

## SECTION 08 88 00 SPECIAL FUNCTION GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. SageGlass® electrically tintable insulating glass units for dynamic light and heat control.

~~DELETE SECTIONS NOT IN PROJECT. ADD SECTIONS AS NECESSARY.~~

- B. Related Sections:
  - 1. Division 8 – Openings.
  - 2. Division 25 - Integrated Automation.
  - 3. Section 26 09 00 – Instrumentation and Control for Electrical System.
  - 4. Division 26 - Electrical.

#### 1.2 DEFINITIONS

- A. 2-ply Laminated Glass: 2-sheets of monolithic glass bonded together with plastic interlayer by heat and pressure.
- B. Bite: Dimension by which edge of glass product is engaged into glazing channel.
- C. Fenestration: Openings in building's envelope including windows, doors, and skylights.
- D. Framing System: Basic rigid supporting structure of window.
- E. Frame Wire Harness: Wire that runs through framing system and connects IGU pigtail to low-voltage wiring on interior of building.
- F. Glazing System: Soft material used in framing system.
- G. IGU Pigtail: Wire that extends from individual insulated glass units.
- H. IGU: Insulated Glass Unit.
- I. Inboard Lite: Pane of IGU that faces interior of building.
- J. Laminate Inner-Ply: Glass pane in laminated glass construction that faces exterior of building.
- K. Laminate Outer-Ply: Glass pane in laminated glass construction that faces interior of building.
- L. Outboard Lite: Pane of IGU that faces exterior of building.
- M. Performance Characteristics:
  - 1. Center-of-Glass Characteristics: Performance values that take only center portion of IGU into account and not framing members.
  - 2. Fenestration Performance: Performance based on total fenestration (center-of-glass and framing members). Values that can be validated and certified by National Fenestration Rating Council (NFRC).
- N. Sealing Insulating Glass Unit Surfaces and Coating Orientation:
  - 1. Surface 1: Exterior surface of outer pane.

- 2. Surface 2: Interior surface of outer pane.
- 3. Surface 3: Exterior surface of inner pane.
- 4. Surface 4: Room side surface of inner pane.
- O. Tinted: On state, with lowest visible light transmission.
- P. Untinted: Off state, with highest visible light transmission.

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements:
  - 1. SageGlass® electrically tintable insulating glass units shall be operated by a SageGlass® control system as specified in Section 26 09 00.

#### FRAMING AND GLAZING NOT PROVIDED BY SAGE ELECTROCHROMICS.

- 2. Framing and Glazing Systems:
  - a. Designed to accommodate IGU components below:
    - 1) Edge clearance: 1/4 inch (6 mm)
    - 2) Bite clearance: 5/8 inch (16 mm)
    - 3) Face clearance: 3/16 inch (5 mm)
  - b. Accommodate controls wiring.
  - c. Has glazing materials that is compatible with materials of SageGlass® IGU.
  - d. Provide glazing and framing systems capable of withstanding normal thermal movements, wind loads, and impact loads, without failure, including loss due to defective manufacture, fabrication, and installation, deterioration of glazing materials, and other defects in construction.
    - 1) Normal Thermal Movement: Resulting from ambient temperature range of 120 degrees F (67 degrees C) and from consequent temperature range within glass and glass framing members of 180 degrees F (100 degrees C).
    - 2) Deterioration of Laminated Glass: Development of manufacturing defects including edge separation or delamination that materially obstructs vision through glass.
- 3. Provide glass products in thicknesses and strengths (annealed or heat-treated) required to meet or exceed the following criteria based on Project loads and in-service conditions per ASTM E1300.
  - a. Select minimum thickness of annealed or heat-treated glass products to ensure probability of failure does not exceed the following:
    - 1) 8 breaks per 1000 for glass installed vertically or not over 15 degrees or more from vertical plan and under wind action.
    - 2) 1 break per 1000 for glass installed 15 degrees or more from vertical plane and under action of wind, snow, or both.

### 1.4 SUBMITTALS

- A. Product Data: Manufacturer's Product Data sheets including installation instructions.
- B. Documentation indicating compliance with ASTM E2141-02, Chromogenic fenestration standard as verified by third party test laboratory such as National Renewable Energy Laboratory (NREL).

#### SHOP DRAWINGS NOT PROVIDED BY SAGE ELECTROCHROMICS. THESE NEED TO BE PROVIDED BY OTHERS.

- C. Shop Drawings: Indicate framing system and accommodations for wiring paths, connectors, routing, and exit from framing system.

