

This specification is written according to the Construction Specifications Institute (CSI) 3-Part Format. The specification can be customized for your project by including details for the products you are specifying. Text in blue italics is intended to be altered to identify the specific product you selected.

Vitrum Glass Group does not assume any responsibility for the adequacy of this guide. The user is solely responsible for determining the suitability of Vitrum's products, recommendations and advice to ensure the products and services will be safe and suitable for end-use conditions. The user must confirm applicable local building codes and design requirements.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide transparent and translucent glass glazing for general and special purpose applications.
- B. Provide double glazed Insulated Glass Units.
- C. Provide triple glazed Insulated Glass Units.
- D. Provide the following types of glass: float, fritted, heat strengthened, impact resistant, laminated, and tempered glass.
- E. Provide the following types of glass coatings:
 - 1. Low-E sputter coated by vacuum deposition.
 - 2. Reflective pyrolitic coatings
- F. Provide back painted glass and glazing as indicated.
- G. Provide fritted glass as indicated.
- H. Provide the following type of films for glazing systems:
- I. Provide the glazing accessories as indicated and as required for a complete installation.
- J. Prior to ordering glazing products coordinate the work of this section with Section 07 92 00 Joint Sealants [Division 7] to ensure sealants and caulking specified there are compatible with sealant specified in insulated glass units.

1.2 RELATED SECTIONS

- A. 05 52 00 Metal Railings.
- B. 05 50 00 Metal Fabrications.
- C. 08 10 00 Metal Doors and Frames.
- D. 08 21 00 Wood Doors.
- E. 08 41 00 Aluminum Framed Entrances and Storefront.
- F. 08 44 13 Glazed Aluminum Curtain Walls.
- G. 08 51 00 Metal Windows.
- H. 08 51 13 Aluminum Windows.
- I. 08 51 23 Steel Windows.
- J. 08 52 00 Wood Windows.
- K. 08 52 13 Metal-Clad Wood Windows.
- L. 08 52 16 Plastic-Clad Wood Windows.
- M. 08 53 00 Plastic Windows.
- N. 08 53 13 Vinyl Windows.
- O. 08 60 00 Roof Windows and Skylights.

- P. 14 21 00 Electric Traction Elevators.
- Q. 14 24 00 Hydraulic Elevators.

1.3 REFERENCES

Note to Specifier: Edit standards and coordinate them with the standards of products specified.

- A. ANSI Z97.1 American National Standard for Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- B. ASTM C162 Standard Terminology of Glass and Glass Products.
- C. ASTM C1036 Standard Specification for Flat Glass.
- D. ASTM C1048 Standard Specification for Heat-Treated Flat Glass -- Kind HS, Kind FT Coated and Uncoated Glass.
- E. ASTM C 1349 Standard Specification for Architectural Flat Glass Clad Polycarbonate.
- F. ASTM C1376 Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass.
- G. ASTM C1464 Standard Specification for Bent Glass.
- H. ASTM E1300 Standard Practice for Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load.
- I. ASTM E2188 Standard Test Method for Insulating Glass Unit Performance.
- J. ASTM E2189 Standard Test Method for Testing Resistance to Fogging in Insulating Glass Units.
- K. ASTM E2190 Standard Specification for Insulating Glass Unit Performance and Evaluation.
- L. CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials.
- M. CAN/CGSB-12.1-M Tempered or Laminated Safety Glass.
- N. CAN/CGSB-12.2-M Flat, Clear Sheet Glass.
- O. CAN/CGSB-12.3-M Flat, Clear Float Glass.
- P. CAN/CGSB-12.4-M Flat, Heat Absorbing Glass.
- Q. CAN/CGSB-12.8-M Insulating Glass Units.
- R. CAN/CGSB-12.10-M Light and Heat Reflecting Glass
- S. Insulating Glass Manufacturers Alliance (IGMA) Glazing Guidelines.
- T. Insulating Glass Manufacturers Association of Canada (IGMAC) Glazing Guidelines.
- U. GANA Glazing Manual; Glass Association of North America.
- V. GANA Sealant Manual; Glass Association of North America.

