SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed curtain walls.
4. Glazed entrances.
5. Storefront framing.

B. Related Requirements:

1. Section 01 91 19 "Building Enclosure Commissioning."
2. Section 07 92 00 "Joint Sealants" for perimeter sealing at openings.
3. Refer to Section 08 44 13 "Glazed Aluminum Curtain Walls" for requirements applicable to single subcontract responsibility for glazing.
4. Appendix B - Testing, Inspection, and Observation by Owner.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each glass product and glazing material indicated.

B. Samples: Label samples to indicate product, characteristics, and locations in the Work. Furnish seven (7) samples of the following:

1. Except for clear glass, submit samples of each glass type specified, in the form of 12 inch (300 mm) square Samples.
2. Submit samples of each glass type specified where production run variations and defects are expected.
3. Furnish 12 inch (300 mm) square glass samples with break-out window indicators applied thereon.

C. Preconstruction sealant adhesion, stain and compatibility test reports.

D. Field re-glazing details and procedures.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Submit a letter from glass manufacturer certifying that he has reviewed the glazing details proposed for the Project, including the use of gaskets and sealants, and that each product to be furnished is recommended for the application shown.

B. Design Data: Submit the following from the glass manufacturer:

1. Thermal Stress Analysis: For each exterior glass unit type, each building elevation. The analysis shall clearly indicate all the expected service temperature ranges and the effects of partial and full shading on the glass. Append to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified "statistical probability of breakage."
2. Wind Load Analysis: For each glass unit type, each building elevation. The analysis shall clearly indicate that the statistical probability of breakage at the design wind pressure will not exceed the specified statistical probability of breakage.

C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. Material Certificates: Submit glass treatment certificates signed by manufacturer of the heat-soaked glass products certifying that products furnished comply with requirements.

D. Product Test Reports: Submit product test reports for each type of glazing sealant and gasket indicated.

E. Warranties: Submit special warranties specified in this Section.

F. Field Quality Control Reports.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra lites of the respective types and quantities of glass as follows:

1. Exterior Units:

a. Vision Glass: Two units for each glazing type and module size.
b. Spandrel Glass: Two units for each glazing type and module size.
c. Glazing stops.

B. Deliver in manufacturer's containers suitable for storing, clearly labeled as to type, size, and thickness. Include manufacturer's instructions for care and storage of glass. Store on the premises where directed.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations for Glass and Glazing Accessories: Obtain glass and glazing accessories from one source for each product indicated below:

1. Primary glass.
2. Coated glass.

3. Heat-treated glass, including heat-strengthened, tempered, and heat-soaked glass.
4. Insulating glass.
5. Laminated glass.
6. Glazing gaskets.

C. Safety Glass: Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction. Wherever requirements conflict, the more stringent shall be required. Obtain approvals from all such authorities. As a minimum, provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations) and ANSI Z97.1 for Category A performance.

1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction. Locate permanent markings in one corner, and in the same location, of each glass lite in accordance with the requirements of the SGCC labeling guidelines. Markings shall have a nominal size of no greater than 1-inch (25.4-mm) in diameter, and be located with glass edge clearances, at the corner, by not more than 3/4-inch (19-mm) up and 3/4-inch (19-mm) over.

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

1. GANA Publications: GANA's "Glazing Manual" and "Laminated Glass Design Guide."
2. IGMA Publications: IGMA TM-3000, "Vertical Glazing Guidelines."

E. Mockups: Refer to Section 08 44 13 "Glazed Aluminum Curtain Walls" for requirements applicable to mockups.

1. Representatives of glass and glazing materials manufacturers, together with Contractor's field supervisor for glazing, shall be present during construction and field testing (if any) of sample installations.
2. Prepare sample installations where shown and as required to match approved shop drawings and the Contract Documents in all respects before proceeding with the Work.
3. Accepted sample installations may remain as a portion of the completed Work.

