

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 CONTROLLING DOCUMENTS

- A. This specification is controlled by Division 08, Section 08 40 00 "Exterior Enclosure System Requirements". In addition to the requirements of this document, all requirements of Controlling Documents must also be met. The more onerous conditions of this document or the Controlling Document must be met.

1.2 SUMMARY

- A. Provide the work of this Section in accordance with requirements of the Contract Documents.
- B. This Section includes, but is not limited to glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors
 - 2. Aluminum framed storefront and entrances
 - 3. Glazed curtain walls
 - 4. Glazed interior and exterior entrances
 - 5. Glazing sealants and accessories.
 - 6. Glazing film.
- C. Related Requirements:
 - 1. Division 07, Section 07 92 00 "Joint Sealants".
 - 2. Division 08, Section 08 40 00 "Exterior Enclosure System Requirements."
 - 3. Division 08, Section 08 41 13 "Aluminum-Framed Entrances and Storefronts."
 - 4. Division 08, Section 08 88 36.16 "Electronically Controlled Switchable Glass".
 - 5. Division 08, Section 08 44 13 "Glazed Aluminum Curtain Walls"

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036. Nominal glass thicknesses will be called out in this document. The more onerous of maximum or minimum thicknesses as defined in ASTM C1036 shall be used in all calculations and dimensions
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

- E. Deterioration of Coated Glass: 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.
- F. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- G. Deterioration of Laminated Glass: 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 laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of glass and glazing product.
- B. Sustainable Design Submittals:
 - 1. Building Product Disclosure and Optimization - Sourcing of Raw Materials:
 - a. Extended Producer Responsibility (EPR): Submit documentation indicating that manufacturers have a take back or recycling program for the product purchased.
 - b. Bio-based Materials: For bio-based products and materials other than wood, submit documentation of product data and testing results in compliance with LEED requirements.
 - c. Wood Products: Submit documentation of Forest Stewardship Council or USGBC equivalent certification.
 - d. Materials Reuse: For products that are salvaged, refurbished, or reused, include a statement indicating costs for each product.
 - e. Recycled Content: For products having recycled content, indicate percentages by weight of post-consumer and pre-consumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.

- f. Regional Materials: For products that are required to comply with requirements for regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 1) Include statement indicating distance to Project, cost for each regional material and the fraction by weight that is considered regional.
 - 2. Indoor Environmental Quality, Low Emitting Materials: Building Products must be tested and compliant with the California Department of Public-Health (CDPH) Standard Method V1.1-2010 or v1.2 2017, using the applicable exposure scenario.
 - a. For paints, and coatings, wet applied, include printed statement of VOC content, showing compliance with the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure for Architectural Coatings or the South Coast Air Quality Management District (SCAQMD) Rule 1113-2011.
 - b. Adhesives and Sealants: For wet applied on-site products, submit printed statement showing compliance with the applicable chemical content requirements of SCAQMD Rule 1168, effective July 1, 2005, and rule amendment date of January 7, 2005.
 - c. Alternative tests for VOC above include ASTM D2369-10; ISO 11890 part 1; ASTM D6886-03; or ISO 11890-2.
 - d. Methylene Chloride and perchloroethylene may not be added to paints, coating, adhesive or sealants
 - e. Composite Wood: Submit documentation showing that wood used in the project has low formaldehyde emissions that meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low emitting formaldehyde (ULEF) resins or no added formaldehyde resins.
- C. Shop Drawings: Include elevations, sizes, dimensions, materials, edge details, anchorage, hardware, and attachments to other work. Show sections and profiles of panel units, arrangement, and provision for jointing, anchoring and fastening, supports and other installation details. Indicate locations of panels on elevations. Show large scale details of edge conditions and typical conditions.
 - 1. Include information on size, edge seal, toggle channels, stamp and location for glazing coordinated with submittals for Division 08, Section 08 40 00 "Exterior Enclosure Requirements".
- D. Glass Samples:
 - 1. For each type of glass product other than clear monolithic vision glass; 12 inches (300mm) square.
 - a. Tinted glass.
 - b. Coated glass.
 - c. Laminated glass.
 - d. Insulating glass.
- E. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths.
 - 1. Install sealant Samples between two strips of material representative in color of the adjoining framing system. Provide seal width and edge deletion for structurally glazed IGUs
- F. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

