
1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, equipment, tools, and services necessary for glass and glazing work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ANSI Z97.1, For Safety Glazing Materials used in Buildings - Safety Performance Specifications and Methods of Test.
- .2 ASTM C920, Specification for Elastomeric Joint Sealants.
- .3 ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- .4 ASTM C1376, Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
- .5 ASTM D2240, Test Method for Rubber Property - Durometer Hardness.
- .6 ASTM E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.
- .7 CAN/CGSB-12.1-M, Tempered or Laminated Safety Glass.
- .8 CAN/CGSB-12.3-M, Flat, Clear Float Glass.
- .9 CAN/CGSB-12.8, Insulating Glass Units.
- .10 CAN/CGSB 12.11, Wired Safety Glass.
- .11 Glass Association of North America (GANA) Glazing Manual.
- .12 NFPA 80, Standard for Fire Doors and Other Opening Protectives.
- .13 ULC CAN4 S104-M, Standard Method for Fire Tests of Door Assemblies.
- .14 ULC CAN4 S106-M, Standard Method for Fire Tests of Window and Glass Block Assemblies.

1.3 **DESIGN REQUIREMENTS**

- .1 Glass design:
- .1 Design glass using a probability of breakage of 8 lites per 1000 at the first application of design load.
- .2 Perform stress analysis. Design units to accommodate live, dead, lateral, wind, seismic, handling, transportation, and erection loads.

- .3 Perform a thermal stress analysis on each glass unit with Low-E coating and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
 - .4 Perform a thermal stress analysis on each insulating thermal unit and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
 - .5 Where required, design glazing units so as not to allow thermal stress fracture due to heat build-up behind insulating units.
 - .6 Roller wave:
 - .1 Heat treated flat glass to be by horizontal (roller hearth) process with inherent roller wave distortion parallel to the bottom edge of the glass as installed.
 - .2 Maximum peak to valley roller wave 0.08 mm in the central area and 0.20 mm within 267 mm of the leading and trailing edge or 100 millidiopter over 95% of the glass surface.
 - .3 Maximum bow and warp 0.79 mm per 300 mm.
 - .4 Roll distortion is to run parallel to the width dimension when installed in the building.
 - .7 Coordinate with applicable Sections as required to meet intended energy and performance requirements for insulating glass units.
- .2 Structural glazing:
- .1 Carry out design of structural silicone joints by rational analysis including all movements specified herein. Maximum stress shall not exceed 138 kPa (20 psi) in tension or shear for short term loading. Maximum stress in shear for long term loading due to the dead load of glass shall not exceed 7 kPa (1 psi) or the limit imposed by sealant manufacturer, whichever is less.
 - .2 The joint shall be essentially rectangular in shape and shall include no internal corners which could precipitate tearing or create high local stresses.
 - .3 Single Source Responsibility for Sealants, Gaskets and Other Glazing Accessories: In order to ensure consistent quality of performance, provide all glazing sealants and seals from a single manufacturer.
 - .4 Preconstruction Compatibility and Adhesion Testing: Submit to sealant manufacturer, samples of each glass, gasket, glazing accessory and glass-framing member that will contact or affect glazing sealants for compatibility and adhesion testing. Schedule submission of test samples to provide sufficient time for testing and analysis of results to prevent delay in the progress of work.
- .3 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
 - .4 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
 - .5 Design glazing in accordance with City of Toronto Green Development Standard - Bird Friendly Development Guidelines.
 - .6 Fire Protective Rated Glass: Each lite shall bear permanent, nonremovable label of ULC certifying it for use in tested and rated fire protective assemblies.

1.4 SUBMITTALS

- .1 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 indicating as a minimum:
 - .1 Fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
 - .2 To sealant manufacturer for their review and approval of tensile bead contact/bite dimension and thickness.
- .2 Samples:
 - .1 Submit following samples in accordance with Section 01 33 00
 - .2 Submit one sample of each type of glass.
 - .1 300 x 300 mm of each type of insulating glass unit, complete with each different Low-E coating.
 - .2 300 x 300 mm of each colour of spandrel glass.
 - .3 300 x 300 mm of Mirror.
 - .4 300 x 300 mm of fire rated glass.
 - .5 300 x 300 mm of each colour of insulating panels.
 - .6 300 x 300 mm of glass film and security film.
- .3 Certificates:
 - .1 Submit manufacturer's certification that glass and glazing materials are compatible.
 - .2 Design glass balustrades to meet OBC Supplementary Guideline SB-13.
- .4 Reports:
 - .1 Submit compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
 - .2 Compatibility test report from manufacturer of insulating glass edge sealant, indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, setting blocks, edge blocks and any other material that contacts or can affect the edge seal.
- .5 IGMAC Compliance Audit: Submit in accordance with Section 01 33 00, a written certification of successful completion of a Compliance Audit within the last six months.
- .6 Extended warranty: Submit extended warranty signed and registered by the manufacturer providing the warranty in the name of the Owner for the timeframe and coverage specified in this Section.