#### STRUCTURAL CALCULATIONS NOT PROVIDED BY SAGE ELECTROCHROMICS. THESE NEED TO BE PROVIDED BY CONTRACTOR.

- D. Structural Calculations: Provide structural calculations for framing system certified by structural engineer licensed in the state in which Project is located.

#### 1.5 QUALITY ASSURANCE

- A. Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or referenced standards.
  - 1. GANA Publications
  - 2. AAMA Publications
  - 3. IGMA Publications
- B. Safety glass products in the US are to comply with CPSC 16 CFR Part 1201 for Category II materials.
- C. Glass thermal and optical performance properties shall be based on calculations from the current LBNL WINDOW 5.2 computer program.
- D. Provide glass that is heat-treated by horizontal (roller hearth) process with inherent roller wave distortion parallel to short edge of glass as installed when specified.
- E. Installer Qualifications: Acceptable to SAGE Electrochromics and capable of preparing data for glazed framing systems, based on testing and engineering analysis of SAGE Electrochromics' standard units in assemblies similar to those indicated for this Project.
- F. Pre-Installation Meetings: Conduct pre-installation meeting/teleconference with the following parties in attendance:
  - 1. Architect, Contractor, glazing contractor, framing manufacturer, SageGlass® IGU and Controls manufacturer, electrical contractor, and other parties related to Work of this Section, to review procedures, schedules, safety, and coordination with other elements of Project.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instruction for receiving, handling, storing, and protecting materials.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store materials in original packaging, protected from exposure to harmful environmental conditions, including static electricity, and at temperature and humidity conditions recommended by manufacturer.
- D. Exercise care to prevent edge damage to glass, wire, and coatings on glass.
- E. Where insulating glass units will be exposed to substantial altitude changes, avoid hermetic seal ruptures by complying with manufacturer's recommendations for venting and sealing.

#### 1.7 PROJECT / SITE CONDITIONS

- A. Verify frame channel dimensions are adequate for wire runs as designed.
- B. Environmental Requirements:
  - 1. Ensure that substrate surface and ambient air temperature are minimum of 40 degrees F (5 degrees C) and rising at application time and remain above 40 degrees F (5 degrees C) for at least 24 hours after application.

## 1.8 WARRANTY

- A. Warrant SageGlass® IGUs against defects in material or workmanship causing material obstruction of vision as a result of fogging or film formation of the internal glass as a result of failure of the hermetic seal for a period of ten years from the date of shipping of the SageGlass® IGUs from the Manufacturer.
- B. Warrant SageGlass® electrochromic glass against defects in material or workmanship for a period of five years from the date of shipping of the SageGlass® electrochromic glass from the Manufacturer.
- C. Warrant SageGlass® Controls against defects in material or workmanship for a period of five years from the date of shipping of the SageGlass® Controls from the Manufacturer.

## 1.9 MAINTENANCE

- A. Extra Materials:
  - 1. Furnish 1 percent (minimum of 1 IGU) of each size and type of IGU.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. SAGE Electrochromics, Inc.  
One Sage Way.  
Faribault, MN 55021.  
Telephone: 877-SAGE-EC1. (877-724-3321)  
Fax: 1-507-333-0145.  
E-mail: [commercialsales@sage-ec.com](mailto:commercialsales@sage-ec.com) or [technicalservices@sage-ec.com](mailto:technicalservices@sage-ec.com).  
Internet: <http://www.sage-ec.com>.

### 2.2 MATERIALS

- A. SageGlass® Classic™ Sealed Insulating Glass Units (IGUs):
  - 1. Outboard Lite:
    - a. Glass Type: SageGlass® coated clear float glass.
    - b. Glass Tint: Variable.
    - c. Nominal Thickness: 0.25 in (6 mm) per industry standards.
    - d. Heat Treatment: Tempered.
    - e. Coating Orientation: Surface No. 2.
  - 2. Air Space:
    - a. Spacer Material: Austenitic standard stainless steel.
    - b. Nominal Thickness: 0.50 plus/minus 0.02 in (12.5 mm plus/minus 0.5mm).
    - c. Wall Thickness: 0.008 inch (0.2 cm).
    - d. Gas Fill: 90 percent Argon.
    - e. Desiccant: 4 sides filled with 100 percent molecular sieve and silica gel blend desiccant.
  - 3. Laminated Inboard Lite:
    - a. Outer Ply (Surface 4):
      - 1) Glass Type: Clear float glass.
      - 2) Glass Tint: Clear.
      - 3) Nominal Thickness: 0.125 inch (3 mm).
      - 4) Heat Treatment: Heat-strengthened.
    - b. Interlayer:
      - 1) Interlayer Type: Polyvinyl Butyral.