1.4 ABBREVIATIONS & ACRONYMS

- A. ANSI: American National Standards Institute
- B. ASTM: American Society for Testing and Materials
- C. CAN/CGSB: Canadian General Standards Board
- D. CPSC: Consumer Products Safety Commission
- E. CSA: Canadian Standards Association
- F. FT: Fully Tempered
- G. GANA: Glass Association of North America
- H. HS: Heat-strengthened

- I. ICC: International Code Council
- J. IGCC: Insulating Glass Certification Council
- K. IGMA: Insulating Glass Manufacturers Alliance
- L. IGU Insulating Glass Unit (sealed unit).
- M. LBNL: Lawrence Berkeley National Laboratories
- N. LEED: Leadership in Energy & Environmental Design
- O. NFRC: National Fenestration Rating Council
- P. USGBC: U.S. Green Building Council

1.5 DEFINITIONS

- A. Double Glazed - Insulated Glass Units (IGU) Surface Numbers:
 - Surface 1 - Exterior surface of outer pane (surface facing outdoors of outboard lite)
 - Surface 2 - Interior surface of outer pane (surfacing facing indoors of outboard lite)
 - Surface 3 - Exterior surface of inner pane (surface facing outdoors of inboard lite)
 - Surface 4 - Interior surface/room side of inner pane (surface facing indoors of inboard lite).
- B. Triple Glazed - Insulated Glass Units (IGU) Surface Numbers:
 - Surface 1 - Exterior surface of outer pane (surface facing outdoors of outboard lite).
 - Surface 2 - Interior surface of outer pane (surfacing facing indoors of outboard lite).
 - Surface 3 - Exterior surface of middle pane (surface facing outdoors of middle lite).
 - Surface 4 - Interior surface of middle pane (surface facing indoors of middle lite).
 - Surface 5 - Exterior surface of inner pane (surface facing outdoors of inboard lite).
 - Surface 6 - Interior surface/room side surface of inner pane (surface facing indoors of inboard lite).
- C. Air space: The space between the lites of glass in an insulating glass unit. This space may be specified to contain air or argon gas.
- D. Low-E (Emissivity): Low-emissivity coated glass has various combinations of metal, metal oxide and metal nitride layers that are nearly invisible to the eye. This extremely thin coating is applied to the glass substrate after the float and annealing process. The low-e coating reflects radiant heat, keeping radiant heat on the side of the glass where it originated. Radiant heat originating from indoors in winter is reflected back inside, while heat radiation from the summer sun is reflected away, keeping it cooler inside.
- E. LSG (Light to Solar Gain): Is the ratio between the SHGC and VLT. It provides a gage of the relative efficiency of different glass or glazing types in transmitting daylight while blocking heat gains. The higher the number, the more light transmitted without adding excessive amounts of heat.
- F. SC (Shading Coefficient): An alternative measure of the heat gain through glass from solar radiation. SC is an older term being replaced by SHGC. A lower SC indicates lower solar heat gain. The SC is a ratio of the solar heat gain through a specific glass product in relation to the solar heat gain through a lite of 1/8" (3mm) clear glass. For reference, clear uncoated glass of 1/8" (3mm) thickness is given a value of 1.0.
- G. SHGC (Solar Heat Gain Coefficient): The portion of directly transmitted and absorbed solar energy that enters into the building's interior. The lower the solar heat gain coefficient, the less solar energy transmitted into the building.

- H. VLT (Visible Light Transmittance): The percentage of total visible light that is transmitted through the glass. The lower the number, the less visible light transmitted. Some glazing applications benefit from high visible light while others require lower VLT to reduce glare and overheating.

1.6 GLASS TYPES

- A. Annealed Glass: Glass in its unprocessed form without internal stresses caused by heat treatment, such as rapid cooling, or by toughening or heat strengthening.
- B. Float Glass: A sheet of glass made by floating molten glass on a bed of molten metal. This gives the glass a uniform thickness and very flat surfaces. Float glass is slowly cooled to produce annealed glass.
- C. Heat Soaked Glass: Glass that has been tested using heat soaking. The heat soak test or heat soak process is used to minimize the risk of spontaneous breakage of tempered glass caused by nickel sulfide (NiS) inclusions.
- D. Heat Strengthened Glass: Produced with surface and edge compression levels that are lower than fully tempered glass. Heat strengthened glass does not meet safety glazing requirements. The lower compression levels yield a product that is twice as strong as annealed glass with a large break pattern that typically remains engaged in the glazing pocket, decreasing the possibility of fallout. Heat strengthened glass is typically used in applications that require additional strength and resistance to thermal breakage but do not require safety glazing.
- E. Laminated Glass: A type of safety glass that is made by bonding two or more layers of glass together with layers of polyvinyl butyral (PVB) or ionoplast (SGP). This creates a single sheet of glass. When broken, the interlayer keeps glass layers bonded and prevents them from breaking apart. The added rigidity and stiffness of SGP allows it to maintain its structural integrity even when fully broken.
- F. Safety Glass: Glass that has been tempered or laminated and is less likely to cause injury due to its additional strength and break pattern.
- G. Tempered Glass: A form of safety glass that has been heat-treated to have either a minimum surface compression of 10,000 psi or an edge compression not less than 9,700 psi in accordance with the requirements of ASTM C 1048. Tempered glass is approximately four times stronger than annealed glass and can withstand greater thermal stresses and impact. When broken tempered glass will break into small pieces that are less likely to cause injury.
- H. Toughened Glass: Alternative name for tempered glass, commonly used outside of North America. See tempered glass definition.
- I. Wired Glass: Glass in which a thin metal wire mesh has been embedded. Wired glass is weaker than unwired glass due to the incursions of wire into the glass structure. Wired glass can often cause heightened injury in comparison to unwired glass and should not be used as a safety product. Wired Glass may be specified as a fire-rated glazing option in jurisdictions that still permit it.