1.5 **QUALITY ASSURANCE**

- .1 Insulating glass unit fabricators shall be a certified member of the Fenestration and Glazing Industry Alliance (FGIA). FGIA members must participate in the certification program and shall have successfully passed a Compliance Audit within the last six months.
- .2 Installers qualifications: Perform work of this Section by a company that has a minimum of five years proven experience in the installation of glazing units of a similar size and nature.
- .3 Fire Protective Rated Glass: Each lite shall bear permanent, nonremovable label of ULC certifying it for use in tested and rated fire protective assemblies.
- .4 Each lite fire rated wire glass shall bear permanent, nonremovable label of ULC certifying it for use in tested and rated fire protective assemblies.

1.6 **SITE CONDITIONS**

- .1 Glaze with compounds, sealants, or tapes only when glazing surfaces are at temperatures over 4°C, and when positive that no moisture is accumulating on them from rain, mist, or condensation.
- .2 When temperature of glazing surfaces is below 4 °C, obtain from Consultant and material manufacturer approval of glazing methods and protective measures which will be used during glazing operations.

1.7 **EXTENDED WARRANTY**

- .1 In accordance with Section 08 43 00 and 08 44 00

2 **Products**

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Glass manufacturers:
 - .1 AGC Flat Glass.
 - .2 Cardinal Glass Industries.
 - .3 Guardian Industries.
 - .4 Viracon Inc.
 - .5 Vitro Architectural Glass (formerly PPG Industries Ltd.)
 - .6 Or approved alternative.

2.2 MATERIALS

- .1 General:
 - .1 All materials under work of this Section, including but not limited to, primers, coatings, sealers, sealants, adhesives and cleaners are to have low VOC content limits.
 - .2 All coatings of a similar type shall be applied in a single production run to ensure colour match.
 - .3 Edges of glass shall be free from spalls, flake chips or rough chips which would be either visible or compromise the adhesion of the exterior weather seal or reduce the strength of glass when subjected to temperature differentials.
- .2 Float glass (**FGL**): CAN/CGSB-12.3-M; clear, glazing quality, minimum 6 mm thick. Clear or tinted as indicated. Heat strengthened as required.
- .3 Tempered glass (**TG**):
 - .1 **TGL.1** (Interior glass): CAN/CGSB-12.1-M, Type 2, Class B, Category II, clear tempered, glazing quality, minimum 6 mm thick in insulated glass units, low iron content, colourless and minimum 10 mm thick in interior screens. 'Acuity' by Vitro Architectural Glass (formerly PPG Industries Ltd.).
 - .2 **TGL.2** (Exterior glass): CAN/CGSB-12.1-M, clear, tempered, glazing quality, minimum 6 mm thick in insulated glass units, low iron content, colourless; 'Acuity' by Vitro Architectural Glass (formerly PPG Industries Ltd.).
- .4 Laminated glass (**LGL.1**): to CAN/CGSB-12.1, Category II, consisting of top layer of 9 mm thick clear tempered glass, 0.8 mm thick clear PVB interlayer, and bottom layer of 9 mm thick clear tempered glass. Total thickness: 18.8 mm thick.
- .5 Laminated glass (**LGL.2**): to CAN/CGSB-12.1, Category II, consisting of top layer of 10 mm thick, clear low iron tempered glass, 1.2 mm thick white translucent PVB interlayer, and bottom layer of 10 mm thick, clear low iron tempered glass. Overall glass thickness to be 21.2 mm minimum.
- .6 Fire rated glass (**FRGL**):
 - .1 (**FRGL.1**): 20 min. to 90 min. fire rating tested to ULC CAN4 S104-M and ULC CAN4 S106-M, 5 mm thick or as otherwise noted on Door Schedule with appropriate labelling stating fire rating and approval, clear polished glass. Firelite by Nippon Electric Glass Company Ltd. or approved alternative.
 - .2 (**FRGL.2**): **20 min. to 3 hr. fire rating tested to ULC CAN4 S104-M and ULC CAN4 S106-M, 5 mm thick or as otherwise noted by the Consultant, impact safety resistance to ANSI Z97, impact safety-rated glazing material with fire-rated surface-applied film, Firelite NT by Nippon Electric Glass Company Ltd, or 'Pyran Platinum F' by Pilkington Group Limited (distributed by Technical Glass Products) or approved alternative.**
- .7 Spandrel glass (**SGL**): ASTM C1048, Condition B, 6 mm thick heat strengthened glass, with water-based silicone emulsion coating applied to backside, 'Opaci-Coat 300' by ICD High Performance Coatings or approved alternative. Colour: To the later selection of the Consultant.

