

SECTION 088120 – BOLTED STRUCTURAL GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the system of non-insulated, bolted structural glass panels supported by a steel tube frame.
- B. Work under this Section is the responsibility of the Specialty Glazed Structure Contractor and consists of furnishing all things necessary for and, incidental to, the execution and completion of the point supported structural glass system, steel tube support frame, stainless steel connections and parts, and accessory work. Also, fabrication, packaging and delivery to job site, and installation by an installer approved in writing by the Specialty Glazed Structure Contractor and Owners Representative.
- C. The complete System shall be a single source from the Specialty Contractor.
- D. Related Requirements:
 - 1. Section 051200 - Structural Steel
 - 2. Section 088000 - Glazing.
 - 3. Section 099113 – Exterior Painting

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide structural glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

- A. AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
 - 1. AAMA/WDMA/CSA 101/I.S.2/A440 (2011) Standard/Specification for Windows, Doors, and Skylights.

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI Z97.1 (2009; Errata 2010) Safety Glazing Materials Used in Buildings -Safety Performance Specifications and Methods of Test.

C. AMERICAN WELDING SOCIETY (AWS)

1. AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code – Steel

D. ASTM INTERNATIONAL (ASTM)

1. ASTM C 1248 (2008) Standard Test Method for Staining of Porous Substrate by Joint Sealants
2. ASTM C1036 (2010; E 2012) Standard Specification for Flat Glass
3. ASTM C1048 (2012; E 2012) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
4. ASTM C1172 (2014) Standard Specification for Laminated Architectural Flat Glass
5. ASTM C162 (2010) Standard Terminology of Glass and Glass Products
6. ASTM C639 (2001; R 2011) Rheological (Flow) Properties of Elastomeric Sealants

1.4 SUBMITTALS

A. Preconstruction Submittals

1. Qualifications

- a. List of at least five (5) completed projects using similar systems or equal. All submitted projects must demonstrate the inclusion under one contract, of supply and installation of point supported glazing and steel support system. For each project, submit photographs showing detail of installations.
- b. Proof of five (5) years of relevant experience and the financial ability to perform is a minimum requirement.
- c. Professional Engineer specializing in bolted structural glass structures and licensed in the State of New York.

B. Shop Drawings

1. Elevations, sections, connection details, and glazing layup.
2. Panel thickness shall be sized by the Structural Glass Contractor.
3. Submit complete shop drawings including glass panel and support steel layouts and details. Show dimensioned layout of structural glazing in relation to adjacent work.
4. Include details of all supports and data to show provisions for vertical and horizontal expansion/contraction and building movements as necessary. Indicate expected movement from weather and seismic.
5. Identify all materials, attachments, devices and accessories including necessary tolerances.
6. After approval of shop drawings, provide a detailed set of field installation drawings and a written installation procedure. Identify each part by size and number.

C. Design Data:

1. Preliminary engineering confirming proposed sizes of glass and structural members and all loading reactions to the perimeter structure adjacent to glazed structure.
 2. Prior to fabrication of the structural glazing, submit design calculations prepared in accordance with current design rules for structural glazing and applicable codes. Include analysis and design for all combinations of loads such as live, dead, wind, thermal, snow, seismic, etc.
 3. Supply structural reactions in each axis, at each typical support, for review by the Project Engineer, and the maximum glass deflections in all axes.
 4. Supply calculations for support and other details as necessary.
- D. Product Data: For each glass product and glazing material indicated.
- E. Samples:
1. 12-inch- square, for each type of glass product indicated, other than monolithic clear float glass.
 2. Samples of all fixing hardware assemblies, spiders, bolts and accessories.
- F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer.

1.5 QUALITY ASSURANCE

- A. Specialty Glazed Structure Contractor Qualifications
1. The Specialty Glazed Structure Contractor shall provide in-house services which include full design, engineering and installation service for the structural glazing, steel tube framing and fittings as a single entity. Subcontracting with outside sources for any of these services is not acceptable. The assembly of joint ventures to provide these services is also not acceptable.
 2. Project shall be contracted for and managed directly by the Specialty Glazed Structure Contractor. Tenders or project management by a sales agent, intermediary, glazing contractor, agent or distributor of the listed Specialty Glazed Structure Contractor will not be acceptable.
- B. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing according to ASTM C 1087, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:
- C. Provide materials that are certified by an independent testing laboratory to meet ANSI Z97.1 and CPSC 16 CFR 1201 Category II.
- D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 2. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All glass, steel, hardware, and fittings shall be manufactured, crated, stored, handled and shipped in a manner that will provide unscratched and undamaged units delivered to the site. Fittings which engage with the glass shall be individually boxed in a way to protect edges from damage and/or scratching. Deliver products to the site in unopened containers, labeled plainly with manufacturers' name and brands. Deliver window assemblies in an undamaged condition. Exercise care in handling and hoisting windows during transportation and at the job site. Store components out of contact with the ground, under a weathertight covering.
- B. Finished surfaces shall be protected during shipping and handling using the manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which sealants, caulking, or glazing compounds must adhere.
- C. Time the delivery of materials to the site to ensure uninterrupted progress of the installation work.