- G. Fabrication Engineering and Design Data Submittal: Submit for glazing to verify compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturers of insulating-glass units.
- B. Sustainable Design Submittals:
1. Building Product Disclosure and Optimization – Environmental Product Declarations
 - a. Submit product specific type III EPDs or Industry wide (generic) EPDs, USGBC approved program declaration or products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope.
 2. Building Product Disclosure and Optimization – Material Ingredients
 - a. Material Ingredient Reporting: Submit documentation confirming chemical inventory of products to at least 0.1 % (1000ppm) with at least one of the following:
 - 1) Submit published manufacturer inventory of ingredients identified by name and Chemical Abstract Service Registration Number (CASRN)
 - 2) Submit documentation that product has been certified as Cradle-to-Cradle v3 at the Bronze Level or better
 - 3) Submit Declare product label indicating that all ingredients have been disclosed down to 1000 ppm or designated as Red List Free or Declared
 - 4) Living Product Challenge
 - 5) Product Lens Certification
 - 6) USGBC approved program.
 - b. Material Ingredient Optimization: Submit documentation confirming chemical inventory of products to at least 0.01 % (100ppm) and/or that has a compliant material ingredient optimization report with at least one of the following:
 - 1) Submit GreenScreen V1.2 Benchmark: Third party report prepared by a licensed GreenScreen List Translator, or a full GreenScreen Assessment.
 - 2) Submit third-party verified documentation that product has been certified as Cradle-to-Cradle v3 at the Bronze Level or better
 - 3) Submit third-party verified Cradle to Cradle v3 Material Health certificate at the Bronze Level or better
 - 4) Submit third-party verified Declare product label indicating that all ingredients have been disclosed down to 100 ppm
 - 5) Submit third-party verified documentation that product is Living Product Challenge certified with a Red List Free or LBC Red List Free Declare label.
 - 6) Submit documentation that product has a manufacturer prepared action plan with material inventory to at least 1000 ppm.
- C. Fabrication Engineering Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed to practice in the jurisdiction of the project and responsible for their preparation.
- D. Product Certificates: For glass and glazing from manufacturer, evidencing compliance with testing requirements.

1. Certification: Provide certification from glass producer/fabricator or Exterior Wall Engineer that glass producer/fabricator has reviewed all glazing details and thicknesses and finds same suitable for the purpose intended in accordance with these specifications. This shall include a written wind load and thermal stress analysis showing a probability of failure of no greater than eight (8) lites per thousand for vertical panels and one (1) lite per thousand for horizontal panels at the performance and test loads and local climatic thermal conditions.
 2. Certification, Tempered Glass Testing: Submit certification that tempered glass intended for use on the project has been heat soaked tested in accordance with EN14179-1 "Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass.
 3. Certification, Insulating Glass Testing: Submit certification that the insulating glass units have been granted the labelling in accordance with ASTM E2190 compliance for insulated glass units.
 4. Certification, Insulating Glass: Provide certification that insulating glass primary and secondary seals are capable of withstanding project structural loading requirements.
- E. Fabricator's quality control/quality assurance procedures.
- F. Product Test Reports: For coated glass, insulating glass, and glazing sealants, for tests performed by a qualified testing agency.
1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- G. Preconstruction adhesion and compatibility test report.
- H. Sample Warranties: For special warranties.

1.8 CLOSEOUT SUBMITTALS

- A. Digital data of frit patterns, screens necessary to achieve the Architect's custom frit, and to maintain throughout the life of the curtain wall. Coordinate submittal with requirements specified in "Glazing Schedule" at the end of Part 3 of this Section.
- B. Maintenance Data: For each type of glass and each applied coating to include in maintenance manuals.

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program or has demonstrated 5-year experience on projects of comparable size and scope and has foremen who can demonstrate that they have taken online classes given by the National Glass Association at myglassclass.com in the specialties they are engaged to provide.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- E. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of Insulating Glass Certification Council (IGCC).
- G. Mockups: Before glazing, build mockups for each glass product indicated below, to verify selections made under sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work.
 - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Install glazing in mockups specified in Division 08, Section 08 40 00 "Exterior Enclosure System Requirements", to match glazing systems required for Project, including glazing methods.
 - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 4. Obtain Architect's approval of mockups before starting fabrication.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Demolish and remove mockups when directed.
 - 7. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. 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.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- B. Comply with requirements specified in Section 08 40 00 "Exterior Enclosure System Requirements", Section 08 44 13 "Glazed Aluminum Curtain Walls", "and "Structural Silicone Glazed Aluminum Curtain Walls" for field hose testing of glass panels installed in assemblies erected in the work of those sections.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.12 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with glass by field measurements before fabrication.

