces; complying with ICBO/ICC AC-16.

Provide Solatube Model 330 DS-C Penetrating Ceiling, 21" Daylighting System.

Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.

Outer Dome Glazing: Type DA, 0.143" minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting, impact modified acrylic blend.

LightTracker Reflector: Aluminum sheet, 0.015" thickness, with Spectralight Infinity. Position in dome to capture low angle sunlight.

Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.

Base Material: Sheet steel, corrosion resistant, complying with ASTM A653 or ASTM A463, not less than 0.028" thick.

Base Style: Type F08, self-mounted, 8" high.

Flashing Insulator: Type F1. Thermal isolation material for use under flashing.

PVC Boot: Type P, White PVC for flashing to flat PVC roof surfaces.

Dome Edge Protection Band: Type PB, for fire rated roofs, fabricated from galvanized steel with nominal thickness of 0.039".

Roof Flashing Turret Extensions: Provide manufacturer's standard extensions for applications shown.

Dome Ring: Attach dome ring consisting of 0.090" nominal thickness injection molded high impact PVC to top of base section to prevent thermal bridging between base flashing and tubing and to conduct condensed moisture out of tubing.

Dome Ring Seal: Attach dome ring seal consisting of 0.24" diameter butyl glazing rope to the base of the dome ring to minimize air infiltration.

Dome Seal: Adhesive backed weatherstrip, 0.63" tall by 0.28".

Reflective Tube: Aluminum sheet not less than 0.018" thickness.

Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface Visible spectrum (400 nm to 760 nm) greater than 99 percent. Total solar spectrum (400 nm to 2500 nm) less than 93 percent.

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 to ASTM E308.

Tube Diameter: Approximately 21".

Reflective 30 Degree Adjustable Tube: Aluminum sheet not less than 0.015" thickness.

Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface Visible spectrum (400 nm to 760 nm) greater than 99 percent. Total solar spectrum (400 nm to 2500 nm) less than 93 percent.

Reflective 90 Degree Adjustable Tube: Aluminum sheet not less than .018" thickness.

Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface Visible spectrum (400 nm to 760 nm) greater than 99 percent. Total solar spectrum (400 nm to 2500 nm) less than 93 percent.

Extension Tube Angle Adapter: Provide manufacturer's standard adaptors for applications requiring:

Type A1 one 0 to 90 degree extension tube angle adapter.
Type A2 two 0 to 90 degree extension tube angle adapters.

Diffuser Assemblies for Tubes Penetrating Ceilings: Ceiling mounted box to transition from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube, with compression seal to minimize condensation and bug or dirt infiltration; 23.8" by 23.8" square frame to fit standard suspended ceiling grids or hard ceilings.

Round to Square Transition Box: Opaque polymeric material, classified as CC2, Class C, 0.110" thick.

Natural Effect Lens: Acrylic, classified as CC2, Class C, 0.060" thick, with open cell foam seal to minimize condensation and bug, dirt and air-infiltration per ASTM E283.

Lens: Type L1, OptiView Fresnel lens, design to maximize light output and diffusion with extruded aluminum frame. Visible light transmission shall be greater than 90 percent at 0.022" thick. Classified as CC2.

Secondary Diffuser: Type SS, acrylic plastic classified as CC2 material in thickness not less than 0.100".

Accessories:

Wire Suspension Kit: Type E, Use the wire suspension kit when additional bracing to the structure is required.

2.3 ACCESSORIES:

Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

VOC Content: Not more than 4 percent VOCs by weight in accordance with Section 01 81 16.

Compressible foam joint fillers, polyester polyurethane foam impregnated with neoprene rubber or acrylic ester styrene copolymer manufactured using chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) is not acceptable.

Joint sealers and accessories formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure), fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, or their components are not acceptable.

Do not use joint sealers containing the following:

Mercury.
Butyl rubber.
Neoprene.
SBR (styrene butadiene rubber).
Nitrile.

Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.

Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.

PART 3 - EXECUTION

3.1 EXAMINATION:

Refer to Section 01 73 00 for examination of substrate and job conditions.