1.7 WARRANTY

- A. Provide a five (5) year warranty on the design, engineering and installation workmanship. The start date of the warranty shall be thirty (30) days after completion of the scope of work.
- B. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: 5 years from date of Completion.
- C. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: 5 years from date of Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **SADEV USA Architectural Systems** – 3201 Plank Road, Keokuk, IA 52632 / Tel. 319-524-5600 / Web: www.sadev.com
- B. **Oldcastle Building Envelope** – 291 M St., Perrysburg, OH 43551 / Tel. 201-819-5304 / Web: www.obe.com

- C. **Diversified Glass & Storefronts** – 8 Olympic Drive, Orangeburg, NY 10962 / Tel. 718-547-4141 / Web. www.difersified-glass.com

2.2 DESIGN REQUIREMENTS

- A. Design the structural glazing and steel support system and applicable other components for the locations and conditions shown in the architectural and structural drawings and to the loading requirements and codes specified in the bid documents.
- B. Temperature variation: 0 deg F to +185 degrees F.
- C. Include loads created by installation techniques and lifting devices.
- D. The Structural Glazing engineer shall accommodate the following in the system's design:
 - 1. Deflections of edge beams due to loading applied after the installation of the cladding.
 - 2. Side-sway movements of the adjacent structure due to wind and seismic load.
 - 3. Anticipated deflections due to self-weight of the structural glass system.

2.3 FABRICATION

- A. Provide all glass, steel, structural hardware, connectors, fasteners and accessories required for a complete installation of the structural glazing as indicated in approved shop drawings.
- B. Code each part for easy identification. Cross reference this coding to shop/installation drawings and to shipping lists.

2.4 SYSTEM DESCRIPTION

- A. The system is comprised of glass panels with drilled holes such that the glass can be mechanically attached using stainless steel fasteners attached to the support structure of spiders, channels, and steel tube support frames.
- B. Glass joints are comprised of uninterrupted wet silicone with an extruded silicone profile inner compression seal. Support for the system shall be by means of a steel frame with geometry as indicated on the drawings. All of these elements shall be provided by the Specialty Glazed Structure Contractor as a single source.
- C. Wind pressure acting inward against the glass shall engage the vertical steel tubes. The resulting space frame of shall act in concert to perform within the specified performance requirements.
- D. The steel tube frame shall carry all loads associated with the support of the glass system and related hardware and enclosure elements. Deflection of the frame under full loading shall be minimized and addressed in the calculated design and fabrication drawings and shall not exceed limits that could cause any element to fail.

2.5 METALS FOR GLAZING ATTACHMENT

- A. To prevent bending stresses at the glass holes, the glass attachment bolts shall be grade A316 stainless steel and able to rotate up to 10 degrees in any direction or to an angle as required by the application. The stainless steel shall be separated from the glass with durable and UV resistant rings. The glass hole-ring shall be anodized aluminum and the other rings shall be silicone, nylon or as required. Where rotational fittings are not used, calculations shall be provided that show the glass fixing bolt does not locally impact the glass stresses, and that the connection is able to flex sufficiently in the glass deformed shape without depending on rubber, plastic bushing or similar materials. Bolt diameters shall be per structural requirements. Calculations shall back-up tests as evidence of compliance.
- B. Glazing spiders for the glass bolts shall have provisions for glass thermal movements and resist all design forces. Materials shall be mold formed stainless steel, in a finish to prevent corrosion from sliding surfaces.
- C. The tube support structure, to hold the glazing spiders, shall be of sufficient tolerance to accept the glazing system directly. The required tolerance to be per AISC "Code of Standard Practice" for AESS (or better) and shall be indicated in the submittal drawings as required. The connection between glazing spiders and tube support structure shall be designed as mechanical whenever possible and designed to prevent loosening in service.