1.13 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Heat Soaked Tempered Glass: Manufacturer agrees to replace heat soaked tempered glass (FT) units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) with within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- D. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Manufactured items listed are the Basis of Design selected for the project and serve as the standard of quality required for the project. Equivalent products by other manufacturers/fabricators listed in this section will be considered, provided they match the aesthetic and performance of the items designated. Items that do not match aesthetic and performance characteristics will be rejected. The Architect has the final approval.
- B. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
 - 1. Guardian Glass Industries.
 - 2. Asahi Glass (AGC).
 - 3. Pilkington North America.
 - 4. Schott-North America, Inc.
 - 5. Vitro Architectural Glass (Formerly PPG).
- C. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. Guardian Glass Industries.
 - 2. JEBerkowitz.
 - 3. Old Castle Building Envelope.
 - 4. Viracon, Inc.
 - 5. Vitro Architectural Glass (formerly PPG).
- D. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Fabrication Engineering Design: Engage a qualified professional engineer, as defined in Division 01, Section 01 33 16 "Fabrication Engineering Design Data", and the local building code, to engineer glass and glazing, including comprehensive engineering analysis according to ASTM E1300.
 - 1. Glass Thicknesses indicated are minimums and for detailing only. Confirm glass thicknesses and heat treatment by analyzing Project loads and in-service conditions.
 - 2. Provide glass lites for various openings in nominal thickness indicated, but not less than the thickness and strength (including heat treatment) as required to comply with performance criteria specified.
- C. Structural Performance: Except as modified by requirements of this section glazing shall be engineered, fabricated, and installed to withstand design wind loads, snow loads, seismic loads, sidesway, live and deadloads, structural movement, deflections within limits and under

conditions indicated determined according to the IBC and ASTM E1300, and performance requirements specified in Division 08, Section 08 40 00 "Exterior Enclosure System Requirements.

1. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, engineer glass to resist wind pressure based on glass type factors for short-duration load.
2. Outward wind pressure minus the weight of the glass. Base on glass type factors for short-duration load.
3. Inward wind pressure plus the weight of the glass plus half of the snow load. Base on glass type factors for short-duration load.
4. Half of the inward wind pressure plus the weight of the glass plus the snow load. Base on glass type factors for long-duration load.
5. Load Durations: Engineer glass for load duration factors in accordance with ASTM E1300. For wind loading assume a duration factor of 1.0, for Patterned and Sandblasted Glass assume:
 - a. Short-Duration Glass Type Factor for Patterned Glass: 1.0.
 - b. Long-Duration Glass Type Factor for Patterned Glass: 0.6.
 - c. Short-Duration Glass Type Factor for Sandblasted Glass: 0.5.
6. Thickness of Patterned Glass: Base patterned glass on thickness at thinnest part of the glass, but in no case less than 1/4 inch (6 mm).
7. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm for monolithic glass lites.
8. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites.
 - a. Load duration: 3 seconds.
9. Maximum Lateral Deflection:
 - a. For glass supported on all four edges, limit center-of-glass deflection at wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less, and sloped glass (including glass canopies) not to exceed 1/2 inch at center point.
 - b. For glass supported on two edges, limit center-of-glass deflection at wind pressure to not more than 1/50 times the short-side length or 1/2 inch (12.7 mm), whichever is less.
10. Differential Shading and Heat Build Up: Engineer glass to resist thermal stresses induced by differential shading within individual glass lites.
11. Insulated Glass Units: Design of insulated glass units shall account for the building altitude, temperature, atmospheric pressure, and specified loads.
12. Laminated Glass Units: Structural design of laminated glass units shall account for the stiffness of the interlayer material and in-service material design temperature, but not less than 70 degrees F.
13. Ceramic Coated Glass: Structural design of ceramic coated glass shall account for the reduction in glass strength due to the ceramic coating process.

D. Tempered Glass:

1. Unless otherwise specified tempered glass intended for use on the project shall be heat soaked tested in accordance with EN 14179-1 "Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass" for a minimum of 2 hours at not less than 260 deg C. to minimize the occurrence of nickel sulfide crystals. This process shall be strictly controlled and carried out paying attention to temperature limits and duration of treatment for each phase.
2. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

