
PART 1 GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This 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. Doors.
 2. Glazed curtain walls.
 3. Storefront framing.
 4. Glazed entrances.
 5. Interior borrowed lites.
- B. Related Sections:
1. Division 1 Section "Sustainable Design Requirements" for all materials.
 2. Division 5 Section "Ornamental Railings" for glass panels in railings.
 3. Division 8 Section "All-Glass Entrances and Storefronts."
 4. Division 8 Section "Revolving Entrance Doors."
 5. Division 8 Section "Mirrors."
 6. Division 8 Section "Glazed Aluminum Curtain Walls" for glazing sealants.

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.
- C. Interspace: Space between lites of an insulating-glass unit.
- D. Sloped Glazing: Glass tilted more than 15° off the vertical.

1.4 QUALITY ASSURANCE

- A. The work of this section shall be performed by a company which specializes in the type of glazing work required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
1. Work shall be performed in compliance with Owner's insurance underwriters' requirements and UL approvals and testing for materials, assemblies and procedures.
- B. Manufacturer shall specialize in manufacturing the type of glazing specified in this section, with a minimum of 10 years of documented successful experience, and have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty.
1. Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source.
 2. Producer of fritted type coatings shall have a minimum of 10 years experience in the production of ceramic frit coating in quantities similar to quantities required for this Project.
- C. 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.
- D. 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.
- E. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

- F. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- G. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- H. 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 "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- I. Safety Glazing Labeling: Where safety glazing labeling is indicated, 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.
- J. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.
- K. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Install glazing in mockups specified in Division 8 Section "Glazed Aluminum Curtain Walls" to match glazing systems required for Project, including glazing methods.
- M. Shadow Boxes:
1. Spandrel area "shadow box" assembly shall be constructed of materials specifically recommended by their manufacturers as being suitable for the application and not containing volatiles which may cause the deposit of visible residue on the interior surface of the spandrel glass.
 2. Assembly shall be subject to test, at the option of the Architect, to demonstrate that the appearance of the assembly will not be adversely affected by the formation of residue.
 3. Assembly shall be ventilated.
- N. 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.
- O. Manufacturer's identification tags or marks are not acceptable on surfaces which will remain exposed to view after installation.
1. Evidence of "patching" after removal of tags or marks is not acceptable.

1.5 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. Delegated Design: Design glass, including comprehensive engineering analysis according to 2010 California Building Code by a qualified professional engineer, using the following design criteria:
1. Design Wind Pressures: Determine design wind pressures applicable to Project according to Wind Tunnel Test report, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Structural Drawings.
 2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 3. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
 - a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
 - b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
 - c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.
 4. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
 5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. 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.
- D. Glazing channel dimensions as shown are intended to provide for necessary minimum bite on glass, minimum edge clearance and adequate sealant (or gasket as indicated) thicknesses, with reasonable tolerances.
1. Contractor is responsible for correct glass size for each opening, within tolerances and necessary dimensions established.
- E. Limit the stresses on structural glazing sealant under full design loads and maximum building deflections, so as to produce sealant stress not exceeding 20 psi in accordance with the sealant manufacturer's instructions.
1. Structural Silicone and Related Structural Components Performance Requirements:
 - a. Wind Pressure Force: Support in tension or shear, but not tension and shear simultaneously.
 - b. Allowable Tension Stress or Shear Stress (but not combined tension and shear stress): Do not exceed 20 psi at design pressures and loads.
 - c. Do not increase allowable stress by 1/3 or other factor for wind load.
 - d. Do not use structural silicone to support dead weight of vertical glass or panels.
 - e. Ultimate Stress Test: Test structural silicone to at least three times stress caused by design conditions.
 - 1) The force per linear inch corresponding to ultimate silicone stress (three times design) shall be transmitted without failure by metal finish (including paint and fritted films), glass coatings, insulated glass edge, laminated glass edge and other components in stress line.
 - f. Adhesive or Cohesive Failure: Not permitted.
 - g. Where glass is supported by structural silicone, demonstrate glass edge construction's (including glass lamination, reflective coating) ability to transmit without failure force per linear inch equal to three times design conditions.

