SECTION 08836.16 – ELECTRONICALLY CONTROLLED SWITCHABLE GLASS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. On-Demand Privacy Glass for windows, doors, interior borrowed lites, storefront framing, glazed curtain walls, sloped glazing, skylights.
2. Glazing sealants and accessories.

B. Related Sections
1. Section 079200 – Joint Sealants
2. Section 081113 – Hollow Metal Doors and Frames
3. Section 081216 – Aluminum Frames
4. Section 081416 – Flush Wood Doors
5. Section 084113 – Aluminum Entrances and Storefronts
6. Section 084126 – All Glass Entrances and Storefronts
7. Section 084229 – Automatic Entrances
8. Section 084243 – ICU/CCU Entrances
9. Section 084413 – Glazed Aluminum Curtain Walls
10. Section 085123 – Metal Framed Skylights
11. Section 087100 – Door Hardware
12. Section 088000 – Glazing
13. Division 26 – Electrical

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. On-Demand Privacy Glass:
1. Transparent State: The clear state in which the glass is powered on.
2. Privacy State: The diffused state in which the glass is powered off.
3. Switch Speed: The time required to fully transition between Clear and Privacy States.

1.3 REFERENCE STANDARDS

A. American Society of Test and Material (ASTM)
1. ASTM C162: Standard Terminology of Glass and Glass Products
2. ASTM C920: Standard Specification for Elastomeric Joint Sealers
3. ASTM C1036: Standard Specification for Flat Glass
4. ASTM C1172: Standard Specification for Laminated Architectural Flat Glass
5. ASTM D1003: Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics

6. ASTM E413: Classification for Rating Sound Insulation

B. American National Standards Institute (ANSI)
1. ANSI Z97.1: For Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

C. Consumer Products Safety Commission
1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials

D. International Organization of Standards (ISO)
1. ISO 3585: Borosilicate glass 3.3 — Properties

E. European Standards (EN)
1. EN 1748-1-1:2004 - Glass in building - Special basic products

F. Underwriters Laboratory (UL)
1. UL 60730: Automatic Electrical Controls for Household and Similar Use

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide required glass bite, minimum edge and face clearances, and sealant thicknesses in accordance with manufacturer’s installation instructions.

B. Coordinate installation of electrical wiring with related sections including, but is not limited to, provisions for the concealing of wire inside glazing frame, penetration of framing member, and connection points.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product provide performance characteristics, certificates of compliance, installation instructions, and cleaning and maintenance instructions.

B. Glass Samples: For each glass type have a 14.0 x 20.0-inch functioning sample and electronics available.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Sample Warranty: Manufacturers standard warranty as specified.

1.6 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

B. Installation Pre-Approval: Submit manufacturer’s written approval that planned installation techniques and/or shop drawings illustrating that the glass bite, clearances, setting and edge blocking, frame penetrations, wire routing, etc. meet system requirements.

1.7 CLOSEOUT SUBMITTALS

A. Warranty Documentation: Manufacturer’s executed warranty documents to cover requirements as specified.

B. Cleaning Instructions: Manufacturer’s cleaning and maintenance instructions.

1.8 QUALITY ASSURANCE

A. Single Source Responsibility: Provide materials obtained from one source for each type of glass and glazing product indicated.

B. Manufacturer's Qualifications:
1. Minimum of 5 years’ experience manufacturing float glass complying with Type and Class indicated.
2. Minimum of 5 years’ experience fabricating laminated glass units meeting ASTM C 1172 and CPSC 16 CFR-1201.

C. Installer Qualifications: Minimum of 5 years’ experience installing similar material or written approval by material supplier to affirm the installer possesses knowledge of the appropriate handling and installation techniques.

D. Mock-Up (optional): Provide a mock-up for evaluation of glazing unit fabrication and installation workmanship.
1. Install in locations designated by Architect.
2. Mock-ups not part of the billable installation are to be a chargeable item.
3. Do not proceed with remaining work until workmanship is approved by Architect.
4. Rework mock-up area as required to produce acceptable work

E. Installation:
1. Comply with manufacturer’s installation guidelines or those outlined in industry recognized publications for type and application indicated. See Section 2.3.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glass and glazing materials during delivery, storage, and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.

1.11 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation, or other causes. Install glazing sealants only when temperatures are in middle third of manufacturer's recommended installation temperature range.

1.12 WARRANTY

A. Manufacturer's Special Warranty for On-Demand Privacy Glass: Manufacturer agrees to replace on-demand privacy glass due to a loss of switchable functionality.

1. Warranty Period: Five (5) years from date of Substantial Completion.

B. Manufacturer’s Special Warranty for Controllers and Power Supply: Manufacturer agrees to replace original equipment switchable controllers and power supplies that fail to operate properly within the specified warranty period. Electronics must have been installed in accordance with manufacturer’s written instruction. Use of non-original equipment electronics will void warranty of on-demand privacy glass.

1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements, provide Cardinal Glass Industries or approved equal product by one of the following:
1. Cardinal Glass Industries (Basis of Design)
2. Substitutions: Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.

C. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with clear state performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 7.8 computer program, expressed as Btu/sq. ft. x h x deg F.
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBNL's WINDOW computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

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

1. GANA Publications: “Laminated Glazing Reference Manual", "Glazing Manual", and “Sealant 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."