Do not begin installation until substrates have been properly prepared.

Start of this work constitutes acceptance of substrates as suitable for satisfactory performance of work of this section.

3.2 PREPARATION:

Clean surfaces thoroughly prior to installation.

Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION:

Install in accordance with manufacturer's printed instructions.

Separate metal surfaces of tubular skylight units from dissimilar metals, and from wood and cementitious substrates, by a thick coating of fibrated bituminous compound or other separation as recommended by the metal manufacturer, and as required to prevent corrosive action.

Anchor tubular skylight units permanently to the substrate by methods which are adequate for the sizes and locations of units.

Bed flanges of tubular skylight units in mastic or compound which is compatible with roofing and flashing.

After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner, Architect and Contractor, or their designated representatives. Correct if needed before proceeding with installation of subsequent units.

3.4 CLEANING AND PROTECTION:

Clean surfaces of tubular skylight units as required to prevent deterioration and uneven weathering.

Touch-up, repair or replace damaged products before Substantial Completion.

Protect installed products until completion of project.

The Installer shall advise the Contractor, in writing, of protection and surveillance requirements, to ensure that tubular skylight units will be without deterioration or damage at the time of acceptance by the Owner.

END OF SECTION 08 62 23

SECTION 08 80 00
GLAZING

## PART 1 - GENERAL

### 1.0 RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

### 1.1 SUMMARY:

Section Includes:

Glass and glazing work as shown on the drawings for:

Exterior aluminum-framed entrance and "storefront" construction.
Interior doors, sidelights, borrowed light frames, partitions and miscellaneous interior glazing.

Related Sections:

Hollow Metal Systems: Section 08 11 13.
Aluminum-Framed Entrances and Storefronts: Section 08 41 13.
Glazed Aluminum Curtain Wall: Section 08 44 13.
Packaged mirror units: Section 10 28 00.

### 1.2 PERFORMANCE REQUIREMENTS:

General:

Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

Glass Design:

Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E1300, according to the following requirements:

Specified Design Wind Loads: As indicated on the drawings. As indicated on the drawings, but not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads." Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings, but not less than required by the 2018 International Building Code utilizing the following values.

Basic Ultimate Wind Speed: 160 miles per hour.
Rick Category: III.

Exposure Category: C.
Minimum Design Pressures: As specified in Section 08 44 13.

Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

Load Duration: 60 seconds or less 3 seconds.

Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

For insulating glass.

Minimum Glass Thickness for Exterior Lites: Not less than 0.25".

Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

Elevation of Installation: 5,328 feet above sea level.

Thermal Movements:

Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

Thermal and Optical Performance Properties:

Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

For insulating-glass units, properties are based on units of 1" thickness for overall unit and 0.25" for each lite.

Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.2 computer program for the following methodologies:

U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
Solar Heat Gain Coefficient: NFRC 200.
Solar Optical Properties: NFRC 300.

## 1.3 SUBMITTALS:

Product Data:

Submit product data for each glass product and glazing material indicated. Include product test reports for the following:

Tinted float glass.
Coated float glass.
Fire-resistive ceramic glazing products.
Insulating glass.

Glazing sealants.
Glazing gaskets.

Samples:

Submit 6" square glass samples and 12" long samples of glazing compounds and glazing gaskets showing corner and "tee" joints of gaskets. Samples will be reviewed for appearance only. Submit 2 samples of each of the following:

Color of tinted float glass.
Coated vision glass.
Fire-resistive ceramic glazing products.
For each color (except black) of exposed glazing sealant indicated.

Glazing Schedule:

Submit glazing schedule using same designations indicated in the schedule at the end of this section for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

Certification:

Submit product certificates signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

1.4 QUALITY ASSURANCE:

Standards:

Prime Glass: ASTM C1036.

Safety Glass: Comply with Colorado State Statutes, IBC Section 2406, ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials, with certifying label on each piece.

Where glazing units, including Kind FT glass, are specified herein for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

Heat-Treated Glass: ASTM C1048.