- E. Structural Glazing: To limit the stresses on structural glazing sealant under full loads and maximum building deflections, to produce sealant stress not exceeding 20 psi with a minimum safety factor of 2.5:1 per ASTM C1249 and the sealant manufacturer's instructions.
- F. Safety Glazing: For glass panels that are accessible to pedestrians (and not protected by an 18-inch-high obstruction) and glass in doors and door sidelights, and where safety glazing is indicated or required by Building Code, provide glazing that complies with 16 CFR 1201, Category II.
 - 1. Permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - 2. European alternate for certification of safety glazing is acceptable. All laminated glass is safety glazing.
- G. Water Immersion: Engineer insulating glass units to be free of water immersion.
- H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- I. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
 - 2. For laminated glass lites, properties are based on products of construction indicated.
 - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.
- J. Low-Emitting Materials:
 - 1. Architectural paints and coatings wet-applied inside the weather-proofing system must meet the VOC general emissions testing criteria of CDPH Standard Method v1.2.
 - 2. All paints and coatings wet-applied inside the weather-proofing system must have VOC content in compliance with the applicable VOC limits (g/L) found in tables in Division 01, Section 01 81 13 "Sustainable Design Requirements - LEED v4 BD+C."
 - 3. Adhesives and Sealants wet-applied inside the weather-proofing system must meet the VOC general emissions testing criteria of CDPH Standard Method v1.2.
 - 4. All adhesives and sealants wet-applied inside the weather-proofing system must have VOC content in compliance with the applicable VOC limits (g/L) found in tables in Division 01 Section 01 81 13.14 "Sustainable Design Requirements - LEED v4 BD+C."

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. FGIA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
 2. Consumer Product Safety Commission (CPSC): Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of CPSC 16 CFR Part 1201 for category II materials.
 3. National Glass Association NGA Publication: "Laminated Glazing Reference Manual" and "GANA Glazing Manual" and "Sealant Manual".
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
1. Subject to compliance with requirements and local authorities having jurisdiction, provide safety glass with a removable certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum and is for detailing only Confirm glass thickness and heat treatment necessary for glass unit sizes required against performance requirements for exterior glazing and in-service conditions. Provide glass that complies with performance requirements and is not less than the thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 1/4 inch (6 mm).
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength:
1. Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article.
 2. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article.
 3. Where fully tempered float glass is indicated, provide fully tempered float glass.
- F. Regional Materials: Provide a minimum of 20 percent of building materials (by cost) that are regionally extracted, processed, and manufactured materials within a radius of 100 miles.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Heat-Treated Float Glass: ASTM C1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. Flatness Tolerances: Overall bow and warp shall not exceed 50 percent of values tabulated in ASTM C1048.
 2. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3 (glazing select).

3. Fully Tempered Glass: Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3 (glazing select).
 - a. Tempered architectural safety glass shall conform to ANSI Z97.1 and CPSC 16 CFR 1201.
 4. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated. Direction of roller wave shall be consistent throughout building. Measurements of roller wave shall be performed in accordance with ASTM C1651.
 - a. Roller wave peak-to-valley deviation shall not exceed 0.002 inch (0.051 mm) "Peak to Valley" in the central area and 0.008 inch (0.2 mm) within 10-1/2 inches (267mm) of the leading and trailing edge.
 5. ASTM C1048 for uncoated glass, comply with requirements for Condition A.
 6. ASTM C1048 for coated vision glass, comply with requirements for Condition B for fully or partially ceramic coated glass, and Condition C (other coated glass).
 7. Provide heat soak testing for all tempered glass, conforming to EN 14179-1: 2016 which includes a 2-hour dwell at 482°F ± 18°F (260°C ± 10°C).
 8. After heat soak testing, all tempered glass shall be checked for
 - a. minimum residual compressive surface stresses in accordance with ASTM C1048.
 - b. safety glazing performance in accordance with 16 CFR Part 12 and ANSI Z97.1
- C. Low-Emissivity (Low 'E') Coated Glass: Provide low-emissivity factory applied coating complying with ASTM C1376 and resulting in a stable, uniform, nearly invisible coating which imparts average maintained insulating performance.
1. Provide accurate and straight edge deletions of coatings at areas of insulating glass assemblies where Low "E" coatings, metallic coating or other decorative coatings are applied to surfaces scheduled to be in contact with the primary seal of insulating glass units.
- D. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGC Glass Company North America, Inc.; Spotless Ti.
 - b. Cardinal Glass Industries; Neat.
 - c. Pilkington North America; Activ.
 - d. Vitro Architectural Glass SunClean.
 - e. Saint Gobain; Bioclean.
- E. Ceramic-Coated Glass:
1. ASTM C1048, Type I, Condition B, Quality-Q3 and complying with NSA "Engineering Standards Manual" 66-9-20 Specification for Heat-Strengthened or Fully Tempered Ceramic Enameled Spandrel Glass for Use in Building Window/Curtain Walls and other Architectural Applications.
- F. Decorative Glass:
1. Laminated Glass: ASTM C1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Blemishes that may form or grow over time shall not exceed the limits defined in ASTM C1172. . Use materials that have a proven record of no tendency to bubble, discolor, or lose physical

and mechanical properties after fabrication and installation. Misalignments between laminated lites may not exceed 1/32".

