## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 1 Section “Sustainable Design Requirements”.

### 1.2 SUMMARY

A. This Section includes:
1. Glazed aluminum curtain wall systems:
   a. Conventionally glazed.
   b. Two-sided, structural-sealant-glazed.

B. Related Requirements:
1. Division 1 Section “Sustainable Design Requirements – WELL v2”.
2. Division 1 Section “Sustainable Design Requirements – LEED v4”.
3. Division 1 Section "Mockups" for preconstruction laboratory mockup testing.
4. Division 1 Section "Exterior Enclosure Commissioning."
5. Division 7 Section "Façade Insulation, Safing and Smoke Seal" for perimeter fire-containment systems field installed with glazed aluminum curtain walls.
6. Division 7 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
7. Division 8 Section "Structural-Sealant-Glazed Curtain Walls" for four-sided structural-sealant-glazed curtain walls.
8. Division 8 Section "Glazing" for curtain wall glazing.
9. Division 8 Section “Aluminum Framed Entrances and Storefronts”
10. Division 8 Section “Folding Glass Doors”
11. Division 8 Section “Fixed Louvers”
12. Division 9 Section “Stone Wall Facing”.
13. Division 9 Section “High Performance Architectural Coatings”.

C. Extent of Work: Details for the glazed aluminum curtain wall are shown schematically and together with the profiles to be developed are intended to establish performance, profiles and material qualities desired.
1. The glazed aluminum curtain wall as shown shall be a complete system including all stiffeners, fasteners, sealants, drainage systems, gasket, joining, thermal breaks, miscellaneous pieces, and material thicknesses as required to form a high-quality weatherproof enclosure with two distinct lines of protection for air and water infiltration in accordance with the profiles shown.
   a. Pressure equalize system at its interior face.
      1) Exterior rain barrier not tightly sealed but capable of protecting openings to the exterior.
      2) Backup air space to equalize to exterior air pressure.
      3) Airtight and watertight structural barrier to the interior.
      4) Second line of weathertight sealant to the interior inside of thermal barrier system shall have the same capacity as exterior barrier.
2. Details not shown are similar in character to those detailed.
3. The Contractor shall be responsible for development of final details to accommodate the engineering, fabrication, erection, and installation of the work in accordance with the design intent shown.
4. All proposed details and finishes for each type of glazed aluminum curtain wall system shall be reviewed and accepted by the Architect prior to fabrication.

D. Design Drawings: The Architect’s drawings indicate the design concept, the visual overall size, profile, intent and location of various glazed aluminum curtain wall components and relation to adjacent construction, and together with specified “Performance Requirements”, tolerances, materials, finishes

and glazed aluminum curtain wall standards, impose the requirements to be conformed to by the Contractor's proposed glazed aluminum curtain wall system.

E. Design Modifications: Drawings include visual size of profile and relation to adjacent construction and are not indicative of a known system.
   1. Make design modifications of work shown only as may be necessary to meet performance requirements and coordinate the work, subject to the Architect's approval.
   2. Variations in details and materials which do not adversely affect appearance, durability or strength shall be submitted to the Architect for review.
   3. Maintain the general glazed aluminum curtain wall design concept without altering profiles and alignments shown.

## 1.3 DEFINITIONS

A. Permanent Deformation: Deflection without recovery exceeding 1/1000 of span.

B. Water Penetration: Appearance of uncontrolled water, other than condensation, on inboard surface of glazed aluminum curtain wall.

C. Uncontrolled Water: Presence of water appearing on interior metal surfaces through caulked joints or at glazing or other gaskets that may flow to the building interior and cause finish damage.
   1. Water contained within gutters, channels or other devices leading to weepage is permitted.

D. Excessive Condensation: Visible water, ice or frost on more than 5% of the area of any module of the glazed aluminum curtain wall, or the accumulation of uncontrolled condensation flowing from the glazed aluminum curtain wall at any location.

E. Excessive Fading: Change in appearance which is perceptible and objectionable to Architect when viewed visually in comparison with original acceptable color range.

F. Excessive Non-Uniformity of Color or Shade: Non-uniform fading during warranty period to extent that adjacent panels have color difference greater than original acceptable color range.

G. Cracking, Peeling, Pitting or Corroding: Defects discernible from a distance of 10', resulting from natural elements.

H. Color Fade: Not to exceed 5 E units (National Bureau of Standards) calculated in accordance with ASTM D2244 on exposed surfaces cleaned with clean water and soft cloth.