- .7 Ceramic frit glass (**CFG**): 6 mm thick unless otherwise indicated, glass with colour of ceramic frit coating applied to surface #1. Colours: 'Viraspan V-175 High Opacity White'. Screen transferred to glass surface and heat cured. 'Silk-Screen, Viraspan Design' by Viracon, 'Birdsmart Glass' by Vitro Architectural Glass (formerly PPG Industries Ltd.) or approved alternative. Provide the following frit patterns:
 - .1 **Standard: Bird-Friendly frit pattern as indicated on Drawings, applied on surfaces as indicated on Drawings.**
 - .2 **Alternate: Allow for 10% of glazing with ceramic frit noted on drawings to be custom bird-friendly frit pattern, supplied by Architect.**
- .11 Glass film (**GF**): 50-80% opacity, 'Fasara - 'Frost Light Grey' by 3M or approved alternative. Application pattern as indicated on glazing schedule.
- .8 Security film (**SF**):
 - .1 Glass surface area 1.8 sq. m. or greater: ANSI Z97.1, Class A, UL 972; 8 mil micro-layered polyester film. 'ScotchShield Ultra S800 Series' by 3M Film or approved alternative.
 - .2 Glass surface less than 1.8 sq. m.: ANSI Z97.1, Class A, UL 972; 14 mil monolithic polyester film. 'Safety S140' by 3M Film or approved alternative.
 - .3 Perimeter anchoring system for film as recommended by film manufacturer for intended end use.
- .9 Insulating glass units:
 - .1 To CAN/CGSB-12.8-M, ASTM E2190 and IGMA requirements utilizing approved stainless steel edge spacer. Dual and triple seal with a PIB primary seal and silicone secondary seal.
 - .2 To comply with IGMA labelling requirements to be considered certified. Materials, excluding the glass, shall be from the same manufacturer as those employed for the certification of the insulating glass units.
- .10 Argon gas: 100% pure. Argon gas to be used to fill air space at all insulated glass units.
- .11 Low-E coating (Soft coat): ASTM C1376, high performance sputtered low-E coating. Provide insulating glass units with low-E coating edge deletion and low-E coating. Apply low-E coating to surface three unless otherwise indicated. 'Solarban 70' by Vitro Architectural Glass (formerly PPG Industries Ltd.) Or approved alternative
- .12 Glazing and rebate primers, sealants, sealers, and cleaners: Compatible with each other. Type as recommended by sealant, spline, and glass manufacturer.
- .13 Glazing sealant: Silicone sealant as recommended by glazing manufacturer. Verify compatibility with insulating glass unit secondary sealant.
- .14 Glazing sealant (structural glazing - exterior):
 - .1 Silicone, One Part in accordance with ASTM C920, Type S or M, Grade NS, Class 25.
 - .2 Structural glazing tensile bead: 'Proglaze SSG' by Tremco or 'Dowsil 795' by Dow Consumers Solution.

- .3 Structural glazing weather bead: 'Spectrem 2 Sealant' by Tremco or 'Dowsil 795' by Dow Consumers Solution.
- .4 Structural glazing (factory glazed): Two-part, neutral cure silicone sealant, 'Proglaze II' by Tremco or 'Dowsil 983' by Dow Consumers Solution.
- .5 Colour: Colour to be selected by the Consultant from full colour range.
- .15 Glazing sealant (structural glazing - interior):
 - .1 Silicone, One Part in accordance with ASTM C920, Type S or M, Grade NS, Class 25.
 - .2 Structural glazing tensile bead: 'Proglaze SSG' by Tremco or 'Dowsil 795' by Dow Consumers Solution.
 - .3 Structural glazing (factory glazed): Two-part, neutral cure silicone sealant, 'Proglaze II' by Tremco or 'Dowsil 983' by Dow Consumers Solution.
 - .4 Colour: Colour to be selected by the Consultant from full colour range.
- .16 Security sealant: ASTM C920; Type S, Grade NS, Class 50. One-component, self-priming, neutral cure silicone sealant. 'Dowsil 995' by Dow Consumer Solution or approved alternative.
- .17 Heel & toe bead: Silicone sealant as recommended by glazing manufacturer.
- .18 Glazing gasket: 'Visionstrip' or Polyshim II' by Tremco Ltd., glazing seal, size as recommended by manufacturer.
- .19 Glazing tape: 'Polyshim II' glazing tape EPDM shim.
- .20 Glazing tape (fire rated glass): Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 1,393 sq. inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.
- .21 Glazing splines: EPDM or neoprene, extruded shape to suit glazing channel retaining slot, colour as selected.
- .22 Setting blocks (regular): EPDM, 80 - 90 Shore A durometer hardness to ASTM D2240, sized to suit glazing method, glass unit weight and area.
- .23 Setting Block (Structural Glazing): Silicone setting blocks with Shore, Type A durometer hardness of 85, plus or minus 5 to ASTM D2240, sized to suit glazing method, glass unit weight and area.
- .24 Edge blocks: EPDM, 60-70 Shore A Durometer hardness, self adhesive on face, sized with 3 mm clearance from glass edge and spanning glass thickness(es).
- .25 Glass presence markers: Easily removable, non-residue depositing.
- .26 Screws, bolts and fasteners: Type 304 stainless steel.