Fire-Resistant Ceramic Glass: Tested per ASTM E163 (UL 9) and listed by UL for "fire resistance". Provide glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to the City of Boulder, for fire ratings indicated, based on testing according to NFPA 257.

Insulating Glass: Seal standard ASTM E774, Class A. Provide units manufactured by SIGMA member and bearing IGCC certification numbers.

Glazing Standards: Comply with recommendations of Flat Glass Marketing Association "Glazing Manual" and "Sealant Manual".

Elastomeric Sealant Standard: Comply with ASTM C920 requirements for Type, Grade, Class and Uses.

Installer (Glazier):

Engage an experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

Glass Product Testing:

Obtain glass test results for product test reports required herein from a qualified testing agency based on testing glass products.

Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E548.

Elastomeric Glazing Sealant Product Testing:

Obtain sealant test results for product test reports required herein from a qualified testing agency based on testing current sealant formulations within a 36-month period.

Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated, as documented according to ASTM E548.

Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.

Preconstruction Adhesion and Compatibility Testing:

Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:

Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

Glazing for Fire-Rated Door Assemblies:

Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

Glazing for Fire-Rated Window Assemblies:

Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

1.5 DELIVERY, STORAGE AND HANDLING:

Comply with manufacturer's instructions for shipping, handling, storing and protecting glass and glazing materials. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coatings (if any) on glass.

Where insulating glass units will be exposed to substantial altitude changes, comply with insulating glass fabricator's recommendations for venting and sealing.

1.6 PROJECT/SITE CONDITIONS:

Weather Conditions: Do not proceed with installation of liquid sealants under adverse weather conditions, or when ambient and substrate temperatures are below or above manufacturer's recommended limitations for installation.

1.7 WARRANTY:

Provide insulating glass manufacturer's written warranty, agreeing to, within specified warranty period, furnish FOB project site, replacements for insulating glass units which have defective hermetic seals (excluding that due to glass breakage); defined to include intrusion of moisture or dirt, internal condensation or fogging, deterioration of internal glass coatings, and other visual evidence of seal failure or performance failure; provided manufacturer's instructions for handling, installation, protection and maintenance have been adhered to during warranty period.

Warranty period is 10 years after seal date permanently imprinted on unit, but not less than 9 years after date of substantial completion.

Provide coated glass manufacturer's written warranty agreeing to, within specified warranty period, furnish FOB project site, replacements for insulated glass units exhibiting defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

Warranty period is 10 years after seal date permanently imprinted on unit, but not less than 9 years after date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

Approved Basic Manufacturers and Fabricators:

AFG Industries, Inc. Ford Glass Div.

| | |
|---|---|
| Guardian Industries | Pilkington |
| Vitro Architectural Glass | Saint-Gobain/Euroglass |
| Old Castle Glass | Viracon, Inc. |
| Approved equal | |

2.2 PRIME GLASS:

Clear Float Glass:

Type I, Class 1 (clear) Quality q3 (glazing select), 0.25" thick.

Tinted Float Glass:

Type I, Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select), 0.25" thick, manufacturer's standard light green color meeting performance requirements specified for low E coated glass.

Provide Solexia by Vitro Architectural Glass or approved equal by listed manufacturer.

Ceramic Glass:

Provide solid, clear, polished to eliminate distortions, ceramic glass without gel core, thicknesses as indicated or required to meet indicated fire-rating, by Technical Glass Products (TGP, 1-800-426-0279) or approved equal by O'Keeffes or St. Gobain with UL label to meet fire-rating scheduled on the drawings. The following listed products are by TGP.

60 (or 45) Minute Fire and Safety Rated Openings: "FireLite Plus Premium", 0.313" thick.
For 45 minute openings, provide glazing with 60 minute label.
90 Minute Fire and Safety Rated Openings: "FireLite Plus Premium", 0.313" thick.

2.3 HEAT TREATED GLASS:

Provide prime glass of color and type indicated, which has been heat-treated to strengthen glass in bending, Kind HS (heat strengthened) or FT (fully tempered) as specified, horizontally heat treated with minimal waviness or distortion at bottom edge of glass and free of tong marks.

Provide Kind FT glass where safety glass is indicated or where required by applicable laws and Codes.