F. Pre-Construction Testing:

1. Bow and Warp Distortion (Flatness) Tolerance Testing:

a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each mockup lite for bow and warp in accordance with ASTM C 1048. Measure the lites on a vertical plane with an aluminum straight edge or fishing line.

1) Measure the mockup glass lites for compliance with the bow and warp tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances."

b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum bow and warp limits and certify that these non-conforming glass lites will not be incorporated into the Work.

1) Provide written documentation of the bow and warp readings in fractions of an inch or millimeters for each mockup glass lite to the Owner and Architect at the preconstruction glass mockup meeting. Provide additional written documentation as requested by the Owner and Architect.

2. Roll Ripple Distortion (Flatness) Tolerance Testing:

a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each monolithic lite in the mockup containing low emissivity coated, unfritted, heat-treated glass having a 1/4-inch- (6-mm-) thickness or greater using a LiteSentry or Osprey Series type optical scanning measurement device complying with ASTM C 1652 for digital grid scanning glass devices. Measure each monolithic mockup lite having 100 percent full screen, frit coated monolithic heat-treated glass having a 1/4-inch- (6-mm-) thickness or greater using a trolley type scanning measurement device complying with ASTM C 1651.

1) Measure the monolithic mockup glass lites for compliance with the flatness tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances."

b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum flatness limits and certify that these non-conforming glass lites will not be incorporated into the Work.

1) Provide written documentation of the flatness readings in fractions of an inch, in millimeters, and in millidiopters, for each mockup glass lite to the Owner and Architect at the preconstruction glass mockup meeting. Provide additional written documentation as requested by the Owner and Architect.

3. Color Tolerance Testing:

a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each monolithic mockup glass unit using either an off-line, or on-line, spectrophotometer. Color measurement shall be taken from the uncoated side.

1) Tolerance limits for the color variation shall be as accepted on the visual mockup.

b. Document and record results for each glass unit. Tag each unit of glass that falls outside of the color variation limits and certify that these non-conforming glass units will not be incorporated into the Work.

G. Quality Control (Production) Testing: As a minimum, provide the following quality control (production) testing for the exterior glass units:

1. Bow and Warp Distortion (Flatness) Tolerance Testing:

    a. During the production of the heat-treated glass lites, measure for bow and warp in accordance with ASTM C 1048. Measure the lites on a vertical plane with an aluminum straight edge or fishing line.

        1) Measure the monolithic glass lites for compliance with the bow and warp tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.

    b. During glass production, and once an hour, randomly select a single heat-treated glass lite and measure it. Document and record results. Tag each glass lite that falls outside of the maximum bow and warp limits and certify that these non-conforming glass lites were not incorporated into the Work.

    c. Provide written documentation of the bow and warp readings in fractions of an inch or millimeters for each tested glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.

2. Roll Ripple Distortion (Flatness) Tolerance Testing:

    a. During the production of the heat-treated glass lites, measure each low emissivity coated, unfritted, monolithic glass lite having a 1/4-inch- (6-mm-) thickness or greater using a LiteSentry or Osprey Series type optical scanning measurement device complying with ASTM C 1652 for digital grid scanning glass devices. During the production of the 100 percent full screen, frit-coated monolithic heat-treated glass lites having a 1/4-inch- (6-mm-) thickness or greater, and at a frequency of at least once an hour, randomly select a monolithic single lite and measure it using a trolley type scanning measurement device complying with ASTM C 1651.

        1) Measure the monolithic glass lites for compliance with the flatness tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.

    b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum flatness limits and certify that these non-conforming glass lites were not incorporated into the Work.

        1) Provide written documentation of the flatness readings in fractions of an inch, in millimeters, and in millidiopters, for each glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.