2.6 GLASS

- A. Shall meet the requirements of Section 08 80 00 - GLAZING as amended herein. Sizing and engineering of all units as indicated shall be the responsibility of the Specialty Glazed Structure Contractor.
- B. All glass shall be tempered and laminated. All glass to be heat soak tested to check for nickel sulfide inclusions. Overall thickness and lay up design of the glass panels is to be determined by the Glazed Structure Contractor in accordance with specifications and drawings. Laminated glass is to be produced using a laid-in-place SGP interlayer bonded via an autoclave heat and pressure process. Minimum interlayer thickness is to be 0.060". Poured or cast resin laminates will not be permitted. Clear or colored interlayer shall be used as indicated on the drawings.
- C. All glass must be horizontally tempered, eliminating tong marks. All edges will be ground flat with a frosted appearance unless otherwise noted. All edgework, holes and notches in the tempered glass panels will be completed before tempering and will comply with the requirements stated below:
 - 1. ASTM C1036 Standard Specification for Flat Glass.
 - 2. ASTM C1048 Standard Specification for Heat-Treated Flat Glass.
 - 3. ASTM C1172 Standard Specification for Laminated Architectural Flat Glass.
- D. The specialty glazed structure subcontractor shall demonstrate that the stresses induced in the glass by the fittings are compatible with the strength of the glass and the needs of the performance section of this specification, especially at the holes. Provide finite element calculations to show compliance. Pre-stressing of the glass around holes, to a level which is compatible with the design and use of the fittings, is not permissible.
- E. Glass Tolerances: Squareness of panels governs other tolerances and shall be within 3.0 mm of specified dimensions. Edge lengths shall be within 1.5 mm of specified dimensions. Holes shall be within 1.0 mm of specified locations.

- F. Glass Holes: Drilled holes shall be straight through. Fitting type shall be as shown in the architectural drawings. All edges of holes shall be cleaned and free of loose or ground materials.

2.7 ARCHITECTURALLY EXPOSED STEEL STRUCTURE (AESS)

- A. Shall meet the requirements of Section 05 12 00 - STRUCTURAL STEEL as amended herein. Sizing and engineering of all members as indicated shall be the responsibility of the Specialty Glazed Structure Contractor.
- B. Plates, tubes, and profiles shall typically be A36, A500 Gr. B or as required by the approved calculations and as indicated on the approved drawings.
- C. High-Strength bolts, nuts and washers: Provide standard carbon steel mechanically galvanized or inorganic coated finish, as necessary, to avoid nickel sulfide failures and provide corrosion protection.
- D. Other bolts and nuts: Bolts that are not high-strength or stainless and are subject to corrosive environment, shall be hot dip galvanized or mechanically galvanized or electroplated. In no circumstances shall bolts without any finish be used, unless noted in the approved drawings.
- E. Coating specification: Surface preparation: All surfaces must be cured, clean, sound and free of all mill scale, rust, oil, dirt, grease and any other contamination, including salt deposits, which would interfere with new coating adhesion. Surface may not be wet. Bare surfaces must be properly prepared prior to coating application.
 - 1. Ferrous metal surfaces:
 - a. Power or hand washing is required to remove contamination.
 - b. Use of a cleaner/degreaser is required to remove any oil or grease.
 - c. All cleaning residue must be completely rinsed from surface and surface allowed to dry.
 - d. Abrasive blast new steel to SSPC-SP-10 Near-White Blast Cleaning to achieve a 1.5 to 2.0 mil profile.
 - e. Blast surface to be primed before flash rusting occurs.
 - 2. Paint: See Section 09 91 13 – EXTERIOR PAINTING.

2.8 STRUCTURAL SILICONE SEALANT

- A. All glass shall be sealed with silicone building sealant. Backer material in joint shall be provided by an extruded silicone profile material.
 - 1. Type: One-component, neutral-cure, RTV (room temperature vulcanizing) silicone rubber sealant for structural glazing. Sealant material shall meet or exceed the following standards:
 - a. ASTM C920, Type S, Grade NS, Class 50, Use NT, G, A and O.
 - b. ASTM C1184, Type S, Use G, A, and O.
 - c. CID A-A-272 - Sealing Compound: silicone rubber base (for caulking, sealing, and glazing in buildings and other structures).