1.6 SUBMITTALS

- A. Submit the following according to Conditions of the Construction Contract and Division 1 Specification Sections.
- B. Product Data: For each glass product and glazing material indicated.
- C. LEED Submittals:
1. MR 4.1 and 4.2 – List of Proposed materials with recycled content: Indicate projected materials cost, projected post-industrial (pre-consumer) recycled content, and projected post-consumer recycled content for each product projected to have recycled content.
 2. MR 5.1 and 5.2 – Product Certificates for Credit: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

3. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
- D. Glass Samples: For each type of glass product; 12 inches (300 mm) square.
- E. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- F. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- G. Glass and Glazing Documentation:
 1. Shall be prepared and approved by glass manufacturer to include but not be limited to locations and types of glass, windload requirements, thermal stress requirements, safety glass locations, compliance with specified and applicable codes, and Contract Documents.
 - a. Submit thermal stress analysis for each interior and exterior glass unit type, each building elevation. The analysis shall clearly indicate all the expected service temperature ranges and effects of partial and full shading on the glass. Append to the analysis a statement signed by glass manufacturer stating that resulting thermal stresses will not reduce "Glass Statistical Factor".
 - b. Submit wind load analysis for each glass unit type, each building elevation. The analysis shall clearly indicate that the glass statistical factor at design wind pressures will not exceed the specified glass statistical factor.
 2. "Glass and Glazing Documentation," as defined above, is required for work of each of the following sections after glass manufacturer has reviewed that "Glass and Glazing Performance Evaluation" prepared by the manufacturer of each of the following:
 - a. Division 8 Section Glazed Aluminum Curtain Wall.
 - b. Division 8 Section Revolving Entrance Doors.
 - c. Division 8 Section All-Glass Entrances and Storefronts.
 - d. Division 8 Section Aluminum Framed Entrances and Storefronts.
 3. "Glass and Glazing Documentation" approved by glass manufacturer will not relieve Contractor from responsibilities and requirements of this section for glass and glazing work required for this Project.
 4. Contractor is responsible for verifying the glass types and locations of installation are in compliance with "Glass and Glazing Documentation" prepared and approved by glass manufacturer.
- H. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- I. Qualification Data: For installers, manufacturers of insulating-glass units with sputter-coated, low-e coatings, glass testing agency and sealant testing agency.
- J. Product Certificates: For glass and glazing products, from manufacturer.
- K. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass, coated glass, insulating glass, glazing sealants and glazing gaskets.
 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
 2. Include UV transmittance test reports for each vision glass product.
- L. Maintenance Data: Shall clearly indicate manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions and precautions against materials and methods which may be detrimental to finishes and performance.
- M. Preconstruction adhesion and compatibility test report.
 1. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
- N. Warranties: Sample of special warranties.
- O. Hazardous Materials Notification: In the event no product or material is available that does not contain asbestos, PCB or other hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

- P. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB), using format in Article 3 of General Conditions.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with General Conditions and Division 1 Section Product Requirements.
- B. 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.
- C. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 PROJECT 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 below 40 deg F (4.4 deg C).
 2. Do not perform glazing when temperature is below 40°F, unless the manufacturer of the glazing materials specifically recommends application of manufacturer's materials at lower temperatures.
 - a. If job progress or other conditions require glazing work when temperatures are below 40°F (or below the minimum temperature recommended by the manufacturer), consult the manufacturer and establish the minimum provisions required to ensure satisfactory work.
 - b. Record in writing to the manufacturer with copy to the Owner, the conditions under which such glazing work was performed and the provisions made to ensure satisfactory work.