2. Heat-treated floated glass in accordance with paragraph 2.4.B, Kind FT (fully tempered), Type I, Class 1 (clear), Quality-Q3, Condition C (other coated glass).

2.5 COATED FLOAT GLASS

- A. General: Provide coated glass complying with requirements indicated in this Article
1. Sputter-Coated Float Glass: Float glass with the coating(s) specified in schedules at the end of Part 3, deposited by magnetron sputtered vacuum deposition process after manufacture and heat treatment (if any). Pyrolytic, and wet chemical deposition, glass coatings will not be permitted.
 2. Coating Quality: The allowable range of defects in coatings applied to glass shall be as accepted through glass sample submissions. Installed coated glass products which are outside of the accepted sample range shall be subject to rejection by the Architect. To reduce the possibility of glass rejection, the supplier of coated glass products shall provide glass coating production runs for the entire project from a single coating facility. The allowable range of defects are defined as follows:
 - a. The vision glass area is defined as the field of glass which is greater than 3 inches (76 mm) from the glass unit edge.
 - 1) Pinholes: At an indoor viewing distance of 6 feet (1829 mm) for low emissivity coatings, and 15 feet (4572 mm) for reflective coatings:
 - a) Pinholes greater than 1/16 inch (1.5 mm) in dia. shall not be permitted.
 - b) Large clusters or close spacing of pinholes 1/16 inch (1.5 mm) and smaller shall not be permitted in the vision glass area; and
 - c) Large clusters or close spacing of pinholes 1/16 inch (1.5 mm) and smaller may be permitted outside of the vision glass area subject to Architect's acceptance.
 - 2) Scratches: At an indoor viewing distance of 10 feet (3048 mm) for low emissivity coatings, and 15 feet (4572 mm) for reflective coatings:
 - a) Scratches smaller than 3 inches (76 mm) long are allowed in any glass area.
 - b) Scratches from 3 inches to 4 inches (76 mm to 102 mm) long are allowed only within 3 inches (76 mm) of an edge; and
 - c) Scratches greater than 4 inches (101 mm) long shall not be permitted in the vision glass area.
 - d) Concentrated scratches, scuffs, rub marks, cup marks or abraded areas shall not be permitted in any glass area.
 - 3) Reflectance and Transmission Inspection: When viewed outdoors against a bright uniform opaque background at a 10 ft. (3048 mm) distance for low emissivity coatings (15 feet (4572 mm) for reflective coatings), color, reflectance and transmission will be permitted to have a slight variance subject to Architect's acceptance.
 - a) Mottling and streaking of the coating shall not be permitted.

2.6 LAMINATED GLASS

- A. Fabricators: Subject to compliance with requirements, provide product by one of the following:
1. AGC Glass Company North America, Inc.

2. Oldcastle Glass, Inc.
 3. Vitro Architectural Glass
 4. Viracon, Inc.
 5. Agnora
 6. Cristacurva
- B. Laminated Glass: ASTM C 1172 and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Blemishes that may form or grow over time shall not exceed the limits defined in ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Misalignments between laminated lites may not exceed 1/32 inch. At edges, where PVB interlayers may contact silicone sealant, provide 3M glazing tape recommended for separation of silicone and PVB interlayer.
- C. Polyvinyl Butyral Interlayer: Polyvinyl butyral sheets of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
1. Laminate lites with polyvinyl butyral interlayer in autoclave with heat plus pressure.
 2. Provide clear polyvinyl butyral sheets for laminating clear glass.
 3. Provide ultraclear polyvinyl butyral sheets for laminating ultraclear (low-iron) glass.
- D. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.
1. Construction: Laminate glass with interlayer to comply with interlayer manufacturer's written instructions.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Color: Clear unless otherwise specified.
 4. Where laminated glass is held using sealants, verify compatibility of interlayers and sealant with sealant manufacturer.
- E. Laminated Safety Glass Units: Two sheets of glass of equal thickness, laminated together with not less than 0.060 inch thick clear interlayer, made specifically for laminating glass. At glazed doors and sidelights, provide glass complying with the requirements of 16 CFR 1201 Category II.
1. Prior to laminating, cut glass to required sizes and profiles as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field.

2.7 INSULATING GLASS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide e product by one of the following:
1. Avic Sanxin
 2. Oldcastle Glass, Inc.
 3. Cristacurva
 4. Vitro Architectural Glass
 5. Viracon, Inc.
 6. Guardian Glass Industries.