B. Safety Glazing Labeling: Where safety glazing 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.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

D. Strength: All glass to be annealed float glass as indicated in product construction.

2.4 GLASS PRODUCTS

A. Clear Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Low Iron Float Glass: ASTM C1036, Type 1, Class 1 (low iron), Quality-Q3

C. Borosilicate: ISO 3585, EN 1748 T1

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. 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 using polyvinyl butyral interlayer with appropriate UV blocking additives.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.6 ON-DEMAND PRIVACY GLASS

A. Liquid Crystal Switchable Glass: Factory-assembled units consisting of laminated glass separated by a liquid crystal device conforming to ASTM C1172.

1. Construction:
   a. Nominal Thicknesses: 3/8” (9.9mm) or 7/16 (11.5mm)
   b. Multi-ply laminated composite
   c. Glass Lites: Clear and borosilicate float glass
   d. Interlayer: Polyvinyl Butyral (PVB)
   e. Switchable Technology: Cardinal’s Exclusive Polymer Stabilized Cholesteric Texture (PSCT) Liquid Crystal Mixture
   f. Conductive Glass Lites: ITO coated float glass
2. Color:
   a. Privacy State: translucent white
   b. Transparent State: clear
3. Operators:
   a. Manual switch (non-dimming)
   b. Portable Electronic Device Application
   c. Building Management System
4. Power Supply
   a. Low voltage: 24v DC 100-watt UL-1310 Class-2
   b. Wire Length: 100m maximum (18 gauge)
5. Control Unit
   a. Proprietary CLiC controller
   b. FCC certified & UL compliant
6. Labeling
   a. Provide permanent safety glazing label on glass

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they 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. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corporation.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. May National Associates, Inc.; a subsidiary of Sika Corporation.
d. Pecora Corporation.
e. Sika Corporation.
f. Tremco Incorporated.
g. <**Insert manufacturer's name**>.

2. Applications: **<Describe types of glazing applications where this sealant is required>**.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corporation-Construction Systems.
b. Dow Corporation.
c. GE Construction Sealants; Momentive Performance Materials Inc.
d. May National Associates, Inc.; a subsidiary of Sika Corporation.
e. Pecora Corporation.
f. Polymeric Systems, Inc.
g. Sika Corporation.
h. Tremco Incorporated.
i. <**Insert manufacturer's name**>.

2. Applications: **<Describe types of glazing applications where this sealant is required>**.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bostik, Inc.
b. Dow Corporation.
c. GE Construction Sealants; Momentive Performance Materials Inc.
d. May National Associates, Inc.; a subsidiary of Sika Corporation.
e. Polymeric Systems, Inc.
f. Schnee-Morehead, Inc., an ITW company.
g. Sika Corporation.
h. Tremco Incorporated.
i. <**Insert manufacturer's name**>.

2. Applications: **<Describe types of glazing applications where this sealant is required>**.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining and non-migrating 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 C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

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:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

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

B. Non-Fire Rated Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 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.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from project site and legally dispose of. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance or appearance.

C. Prevent damage to wire and electrical connections during glazing. Damaged wires should be repaired or replaced based on manufacturer's recommendation.

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).

H. 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.

3.2 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, then to jambs. Cover horizontal framing joints by applying tapes to jambs, 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. Apply heel bead of elastomeric sealant where indicated.

F. Center glass lites in openings on setting block 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.

G. Apply cap bead of elastomeric sealant over exposed edge of tape where indicated.

3.3 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.

3.4 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.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. 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.

1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.6 ON-DEMAND PRIVACY GLASS SCHEDULE

A. Glass Type [**PG-1**]: CLiC by Cardinal Glass Industries (Basis of Design)

1. Overall Thickness: 7/16” (11.5mm) nominal
2. Construction
   a. Thickness each glass ply: 2.0mm (minimum)
   b. Interlayer: .030 inch clear PVB (minimum)

c. LC Device: CLiC by Cardinal Glass Industries
3. Switch Time: <1.0 sec
4. Visible Light Transmittance:
   a. Clear state: 80% minimum
   b. Privacy state: 65% minimum
5. UV Transmission:
   a. Maximum 1.0% at 380nm
   b. Maximum 5.0% at 400nm or lower
6. Haze:
   a. Clear state:
      1) 3.0% maximum at 90degrees
      2) 5.0% maximum at all angles
   b. Privacy state: 97% minimum
7. Acoustical Properties
   a. STC 38 minimum
8. Controls: CLiC proprietary controller
9. Power Supply: 24v DC 100-watt UL-1310 Class-2

B. Glass Type [**PG-2**]: CLiC by Cardinal Glass Industries (Basis of Design)

1. Overall Thickness: 3/8” (9.9mm) nominal
2. Maximum size: <15 square feet
3. Construction
   a. Thickness each glass ply: 2.0mm (minimum)
   b. Interlayer: .030 clear inch PVB (minimum)
   c. LC Device: CLiC by Cardinal Glass Industries
4. Switch Time: <1.0 sec
5. Visible Light Transmittance:
   a. Clear state: 80% minimum
   b. Privacy state: 65% minimum
6. UV Transmission:
   a. Maximum 1.0% at 380nm
   b. Maximum 5.0% at 400nm or lower
7. Haze:
   a. Clear state:
      1) 3.0% maximum at 90degrees
      2) 5.0% maximum at all angles
   b. Privacy state: 97% minimum
8. Acoustical Properties
   a. STC 38 minimum
9. Controls: CLiC proprietary controller
10. Power Supply: 24v DC 100-watt UL-1310 Class-2

END OF SECTION 088000