1.7 PERFORMANCE REQUIREMENTS – GENERAL

Note to Specifier: The performance of insulating glass units (IGUs) is affected by several factors including the type of glass specified (float glass, tempered glass), the color of the glass, the coating specified (Low E), and on which surface the coating is placed (No. 2, No. 3, No. 4), back painting if any, the type of IGU selected (double glazed or triple glazed), and the unit's orientation (north, south, east, west). To obtain the performance required the designers can select one of two paths for ensuring IGUs meet their requirements. Vitrum Glass Group has modeling software to assist the design professional in selecting appropriate glazing systems to meet specific project requirements.

Method One: Identify the performance measures required (U-Value, VLT and SHGC) and in consultation with the glazing manufacturer, select glazed units that can meet those performance requirements.

Method Two: Select the desired glazing combinations (glass color, sealed unit type, back painting or fritting required), and in consultation with the glazing manufacturer, determine the performance capabilities of the units selected.

Refer to Schedules in Part 4 of this document to assist with glass selection.

1.8 PERFORMANCE REQUIREMENTS – LOCATION 1

Note to Specifier: For units indicated below insert the exposure, elevation or location of the unit (i.e. podium, amenities building, north, south, etc). All performance values are center-of-glass. Delete performance requirements that are not applicable.

- A. Insulating Glass Unit #1 (IGU-1): Double Glazed Unit Location: [_____]
- 1. Visible Light Transmittance: [__-__%] [60-70%] [70-75%]
 - 2. Exterior Reflectance: [Input Exterior Reflectance %]
 - 3. Winter U-Value: [Input U-Value]
 - 4. Solar Heat Gain Coefficient (SHGC): [Input SHGC]
 - 5. Light to Solar Gain Ratio (LSG): [Input LSG]
 - 6. Sound Transmission Class: [Input STC]

1.9 PERFORMANCE REQUIREMENTS – LOCATION 2

- A. Insulating Glass Unit #2 (IGU-2): Double Glazed Unit Location: [_____]
- 1. Visible Light Transmittance: [__-__%] [60-70%] [70-75%]
 - 2. Exterior Reflectance: [Input Exterior Reflectance %]
 - 3. Winter U-Value: [Input U-Value]
 - 4. Solar Heat Gain Coefficient (SHGC): [Input SHGC]
 - 5. Light to Solar Gain Ratio (LSG): [Input LSG]
 - 6. Sound Transmission Class: [Input STC]

1.10 PERFORMANCE REQUIREMENTS – LOCATION 3

- A. Insulating Glass Unit #3 (IGU-3): Triple Glazed Unit Location: [_____]
- 1. Visible Light Transmittance: [__-__%] [60-70%] [70-75%]
 - 2. Exterior Reflectance: [Input Exterior Reflectance %]
 - 3. Winter U-Value: [Input U-Value]
 - 4. Solar Heat Gain Coefficient (SHGC): [Input SHGC]
 - 5. Light to Solar Gain Ratio (LSG): [Input LSG]
 - 6. Sound Transmission Class: [Input STC]

1.11 SUBMITTALS

- A. Product Data:

1. Include manufacturer's installation and maintenance instructions.
 2. Submit data on exterior and interior sealant proposed for use.
- B. Shop Drawings: Shop Drawings shall be signed and sealed by a structural engineer licensed to practice in the jurisdiction specified. Engineer to provide Letters of Assurance indicating compliance with the building code specified.
1. Letters of Assurance: Engineer who seals Shop Drawings will submit Schedules S-B and S-C to the Coordinating Registered Professional (CRP):
 - a. Initial Shop Drawing Submission: Submit Schedule S-B, "Assurance of Professional Design and Commitment for Field Review."
 - b. After Completion of Field Reviews: Submit Schedule S-C, "Assurance of Professional Field Review and Compliance."
 2. Provide Shop Drawings indicating:
 - a. Graphic layout of signs.
 - b. Paint Colors.
 - c. Frit patterns.
 - d. Extent and locations of specialty glass.
- C. Samples: Submit three 300 mm (12 inch) square samples of each type of glass specified, except clear monolithic glass products.
- D. Certification: Submit documentation certifying that glass meets special requirements indicated.