2.3 — **GLAZING AND FILM SCHEDULE**

- ~~.1 Glass and film types shall be as indicated on Drawings unless otherwise required due to thermal stress analysis.~~

2.3 GLAZING AND FILM SCHEDULE

- .1 General: Glass types shall be as indicated below and on Drawings unless otherwise required due to thermal stress analysis.**
- .2 GL-1: Double glazed unit consisting of 6 mm thick clear TGL.2 outside with Low E coating on surface #2, 10% air and 90% argon filled air space, 6 mm thick clear TG.2 inside. 25 mm maximum overall thickness.**
- .3 GL-2: Double glazed unit consisting of 6 mm thick clear TGL.2 outside with bird friendly ceramic frit on surface #1 and Low E coating on surface #2, 10% air and 90% argon filled air space, 6 mm thick clear TGL.2 inside. For use at exterior doors. 18 mm maximum overall thickness.**
- .4 SB: Double glazed unit consisting of 6 mm thick clear TGL.2 outside with bird friendly frit on surface #1 and Low E coating on surface #2, 10% air and 90% argon filled air space, 6 mm thick clear TGL.2 inside. For use at shadow box locations. 44 mm maximum overall thickness.**
- .5 SGL: SGL outside, air space, TGL.2 inside. 25 mm overall thickness.**
- .6 FRGL: used at fire rated interior screens.**
.1 FRGL.1: 1.5 hr fire resistance rating, 5 mm thick.
.2 FRGL.2: 3 hr fire resistance rating, 5 mm thick.
- .7 TGL: Where indicated.**
.1 TGL.1: Minimum 6 mm thick for interior insulated glazed screens, and minimum 10 mm thick for interior single glazed screens.
.2 TGL.2: Minimum 6 mm thick low iron tempered glass for exterior insulated glass units.
- .8 LGL: Where indicated.**
.1 LGL.2: Minimum 10 mm thick low iron tempered glass.
- .9 GG: Glass Guards;**
.1 LGL-1: Laminated glass for interior glass guards (GG), 16.8 mm thick.
.2 LGL-2: Laminated exterior glass guards, 16.8 mm thick .
- .10 GF/SF: Glass Film**
.1 Glass film (GF): Film system at interior screens, for use at interior glazed screens and door lites where indicated. Layouts as per Drawings

.2 *Security film (SF):Film system at interior screens, for use at interior glazed screens and door lites where indicated. Layouts as per Drawings*

.11 *SPG: used at interior screens.*

2.4 FABRICATION

- .1 Verify glazing dimensions on Site.
- .2 Clearly label each glass lite with maker's name and glass type. Ensure labels are easily removable, non-residue depositing type. Do not remove labels until after Work is accepted by Consultant.
- .3 Fabricate glazing not less than 3 mm smaller than rebate size in either dimension; allow for edge spacers, shims, and setting blocks as necessary.
- .4 Work shall have smooth finished surfaces free from distortion and defects detrimental to appearance and performance.
- .5 Carefully make and fit details. Take special care with exposed finished work to produce a neat and correct appearance to the Consultant's acceptance.
- .6 Grind and polish a 1.5 mm arris to both edges of exposed glazing at locations where glazing is not encapsulated in framing and where edges are exposed to occupants.
- .7 Fabricate argon filled thermal units with air space filled minimum 90% with argon gas.
- .8 Grind a 1.5 mm arris to the front corner of edges of mirrors which are to be set into ceramic tile. Provide polished pencil round edges to frameless surface-mounted mirrors.
- .9 Provide bird warning glass in accordance with City of Toronto Green Development Standard - Bird Friendly Development Guidelines. Style as selected by Consultant.