3. Color Tolerance Testing: During production, test monolithic coated and coated insulating glass units for color compliance as follows:

    a. Establish a color target selected from the accepted pre-construction glass mockup unit(s) and perform quality control color control checks using either an off-line, or

on-line, spectrophotometer. Examples of acceptable off-line devices include Minolta 2500d/2600d; examples of acceptable on-line devices include Benchmodel Spectrophotometers. Color measurement shall be taken from the uncoated side.

b. Frequency: Test a minimum of one unit every hour.

c. Document and record results for each glass unit. Tag each unit of glass that falls outside of the color variation limits and certify that these non-conforming glass units will not be incorporated into the Work.

4. Insulating Glass Unit Testing Requirements: During production, test insulating glass units as follows:

a. Butterfly Unit Adhesion Pull Testing:

1) Adhesion Criteria: Comply with the pass/fail requirements of the sealant manufacturer's published guidelines and/or sealant manufacturer's certification audit requirements/recommendations. Minimum pull back to 30 degrees from horizontal with no adhesive failure.
2) Frequency: Test one minimum 4-by-6-inch- (100 x 150-mm-) size unit each eight-hour shift and after each sealant drum change.
3) Test units shall be fabricated on the same production line and processing equipment and with the same spacers and sealant used in the production of the insulating glass units fabricated for the Project.

b. Desiccant Temperature Rise Testing:

1) Test Criteria: Comply with the desiccant manufacturer's written recommendations.
2) Frequency: Test a minimum of once every eight-hour shift and after each drum change.

c. Bow/Warp and Air Space Measurement Concave/Convex Testing:

1) Measure and record bow and warp once every hour on a vertical plane with an aluminum straight edge or with a laser.
2) Measure and record unit center air space a minimum of once an hour with a checking gage (FDR Designs, or equal) and visually inspect all units.

d. Skips and voids in the primary or secondary seals are prohibited and maximum gap at primary/secondary seal interface shall be 1 inch (25.4 mm) in length and 3/32 inch (2.38 mm) in width.

e. Document and record results. Provide additional documentation upon request by the Owner or Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 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.

1.8 WARRANTY

A. Manufacturer's Special Warranty on Ceramic Frit-Coated-Glass Products: Written warranty, made out to Owner and signed by coated-glass manufacturer agreeing to furnish replacements for those coated-glass units whose coatings flake, peel, or crack within the specified warranty period indicated below. Upon notification of such deterioration within the warranty period, furnish replacement glass units for those glass units whose coatings have flaked, peeled or cracked at the convenience of the Owner.

1. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass manufacturer agreeing to furnish replacements for laminated-glass units that develop edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those specified within the warranty period indicated below. Upon notification of such deterioration within the warranty period, furnish replacement glass units for those glass units having edge separation, delamination, and blemishes at the convenience of the Owner.

1. Warranty Period: Five years from date of Substantial Completion.

C. Heat-Soaked Tempered Glass Special Warranty: Executed by the Contractor, manufacturer and the glass installer agreeing to replace glass units that spontaneously break as a result of Nickel Sulfide (NiS) inclusions within the specified warranty period without material or labor charges to the Owner.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Refer to Section 07 06 00.14 "Schedule for Exterior Finishes" and Section 09 06 00.14 "Schedule for Interior Finishes" for the extent of glass types and locations. Glass types indicated on the Drawings are keyed to the Part 3 Glass Schedule Articles at the end of this Section. The Contractor shall confirm the levels of heat-treatment required for each glass type scheduled as contained in "Performance Requirements" and "Quality Assurance" Articles.

2.2 PERFORMANCE REQUIREMENTS

A. General: Provide and install watertight and airtight glazing systems capable of withstanding thermal movement and wind and impact loads without failure of any kind, including loss or breakage of glass, failure of seal or gaskets, exudation of glazing sealants, and excessive deterioration of glazing materials.

B. Glass Design: Glass thicknesses and heat treatments indicated are minimum requirements. Glazing details shown are for convenience of detailing only and are to be confirmed by the Contractor relative to cited standards and final framing details. Confirm glass thicknesses and heat treatments, verified by analysis, as required to meet the performance and testing requirements specified in Section 08 44 13 "Glazed Aluminum Curtain Walls."