1.9 WARRANTY

- A. Comply with General Conditions and Division 1 Section Product Requirements, except extend to 10 years, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:
1. Water leaks.
 2. Air leakage.
 3. Shifting of glass within framed opening.
 4. Migration of edge spacer channel within insulating glass unit.
 5. Breakage due to faulty installation or thermal failures.
 6. Delamination of glass and coating.
 7. Deterioration of laminated glass, including edge separation, edge fogging, or delamination which materially obstructs vision through glass.
 8. Deterioration of ceramic enameled patterned glass, including peeling or uneven color fading.
 9. Deterioration of FPRC Coated Glass (noted as DTG Glass), including peeling, cracking, crazing or uneven color fading.
 10. Deterioration of back painted glass, including peeling, delaminating or uneven color fading.
 11. Spontaneous breakage of tempered glass and all other glass types.
 12. Loose or faulty installation.
 13. Noncompliance with ANSI Standard Z97.1 and CPSC 16 CFR 1201 as required.
 14. Labels or identification in exposed to view areas, except for those required by code or governing authorities.
 15. Sealed glass units seal failure, interpane dusting or misting, internal condensation at temperatures of -20°F and other evidence of hermetic seal failure.
 16. Failure to meet performance requirements of specification in various sections.
- B. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass 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.

- C. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which 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.
- D. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which 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.
- E. Contractor shall be responsible for continuing corrections to the defective work beyond warranty period if initial corrective measures were executed per the requirement as noted above but later found to be inadequate or not acceptable after the specified warranty period.
1. Repair work shall carry same warranty as the initial installation.
 2. Repair warranty shall start after all related repair work is completed.

1.10 EXTRA MATERIAL

- A. Provide 1% of each type and size of glass specified (except clear glass).
1. Deliver in manufacturer's containers, suitable for storing, clearly labeled as to type, size, thickness and location.
 2. Include manufacturer's instructions for care and storage of glass.
 3. Store on the premises where directed.
 4. Additional Construction Stock: Order a minimum of 2% additional units of laminated and insulated glass and a minimum of 3% additional units containing fully tempered glass to cover breakage or damage during construction.
 - a. Provide itemized pricing of all units for Owner purchase option of any unused additional construction stock.

1.11 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing will not be 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 sufficient 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. Preconstruction Distortion Tolerance Testing:
1. With the exception of screened glass, measure each pane of monolithic heat-treated or coated glass of 6 mm thickness or more used in the Project, including glass used in visual mock-ups. Measure the first five (5) screened lites and then measure one (1) additional lite every hour.
 2. Measurement Device: Use LiteSentry measurement system, or equal, for all panes except silk-screened glass, full coverage ceramic fritted glass, glass of greater than 3/8" thickness, or dark tinted 3/8" glass. Use a 3 point trolley, or equal for silk-screened glass, full coverage ceramic fritted glass, glass of greater than 3/8" thickness, or dark tinted 3/8" glass.
 3. Roll Wave Criteria (horizontal): Maximum .003 Center / .008 Edges (Peak to Valley).
 4. Milliopter Criteria: (90% surface) Maximum + or - 125 A, or the highest overall measurement from the approved visual mock-up that is less than + or - 125 A overall, whichever is less.