- d. GSA CID A-A-1556-Sealing Compound Elastomeric Type, single component (for caulking, sealing, and glazing in buildings and other structures).
2. Shelf Life: 12 months.
3. Tack-free time: 3 hours.
4. Working time: 20 to 30 minutes.
5. Curing time: 7 to 14 days.
6. Full adhesion time: 14 to 21 days.
7. Flow, sag, or slump: 2.5mm tested in accordance with ASTM C639.
8. Volatile organic compound (VOC) content: 28grams/liter.
9. Cured Sealant Properties after 21 days at 50% relative humidity:
 - a. Joint movement capability: Plus and minus 50%, tested in accordance with ASTM C719.
 - b. Hardness: 35-durometer hardness, Shore A, tested in accordance with ASTM D 2240.
 - c. Maximum Peel Strength: 5.7kg/cm testing in accordance with ASTM C794-10.
 - d. Staining: None on concrete, marble, granite, limestone, and brick, when tested in accordance with ASTM C 1248.
 - e. Service Temperature Range: Minus 40 to Plus 300 degrees F.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Scope of this section includes the installation of structural glass, point support glass fixings, steel tube frame and other items being supplied in the scope. The Erector shall check all metal components upon delivery for dents, gouges or other imperfections which may result in rejection of the appearance or reduce strength.
- B. The Erector shall check the glass panels upon delivery for scratches, imperfections and edge damage. Damaged glass shall not be installed.

3.2 PREPARATION

- A. Provide connections for temporary shoring, bracing and supports as noted on the installation drawings. Handle, lift and align pieces using padded slings, suction cups and/or other protection required to maintain the appearance of the system throughout the installation process.
- B. Only lift at connections as approved by the system's Design Engineer.

3.3 INSTALLATION

- A. Erect structural glazing, steel tube frame and other items being supplied in the scope in strict accordance with the approved shop/installation drawings and installation procedures.
 1. Glass shall not be positioned by the use of force. Provide temporary bracing and support as required to ensure stability during installation process.
 2. Bolt Head Orientation: All exposed bolt heads shall be oriented as indicated on the approved drawings. Where bolt head alignment is specified, the orientation shall be noted for each connection on the installation drawings. Where not noted, the bolt heads in a given connection shall be oriented to one side.

3. Field Welding: If required at concealed metal assemblies, weld profile, quality and finish shall be consistent with the quality of any shop welds. If not visible, then welds shall comply with visual appearance specified in AWS D1.1/D1.1M. Weld size and type shall be per the approved shop drawings. Glass and other heat sensitive material must be protected from heat and splatter.
4. All bolts shall be fully tightened in accordance with methods indicated in the installation drawings. Specified pre-stressed bolts and cable tightening shall be tightened using the necessary tools and the torques checked. Reset calibrations often to ensure torque is accurate.
5. Clean glazing connectors receiving glazing materials of deleterious substances that might impair the work. Remove protective coatings that might fail in adhesion or interfere with bond of sealants. Comply with the manufacturer's instructions for final wiping of surfaces immediately before the application of primer and glazing sealants. Wipe metal surfaces with an appropriate cleaning agent.
6. Sealants: Prime surfaces that are to receive glazing sealants in accordance with the manufacturer's recommendations, using recommended primers.
7. Locate setting blocks, if required by the drawings, at the quarter points of the sill, but no closer than 6 inches to corners of the glass. Use blocks of proper sizes to support the glass in accordance with the manufacturer's recommendations.
8. Ensure neoprene spacers separate the glass from attachment plates.
9. Set the glass in a manner that produces the greatest possible degree of uniformity in appearance. Face all glass, which has a dissimilar face, with matching faces in the same direction. Carefully remove all stickers and clean affected area.
10. Use masking tape or other suitable protection to limit the coverage of glazing materials on the surfaces intended for sealants.
11. Tool the exposed surface of glazing materials.
12. Clean excess sealant from the glass and support members immediately after the application, using solvents or cleaners recommended by the manufacturers. Protect edges of laminated glass from solvents and cleaners that could deteriorate interlayer or bond.

3.4 FIELD QUALITY CONTROL AND CLEANING

- A. Structural Requirements: The Owner will engage an independent testing and inspecting agency to perform field inspections, testing and prepare test reports.
- B. Product Acceptance: The structural glazing, cable trusses, steel tube frame and other items being supplied in the scope shall be installed clean by the Structural Glass Contractor and then protected by the General Contractor and any other following trades at their expense.

3.5 TOUCH-UP AND FINAL CLEANING

- A. Touch-up Painting: Cleaning and touch-up painting of any field welds and abraded areas of shop paint or stainless parts shall be completed to blend with the adjacent surfaces of the product. Such touch-up work shall be done in accordance with manufacturer's instructions.

END OF SECTION 08 81 20