2.4 COATED GLASS:

General:

Except where otherwise indicated, provide heat strengthened coated float glass. Provide tempered units where coated safety glass is designated or required.

Performance characteristics are for 1" insulating glass units.

Low Emissivity Coated Glass:

Manufacturer's standard durable neutral color, low emissivity metallic coating deposited by either pyrolytic or vacuum process on glass and surface indicated.

Glass: 0.25" thick, tinted light green.
Kind: HS, except FT where indicated or required by Code or as scheduled.
Surface Coated: 2.

Performance Characteristics: Visible light transmittance of not less than 61 percent, summer daytime U-value of not more than 0.27, winter nighttime U-value of not more than 0.29, shading coefficient of not more than 0.37, solar heat gain coefficient of not more than 0.32 and outdoor visible reflectance of not more than 9 percent.

Performance characteristics are based on Solarban 60 (2) Solexia + Clear by Vitro Architectural Glass.

2.5 INSULATING GLASS UNITS:

Exterior Vertical Insulating Glass Units:

Provide preassembled units consisting of organically double sealed panes of glass enclosing a hermetically sealed dehydrated air space as follows:

Use two thicknesses of glass of specified prime or coated types as scheduled at the end of this section with thermally improved spacer channel (such as Technoform TGI Spacer) of dimension scheduled with welded or sealed corners as standard with the manufacturer and double sealed units with polyisobutylene primary sealant and polyurethane secondary sealant.

Spacer Color: To match clear anodized aluminum.

Interior Vertical Insulating Glass Units:

Provide preassembled units consisting of organically double sealed panes of glass enclosing a hermetically sealed dehydrated air space as follows:

Use two thicknesses of glass of specified prime types as scheduled at the end of this section with aluminum spacer channel of dimension scheduled with welded or sealed corners as standard with the manufacturer and double sealed units with polyisobutylene primary sealant and polyurethane secondary sealant.

2.6 GLAZING SEALANTS AND TAPES:

General:

Provide black exposed glazing materials, unless another color is indicated, or unless another color is selected by Architect from manufacturer's standard colors.

Provide hardness of materials as recommended by the manufacturer for the required application and condition of installation in each case. At fire rated assemblies, provide materials in compliance with the tested UL assembly. Provide only sealants and tapes which are known (proven) to be fully compatible with surfaces contacted, including glass products, seals of insulating glass units and glazing channel surfaces.

Compressible foam joint fillers, polyester polyurethane foam impregnated with neoprene rubber or acrylic ester styrene copolymer manufactured using chlorofluorocarbons (CFCs) or hydrochloro-fluorocarbons (HCFCs) is not acceptable.

Joint sealers and accessories formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure), fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, or their components are not acceptable.

Do not use joint sealers containing the following:

Mercury.
Butyl rubber.
Neoprene.
SBR (styrene butadiene rubber).
Nitrile.

1-Part Acid Curing High Modulus Silicone: (Use for Butt Glazing)

Type S; Grade NS, Class 25, Uses NT, G, A and as applicable to uses indicated, O.

VOC Content: Not more than 4 percent VOCs by weight in accordance with Section 01 81 16.

Products: Provide one of the following or approved equal:

"Chem-Calk 1200"; Bostik Construction Products Division
"Dow Corning 999"; Dow Corning Corporation
"SCS 1200"; General Electric Corporation
"863"; Pecora Corporation
"Rhodorsil 3B"; Rhone - Poulene, Inc.
"Omniglaze"; Sonneborn Building Products Division; Rexnord Chemical Products, Inc.
"Proglaze"; Tremco, Inc.

Use black color at glass to glass abutting joints.

1-Part Structural Silicone Sealant/Adhesive: (Use as Adhesive for Butt Glazing)

Type S; Grade NS, Class 40, Use T, NT, M, G, A, and as applicable to uses indicated, O.

VOC Content: Not more than 4 percent VOCs by weight in accordance with Section 01 81 16.

Products: Provide the following or approved equal:

"Dow Corning 795"; Dow Corning Corporation.