I. Chalking: Not exceeding rating No. 8 on exposed unwashed surfaces.

J. Stack Joint: Junction of one unit to another at a continuous horizontal datum.

K. Unitized: Custom shop fabricated aluminum assembly width and height as shown, with continuous gutter and 2 distinct lines of air and water protection utilizing pressure equalization chamber

## 1.4 QUALITY ASSURANCE

A. The work of this section shall be performed by a company which specializes in the type of glazed aluminum curtain walls work required for this Project, with a minimum of 5 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
   1. Work shall be performed in compliance with Owner's insurance underwriters' requirements and UL approvals and testing for materials, assemblies and procedures.

B. Manufacturer shall specialize in manufacturing the type of glazed aluminum curtain walls specified in this section, with a minimum of 5 years of documented successful experience, and have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM)

contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

D. Laboratory Mockup Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

E. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.

F. Plant/Project Site Documentation:
1. Quality control procedures in the plant and at Project site shall be documented in writing and submitted to Architect and Owner for review.
2. Documentation shall include schedules, details, isometric or explanatory sketches clearly and adequately cross-referenced to shop drawings to ensure fabrication and installation of curtain wall system are in accordance with Contract Documents and certified for structural compliance by an engineer registered in Washington, D.C.

G. Plant Inspection:
1. At Architect's and Owner's option, arrange free access to curtain wall manufacturing plant for observation of manufacturing, glazing and finishing process.

H. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

I. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of structural-sealant-glazed curtain wall assemblies.

J. Manufacturer’s identification tags or marks are not acceptable on surfaces which will remain exposed to view after installation.
1. Evidence of “patching” after removal of tags or marks is not acceptable.

## 1.5 ACTION SUBMITTALS

A. Submit the following according to Conditions of the Construction Contract and Division 1 Specification Sections.

B. Preliminary Design Proposals:
1. Submit a "preliminary design proposal" with Bid, including drawings and structural calculations for review of basic concept of curtain wall system, which shall be prepared, sealed and signed by a professional structural engineer registered in the state in which this Project is located.
   a. Drawings shall include framing members, glass, components and sufficiently detailed information for proper evaluation.
   b. Structural analysis data shall be complete as specified in this section under "Shop Drawings".
2. Do not submit shop drawings and other submittals until "preliminary design proposal" is accepted by Architect and Owner.

C. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

A. Sustainable Design Submittals:
1. Division 1 Section “Sustainable Design Requirements LEED Submittal Requirements – LEED EQ and LEED MR Tracking Forms”.

D. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.
   e. Flashing and drainage.
3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Structural calculations shall include the following:
   a. Shall be prepared, sealed and signed by the same professional structural engineer, registered in Washington D.C. that signed the submitted shop drawings.
   b. Shall include but not be limited to the justification of all glazed aluminum curtain wall elements, fasteners, miscellaneous accents, sunshade and anchorage components for compliance with criteria established in Contract Documents, including magnitude of allowable structural deflections at all principal framing elements and structural analysis of all connections in static and dynamic modes, in compliance with the Building Code, structural calculations, manufacturer's recommendations, and Contract Documents.
   c. Shall be cross-referenced to shop drawings and include all computations and information required for design and fabrication of glazed aluminum curtain wall elements.
   d. Review of structural calculations for conformance with performance criteria by the Architect or the Owner's or Architect's Consultants shall not relieve Contractor from responsibilities and requirements for the performance specified for the Work of this Section.
   e. Shall be submitted with each set of "preliminary design proposal" and shop drawings.
5. Full compliance with requirements of this section, applicable codes, Contract Documents and structural calculations as required in this section.
6. Compliance and coordination with "glass and glazing documentation" approved by glass manufacturer as specified in this section.
7. Plans, elevations, sections, full size details of curtain wall framing members and components, complete with references to detail numbers on architectural drawings and references to Specification section and paragraph numbers to identify material types and finishes.
8. Types, sizes, shapes, materials and quality of all components required to complete the curtain wall work.
9. Method of anchorage to structure, joints and connections, method of assembling sections, details of curtain wall components coordinated with all adjoining work.
10. Types of welded connections using AWS welding symbols.
11. Layout of anchorage devices.
12. Fabrication and erection tolerances for the work of this section and adjoining work.
13. Direction and magnitude of thermal expansion, and the direction and magnitude of applicable building movements.
14. Types of sealants, backer rods and other sealing materials required to make curtain wall watertight and airtight, clearly indicating compliance with Division 7 Section "Joint Sealants."
15. Weeps, baffles and internal sealing methods.
16. Maximum and minimum size joint gaps.
17. Types and thicknesses of glass and glazing material.
18. Type and mil thickness of finish for exposed aluminum surfaces of curtain wall.
19. Type of finish for concealed accessories and components.
20. Continuous air and vapor barrier.
21. Continuous insulation.
22. Components intersection details.
23. Reinforcing: Corners of frames, inserts, anchors, etc.
24. Reglazing sequence: including step-by-step process, all typical details, and method for temporarily retaining glass units in place during silicone cure period, signed and sealed by the system manufacturer/ installer's engineer of record.