C. Thermal and Optical Performance Properties: Provide insulating glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2 inch (13 mm) wide interspace.
2. Center-of-Glass U-Values: NFRC 100 methodology using LBL WINDOW 6.3 computer program, expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).
3. Solar Heat Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL WINDOW 6.3 computer program.
4. Visible Reflectance (Solar Optical) Properties: Center-of-glazing values, according to NFRC 300.

2.3 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); Class 1, clear Class 1, ultra clear low iron with visible light transmission of not less than 91 percent Class 2, tinted as indicated in schedules.

1. Ultra Clear, Low Iron Glass: Where indicated in the schedules clear, low iron glass shall mean low iron products as follows:

    a. AGC Asahi Glass Co. Ltd.; Krystal Klear.
    b. Guardian Industries Corp.; UltraWhite.
    c. Pilkington North America; Optiwhite.
    d. Vitro S.A.B. de C.V. "Starphire."

2. In order to reduce the possibility of glass color range rejection, the supplier of float (primary) glass products shall provide glass for the entire Project from a single facility using stockpiled batch run materials from a single source for the entire Project.
3. Float Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1036, all glass shall be supplied meeting the following quality standards:

    a. Point blemishes - seeds/stones with distortion, stain spots, dirt, surface damage - shall be limited to 0.060 inch (1.52 mm) maximum separated by 12 inches (304.8 mm) minimum.

b. Glass scratch/rubs shall be rejected if detectable at 10 feet (3048 mm).
c. Water blow-off stains, tag residue, and handprints will not be permitted.

2.4 HEAT-TREATED FLOAT GLASS

A. General: Heat-treat glass where the need is determined by thermal stress analyses, by wind load analyses, and where required to meet safety glazing requirements. Heat treated glass shall be heat strengthened, unless otherwise required to be fully-tempered for safety or structural purposes.

B. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of installed glass unit.

C. Sizes and Cutting: Prior to heat treatment, cut glass to required sizes 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. Make all cuts for hardware, access, or glass-mounted trim or accessories before heat treating.

D. Heat-Strengthened Glass: Provide glass complying with ASTM C 1048 Kind HS. Surface compression range shall be between 4,000 psi (27.6 MPa) and 7,000 psi (48.3 MPa) for 1/4 inch (6 mm) thick glass.

1. Heat-Strengthened Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:

a. Chill cracks, roller marks, and picture framing shall not be permitted.
b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet (3048 mm).

E. Fully Tempered Glass: Provide glass complying with ASTM C 1048 Kind FT and meeting the requirements of ANSI Z97.1 for Category A performance and 16 CFR 1201 for Category II performance. Surface compression shall be equal to or greater than 10,000 psi (69 MPa). After tempering, heat-soak 100 percent of all fabricated glass units to European Union Standard EN14179 to reduce the potential for inclusion related glass breakage. Statistical heat soaking shall not be permitted.

1. The appearance of anisotropy, also known as 'leopard spots' • and 'quench patterns', is known to be associated with toughened (tempered) glass under certain polarized lighting conditions. This will not be considered a fault unless it is visible in a range of reasonably typical naturally occurring conditions. The Architect will determine the acceptable range(s) of anisotropy from glass sample submittals. Any visible anistropy is to be oriented in the horizontal direction and not vertically. Coatings applied to tempered glass products shall not exacerbate anisotropy to an unacceptable range(s).

2. Tempered Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:

a. Chill cracks, roller marks, and picture framing shall not be permitted.
b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet (3048 mm).

F. Flatness Tolerances: All heat-treated glass shall be fabricated to the following flatness tolerances. Verification of compliance for overall bow and warp shall be in accordance with ASTM C 1048. Verification of compliance for flatness shall be via an optical scanning device such as LiteSentry or Osprey Series.