5. Documentation:
 - a. Document and record results for each pane.
 - b. Tag each pane of glass that falls outside of the maximum distortion limits and certify that these non-conforming glass panes will not be fabricated and supplied to the Project.
 - c. Provide written documentation of the Roll Wave and Millidiopter measurements of the glass used in visual mock-ups before the mock-ups are reviewed by the Owner and Architect for approval.
 - d. Provide additional written documentation upon request by the Owner or Architect.
 6. Bow/Warp Tolerance:
 - a. Maximum $\frac{1}{2}$ of ASTM Specification C1048 or $\frac{1}{32}$ " per lineal foot, whichever is greater.
 - b. Measure every hour on a vertical plane with a metal straight edge.
 - c. Provide recorded written documentation upon request
- C. Preconstruction Insulating Glass Unit Requirements and Sealant and Desiccant Testing:
1. Test insulating glass units.
 2. Butterfly Primary Seal Unit Adhesion Pull Testing:
 - a. Adhesion Criteria: Comply with pass / fail requirements of manufacturer's published guidelines and/or manufacturer's certification audit requirements / recommendations. Minimum pull back to 30 degrees from horizontal with no significant adhesive failure.
 - b. Test one (1) unit each shift and after each carton change and/or project or product change.
 - c. Minimum unit size 24" x 36".
 - d. 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.
 3. Desiccant Temperature Rise Testing:
 - a. Test Criteria: Comply with desiccant manufacturer's written recommendations.
 - b. Test a minimum of once every shift and after each drum change.
 - c. Perform Residual Moisture Test: Minimum temperature rise equal to or greater than 50 degrees Fahrenheit.
 4. Bow / Warp and Air Space Measurement. Concave / Convex.
 - a. Measure bow warp every hour on a vertical plane with a metal straight edge.
 - b. Measure center air space every hour and all units equal to or more than 35 square feet. Measure positive/negative air within the insulating glass unit controlled to plus or minus $\frac{1}{16}$ " at the time of fabrication utilizing a laser, or other device acceptable to the Architect, at a minimum frequency of every hour. Visually check each unit.
 5. Skips and voids in the primary or secondary seals are prohibited and maximum gap at primary / secondary seal interface is 2" length and $\frac{1}{16}$ " in width. The PIB must be continuous with a targeted width of $\frac{5}{32}$ " and minimum width of $\frac{3}{32}$ ".
 6. Documentation:
 - a. Document and record results.
 - b. Tag each Insulating Glass Unit that falls outside of the defined limits and certify that these non-conforming Insulating Glass Units will not be supplied to the Project.
 - c. Provide additional written documentation upon request by the Owner or Architect.
- D. Preconstruction Glass Color Testing:
1. Measure monolithic coated glass and coated insulating glass units.
 2. Establish color target and perform quality color control checks using on-line or off-line spectrophotometer instrumentation (Minolta 2500d / 2600d or equal). Color measurement taken from uncoated side in the central area. Measure the first fifteen (15) panes / units, then measure a minimum of one (1) unit every hour and each product change.
 3. Tolerances for color variation shall be less than 4.5 DE or as defined in ASTM Specification C1376.
 4. Documentation: Document and record results. Tag each pane / unit of glass that falls outside of the maximum color variation limits and certify that non-conforming glass will not be fabricated and or supplied to the Project.

PART 2 PRODUCTS

2.1 UNAUTHORIZED MATERIALS

- A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

- A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.
- B. Substitutions: Comply with Division 1 Section Product Requirements using form in Division 1 Section Substitution Request Form.

2.3 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. 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 of thickness indicated.
 - 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.
- D. Recycled Content: For materials containing post-industrial (pre-consumer) and/or post-consumer recycled content, contractor shall document the cost and percentage (by weight) of each material broken out by post-industrial (pre-consumer) and post-consumer content.
- E. Regional Content: For material that is extracted, harvested or recovered as well as manufactured within 500 miles of the project site – 101 First Street, San Francisco, CA, contractor shall document the cost and percentage (by weight) of each material that is regional.
- F. VOC Content: Adhesive and sealants used inside the waterproofing system and applied onsite shall have VOC content equal to or less than the applicable VOC limits. Refer to Section 01 81 13 / Sustainable Design Requirements for additional information.

2.4 GLASS PRODUCTS

- A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Ultraclear Float Glass: ASTM C1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent and solar heat gain coefficient not less than 0.87.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AFG Industries, Inc.; Krystal Klear.
 - b. Guardian Industries Corp.; Ultrawhite.
 - c. Pilkington North America; Optiwhite.
 - d. PPG Industries, Inc.; Starphire.
- C. Heat-Treated Float Glass: ASTM C1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - a. Measurement Device: LiteSentry measurement system, or equal.
 - b. Roll Wave Criteria (horizontal): Maximum .003 Center / .008 Edges (Peak to Valley).
 - c. Millidiopter Criteria: (90% surface) Maximum + or – 125 A overall, or the highest overall measurement from the approved visual mock-up that is less than + or – 125 A overall, whichever is less.
 - d. Do not exceed maximum warpage in any direction.