1-Part Acrylic Glazing Sealant: (Use for Interior Glazing of Hollow Metal or Wood Work)

Water-based, acrylic emulsion sealant; nonsag, mildew resistant, paintable; complying with ASTM C834.

VOC Content: Not more than 4 percent VOCs by weight in accordance with Section 01 81 16.

Back-Bedding Mastic Glazing Tapes:

Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C1281 and AAMA 800 for products indicated below:

VOC Content: Not more than 10 percent VOCs by weight in accordance with Section 01 81 16.

AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

Expanded Cellular Glazing Tapes:

Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

Type 1: For glazing applications in which tape acts as the primary sealant.

Type 2: For glazing applications in which tape is used in combination with a full bead of liquid sealant.

VOC Content: Not more than 10 percent VOCs by weight in accordance with Section 01 81 16.

## 2.7 GLAZING GASKETS:

Glazing gaskets for aluminum framing systems are furnished by Installer of Sections 08 41 13 and 08 44 13 and installed as herein specified.

Cellular Glazing Gaskets: (Use for "Dry Glazing" Aluminum Work)

Molded or extruded closed cell integral-skinned neoprene gaskets for watertight construction; complying with ASTM C509, Type II, black.

Manufacturer: Provide by one of the following or approved equal:

D.S. Brown Company
Maloney Precision Products Company
Tremco, Inc.
Mantaline Corp.

Elastomeric Compression Glazing Gaskets: (Use for "Dry-Glazing" Aluminum Work).

Extruded, flexible gaskets of EPDM of the profile and hardness as required for watertight construction; comply with ASTM C864.

Manufacturer: Provide by one of the following or approved equal:

D.S. Brown Company
Maloney Precision Products Company
Tremco, Inc.
Mantaline Corp.

## 2.8 MISCELLANEOUS GLAZING MATERIALS:

Compatibility: Provide materials compatible with surfaces and sealants contacted in installation.

Setting Blocks: Neoprene, EPDM or silicone 80-90 Shore A durometer hardness, with proven compatibility with sealants used.

Spacers and Edge Blocks: Neoprene, EPDM or silicone with proven compatibility with sealants used, of size, shape and hardness as recommended by glass and sealant manufacturers. Provide edge blocks to limit lateral movement of glass.

Cleaners, Primers and Sealants: Type recommended by sealant or gasket manufacturer.

Aerosol Glass Cleaners: Not more than 12 percent VOCs by weight in accordance with Section 01 81 16.

Non-Aerosol Glass Cleaners: Not more than 4 percent VOCs by weight in accordance with Section 01 81 16.

Metal Cleaners: Not more than 30 percent VOCs by weight in accordance with Section 01 81 16.

VOC Content for Primers: Not more than 100 grams per liter in accordance with Section 01 81 16.

VOC Content for Sealants: Not more than 4 percent VOCs by weight in accordance with Section 01 81 16.

## PART 3 - EXECUTION

### 3.0 EXAMINATION:

Refer to Section 01 73 00 for examination of substrate and job conditions.

Examine framing glazing, with Installer present, for compliance with the following:

Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

Presence and functioning of weep system.

Minimum required face or edge clearances.

Effective sealing between joints of glass-framing members.

Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.1 PREPARATION:

Clean the glazing channel or other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.

### 3.2 INSTALLATION:

Performance:

Watertight and airtight installation of each piece of glass is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading and impact loading (for operating doors) without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and air-tight, deterioration of glazing materials and other defects in the work.

General:

Protect glass from edge damage at all times during handling, installation and operation of the building.

Glazing channel dimensions as shown are intended to provide for necessary minimum bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. The Glazier is responsible for correct glass size for each opening, within the tolerance and necessary dimensions established.

Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified, and except where manufacturer's technical representatives direct otherwise.

Comply with "Glazing Manual" and other applicable publications by Flat Glass Marketing Association except as shown and specified otherwise, and except as specifically recommended otherwise by the manufacturers of the glass and glazing materials.

Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

Inspect each piece of glass immediately before installation, and discard any which have observable edge damage or face imperfections.

Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Set with pattern, draw and bow oriented in the same direction as other pieces.

Cut and install colored (tinted) and heat absorbing glass as recommended in TSR No. 130, "Installation Recommendations Tinted and Reflective Glass", by PPG Industries, or similar reports by other manufacturers.

Install insulating glass units to comply with recommendations by SIGMA and TSR No. 230, "Installation Recommendations Twindow" by PPG Industries, Inc., except as otherwise specifically indicated or recommended by glass and sealant manufacturers.

3.3 GLAZING:

General:

Install setting blocks of proper size at quarter points of sill rabbet but not less than 6" from corner of glass to edge of setting block. Set blocks in thin course of the heel-based compound, if any.

Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

Provide spacers inside and out, and of proper size and spacing, for all butt glazed glass or glass sized larger than 50 united inches, except where gaskets or glazing tapes are used for glazing. Provide 0.125" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

Clean and trim excess glazing materials from the glass and stops or frames promptly after installation, and eliminate stains and discoloration.

Tape and Sealant Glazing:

Cut glazing tape to length and set against permanent stop 3/16" below sightline. Butt tape at corners and daub joint with butyl sealant.

Place setting blocks and rest glass pane on blocks and push against tape to attain full contact with glass perimeter.

Place glazing tape on glass and install removable stop.

Apply cap bead of acrylic sealant along external and internal void to uniform line and with "wash" away from glass. Tool or wipe sealant with solvent for smooth appearance.

Butt Glazing:

Clean vertical members of aluminum curtain wall framing to receive sealant. Install glazing gaskets and gasket backing for sealant.

Place inside vertical structural silicone adhesive bead.

Place setting blocks and rest panes of glass on blocks and push against gaskets and adhesive.

At vertical butt glazed joint, place backer rod and install acid-curing silicone sealant following manufacturer's recommendations. Tool sealant to a clean, uniform, slightly concave appearance on both sides of the glass.

Sealant, backer rod, and other materials that come in contact with the silicone must be compatible.

Gasket Glazing:

Where wedge-shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to dynamic movement.

Square cut wedge-shaped gaskets at corners and install gasket as recommended by gasket manufacturer to prevent pull away at corners. Seal corner and butt joints with sealant as recommended by gasket manufacturer.

Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

Install gaskets so they protrude past face of glazing stops.

Sealant Glazing (Wet):

Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

Tool exposed surfaces of sealants to provide a substantial wash away from glass.

## 3.4 CURE, PROTECTION AND CLEANING:

Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

Protect exterior glass from breakage immediately upon installation, by attachment of crossed streamers to framing held away from glass. Do not apply markers of any type to surface of glass.

Remove nonpermanent markers and clean surfaces.

Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during the construction period, including natural causes, accidents and vandalism.

Washing of glass is specified in Section 01 74 23.

## 3.5 SCHEDULE:

Type 1: (Exterior Vertical Glazing Unless Otherwise Noted)

Total Thickness: 1".

Exterior Light: 0.25" tinted, Kind HS, float glass pane with Low E coating on Number 2 surface.

Air Space: 0.5".

Interior Light: 0.25" clear, Kind HS, float glass.

Type 1T: (Exterior Vertical Safety Glazing)

Total Thickness: 1".

Exterior Light: 0.25" tinted, Kind FT, float glass pane with Low E coating on Number 2 surface.

Air Space: 0.5".

Interior Light: 0.25" clear, Kind FT, float glass.

Type 2: (Interior Safety Glazing Not Otherwise Indicated)

0.25" clear, Kind FT, float glass.

Type 3: (Interior Glazing Not Otherwise Indicated)

0.25" clear float glass.

Type 4: (Interior UL Label Openings)

Laminated ceramic glazing in thickness to meet required fire and safety ratings.

Type 5: (Interior Vertical Glazing Between Public Seating and Courtroom)

Total Thickness: 1".

Public Seating Light: 0.25" clear, Kind FT, float glass.

Air Space: 0.5".

Courtroom Light: 0.25" clear, Kind FT, float glass.

END OF SECTION 08 80 00