1. Overall Bow and Warp: Not greater than the maximum bow and warp tolerances in any direction as listed in ASTM C 1048 Table 2. Localized warp limited to 1/32 inch in 12 inches (0.79 mm in 304.8 mm).
2. Roll Ripple: The deviation from flatness at any peak (peak to valley deviation) shall not exceed 0.003 inches for 6 mm (0.0762 mm for 6 mm) thick glass in the glass center, with leading and trailing edge deviation not to exceed 0.008 inches for 6 mm (0.2032 mm for 6 mm) thick glass.

G. Millidiopter Criteria: Maximum +/- 120 millidiopters overall or the highest overall measurement from the approved visual mockup that is less than +- 120 millidiopter overall whichever is less when viewed outdoors.

2.5 CERAMIC-COATED GLASS

A. Ceramic-Coated Vision Glass: Float glass with ceramic coating applied by silk-screened process and complying with ASTM C 1048, Condition C (other coated glass), Type I (transparent glass, flat), Quality q3 (glazing select); and complying with Specification No. 95-1-31, "Specification for Decorative Architectural Flat Glass" in GANA's "Engineering Standards Manual"; and with other requirements indicated in glass schedules.

1. Provide ceramic coated vision glass at units indicated to receive breakout indicators and where scheduled or shown..

B. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B (spandrel glass, one-surface ceramic coated), Type I (transparent glass, flat), Quality q3 (glazing select), and complying with other requirements indicated in glass schedules.

1. Factory apply opacifier of polyester film laminated to glass with solvent-based adhesive to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA's "Engineering Standards Manual."

2.6 COATED FLOAT GLASS

A. General: Provide coated glass complying with requirements indicated in this Article, under Paragraph "Insulating Glass," and in schedules.

1. Sputter-Coated Float Glass: Float glass with the coating(s) specified in schedules, deposited by magnetron sputtered vacuum deposition process after manufacture and heat treatment. Post-temperable glass coatings will not be permitted on glass thicknesses of

greater than 1/4 inch (6 mm). 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. In order 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. All coated glass shall be provided 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 1 inch (25.4 mm) from the glass unit edge.

        1) Pinholes: At an indoor viewing distance of 10 feet (3048 mm) for non-reflective and reflective low emissivity coatings:

            a) Pinholes greater than 1/16 inch (1.5 mm) in diameter shall not be permitted in 80 percent of the central portion of the vision glass area and separated by greater than or equal to 12 inches (300 mm). Pinholes larger than 3/32 inch (2.4 mm) are not allowed in the outer 20 percent of the perimeter vision glass area and separated by greater than or equal to 12 inches (300 mm).
            b) No more than two readily apparent blemishes are allowed in a 3 inch (75 mm) diameter circle and no more than five readily apparent blemishes are allowed in a 12 inch (305 mm) diameter circle.

        2) Scratches: At an indoor viewing distance of 10 feet (3048 mm) for non-reflective and reflective low emissivity coatings, and 15 feet (4572 mm) for reflective coatings:

            a) Scratches are allowed in 80 percent of the central glass area if not detectable at the viewing distance, and scratches less than or equal to 1 inch (25 mm) are allowed in the outer 20 percent area if not detectable at the viewing distance. Concentrated scratches or abraded areas are not allowed.
            b) 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 distance of 10 feet (3048 mm) for low emissivity 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.
            b) Coating arcing will not be permitted.
            c) Water blow-off stains will not be permitted.
            d) Handprints will not be permitted.
            e) Roller marks shall not be permitted.
            f) Positive and negative air distortion shall not be permitted.
            g) Tag residue shall not be permitted.