1.12 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacture's instruction for receiving, handling, storing and protecting glass and glazing materials.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged container with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
- D. Exercise exceptional care to prevent edge damage to glass and damage/deterioration to coating on glass.
- E. Where insulating glass units will be exposed to substantial altitude changes, comply with Fabricator's recommendations for venting and sealing.

1.13 QUALITY ASSURANCE

- A. Source Quality Control: Glass and glazing products specified in this Section shall be supplied from a single fabricator.
- B. Manufacturers: Fabrication processes, including, insulating, laminated, screen-printing and tempering shall be completed by a single Fabricator with a minimum of ten (10) years of fabrication experience and be IGMA or IGMAC certified.
- C. Mock-ups:
 1. Before glazing, build mock-ups for [each glass product] [sealed unit] [tempered glass unit] [laminated glass unit] [laminated/tempered/ fritted glass combinations] [reflective glass] indicated to verify selections and to demonstrate aesthetic effects and qualities of materials and execution.
 2. Construct mock-ups with glass and glazing systems specified, including typical lite size, framing systems and glazing methods, and accessories, including air barrier, membrane flashing and metal flashing.

3. Notify Architect [Consultant] [] days in advance of dates when mock-ups will be available for viewing.
4. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work. Accepted mock-ups may become part of the completed work if undisturbed at the time of Substantial Completion [Performance].

1.14 PROJECT CONDITIONS

- A. Do not proceed with glazing when ambient and substrate temperature conditions are outside limits recommended by the glazing material manufacture and when glazing channel substrates are wet from rain, frost, condensation or other sources.
- B. Installation of glass products at ambient air temperatures below 4 degrees C is prohibited.

1.15 WARRANTY

- A. Provide manufacturer's standard one (1) year warranty from date of manufacture on Heat Strengthened, Tempered, Painted and Fritted Glass.
- B. Provide Fabricator's five (5) year warranty from date of manufacture on laminated glass.
- C. Provide Fabricator's five (5) year warranty from date of manufacture on float mirror.
- D. Provide Fabricator's five (5) year warranty from date of manufacture for insulating glass units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specifications the following primary glass manufacturers are acceptable:
 1. PPG Industries.
 2. Guardian Industries.
 3. Saint-Gobain.

2.2 FABRICATORS

- A. Subject to compliance with specifications the following fabricators are acceptable:
 1. Vitrum Glass Group, Vitrum Industries Ltd. 9739 201 Street Langley, BC V1M 3E7
www.vitrum.ca. T: 604.882.3513.

2.3 GLASS

- A. Glass Products General: Products shall comply with ANSI/ASTM/CGSB Standards and requirements.
- B. Glass 1 (GL-1): Safety (Tempered) Glass: Tempered; Class B, float or plate glass, clear; conforming to CAN/CGSB 12.11, minimum thickness as indicated or as required by Code.
- C. Glass 2 (GL-2): Polished Wired Glass: Type 1 (polished both sides); Style 3 (square wire mesh); conforming to CAN/CGSB 12.11. Thickness: 6 mm (1/4 in.).
- D. Glass 3 (GL-3): Float Glass: Type Architectural glazing quality, conforming to CAN/CGSB 12.3 / ASTM C1036, minimum thickness as indicated or as required by Code.
- E. Glass 4 (GL-4): Safety (Tempered, Laminated) Glass: Type 1, tempered laminated; [Class B], float or plate glass, conforming to CAN/CGSB 12.1, minimum thickness as indicated or as required by Code. [Thickness: 6 mm (1/4 in.)].

Recommendation to Specifier: Fabricated glass (holes, notches, cut-outs) and large panels typically require a minimum of 0.060 PVB interlayer, for other applications 0.030 may be suitable and in some applications 0.090 will be required, check with fabricator to determine suitability of the product.

1. Interlayer: 0.030 [0.60] [0.90] mm thick, 'SonicGuard™' by Vitrum Industries.

- F. Glass 5 (GL5): Fritted Glass: Type 2, tempered; Class B, float or plate glass, clear; conforming to CAN/CGSB 12.11. [Match Architect's {Consultant's} sample].

2.4 SPECIALTY GLASS

Note to Specifier: Fire rated glass and impact resistant glass, are considered specialty products. Specifiers are directed to the manufacturers of those products to obtain additional information on the products.

- A. Glass 6 (GL-6): Fire Rated Glass: To achieve a rating of [60] [90] minutes. [Specify hose spray resistance].
- B. Glass 7 (GL-7): Impact Resistant Glass: To resist and impact of [___ pound / kilo] force.
- C. Glass 8 (GL-8): Ballistic Glass: Glass Laminate [Glass-Clad Polycarbonate] Thickness: [3/4 in.] to [3.5 in.] [19mm] to [76mm].