- e. Warp and burn per ASTM C1048, Table 2 and localized warp limited to 1/32" in 12". Roll ripple peak to valley deviation shall not exceed 0.003 inches for 6 mm thick glass.
 - 2. For uncoated glass, comply with requirements for Condition A.
 - 3. For coated vision glass, comply with requirements for Condition C (other coated glass).
 - 4. Glass shall be subject to quality control measures as recommended by the glass manufacturer, which at the manufacturer's option may include, but not be limited to, statistical heat soaking, to minimize inclusions which could result in spontaneous glass breakage (such inclusions are defined as material defects by this specification).
 - 5. Sizes and Cutting: Prior to heat treating, cut glass to required sizes as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances.
 - a. Cut and process edges in accordance with glass manufacturer's recommendations.
 - b. Do not cut or treat edges in the field.
- D. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.
- 1. Products: Subject to compliance with requirements, provide as defined in "Glass Type" in this Section.
- E. Polished Wired Glass: ASTM C1036, Type II, Class 1 (clear), Form 1, Quality-Q6, complying with ANSI Z97.1, Class C.
- 1. Products: Subject to compliance with requirements, provide as defined in "Glass Types" in this Section.
 - 2. Mesh: M2 (square).
- F. Ceramic-Coated Vision Glass: Heat-treated float glass, Condition C; with ceramic enamel applied by silk-screened process; complying with Specification No. 95-1-31 in GANA's Tempering Division's "Engineering Standards Manual" and with other requirements specified.
- 1. Products: Subject to compliance with requirements, provide as defined in "Glass Types" in this Section.
- G. Reflective-Coated Vision Glass: ASTM C1376, coated by vacuum deposition (sputter-coating) process, and complying with other requirements specified.
- 1. Products: Subject to compliance with requirements, provide as defined in "Glass Types" in this Section.
- H. Ceramic-Coated Spandrel Glass: ASTM C1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.
- 1. Products: Subject to compliance with requirements, provide as defined in "Glass Types" in this Section.
- I. Reflective-Coated Spandrel Glass: ASTM C1376, Kind CS; coated by vacuum deposition (sputter-coating) process, and complying with other requirements specified.
- 1. Products: Subject to compliance with requirements, provide as defined in "Glass Types" in this Section.

2.5 LAMINATED GLASS

- A. Manufacturers: Subject to compliance with requirements, provide as defined in "Glass Types" in this Section.
- B. Laminated Glass: ASTM C1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
- 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
 - a. Solutia, Inc/St. Louis, Missouri or Butacite, E. I. du Pont de Nemours & Co., Inc/Wilmington, Delaware.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.
 - 4. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.
 - a. Provide type and thickness of glass sheets as shown or specified.
 - b. 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.
 - c. Cut and process edges in accordance with glass manufacturer's recommendations.
 - d. Do not cut or treat edges in the field.
 - e. Edge seal laminated glass in accordance with manufacturer's literature.
- C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.6 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, provide as defined in "Glass Types" in this Section.
- B. 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 seal, with polyisobutylene and silicone primary and secondary.
 - 2. Spacer: Aluminum with powdered metal paint finish in color selected by Architect.
 - 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.
- D. DTG Coated Glass: Apply fluoropolymer resinous coating directly to glass surface in custom colors indicated, by manufacturer's standard heat treatment process.

2.7 GLAZING GASKETS

- A. Glazing gaskets shall be continuous extrusions, with integral projection to engage into and remain inter-locked with the continuous recess in the metal glass holding members and shall be designed to remain firmly in position and to provide a continuous and watertight contact between the glass and the adjacent elements at all levels of the specified performance criteria for dynamic loading and building or thermal movements.
 - 1. Fixed Glazing Gaskets: Shall be extruded (cellular or dense) neoprene, EPDM or silicone conforming to ASTM C864 for dense; ASTM C509, Type II for cellular; and ASTM C1115, Type C, Class F, 45 to 55 Shore A durometer hardness, Grade 5 for silicone.
 - a. Cellular gaskets shall be designed to provide 20% to 36% compression when installed.
 - b. Length and locations as required and recommended in writing by the applicable glass manufacturer.
 - c. Gasket shall be smooth and of sizes indicated on the drawings.
 - 2. Wedge Glazing Gaskets: Shall be extruded dense neoprene, EPDM or silicone conforming to ASTM C1115, Type C, having between 65 and 75 Shore A durometer hardness.
 - a. Lengths and locations shall be as required and recommended in writing by the applicable glass manufacturer.
 - b. Gasket shall be smooth and of sizes indicated on the drawings.
- B. Inside and outside glazing gaskets for any one lite or glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs.
- C. Size: Glazing gaskets shall be in lengths or units to provide a minimum crowd-in of 1° to 2° to ensure against pull-back at corners, or as otherwise recommended by manufacturer and shall be designed to produce glass edge pressure of 4 to 10 pounds per linear inch.