- 2) Interlayer Tint: None.
      - 3) Nominal Thickness: 0.06 inch (1.52 mm).
    - c. Inner Ply (Surface 3):
      - 1) Glass Type: Clear float glass.
      - 2) Glass Tint: Clear.
      - 3) Nominal Thickness: 0.125 inch (3 mm).
      - 4) Heat Treatment: Heat-strengthened.
  - 4. Pigtail:
    - a. 2-conductor sheathed cable type CM/CL2, 0.15 inch nominal OD.
    - b. Molex 52213-0211 2-pin connector.
  - 5. Untinted Performance Characteristics (Center of Glass):
    - a. Visible Transmittance: 62 percent.
    - b. Interior Visible Reflectance: 14 percent.
    - c. Exterior Visible Reflectance: 21 percent.
    - d. Summer U-factor (U-value): 0.28.
    - e. Winter U-factor (U-value): 0.28.
    - f. Krochman Damage Function (KDF): 15 percent.
    - g. Solar Heat Gain Coefficient (SHGC): 0.48.
  - 6. Tinted Performance Characteristics (Center of Glass):
    - a. Visible Transmittance: 3.5 percent.
    - b. Interior Visible Reflectance: 10 percent.
    - c. Exterior Visible Reflectance: 6 percent.
    - d. Summer U-factor (U-value): 0.28.
    - e. Winter U-factor (U-value): 0.28.
    - f. Krochman Damage Function (KDF): 1.7 percent.
    - g. Solar Heat Gain Coefficient (SHGC): 0.09.
- B. SageGlass® See Green™ Sealed Insulating Glass Units (IGUs):
- 1. Outboard Lite:
    - a. Glass Type: SageGlass® coated clear float glass.
    - b. Glass Tint: Variable.
    - c. Nominal Thickness: 0.25 inch (6 mm) per industry standards.
    - d. Heat Treatment: Tempered.
    - e. Coating Orientation: Surface No. 2.
  - 2. Air Space:
    - a. Spacer Material: Austenitic standard stainless steel.
    - b. Nominal Thickness: 0.50, plus/minus 0.02 inch (12.5 mm plus/minus 0.5mm).
    - c. Wall Thickness: 0.008 inch (0.2 cm).
    - d. Gas Fill: 90 percent percent argon.
    - e. Desiccant: 4 sides filled with 100 percent molecular sieve and silica gel blend desiccant.
  - 3. Inboard Lite:
    - a. Glass Type: PPG tint float glass.
    - b. Glass Tint: Azuria™.
    - c. Nominal Thickness: 0.25 inch (6 mm) per industry standards.
    - d. Heat Treatment: Tempered.
  - 4. Pigtail:
    - a. 2-conductor sheathed cable type CM/CL2, 0.15 inch nominal OD.
    - b. Molex 52213-0211 2-pin connector.
  - 5. Untinted Performance Characteristics (Center of Glass):
    - a. Visible Transmittance: 48 percent.
    - b. Interior Visible Reflectance: 10 percent.

- c. Exterior Visible Reflectance: 20 percent.
  - d. Summer U-factor (U-value): 0.28.
  - e. Winter U-factor (U-value): 0.29.
  - f. Krochman Damage Function (KDF): 15 percent.
  - g. Solar Heat Gain Coefficient (SHGC): 0.44.
6. Tinted Performance Characteristics (Center of Glass):
- a. Visible Transmittance: 3 percent.
  - b. Interior Visible Reflectance: 8 percent.
  - c. Exterior Visible Reflectance: 6 percent.
  - d. Summer U-factor (U-value): 0.28.
  - e. Winter U-factor (U-value): 0.29.
  - f. Krochman Damage Function (KDF): 1.8 percent.
  - g. Solar Heat Gain Coefficient (SHGC): 0.09.
- C. SageGlass® Clear View Blue™ Sealed Insulating Glass Units (IGUs):
1. Outboard Lite:
    - a. Glass Type: SageGlass® coated clear float glass.
    - b. Glass Tint: Variable.
    - c. Nominal Thickness: 0.25 inch (6 mm) per industry standards.
    - d. Heat Treatment: Tempered.
    - e. Coating Orientation: Surface No. 2.
  2. Air Space:
    - a. Spacer Material: Austenitic standard stainless steel.
    - b. Nominal Thickness: 0.50 plus/minus 0.02 inch (12.5 mm plus/minus 0.5mm).
    - c. Wall Thickness: 0.008 inch (0.2 cm).
    - d. Gas Fill: 90 percent Argon.
    - e. Desiccant: 4 sides filled with 100 percent molecular sieve and silica gel blend desiccant.
  3. Laminated Inboard Lite:
    - a. Outer Ply (Surface 4):
      - 1) Glass Type: Clear float glass.
      - 2) Glass Tint: Clear.
      - 3) Nominal Thickness: 0.125 inch (3 mm).
      - 4) Heat Treatment: Heat-strengthened.
    - b. Interlayer:
      - 1) Interlayer Type: Polyvinyl Butyral.
      - 2) Interlayer Tint: Vanceva 0212.
      - 3) Nominal Thickness: 0.06 inch (1.52 mm).
    - c. Inner Ply (Surface 3):
      - 1) Glass Type: Clear float glass.
      - 2) Glass Tint: Clear.
      - 3) Nominal Thickness: 0.125 inch (3 mm).
      - 4) Heat Treatment: Heat-strengthened.
  4. Pigtail
    - a. 2-conductor sheathed cable type CM/CL2, 0.15 inch nominal OD.
    - b. Molex 52213-0211 2-pin connector.
  5. Untinted Performance Characteristics (Center of Glass):
    - a. Visible Transmittance: 40 percent.
    - b. Interior Visible Reflectance: 8 percent.
    - c. Exterior Visible Reflectance: 19 percent.
    - d. Summer U-factor (U-value): 0.28.
    - e. Winter U-factor (U-value): 0.29.