2.5 SKYLIGHTS

Note to Specifier: Structural engineer may require thicker glass or custom make-ups to meet snow load and structural requirements. Glass thicknesses specified below are common minimums.

- A. Skylight Glazing: Insulated Glass Unit with interior laminated glass
1. Exterior lite:
 - a. Glass Type: Tempered. [_____].
 - b. Thickness: 6 mm (1/4 in.). [_____].
 - c. Colour: Clear, match Architect's [Consultant's] sample.
 - d. Frit: _____.
 - e. Low E coating: As specified below, on No. 2 surface.
 2. Spacer: 13 mm (1/2 in.) argon filled [air filled].
 3. Interior lite:
 - a. Glass Type: Annealed [Heat Strengthened] .
 - b. Glass Thickness: 3 mm (0.16 in.). Colour: Clear. [_____].
 - c. Interlay: 0.030, [0.060] [0.090] PVB.
 - d. Glass Thickness: 3mm (0.16in.). Colour: Clear. [_____].

2.6 CANOPY GLAZING

Note to Specifier: Structural engineer may require thicker glass or custom make-ups to meet snow load and structural requirements. Glass thicknesses specified below are common minimums.

- A. Canopy Glazing:
1. Top Layer: 6mm [___] Tempered Glass.
 - a. Color: Clear [_____].
 2. Interlayer: 0.060 [0.090] PVB [SGP].
 - a. Color: Clear [white] [_____].
 3. Bottom Layer: 6mm [___] Tempered Glass.
 - a. Color: Clear [_____].
 4. Overall Thickness: 12mm [_____].

2.7 INSULATED GLASS UNITS

- A. Insulated Glass Units: Shall conform to CAN/CGSB 12.8/ASTM E 2190; certified through the Insulating Glass Manufacturer's Association of Canada (IGMAC), with dual seal type edge construction to maintain a hermetic seal. Provide tempered or laminated glass in sealed units where required by code or other applicable standards.

Note to Specifier: Not all glass types and glass coatings can be combined. Select glass substrate and glass coating from same primary manufacturer. Refer to Part 4 – Schedules.

Review performance requirements with Fabricator prior to selecting glass. Fabricator can assist designer in selecting types of glazing that can meet the designer's performance requirements.

Delete coatings from surfaces on which they are not required. Not all low-e coatings can be used on the interior lite. Contact fabricator for further guidance.

Refer to Definitions for glass type selection criteria.

- B. Glass Manufacturers: Unless indicated otherwise glass used for manufacture of sealed units shall be by PPG [Guardian] [Saint-Gobain].

- C. IGU Type 1: Double Glazed – Clear Glass.

1. Exterior lite:

- a. Glass Type: [Annealed/Float] [Tempered] [Heat Strengthened] [Heat Soaked]
- b. Thickness: 6 mm (1/4 in).
- c. Glass Substrate: Clear, match Architect's [Consultant's] sample.
- d. Low E coating: As specified below, on No. 2 [No. 3] surface.

2. Air Space: 13 mm (1/2 in.) argon filled [air filled].

3. Interior lite:

- a. Glass Type: [Annealed/Float] [Tempered] [Heat Strengthened] [Heat Soaked]
- b. Thickness: 6mm (0.25 in.). Colour: Clear. [_____]

- D. IGU Type 2: Double glazed – Tinted Glass.

1. Exterior lite:

- a. Glass Type: Tempered [Heat Strengthened] [Heat Soaked]
- b. Thickness: 6 mm (1/4 in).
- c. Glass Substrate: Tinted, match Architect's [Consultant's] sample.
- d. Low E coating: As specified below, on No. 2 [No. 3] surface.

2. Air Space: 13 mm (1/2 in.) argon filled [air filled].

3. Interior lite:

- a. Glass Type: [Annealed/Float] [Tempered] [Heat Strengthened] [Heat Soaked]
- b. Thickness: 6 mm (1/4 in).
- c. Glass Substrate: Clear [Tinted], match Architect's [Consultant's] sample.
- d. Low E coating: As specified below, on No. 3 surface.