2.8 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the requirement of Division 7 Section "Joint Sealants":
 - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will 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. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
 - 4. Colors of Exposed Glazing Sealants: Match Architect's samples.
- B. Glazing Sealant: 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; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. Pecora Corporation; 890.
 - d. Tremco Incorporated; Spectrem 1.
 - 2. Applications: As required by curtain wall system design.

- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
- Products: Subject to compliance with requirements, provide one of the following:
 - Dow Corning Corporation; 756 SMS, 791, 795, 995.
 - GE Advanced Materials - Silicones; SilGlaze II SCS2800, SilPruf NB SCS9000, SilPruf SCS2000, UltraPruf II SCS2900.
 - Pecora Corporation; 864, 895, 898.
 - Tremco Incorporated; Spectrem 2, Spectrem 3.
 - Sika Corporation: Sika 550 SG.
 - Applications: As required by curtain wall system design.
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
- Products: Subject to compliance with requirements, provide one of the following:
 - Dow Corning Corporation; 799.
 - GE Advanced Materials - Silicones; UltraGlaze SSG4000, UltraGlaze SSG4000AC.
 - Tremco Incorporated; Proglaze SSG, Tremsil 600.
 - Applications: As required by curtain wall system design.

2.9 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:
- AAMA 804.3 tape, where indicated.
 - AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
 - Product: Polyshim II Tape by Tremco, Inc.
 - AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
 - Product: 440 II Tape by Tremco, Inc.
- 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:
- AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.10 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 contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- Silicone Type: Extruded type conforming to ASTM C1115, Type C, 85 ±5 Shore A hardness.
 - Required only where structural silicone glazing occurs at the sill.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, adhesive-backed on one face only, tested for compatibility with specified glazing compound.
 - Silicone or EPDM spacers required if in contact with silicone sealant.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- Type: Extruded neoprene conforming to ASTM D395/Method B of between 50 (+ or -5) Shore A durometer hardness.
 - Lengths and Locations: As required and recommended in writing by glass manufacturer.

- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.11 FABRICATION OF GLAZING UNITS

- A. Fabricate 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 system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.
- D. Cutting: Obtain sizes from shop drawings or by field measurement.
 1. Cut glass to fit each opening with edge clearances and bite on glass as recommended by glass manufacturer.
 2. Do not nip glass edges.
 3. Factory cut heavy heat absorbing glass (3/8" and above) and heavy plate or float glass (1/2" and above).
 4. Edges may be wheel cut or sawed and seamed at manufacturer's option.
 5. Do not cut, seam, nip or abrade glass after heat-tempering.

2.12 GLASS TYPES

- A. General: Each type of glass specified below shall comply with "General Requirements" for glass specified in this section.
- B. **Glass GL-1A:** Clear low-e insulating vision unit.
 1. Exterior Pane: clear glass, thickness TBD, heat-strengthened.
 - * 2. Air Space: 1/2", w/ black spacer and sealant color.
 3. Interior Pane: clear glass, thickness TBD, tempered.
 4. Coating: Reflective Low-E coating on #2 surface equal to Viracon VRE 1-59, VRE 1-54 or Guardian Sunguard AG-50; TBD in visual mockup.
 5. Overall Thickness: TBD.
 6. Location: Typical tower flat vision glass.
- C. **Glass GL-2A:** Insulating spandrel unit.
 - * 1. Exterior Pane: clear glass, thickness TBD, heat-strengthened.
 2. Air Space: 1/2", w/ black spacer and sealant color.
 3. Interior Pane: clear glass, thickness TBD, tempered, with Custom color ceramic floodcoat opacifier on #4 surface, TBD in visual mockup.
 4. Coating: Reflective Low-E coating on #2 surface to match GL-1A.
 5. Overall Thickness: TBD, to match GL-1A.
 6. Location: Typical tower flat spandrel glass.
- D. **Glass GL-3A:** Clear low-e insulating vision unit, or laminated insulated, as required.
 - * 1. Exterior Pane: clear glass, thickness TBD, heat-strengthened.
 2. Air Space: 1/2", w/ black spacer and sealant color.
 3. Interior Pane: clear glass, thickness TBD, tempered, or laminated, as required.
 4. Coating: Reflective Low-E coating on #2 surface equal to Viracon VRE 1-59, VRE 1-54 or Guardian Sunguard AG-50; TBD in visual mockup.
 5. Overall Thickness: TBD, to match GL-1A.
 6. Location: Typical tower radiused vision glass.
- E. **Glass GL-4A:** Insulating spandrel unit, or laminated insulated, as required.
 - * 1. Exterior Pane: clear glass, thickness TBD, heat-strengthened.
 2. Air Space: 1/2", w/ black spacer and sealant color.
 3. Interior Pane: clear glass, thickness TBD, tempered, or laminated, as required with Custom color ceramic floodcoat opacifier on #4 surface, TBD in visual mockup.