7. Agnora
 8. AGC Interpane
- C. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190, and complying with other requirements specified.
1. Sealing System: Dual edge sealed insulating glass units, with polyisobutylene primary and silicone secondary sealants.
 2. Fabricate units at factory with sheets of glass hermetically sealed at edges with a permanent elastomeric sealant. Dehydrate entrapped air. Glass lights with bent, welded or fused corners, splices or joints shall be separated by desiccant filled d spacer specified below, marked with the appropriate classification, listed manufacturer and approval marked on the spacer
 3. Spacer:
 - a. "TGI Warm Edge Spacer" (Technoform); black color.
 4. Skips and voids in the primary or secondary seals are prohibited and maximum gap at primary/secondary seal interface is 1 inch in length and 3/32 inch in width.
 5. Documentation
 - a. Document and record results
 - b. Tag each insulating Glass Unit that falls outside the defined limits and certify that these non-conforming insulating glass units will not be supplied to the Project.
 6. Quality Assurance: Provide method to assure spacer is square to the edge, polyisobutylene seal is within acceptable visual tolerances per mockup. In addition, provide quality assurance measures to control:
 - a. Spacer Alignment, location, polyiso bleed.
 - b. Argon gas initial fill and acceptable loss rate. Fill level for calculations
 - c. Altitude effects
 - d. Barometric Pressure variation effects
 7. Low E Coating Edge Deletion in Insulating Glass Units: Provide accurate and straight edge deletions of coatings at areas of insulating glass assemblies where coatings, metallic coating or other decorative coatings are applied to surfaces scheduled to be in contact with the primary seal of insulating glass units or provide masking of edge to prevent low "E" coating from continuing to bonded edge.
 - a. In IGUs, provide "Red line" installation, overlapping low e coating and primary seal no more than 50% of thickness of primary seal.
- D. Argon Fill: Minimum fill 90% in accordance with EN1279 and ASTM E2190.

2.8 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
1. Neoprene complying with ASTM C864.
 2. EPDM complying with ASTM C864.
 3. Silicone complying with ASTM C1115.
 4. Thermoplastic polyolefin rubber complying with ASTM C1115.

- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.9 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 4. Colors of Exposed Glazing Sealants: Match Architect's samples.
- B. Sealant Types: As Specified in Division 07, Section 07 92 00 "Joint Sealants".
- C. Structural Glazing Seal **SE-01**: Neutral-curing structural silicone glazing sealant complying with ASTM C920 and ASTM C1184, Grade NS, Class 25 for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; DOWSIL 983 for field use and 995 or 121 for shop application.
 - b. GE Silicones; UltraGlaze SSG4600 for shop application and UltraGlaze SSG4000AC for field application
 - c. Sika; "Sikasil SG-500" for shop use and SG18 or SF500 for field use
 - 2. Applications: For Structural Seals.
- D. Glazing Sealant **SE-02**: Low modulus, neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; DOWSIL 790, 791 or 795.
 - b. GE Silicones; SilPruf LM SCS2700 or SilPruf SCS2000.
 - c. Sika Corporation; Sikasil WS290 or Sikasil WS295.
 - 2. Applications: Weather seal.
- E. Glazing Sealant **SE-03**: Medium modulus, neutral-curing stain resisting, silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 756 SMS.
 - b. Momentive Performance - Silicones; SilPruf NB SCS9000.
 - c. Sika Corporation, Sikasil - WS295
 - 2. Applications: Stain resistant weather seal.

- F. Sealant for IGU secondary seals: Compliant with ASTM C1369, and ASTM C1249 Guidelines.

2.10 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; 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; and complying with ASTM C1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.11 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Silicone material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Silicone material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material) and Type C (Closed Cell), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance, complying with requirements specified in Division 07, Section 07 92 00 "Joint Sealants".

2.12 GLAZING FILM

- A. Glazing Privacy Film **GF-01**:
1. Can be applied to the interior surface of glazing units.
 2. Visible light transmittance of maximum 30%.
 3. Film thickness of minimum 2.0 mil.
 4. Matte frosted surface finish.

5. White translucent color.
6. Film width and length suit glass sizes so that a single continuous piece may be applied on each glass unit.
7. Pressure sensitive clear adhesive applied with wet application method.
8. Product: Fasara SH2MLCRX – Milky Crystal by 3M Canada.

B. Entrance Glass/Visual Distraction Marks **GF-02**:

1. Visible light transmittance of maximum 30%.
2. Film thickness of minimum 2.0 mil.
3. Color to be later selected by Architect from manufacturer's full range.
4. Pressure sensitive clear adhesive applied with wet application method.
5. Product: Controltac Graphic Film 3M Canada.