- E. IGU Type 3 – Triple Glazed:

1. Exterior lite:

- a. Glass Type: [Annealed/Float] [Tempered] [Heat Strengthened] [Heat Soaked]

- b. Thickness: 6 mm (1/4 in).
- c. Glass Substrate: Clear [Tinted], match Architect's [Consultant's] sample.
- d. Low E coating: As specified below, on No. 2 surface.
- 2. Air Space: 13 mm (1/2 in.) argon filled [air filled].
- 3. Middle lite:
 - a. Glass Type: [Annealed/Float] [Tempered] [Heat Strengthened] [Heat Soaked]
 - b. Thickness: 4 mm (0.16 in.).
 - c. Glass Substrate: Clear [Tinted], match Architect's [Consultant's] sample.
 - d. Low E coating: As specified below, on No. 3 surface.
- 4. Air Space: 13 mm (1/2 in.) argon filled [air filled].
- 5. Interior lite:
 - a. Glass Type: [Annealed/Float] [Tempered] [Heat Strengthened] [Heat Soaked]
 - b. Thickness: 4 mm (0.16 in.).
 - c. Glass Substrate: Clear [Tinted], match Architect's [Consultant's] sample.
 - d. Low E coating: As specified below, on No. 2 [No. 3] [No. 4] [No. 5] surface.

2.8 SEALS

Note TO SPECIFIER: Select primary sealant, secondary sealant, and spacer bars that are the same color for aesthetic purposes.

- A. Primary Seal: Polyisobutylene. The target width of the primary seal shall be 5/32" (3.97mm). There shall be no voids or skips in the primary seal. Color: black [gray].
- B. Secondary seal: Silicone or polysulphide, minimum thickness 1/16" (1.59mm). Color: black [gray].
- C. Sealed Unit Tolerances:
 - 1. Double glazed insulating unit: overall unit thickness tolerance measured 6" down and 1" in from the outside corner shall be -1/16" (1.59mm) / +1/32" (0.79mm) for a 1". Units constructed with patterned or laminated glass shall be +/- 1/16" (1.59mm).
 - 2. Up to a maximum of 3/32" of the spacer bar may be visible above the primary seal.

2.9 SPACERS

Note TO SPECIFIER: For aesthetic reasons use of black primary and secondary sealants is highly recommended, with a black anodized aluminum spacer or black Vitrum UltraBar™ Plus.

Note to Specifier: Organic foam spacers are not recommended or commonly used in commercial applications. This product should only be used for small windows in single family residential projects with PVC windows.

- A. General: Spacer bar shall be of rigid construction, filled with molecular sieve desiccant and have four (4) continuous bent corners with one (1) or more straight connectors.
- B. Spacer Type 1: Manufacturer's standard aluminum spacer with mill finish [anodized black].
- C. Spacer Type 2: Vitrum Ultrabar™, manufacturer's standard warm edge spacer black [gray].
- D. Spacer Type 3: Structural Sealant Glazing (SSG): anodized black aluminum spacer [black Ultra Bar Plus] spacer, with a black primary sealant and black secondary silicone.

2.10 SPANDREL PANELS

Note to Specifier: Coordinate with architectural details. For spandrel panels the recommend clearance between Opaci-Coat and the back panel and insulation is 2" inches, the minimum distance is 1" inch.

- A. Spandrel Panel #1 (SP-1): Single pane of monolithic glass, back painted.
 - 1. Glass: [Color] [thickness] [glass type] [heat strengthened] [tempered].
 - 2. Back Paint: Color: _____. Ceramic Frit [ICD OpaciCoat 300].
- B. Spandrel Panel #2 (SP-2): Insulating Glass Unit:
 - 1. Exterior Glass Lite: [Tempered] [Heat Strengthened] [Heat Soaked].
 - a. Thickness: 6 mm (1/4 in).
 - b. Colour: Clear [Tinted], match Architect's [Consultant's] sample.
 - c. Low E coating: As specified below, on No. 2 surface. [OR]
 - d. Paint: Colour _____.
 - 2. Air Space: Argon [Air] filled.
 - 3. Interior Glass Lite: [Thickness] [Glass Type] [Heat Treatment]
 - 4. Spandrel Glass Coating: [Opaci Coat] [Ceramic Frit] [Color], #4 [#3] Surface.
- C. Spandrel Panel #3 (SP-3): Glass – Insulation – Metal Panel.
 - 1. Exterior Glass Lite: [Thickness] [Glass Type] [Tempered] [Float] [Laminated]
 - 2. Coating: # 2 Surface [paint colour]: [_____]
 - 3. Insulation: Semi rigid mineral wool insulation, conforming to Code requirements for fire rated assemblies, with a mass of 1.22 kg/m². Acceptable products: Enertek 1200, Fibrex 1240, Roxul RW40, or approved alternative.
 - 4. Interior Panel: Gypsum Board, thickness as indicated. [Window manufacturer's standard aluminum panel].

2.11 COATED VISION GLASS, LOW E COATINGS, SILICONE COATINGS

Note TO SPECIFIER: Low Emissivity coatings can be applied to the number 2, 3, 4, or 5 surface of an insulated glass unit. In Insulated Glass Unit articles, specify which surface is intended to receive the coating. The location of the coating will affect its performance, the default location is surface 2 which will balance winter and summer performance. See addendum for help selecting coating types.