4. Coating: Reflective Low-E coating on #2 surface to match GL-3A.
 5. Overall Thickness: TBD, to match GL-1A.
 6. Location: Typical tower radiused spandrel glass.
- F. **Glass GL-5A:** Clear low iron insulating vision unit.
1. Exterior Pane: low iron clear glass, thickness TBD, heat strengthened or tempered as required.
 2. Air Space: 1/2", w/ black spacer and sealant color.
 3. Interior Pane: low iron clear glass, thickness TBD, tempered.
 4. Coating: Reflective Low-E coating on #2 surface equal to Viracon VE 1-85.
 5. Overall Thickness: TBD.
 6. Location: Vision glass, flat, Retail exterior wall on Floors 1 and 5.
- G. **Glass GL-5B:** Clear low iron vision unit, tempered or heat-strengthened as required.
1. Thickness: TBD, as required for structural performance.
 2. Location: Vision glass, flat, Lobby exterior wall.
- H. **Glass GL-5C:** Clear low iron vision unit, tempered or heat-strengthened as required.
1. Overall Thickness: TBD, as required for structural performance.
 2. Location: Vision glass, radiused, Lobby exterior wall.
- I. **Glass GL-6A:** Insulating spandrel unit.
1. Exterior Pane: clear glass, thickness TBD, heat-strengthened.
 2. Air Space: 1/2", w/ black spacer and sealant color.
 3. Interior Pane: clear glass, thickness TBD, tempered, with Custom color ceramic floodcoat opacifier on #4 surface, TBD in visual mockup.
 4. Coating: Reflective Low-E coating on #2 surface to match GL-2A.
 5. Custom ceramic frit pattern on #2 surface; see drawings for frit pattern.
 6. Overall Thickness: TBD, to match GL-1A.
 7. Location: Spandrel glass, flat, elevator shaft.
- J. **Glass GL-6B:** Insulating spandrel unit, or laminated insulated, as required.
1. Exterior Pane: clear glass, thickness TBD, heat-strengthened.
 2. Air Space: 1/2", w/ black spacer and sealant color.
 3. Interior Pane: clear glass, thickness TBD, tempered, or laminated, as required with Custom color ceramic floodcoat opacifier on #4 surface, TBD in visual mockup.
 4. Coating: Reflective Low-E coating on #2 surface to match GL-2A.
 5. Custom ceramic frit pattern on #2 surface; see drawings for frit pattern.
 6. Overall Thickness: TBD, to match GL-1A.
 7. Location: Spandrel glass, radiused, elevator shaft.
- K. **Glass GL-7:** Clear low iron laminated glass.
1. Inner Lite: Clear low iron, thickness as required.
 2. Interior Pane: 0.060 clear polyvinyl butyral.
 3. Outer Lite: Low iron, thickness as required.
 4. Custom ceramic frit pattern on #3 surface.
 5. Location: Gondola base enclosure on Plaza.
- L. **Glass GL-8:** Clear vision glass units; 1/2" or 3/4" glass, heat-strengthened or tempered as required.
1. Location: Interior glass doors, sidelites and transoms.
- M. **Glass GL-9:** Clear vision glass, thickness as required, heat-strengthened or tempered as required.
1. Ceramic frit horizontal banding pattern as indicated on drawings.
 2. Location: Interior glass at Public Lobby and Retail.
- N. **Glass GL-10:** Low-iron clear vision glass at revolving doors.
1. Type **GL-10A:** 1/2", tempered, at doors.
 2. Type **GL-10B:** Laminated at curved walls, thickness per manufacturer's requirements.
 3. Type **GL-10C:** Laminated at roof, thickness per manufacturer's requirements.