3. Edge Deletion Quality Criteria for Coated Glass Layers Used in Insulating Glass Assemblies:

    a. Edge deletion of coating to be uniform in appearance (no skips or streaks) and visually straight around the entire perimeter of the glass unit.
    b. Edge deletion shall remove a minimum of 95% of the coating.
    c. Edge deletion shall be 1/8 inch less than calculated sightline with a tolerance of +/-1/8 inch.
    d. Perform sealant adhesion testing to ensure that the secondary and primary sealants yield acceptable adhesion to edge deleted areas of coated glass products.
    e. Adhesion testing at the edge deleted area of the coated glass products shall be performed intermittently throughout the days production.
    f. Comply with pass/fail requirements of the insulating glass unit manufacturers published guidelines and/or the manufacturers certification audit requirements/recommendations.

2.7 LAMINATED GLASS

A. Laminated Glass: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified, including those in the Glass Schedule.

B. Interlayer: Unless indicated otherwise, provide 0.060 inch (1.5 mm) thick polyvinyl butyral (PVB) sheet or ionoplast sheet interlayer material with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

1. All interlayer furnished for the Project shall have been manufactured by one of the following:

    a. Eastman Chemical Company.
    b. Kuraray.

C. Laminating Process: 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. Fabricate laminated glass to produce glass free of scuff vinyl markings, handprints, tag residue, and foreign substances such as lint, hair, vinyl shavings in the central glass area and the outer 20 percent area when viewed from a distance of 39 inches (1 meter) and 10 feet (3048 mm), respectively. Handprints, tag residue, scuff vinyl markings, and foreign substances must be separated by more than 12 inches (300 mm) if not detectable at less than the viewing distances. Delaminations, blow-ins, short interlayers, and air or gas pockets shall not be permitted in the central glass area. In the outer 20 percent area, delamination will not be permitted; blow-ins, air or gas pockets, and short interlayers shall be limited to a maximum dimension of 3/32 inch (2.38-mm) in diameter, 3/32 inch (2.38-mm) in diameter, and 1/16 inch (1.5-mm) long, respectively. Laminate units as follows:

1. Laminate lites with interlayer in autoclave with heat plus pressure.

2.8 INSULATING GLASS

A. Insulating-Glass Units: Preassembled units, with dehydrated entrapped air, consisting of sheets of glass hermetically sealed at all edges with a black polyisobutylene primary and a black silicone secondary elastomeric sealant. The black silicone secondary elastomeric sealant sightlines (width) shall be uniform for each insulating glass unit and, where exposed in 2, 3, and 4 sided wet glazing assemblies, sized for the highest wind pressure in the facade. The lites of glass shall be separated by dessicant containing black colored aluminum spacers. All insulating glass units shall be IGCC certified to comply with ASTM E 2190 and with requirements specified in this Article and in the Glass Schedule.

1. Provide Kind HS (heat-strengthened) float glass where needed to comply with "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.

2.9 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Provide glazing sealants and sealant primers , having not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Gasket, Blocking, and Spacer Wet Glazing Materials: Silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.

C. Structural and Butt Glazing Sealants: Refer to Section 07 92 00 "Joint Sealants," Article "Elastomeric Joint Sealants," subparagraph "Structural Glazing."

2.10 GLAZING GASKETS

A. Dense Compression Gaskets:

1. Silicone: Continuous extruded silicone with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 1115, Type C. Provide injection molded corners.

B. Soft Compression Gaskets: Continuous extruded expanded foam with, cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 509, Option II, Type II; provide the following:

1. Silicone.

C. Continuous Structural Gaskets/Spacers: Continuous extruded silicone or silicone compatible rubber, with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown. Gaskets/spacers shall be tested for compatibility with silicone sealants and shall be subject to the acceptance of the sealant manufacturer.

2.11 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces, and wet glazing materials, contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Silicone complying with ASTM C 1115 (Type C), blocks, 85 +/- 5 Shore A durometer hardness, 1/16 inch (1.5 mm) less than the channel width, and length based on the face area of the glass unit to be supported in accordance with GANA standards and glass manufacturer recommendations, but not less than 4 inches (101.6 mm).