3 Execution

3.1 EXAMINATION

- .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.
- .2 Verify that openings for glazing are correctly sized and within tolerance.
- .3 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

- .4 Laminated glass edges shall be completely covered by tape to protect against sealants and water if required by manufacturer.

3.2 **PREPARATION**

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.3 **INSTALLATION**

- .1 Provide glazing in accordance with FGIA recommendations. Provide continuous contact between glazing tapes and gasket to the glazing.
- .2 Install glazing to the work of Sections 08 11 13, and 08 44 00.
- .3 Provide neat, straight sight lines. Trim excess glazing tape flush with top of stops and fixed leg of frames.
- .4 Remove protective coatings, glazing stops, clean rebate and glass contact surfaces with solvent, wipe dry.
- .5 Apply primer/sealer to contact surfaces, prior to glazing.
- .6 Apply glazing tape as per manufacturer's instructions including recommended corner sealant.
- .7 Use setting blocks at 1/4 points and spacers to centre glass unit in frame.
- .8 Install glazing in accordance with reviewed shop drawings and manufacturer's written instructions. Install glazing with full contact and adhesion at perimeter. Maintain edge clearance recommended by glass manufacturer.
- .9 Apply a continuous heel bead of sealant around perimeter of inboard lite of the sealed unit and the metal framing.
- .10 Re-install glazing stops ensuring continuous contact and rattle-free installation. Do not distort glass. Trim tape protruding more than 2 mm above stop.
- .11 Install glazing gasket in accordance with manufacturer's recommendations.
- .12 Do not cut or abrade tempered, heat treated, or coated glass.
- .13 Install glass presence markers in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.

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- .14 Remove, dispose of, and replace broken, cut, abraded glass, and defective glass including but not limited to production dimples, roller wave or marks, tong marks, chips, cracks, etc.
 - .15 Exterior glass: Glaze units with gasket on exterior side and glazing tape on interior side. Seal gap between glazing and stop with sealant to depth equal to bite of frame. Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
 - .16 Structural glazing: Glaze units in accordance with reviewed shop drawings and in accordance with manufacturer's written instructions.
 - .17 Interior glass: Glaze interior glass using glazing gasket glazing tape.
 - .18 Fire rated glass:
 - .1 Install fire rated glass in accordance with ULC and NFPA 80 requirements
 - .2 Place setting blocks located at quarter points of glass with edge block no more than 150 mm from corners.
 - .3 Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
 - .4 Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
 - .5 Place glazing tape on free perimeter of glazing in same manner described above.
 - .6 Install removable stop and secure without displacement of tape.
 - .7 Install so that appropriate ULC markings remain permanently visible.
 - .19 Balustrade glazing
 - .1 Install glass balustrades to extent, locations, sizes and details shown.
 - .2 Install glass with bottom edge, in pocket to depth minimum 10% of exposed height.
 - .3 Maximum vertical space between ends of glass lights or between ends of glass lights and building walls shall be 20 mm except where shown otherwise.
 - .4 Mount glass rigidly in base pocket to proper spacing, level, alignment and plumb, using silicone setting blocks, shims and dental cement as recommended by manufacturer.
 - .5 Apply thin bead of silicone along top edge of cement.
 - .6 Refer to Section 05 52 00 balustrades system.
 - .20 Install bird warning glass in accordance with City of Toronto Green Development Standard - Bird-Friendly Development Guidelines.
 - .21 Glass film
 - .1 Install glass film with adhesive, applied in accordance with film manufacturer's instructions.
 - .2 Place without air bubbles, creases or visible distortion.
 - .3 Fit tight to glass perimeter with razor cut edge.
 - .22 Security film:
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- .1 Install security film with adhesive, applied in accordance with film manufacturer's instructions.
- .2 Place without air bubbles, creases or visible distortion.
- .3 Fit tight to glass perimeter with razor cut edge.
- .4 Apply security sealant from perimeter of glass units in accordance with manufacturers written instructions to achieve specified level of security.

3.4 CLEANING

- .1 Immediately remove sealant and compound droppings from finished surfaces.
- .2 Remove labels, protective material, and glass presence markers from prefinished surfaces.
- .3 Clean glass surfaces with cleaning agents and methods in accordance with Manufacturer's written instructions.
- .4 Do not wash glass film for 30 days after installation.
- .5 Do not use bristle brushes on glass film.

END OF SECTION