- A. Coatings shall comply with ASTM C 1376 Standard for Pyrolitic and Vacuum Deposition Coatings on Glass.
- B. Coated products to be magnetically sputtered vacuum deposition (MSVD) unless specified otherwise.
- C. Low E Coating Type 1: [_____]
- D. Low E Coating Type 2: [_____]
- E. Low E Coating Type 3: [_____]
- F. Low E Coating Type 4: [_____]

2.12 FRITTED - CERAMIC COATINGS

- A. Fritted Glass: Conforming to ASTM C 1048 Standard Specification for Heat-Treated Flat Glass.
- B. Frit Color: _____ As selected by Architect [Consultant].

- C. Frit Pattern: _____ [Custom pattern as indicated] as selected by Architect [Consultant] or from manufacturer's standard architectural patterns.
- D. Percentage of Covering: _____.

2.13 FILMS

Note to Specifier: The application of films to sealed units is not recommended because this would void the warranty on the sealed unit. Films are suitable for single glazed surfaces only. Insert film specifications here if required.

- A. Film #1: Anti-Graffiti Film: [_____]. ___ mm thick, manufactured by [_____].
- B. Film #2: Frosted Film: [_____]. ___ mm thick, manufactured by [_____].
- C. Film #3: Colored film: [_____]. ___ mm thick, manufactured by [_____].

2.14 FABRICATION

- A. Glass Fabrication.
- B. Laminated Glass products to be fabricated in an autoclave. Product shall follow ASTM Standards.
- C. Edge Deletion: When low-e coating or Opaci Coat are used within an insulating glass unit, coating shall be edge deleted to completely seal the coating within the unit. The edge deletion shall be uniform in appearance (visually straight) and remove >95% of the coating.

2.15 TOLERANCES

- A. Tempered Glass Fabrication Tolerances.
 - 1. Glass to be annealed, heat-strengthened, fully tempered or heat soaked and fully tempered as required to meet all applicable codes and/or thermal stress and wind loads.
 - 2. Heat Treated Glass to be horizontally processed with inherent roll wave distortion pattern parallel to the bottom edge of the glass.
 - 3. Maximum bow and warp 1/32" per lineal foot (0.79mm)

Note to Specifier: Not all fabricators can meet the roller wave +/- 100 milidiopter. If tight tolerances on fabrication are not required delete the next sentence.

- 4. Each lite of coated, tinted and reflective glass to have a maximum peak to valley roller wave +/- 100md (millidiopter) over 95% of the glass surface.
- B. Insulated Glass Units - Fabrication Tolerances.
 - 1. Gaps or skips between primary and secondary sealant are permitted to a maximum width of 1/16" (1.59mm) by a maximum length of 2" (51mm) with gaps separated by at least 18" (457mm).
 - 2. Ensure lites are separated by a desiccant filled spacer bar with bent corners and straight key joints, providing a hermetically sealed and dehydrated space.
- C. Fritted Glass Screen-Print Pattern Tolerances:
 - 1. No more than 0.0625" (1.59 mm) off parallel from locating glass edge and no more than 0.125" (3.18 mm) from edges other than locating glass edge.
 - 2. A maximum of a 0.03125" (0.79 mm) variation in dot, hole or line location.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized, within tolerances specified, and that required face and edge clearances have been met.
- B. Verify that a functioning weep system is present.

- C. Correct unsatisfactory conditions.

3.2 PREPARATION

- A. Clean and prepare glazing channels and other framing members to receive glass.
- B. Remove coatings and other harmful materials that will prevent glass and glazing installation from complying with the specified performance criteria.
- C. Ensure outside air temperature and forecasted temperature is within glass manufactures installation limits.

3.3 INSTALLATION

- A. Install products in accordance with glass manufacturer's recommendations, and reviewed Shop Drawings.
- B. Install glass, sealants, gaskets and other glazing materials, in accordance with recommendations and guidelines in the GANA Glazing Manual, unless indicated otherwise.
- C. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.
- D. Protect glass from contaminating substances that are a result of construction operations, such as weld spatter, fireproofing and plaster.

3.4 PROTECTION AND CLEANING

- A. Protect glass and glazing products during storage and installation in accordance with manufacturer's recommendations.
- B. Clean excess sealant or compound from glass and framing members immediately after application using solvents or cleaners recommended by manufacturers.
- C. Clean Glass according to: GANA Glass Information Bulletin GANA 01-0300 – Proper Procedures for Cleaning Architectural Glass Products.
- D. Do not use scrapers, razor blades or other metal tools to clean glass.

END OF SECTION

Refer to Appended Schedules.