D. Edge Blocks: Silicone complying with ASTM C 1115 (Type C), blocks, 65 +/- 5 Shore A durometer hardness, minimum 4 inches (101.6 mm) long and sized to allow 1/8 inch (3.18 mm) clearance between edge of glass and block.

2.12 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze 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 standard, to comply with system performance requirements.

1. Edge and Surface Conditions: Comply with the recommendations of AAMA "Structural Properties of Glass" for "clean-cut" edges, except comply with manufacturer's recommendations when they are at variance therewith.

2. Exposed Glass Edges and Surface Condition:

a. Typical: All edges shall be flat with an arrissed edge profile (small bevel of uniform width not exceeding 1/16 inch (1.5 mm) at an angle of approximately 45 degrees to the surface of the glass) with a polished (surface is reflective in appearance similar to the major surface of the glass) surface.

B. Cutting: Do not nip glass edges. Edges may be wheel cut or sawed and seamed at manufacturer's option. For glass to be cut at site, provide glass 2 inches (50.8 mm) larger than required in both dimensions, so as to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat-treated glass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine glass framing, with glazier and glass framing erector present, for compliance with the following:

1. Compliance with the specified manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or 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 stops, glazing channels, and rabbets which will be in contact with the glazing materials immediately before glazing. Loose particles present or resulting from fabrication and cleaning shall be removed by blowing out joints with oil-free compressed air, or by vacuuming joints. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue. Do not allow solvent to air dry without wiping. Use only lint-free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.

1. Prime surfaces to receive glazing compounds. When priming, comply with wet glazing manufacturer's recommendations.

B. Inspect each glass unit immediately before installation. Do not install any units which are improperly sized or have damaged edges, scratches or abrasion or other evidence of damage. Remove labels from glass immediately after installation.

C. Seal vent (breather or capillary) tubes in insulating glass units in accordance with the insulating glass manufacturer's written recommendations.

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.

1. All glass units shall be installed in accordance with the glass manufacturer's recommendations.

a. Field Glazed Structural Silicone Window and Curtain Wall Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite. Align glass unit edges over vertical mullion

continuous structural gasket/spacers and secure with manufacturer's recommended temporary cleats. Structurally seal glass unit to vertical mullions with specified one-part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass lite; remove excess structural silicone from glass and metal substrates. After full cure of structural silicone sealant, remove temporary cleats. Any holes left in the vertical mullions which were caused by the temporary cleats shall be sealed immediately. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass lite faces; remove excess sealant from glass and metal substrates.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances. Adjust as required by Project conditions during installation.

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 is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to surfaces indicated to receive glazing materials. Use primers as determined by preconstruction compatibility and adhesion testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless more stringent requirements are recommended by glass manufacturer. Place blocks to allow water passage to weep holes. Set blocks in thin course of silicone sealant.

1. For Glass Units Less Than 72 inches (1830 mm): 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. For Glass Units 72 inches (1830 mm) 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 edge blocking to prevent glass lites from moving sideways in glazing channel, sized and located to comply with the glass manufacturer's recommendations and the requirements in referenced glazing publications.

1. Edge blocking will not be required at structural glazed window and curtain walls unless specifically required by the glass manufacturer for the conditions shown.

H. Set glass lites with uniform pattern, draw, bow, and similar characteristics, producing the greatest possible degree of uniformity in appearance on the entire exterior wall elevation.

1. Set glass units with void between edge of units and glazing channel.
2. Shadow Box Enclosure Glazing: Remove any dirt, window and curtain wall debris, and construction debris, from interior portion of shadowbox enclosures. Where lubricants are

recommended for the installation of glazing gaskets, use types which will not release volatiles, or leave visible deposits or residues, on inside of spandrel glass units or metal back panels.