25. Isolation of dissimilar materials.
26. Types, sizes and details of all shims, slip pads, gaskets, seals, setting blocks, edge blocks and fasteners.
27. Type and finish of metal panels including method of attachment.
28. Types of hardware and mounting heights.
29. Window washing provisions.

E. Preconstruction sealant adhesion, stain and compatibility test reports for all sealants and substrates.

F. Thermal simulations utilizing LBNL Therm, Window or comparable program to evaluate thermal performance of all typical details.

G. Samples for Initial Selection: For units with factory-applied color finishes.

H. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

I. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

J. Office Samples:

| Item No. | Quantity | Size | Description |
|---|---|---|---|
| S1 | 12 | 6"x6" | Each approved color range in specified finish of each extrusion and sheet for color coordination with other finishes. |
| S2 | 5 | 6" long | Aluminum extrusions with specified finish and color used in curtain wall as selected by Architect. |
| S3 | 5 | 6"x6" | Field touch-up to match specified finish and color. |
| S4 | 5 | 6" long (cured) | Sealants complete with respective primers, each type and color as specified in Division 7 Section “Joint Sealants.” |
| S5 | 5 | 6" long | Waterproofing and glazing gaskets, including molded corners, tapes, setting blocks, jamb shims, backer rods and separators, each type. |
| S6 | 5 | Actual | Anchor assemblies, each type. |
| S7 | 5 | Actual | Fasteners, including accessory items such as washers, nuts, etc., each type. |

K. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

L. Welding qualifications, certifications, and procedures (WPS) for all welding processes.

## 1.6 INFORMATIONAL SUBMITTALS

A. Mockup Testing Submittals:
1. Testing Program: Developed specifically for Project.
2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

B. Qualification Data:
   1. For Installer and laboratory mockup testing agency and field-testing agency.
   2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
   1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

D. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranties: For special warranties.

I. Glass and Glazing Documentation:
   1. Submit to glass manufacturer detailed diagrams, schedules and all information required for proper evaluation of glazing methods, wind load, wall and building movement, magnitude of thermal expansion, blocking, sealing, surface preparation and other procedures which may affect the curtain wall system for compliance with requirements of this section, applicable codes and Contract Documents.
   2. Verify with glass manufacturer and coordinate with Division 8 Section “Glass and Glazing.”

J. As-Built Drawings.

K. Operations and Maintenance Data: Shall clearly indicate manufacturer's printed instructions for operations and maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions and precautions against materials and methods which may be detrimental to finishes and performance.

L. Certifications of Application: Submit one copy of certification in an approved form, stating that the completed glazed aluminum curtain wall complies with these specifications, that the component parts were properly designed or selected for the application made, and that installation methods complied with manufacturer’s printed instructions and their field representatives’ verbal instructions, and were proper and adequate for the condition of installation and use in each case, signed by the Contractor, the manufacturer and installer or the glazed aluminum curtain wall work.

M. Hazardous Materials Notification: In the event no product or material is available that does not contain asbestos, PCB or other hazardous materials as determined by the Owner, a "Safety Data Sheet" (SDS) equivalent to OSHA Form 20 shall be submitted to the Owner for that proposed product or material prior to installation with concurrent notification to the Architect.

N. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB) using format in Division 1 Section “Closeout Procedures”.

## 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1 Section "Product Requirements".
1. Deliver materials in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.
2. Factory-finishes shall be protected from abrasion and other damages.
3. Stacking and storing of components in shop, in transit and at Project site shall be done using softeners and timbers to keep individual members free from contact with the ground, and with each other.
4. Store materials in unopened containers, off ground, under cover and protected from damage.
5. Protect components from soiling by adjacent fabrication or construction operations.
6. Handle materials so surfaces are protected and distortion is prevented.
7. Materials which are delivered to Project site disfigured, cracked, chipped, or scratched, or otherwise not suitable for installation shall be removed from Project site and replaced with new materials at no additional cost to Owner.

## 1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements, and/or digital 3D survey before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating glazed aluminum curtain wall systems without field measurements.
   a. Coordinate construction to ensure that actual dimensions correspond to established dimensions.
   b. Field verify dimensions and locations of existing elements abutting curtain wall systems.
2. Coordinate glazed aluminum curtain wall work with the work of other sections and provide items to be placed during the installation of other work at the proper time to avoid delays in the work.
   a. Place such items, including inserts and anchors, accurately in relation to the final location of glazed aluminum curtain wall components.