- f. Krochman Damage Function (KDF): 12 percent.
  - g. Solar Heat Gain Coefficient (SHGC): 0.46.
6. Tinted Performance Characteristics (Center of Glass):
- a. Visible Transmittance: 2.5 percent.
  - b. Interior Visible Reflectance: 7 percent.
  - c. Exterior Visible Reflectance: 6 percent.
  - d. Summer U-factor (U-value): 0.28.
  - e. Winter U-factor (U-value): 0.29.
  - f. Krochman Damage Function (KDF): 1.3 percent.
  - g. Solar Heat Gain Coefficient (SHGC): 0.09.
- D. Clear-as-Day Gray™ Sealed Insulating Glass Units (IGUs):
1. Outboard Lite:
    - a. Glass Type: SageGlass® coated clear float glass.
    - b. Glass Tint: Variable.
    - c. Nominal Thickness: 0.25 inch (6 mm) per industry standards.
    - d. Heat Treatment: Tempered.
    - e. Coating Orientation: Surface No. 2.
  2. Air Space:
    - a. Spacer Material: Austenitic standard stainless steel.
    - b. Nominal Thickness: 0.50 plus/minus 0.02 inch (12.5 mm plus/minus 0.5mm).
    - c. Wall Thickness: 0.008 inch (0.2 cm).
    - d. Gas Fill: 90 percent Argon.
    - e. Desiccant: 4 sides filled with 100 percent molecular sieve and silica gel blend desiccant.
  3. Laminated Inboard Lite:
    - a. Outer Ply (Surface 4):
      - 1) Glass Type: Clear float glass.
      - 2) Nominal Thickness: 0.125 inch (3 mm).
      - 3) Heat Treatment: Heat-strengthened.
    - b. Interlayer:
      - 1) Interlayer Type: Polyvinyl Butyral.
      - 2) Interlayer Tint: Vanceva 1221.
      - 3) Nominal Thickness: 0.06 inch (1.52 mm).
    - c. Inner Ply (Surface 3):
      - 1) Glass Type: Clear float glass.
      - 2) Glass Tint: Clear.
      - 3) Nominal Thickness: 0.125 inch (3 mm).
      - 4) Heat Treatment: Heat-strengthened.
  4. Pigtail:
    - a. 2-conductor sheathed cable type CM/CL2, 0.15 inch nominal OD.
    - b. Molex 52213-0211 2-pin connector.
  5. Untinted Performance Characteristics (Center of Glass):
    - a. Visible Transmittance: 35 percent.
    - b. Interior Visible Reflectance: 7 percent.
    - c. Exterior Visible Reflectance: 19 percent.
    - d. Summer U-factor (U-value): 0.28.
    - e. Winter U-factor (U-value): 0.29.
    - f. Krochman Damage Function (KDF): 10 percent.
    - g. Solar Heat Gain Coefficient (SHGC): 0.46.
  6. Tinted Performance Characteristics (Center of Glass):
    - a. Visible Transmittance: 2 percent.