2.13 FABRICATION OF GLAZING UNITS

- A. Fabricate glass and glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with performance requirements.
- B. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.
- C. Cutting: Obtain sizes from shop drawings or field measurement. Cut lites to fit each opening with edge clearances and bite on glass as recommended by manufacturer. Do not nip glass edges.
 1. Factory cut heavy float glass (1/2 inch and above). Edges may be wheel cut or sawed and seamed at manufacturer's option. For glass to be cut at site, provide glass larger than required to obtain, clean-cut edges without seaming or nipping.
 2. Do not cut, seam, nip or abrade glass after heat-tempering. Before tempering glass, provide cutouts to receive hardware.
- D. Edgework for Exposed Edges and Corners: Where edges of glass and corners are to be exposed in the finish work, provide polished edges and slightly eased arrises and eased corners. Where edges butt, provide flat polished and beveled edges.
- E. Edges Concealed: Edges concealed in the finish work shall receive a flat ground finish, with edges free of blemishes, and square edges with slight chamfers at junctions of edges and faces.
- F. Laminated Glass Edges: Zero tolerance and full alignment where exposed in the finish work. Comply with reference standards for laminated glass edges concealed in the finish work.
 1. Ground smooth and polish edges of laminated glass to be butt glazed. Ground smooth and slightly chamfer edges at glass edges to be concealed in the finish work.

2.14 SOURCE QUALITY CONTROL

- A. Provide insulating glass fabricator's quality control/quality assurance procedures and methods to control quality of finished insulating units before units are packaged to leave the fabricator's

site. Do not package or ship insulating glass units that are defective in hermetic seal, are warped, biased, exhibit any of the deterioration that are defined in Part I under "Definitions Article", Part 2 under "Coatings Article", or do not comply with requirements for a fully warranted product. Lites will be inspected by the Installer and Contractor upon arrival and rejected lites will be returned for full replacement at the fabricator's cost.

- B. Provide manufacturer's quality control/quality assurance procedures and methods to control warp and bow (As an alternate to methodology in paragraphs B. through E. of this Article). Provide certification that all heat-treated glass processes are conducted in manufacturing facilities with in line equipment that provides testing and control of glass processes to provide uniform products without rollerwave distortions that are unacceptable to the design Architect. Items listed in paragraphs B. through E., of this section identify how this is controlled in the North and South American Continents.
- C. Distortion Tolerance Testing: Measure in line, each pane of monolithic uncoated and coated heat-treated glass and coated glass of 6 mm thickness or more used on the Project Including visual mockups.
- D. Roll Wave Criteria (Horizontal): Maximum Average 0.003 Center and 0.008 edges (peak to valley) per ASTM C1651 Standard for Test Measurement of Roll Wave Optical Distortion in Heat Treated Glass.
- E. Millidioter Criteria: (95% for pre-temperable coated and 90% for post-temperable coated surface) Maximum +/- 120A overall or highest overall measurement from the approved visual mock-up that is less than +/- 120 A overall, whichever is less.
- F. Documentation
 - 1. Document and record results for each pane.
 - 2. Tag each pane of glass that falls outside the maximum distortion limits and certify that these non-conforming glass panels will not be fabricated and supplied to the project.
 - 3. Provide written documentation of the Roller Wave and Millidioter measurements of the glass used in visual mock-ups before the mock-ups are reviewed by the Owner and Architect for approval.
 - 4. Bow/Warp Tolerance
 - a. 1/2 of ASTM C1048
 - b. Measure every hour on a vertical plane with a straight edge.
 - c. Provide recorded written documentation upon request
 - d. Do not exceed maximum warpage in any direction
 - e. For uncoated glass comply with requirements for Condition A.
 - f. For coated vision glass, comply with requirements for Condition C (other coated glass).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.