PART 4 - SCHEDULES

4.1 UN-COATED GLASS SUBSTRATES

Vitrum Product	Nominal Thicknesses
Clear	3mm/4mm/5mm/6mm/8mm/10mm/12mm/15mm/19mm
Crystal Gray (Light Gray)	6 mm
Starphire	3mm/4mm/5mm/6mm/10mm/12mm/15mm/19mm/25mm
Bronze	3mm/5mm/6mm
Blue	6mm
Green	6mm
Gray	3mm/5mm/6mm
Clear PVB 0.030 Laminated Safety Glass	6mm/8mm/10mm/12mm/16mm/20mm
Clear PVB 0.060 Laminated Safety Glass	6mm/8mm/10mm/12mm/16mm/20mm/24mm/30mm/38mm
Clear SentryGlas Plus 0.035 Laminated Safety Glass	6mm/8mm/10mm/12mm/16mm/20mm
Clear SentryGlas Plus 0.060 Laminated Safety Glass	6mm/8mm/10mm/12mm/16mm/20mm/24mm/30mm/38mm
Clear SonicGuard 0.030 Laminated Acoustical Glass	6mm/8mm/10mm/12mm/16mm/20mm
Clear SonicGuard 0.060 Laminated Acoustical Glass	6mm/8mm/10mm/12mm/16mm/20mm
Mirror	5mm/6mm
Cathedral	4mm
Delta	4mm
Flute	4mm
Glue Chip	3mm/5mm
Pin Head	3mm/4mm/5mm/6mm
Rain	4mm/5mm/6mm
Satin	3mm/5mm/6mm/10mm/12mm
Wired Glass (GPW Fire Rated, Square)	6mm

4.2 SCREEN PRINTED / FRITTED GLASS

Note to Specifier: Ceramic frit can be applied to all glass substrates; however it cannot be applied to most low-e coated glass.

- A. The following table indicates the standard architectural frit patterns. Custom patterns and variations of these are available. Consult fabricator for design assistance.

Product Name	Frit Colour	Glass Substrate & Thickness
1/8" dots staggered on 1/4" centers	Any	All non low-e glass
Holes – 60% coverage – 1/8" holes on 1/4" centers	Any	All non low-e glass
Lines – 50% coverage – 1/8" lines on 1/4" centers	Any	All non low-e glass
Custom Patterns Available consult fabricator for assistance	Any	All non low-e glass

4.3 PERFORMANCE VALUES – ONE INCH INSULATING GLASS UNITS

- A. All glass available in annealed, laminated, tempered, heat-strengthened and tempered with heat-soak. Some low-e coatings require heat treatment.
- B. Additional glass substrates, coatings, thickness and combinations available.

- C. All performance values are for center of glass, tabulated data is based on NFRC methodology using the LBNL Window 7 software. Comparison units are 1-inch (25mm) with ½ inch (13mm) airspace and two ¼-inch (6mm) lites. Please contact Vitrum for custom glass combinations.

Low-E Coating on Surface 2, Clear Interior Glass	Appearance	Visible Light	Exterior Reflectance	Winter U-Value		SHGC	SC	LSG
				Air	Argon			
PPG Glass as fabricated by Vitrum Glass Group								
Solarban® 60 (Clear)	Neutral	70%	11%	0.29	0.24	0.39	0.45	1.79
Solarban® 70XL (Clear)	Neutral	64%	12%	0.28	0.23	0.27	0.32	2.37
Solarban® 67 (Clear)	Neutral	54%	19%	0.29	0.24	0.29	0.33	1.86
Solarban® Z50 (Optiblue)	Light Blue	51%	8%	0.29	0.24	0.32	0.36	1.59
Solarban® R100 (Clear)	Light Silver	42%	32%	0.29	0.24	0.23	0.27	1.83
Guardian Glass as fabricated by Vitrum Glass Group								
Sunguard® SN 68 (Clear)	Neutral	68%	11%	0.29	0.25	0.38	0.43	1.80
Sunguard® SNX 62/27 (Clear)	Neutral	62%	11%	0.29	0.24	0.27	0.31	2.30
Sunguard® SN 54 (Clear)	Neutral	54%	13%	0.29	0.24	0.28	0.32	1.91
Sunguard® SNX 51/23 (Clear)	Light Blue	52%	14%	0.29	0.24	0.23	0.27	2.18
Sunguard® SNR 43 (Clear)	Light Silver	43%	27%	0.29	0.24	0.23	0.26	1.88
Saint-Gobain Glass as fabricated by Vitrum Glass Group								
Cool-Lite SKN 174	Neutral	67%	11%	0.29	0.24	0.38	0.44	1.76
Vitrum Exclusive Coatings								
SS 74								
SS 51								
TS 60								

Note to Specifier: The above table demonstrates the performance values of some of the most common glass types. For a complete selection or for custom make-ups please contact Vitrum.

END OF SCHEDULES