- b. Interior Visible Reflectance: 6 percent.
  - c. Exterior Visible Reflectance: 6 percent.
  - d. Summer U-factor (U-value): 0.28.
  - e. Winter U-factor (U-value): 0.29.
  - f. Krochman Damage Function (KDF): 1.1 percent.
  - g. Solar Heat Gain Coefficient (SHGC): 0.09.
- E. Frame Wire Harness (one per IGU):
- a. 3-conductor plenum rated sheathed cable type CM/CL2, 0.175 inch nominal, red and green conductors tied to single pin on conductor.
  - b. Molex 52266-0211 2-pin connector.
- F. Off state: Untinted.
- G. Operating Voltage: 5 volts DC or less.
- H. Requirements:
1. Heat-Strengthened Float Glass: Comply with ASTM C1048, Type I, Class 1 (clear), Quality Q3, Kind HS.
  2. Tempered Float Glass: Comply with ASTM C1048, Type I, Class 1 (clear), Quality Q3, Kind FT.
  3. Laminated Glass: Comply with ASTM C1172 and other requirements as specified.
  4. Fabricate laminated glass products in autoclave with heat, plus pressure, free of foreign substances and air pockets.
  5. Provide hermetically sealed IGU with dehydrated airspace, primary seal of polyisobutylene (PIB), and secondary seal of silicone and 0.008 inch wall thickness stainless steel spacer as specified.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Site Verification and Conditions
1. Verify that site conditions are acceptable for glass installation.
  2. Verify openings for glazing are correctly sized and within tolerance.
  3. Verify that functioning weep system is present.
  4. Verify that minimum required face and edge clearances are being met.
  5. Verify that glazing channels and recesses are clear and free of obstructions, weeps are clear, and channels and recesses are ready for glazing.
- B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation:
1. Clean and prepare glazing channels and other framing members to receive glass and wire.
  2. Remove coatings and other harmful materials that will prevent glass and glazing installation required to comply with performance criteria specified.

### 3.3 INSTALLATION

- A. Install products using recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in the "GANA Glazing Manual".
- B. Verify that IGU secondary seal is compatible with glazing sealants.

- C. Install glass in prepared glazing channels and other framing members.
- D. Install glass per framing manufacturer's wiring diagram showing IGU orientation and wire exit point into building. Comply with glass manufacturer's labels and instructions for glass orientation.
- E. Use grommets during installation to protect wire when routing through frame.
- F. Verify glazing pocket where IGU Pigtail and Frame Wire Harness connection is made is a dry location.
- G. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA Glazing Manual and IGMA Glazing Guidelines and manufacturer's Glazing Guidelines.
- H. Provide bite on glass, minimum edge and face clearances, and glazing material tolerances recommended by GANA Glazing Manual and as approved by glass manufacturer.
- I. Provide weep system as recommended by GANA Glazing Manual.
- J. Distribute weight of glass unit along edge rather than at corners.
- K. Comply with framing manufacturer's and referenced industry recommendations on expansion joints and anchors, accommodating thermal movement, glass openings, use of setting blocks, use of glass spacers, edge blocks, and installation of weep systems.
- L. Protect glass from edge damage during handling and installation.

EDIT NOTE: DELETE MATERIAL IN PARAGRAPH BELOW THAT ARE NOT ON PROJECT.

- M. Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing, or plaster.
- N. Once electronically tintable IGUs have been removed from SAGE Electrochromics' packaging, remove protective film within 90 days of exposure to sunlight or other UV light sources.

### 3.4 ADJUSTING

- A. Remove glass that is broken, chipped, cracked, or damaged in any way, and replace with new materials.

### 3.5 CLEANING

- A. Clean glass inside and outside, immediately after installation and sealants have cured, per SAGE Electrochromics' written recommendations.
- B. Remove temporary protective film from glass. Remove labels and markings from glass.
- C. Clean glass per:
  1. GANA Glass Informational Bulletin GANA 01-0300 - Proper Procedures for Cleaning Architectural Glass Products.
  2. GANA Glass Information Bulletin GANA TD-02-0402 – Heat-Treated Glass Surfaces Are Different.
- D. Do not use scrapers or other metal tools to clean glass.

END OF SECTION

THE INFORMATION CONTAINED IN THIS PUBLICATION IS OFFERED FOR ASSISTANCE IN THE SPECIFICATION OF SAGE ELECTROCHROMICS, INC. PRODUCTS. IT IS NOT INTENDED TO BE COMPLETE AND SAGE ELECTROCHROMICS DOES NOT ASSUME ANY RESPONSIBILITY FOR THE ADEQUACY OF THE SPECIFICATION FOR A PARTICULAR APPLICATION. DUE TO CONTINUAL RESEARCH AND PRODUCT IMPROVEMENT, THE SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT

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