3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Place blocks to allow water passage to weep holes. Set blocks in thin course of compatible sealant suitable for heel bead.
1. Glass Units Less Than 6 ft. - 0 inches (1.8 m): Locate setting blocks at sill one - quarter of the width in from each end of the glass unless otherwise recommended by the glass manufacturer.
 2. Glass Units 6 ft. - 0 inches (1.8 m) or Greater: Locate setting blocks at sill one - eighth of the width in from each end of the glass, but not less than 6 inches (150 mm), unless otherwise recommended by the glass manufacturer.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series true in line with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Set glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces and building structure.
- L. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- M. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- N. The installation of each lite of exterior glass shall be watertight, airtight, and capable of withstanding temperature changes, wind loading, and impact from operation (doors) without failure of any kind including loss or breakage of glass, failure of seal, exudation of sealant and excessive deterioration of glazing materials.
- O. Glazing Privacy Film Application:
 1. Clean glass surfaces thoroughly and install adhesive film in strict compliance with manufacturer's instructions.
 2. Cut film edges neatly and square at a uniform distance of 1/8 inch to 1/16 inch of glass edges. Replace blade tips after 3 to 4 cuts, for a crisp straight edge.
 3. Spray manufacturer recommended slip solution on glass and adhesive to facilitate proper positioning of film.
 4. Apply film to glass and lightly spray film with slip solution.
 5. Squeegee from top to bottom of each pane of glass receiving adhesive film. Spray slip solution to film and squeegee a second time.
 6. Bump film edge with lint-free towel wrapped around edge of a manufacturer recommended 5-way tool.
 7. Upon completion of film application, allow 30 days for curing film, allowing moisture from film installation to dry thoroughly, and allow film to dry flat without moisture dimples when viewed under normal viewing conditions.
- P. Entrance Glass/Visual Distraction Marks: Provide glazing and door distraction markings on glass surfaces, in colors, uniform patterns and spacing shown. Coordinate with Architect for custom graphics on interlayers to produce visual distraction markings complying with requirements.
 1. Where interlayers are not used, provide applied graphics to comply with referenced standards.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape 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.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. 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.
- C. Installation with Drive-in Wedge Gaskets: 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.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.
- F. Glazed Monolithic and Laminated Glass Units (Butt Glazing): Glass to glass glazing shall be in accordance with the recommendations of sealant and glass manufacturers and shall include the following.
 - 1. Mask both sides of each adjacent piece of glass to be glazed.

2. Provide wood dowel, with a diameter of at least 3 times of the joint width, wrapped in polyethylene and firmly taped to interior face of glass to act as a back-up during glazing operations.
3. Tool face of sealant slightly concave using extreme care not to chip or otherwise abrade corners of glass.
4. Allow sealant to fully cure before removing wood polyethylene wrapped dowel.

3.6 SEALANT GLAZING (WET)

- A. 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.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
 2. Remove and replace glass that cannot be cleaned without damage to coatings.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or otherwise damaged during construction period.

3.8 GLASS SCHEDULE

- A. Fabrication Engineering: Provide the following glass types at general locations indicated below and at locations shown on drawings. Glass thickness and heat treatment values below are minimum selected by Architect for detailing purposes. Provide thicker glass lites and heat treatments necessary for each condition of use to comply with ASTM E1300, performance requirements and Division 08, Section 08 40 00 "Exterior Enclosure Requirements".
 1. Thicker heat strengthened glass which comply with required performance may be proposed in lieu of thinner fully tempered glass at glass panels not adjacent to walking surfaces where fully tempered glass is specified.
- B. Glass Type **GL-02**: Insulating vision glass with low E coating.
 1. Overall Unit Thickness: 1 inch (25 mm).

- a. Outer Lite: Clear FT and heat soaked tinted safety glass, minimum 1/4 inch thick.
 - b. Space: Argon.
 - c. Dual Seal black.
 - d. Inner Lite: Clear FT and heat soaked tinted safety glass, minimum 1/4 inch thick.
 2. Location of low E coating in glass assembly to be confirmed. The intent is to match existing Terminal A IGU's with low E coating.
 3. Performance requirements to be confirmed. The intent is to match existing Terminal A IGU's with low E coating.
- C. Glass Type **GL-03**: Insulated glass unit with ceramic coating.
1. Overall Unit Thickness: 1 inch (25 mm).
 - a. Outer Lite: Clear FT heat strengthened safety glass minimum 1/4 inch thick.
 - b. Ceramic coating, color RAL [] on #4 surface
 - c. Space: Argon.
 - d. Dual Seal black.
 - e. Inner Lite: Clear FT safety glass, minimum 1/4 inch thick.
 2. Performance Requirements.
 - a. Exterior Reflectance: <Insert number> % minimum.
 - b. Winter Nighttime U-Factor: <Insert value> maximum.
 - c. Summer Daytime U-Factor: <Insert value> maximum.
 - d. Solar Heat Gain Coefficient: <Insert value> maximum.
- D. Glass Type **GL-04**: Vision Monolithic Glass.
1. 1/4 inch thick.
 2. Clear FT safety glass.
- E. Glass Type **GL-26a**: Decorative tempered laminated frosted glass
1. Frosted laminated FT glass, two (2) layers of 1/8 inch glass with colored PVB interlayer.
 2. Color: Arctic Snow by AGC.

END OF SECTION