I. Where wedge-shaped gaskets are driven into one side of channel to pressurize gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

3.4 FIELD QUALITY CONTROL

A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01 45 17 "Contractor's Quality Control." Field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I shall not preclude Contractor responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

B. Testing Requirements: Refer to Section 08 44 13 "Glazed Aluminum Curtain Walls."

C. Repair or remove and replace Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.5 PROTECTION AND CLEANING

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way and from any source, including natural causes, accidents, and vandalism.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.6 GLASS SCHEDULE

A. Low-E Insulating Vision Glass **(GL14.001)**: Where glass of this designation is indicated, provide low-emissivity insulating-glass units complying with the following:

1. Basis of Design Product: **VITRO; SOLARBAN 60 Starphire+Starphire.** Glazing selection to be verified via energy performance and project thermal requirements.
2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
3. Interspace Content: Air.
4. Indoor Lite: Type I (transparent glass, flat), Class 1 (ultra clear, low-iron) float glass.

    a. Kind HS (heat strengthened), unless Kind FT (fully tempered) is indicated on Drawings or required by code to meet safety glazing requirements.

5. Outdoor Lite: Type I (transparent glass, flat) float glass.

    a. Class 1 (ultra clear, low-iron).
    b. Kind HS (heat strengthened), unless Kind FT (fully tempered) is indicated on Drawings or required by code to meet safety glazing requirements.

6. Low-Emissivity Coating: Solarban 60 sputtered on second surface.
7. Visible Light Transmittance: 74 percent.
8. Winter Nighttime U-Value: 0.29.
9. Solar Heat Gain Coefficient: 0.41.
10. Outdoor Visible Reflectance: 11 percent.

B. Low-E Insulating Vision Glass **(GL14.002)** at Shadow Box: Where glass of this designation is indicated, provide low-emissivity insulating-glass units complying with the following:

1. Basis of Design Product: **VITRO; SOLARBAN 60 Starphire+Starphire.** Glazing selection to be verified via energy performance and project thermal requirements.
2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
3. Interspace Content: Air.
4. Indoor Lite: Type I (transparent glass, flat), Class 1 (ultra clear, low-iron) float glass.

    a. Kind HS (heat strengthened), unless Kind FT (fully tempered) is indicated on Drawings or required by code to meet safety glazing requirements.

5. Outdoor Lite: Type I (transparent glass, flat) float glass.

    a. Class 1 (ultra clear, low-iron).
    b. Kind HS (heat strengthened), unless Kind FT (fully tempered) is indicated on Drawings or required by code to meet safety glazing requirements.

6. Low-Emissivity Coating: Solarban 60 sputtered on second surface.
7. Visible Light Transmittance: 74 percent.
8. Winter Nighttime U-Value: 0.29.
9. Solar Heat Gain Coefficient: 0.41.
10. Outdoor Visible Reflectance: 11 percent.
11. Shadow Box Metal finish and color: As indicated in Section 07 06 00.14 "Schedule for Exterior Finishes."

~~B.~~C. Ceramic-Coated Spandrel Insulating Glass (~~GL14.002~~ **GL14.003**): Where glass of this designation is indicated, provide low-emissivity insulating-glass units complying with the following:

1. Basis of Design Product: **VITRO; SOLARBAN 60, Starphire + Starphire**. Glazing selection to be verified via energy performance and project thermal requirements.
2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
3. Interspace Content: Air.
4. Indoor Lite: Type I (transparent glass, flat), Class 1 (ultra clear, low-iron) float glass.

    a. Kind HS (heat strengthened).
    b. Ceramic Coating Location: Fourth surface.
    c. Color: As indicated in Section 07 06 00.14 "Section for Exterior Finishes."
    d. Provide safety glazing labeling.

5. Outdoor Lite: Type I (transparent glass, flat) float glass.

    a. Class 1 (ultra clear, low-iron).
    b. Kind HS (heat strengthened), unless Kind FT (fully tempered) is indicated on Drawings or required by code to meet safety glazing requirements.

6. Low-Emissivity Coating: Solarban 60 sputtered on second surface.

END OF SECTION 08 80 00