- O. **Glass GL-11:** Low-iron clear insulated vision glass, heat-strengthened or tempered as required.
 1. Opacifier on #3 surface, color to be determined.
 2. Location: Exterior doors in curtain wall at exits.
- P. **Glass GL-12:** Clear vision glass, heat-strengthened or tempered as required.
 1. Thickness: Minimum 1/4".
 2. Locations: Interior glass as noted on drawings.
- * Q. **Glass GL-13:** Clear vision glass, tempered.
 1. Thickness: Minimum 1/2".
 2. Locations: Glass railings.

PART 3 EXECUTION

3.1 PRE-INSTALLATION MEETING

- A. Prior to the start of the Work, meet at the Project site to review the following:
 1. Material selections.
 2. Methods and sequence of installation.
 3. Glazing procedures standard of workmanship.
 4. Quality control requirements.
 5. Evaluation of suitability of specified compounds and sealants for anticipated weather conditions.
 6. Coordination with other trades.
 7. Other pertinent topics related to the Work.
- B. The meeting shall include the Owner, the Architect, the Contractor, the installer, primary component materials suppliers, and any other subcontractors whose work requires coordination with the Work.

3.2 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.

3.3 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Prime surfaces only where required by the sealant manufacturer to receive glazing compound.
 1. When priming is required, comply with manufacturer's printed recommendations.
- C. 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 will leave visible marks in the completed work.

3.4 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. Standards: Unless otherwise shown or specified, comply with recommendations and requirements of GANA "Glazing Sealing Systems Manual" and "Glazing Manual".
 - a. For the installation of tinted glass comply with manufacturer's recommendations.
 2. Inspect each piece of glass immediately before installation.
 - a. Do not install any pieces which are improperly sized or have damaged edges, scratches or abrasion or other evidence of damage.
 - b. Remove labels from glass when instructed.
 3. Do not use 2 different glazing materials in the same joint system unless the manufacturer of each material has stated in writing that manufacturer's material is fully compatible with the other material.

4. 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 and operable sash) without failure of any kind including loss or breakage of glass, failure of seal, exudation of sealant and excessive deterioration of glazing materials.
 5. Insulating Glass: Set insulating glass units with void between edge of units and glazing channel.
 - a. Do not glaze insulating glass units with glazing compounds which might have a deleterious effect on the seal of the units.
 - b. Completely conceal edge binding of insulating glass units in glazing gaskets.
 6. Appropriate UL markings shall remain permanently visible.
- 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 is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and 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. Set blocks in thin course of compatible sealant suitable for heel bead.
- 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. Face Shims: Provide face shims for all glass sizes larger than 50 united inches, to separate glass from stops, except where continuous glazing gaskets or felts are provided.
 1. Locate face shims opposite each other and no farther than 24" apart and no closer than 12" to a corner.
 2. Make bite of spacer on glass a nominal 1/4" or greater.
- I. 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.
 1. Do not use with structural glazing conditions.
- J. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- K. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- 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.
- 3.5 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 and then to jambs. Cover horizontal framing joints by applying tapes to jambs and 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.

3.6 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.

3.7 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.

3.8 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.9 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass.
 - 1. Do not apply markers to glass surface.
 - 2. Remove nonpermanent labels and clean surfaces.
 - 3. Clean excess sealant or compound from glass and framing members immediately after application using solvents or cleaners recommended by manufacturers.

- B. Protect glass from contact with contaminating substances resulting from construction operations.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing 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 buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- 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 in writing by glass manufacturer.

3.10 FIELD QUALITY CONTROL

- A. After completion of exterior glazing and nominal curing of sealants and glazing compounds, test for water leaks as specified under Division 8 Section Glazed Aluminum Curtain Wall.

END OF SECTION