B. In coordination and collaboration with the GC, and with written approval of the owner, perform necessary localized investigation and probing to fully evaluate the structural integrity and capacity of the existing structure, confirming that structure will sustain loads imposed by glazed aluminum curtain wall system and all associated components.

## 1.10 WARRANTY

A. Comply with General Conditions and Division 1 Section "Product Requirements", except extend to 10 years, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:
1. Abnormal deterioration, aging or weathering of the Work.
2. Failure of anchorage metals due to oxidation, electrolytic damage and deterioration of protective coatings.
3. Loose or missing parts.
4. Failure of operating and moving parts and components to function properly.
5. Leakage of water or air exceeding specified limits.
6. Failure of tapes, gaskets or sealants.
7. Glass breakage.
8. Failure to conform to profiles, locations, arrangements shown on drawings.
9. Failure to conform to manufacturer's recommendations and industry standards as they apply to the various curtain wall components.
10. Staining of curtain wall surfaces caused by incompatibility of adjacent materials.
11. Objectionable appearance or performance resulting from either defective or nonconforming materials or workmanship.
12. Structural failure.
13. Loss of glass bite due to shifting of glass.
14. Loss of glass bearing on setting blocks due to shifting of glass and/or blocks.

15. Collapse of thermal insulation or shifting insulation.

B. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water penetration through fixed glazing and framing areas.
      e. Failure of operating components.
   2. Warranty Period: 10 years from date of Substantial Completion.

C. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of powder coat, or fluoropolymer organic finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Repair warranty shall start after all related repair work is completed.
   3. Repairs shall not change the design and appearance of interior and exterior face of curtain wall.
   4. Warranty Period: 20 years from date of Substantial Completion.

D. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, peeling, or chipping.
   2. Warranty Period: 10 years from date of Substantial Completion.

E. Glass and Glazing Warranty: Submit in accordance with Division 8 Section “Glass and Glazing” as part of curtain wall work.

F. Sealant Warranty: Submit in accordance with Division 7 Section “Joint Sealants” as part of curtain wall work.

G. Failures in the curtain wall system shall result in an extension of the warranty period until the deficiencies are permanently repaired.
   1. The Contractor shall be responsible for continuing corrections to defective work beyond warranty period if initial corrective measures were executed but later found to be inadequate or not acceptable after the specified warranty period.
   2. Repair work shall carry same warranty as the initial installation.
   3. Repair warranty shall start after all related repair work is completed.
   4. Repairs shall not change the design and appearance of interior and exterior face of curtain wall.

## 1.11 EXTRA MATERIAL

A. Deliver to Project site 6 pieces of each type of extrusions in lengths required for reglazing of each shape of glass.
   1. Crate and label as required.
   2. Place in storage location as directed by Owner.
   3. Refer to Division 8 Section "Glazing" for curtain wall glazing.

## 1.12 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

## 1.13 VISUAL MOCKUPS

A. Visual Mock-ups: Prior to installing glazed aluminum curtain wall system, construct mock-ups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.
1. Build mock-ups using materials indicated for completed Work.
2. Locate mock-ups on-site in the location and of the size indicated or, if not indicated, as directed by Architect.
3. Notify Architect 7 days in advance of the dates and times when mock-ups will be constructed.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mock-ups before start of Work.
6. Retain and maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed Work.

## 1.14 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

## 1.15 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on laboratory mockups.
1. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
2. Size and Configuration: As indicated on Drawings.
3. Notify Architect seven days in advance of the dates and times when preconstruction laboratory mockups will be constructed and tested.

B. Preconstruction Laboratory Mockup Testing: Test preconstruction laboratory mockups according to requirements in "Performance Requirements" Article. Perform the following tests in the following order:
1. Structural, 50 percent: ASTM E330/E330M at 50 percent of positive test load.
2. Air Leakage: ASTM E283.
3. Water Penetration under Static Pressure: ASTM E331.
4. Water Penetration under Dynamic Pressure: AAMA 501.1.
5. Structural, 50 and 100 percent: ASTM E330/E330M at 100 percent of positive and negative test loads. Repeat the following:
    1) Air Leakage: ASTM E283.
    2) Water Penetration under Static Pressure: ASTM E331.
6. Vertical Interstory Movement: AAMA 501.7 7 at 100 percent of design displacement. Repeat the following:
    a. Air Leakage: ASTM E283.
    b. Water Penetration under Static Pressure: ASTM E331.
7. Interstory Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:
    a. Air Leakage: ASTM E283.
    b. Water Penetration under Static Pressure: ASTM E331.
8. Thermal Cycling: In accordance with AAMA 501.5. Repeat the following:
    a. Air Leakage: ASTM E283.
    b. Water Penetration under Static Pressure: ASTM E331.
9. Structural, 75 and 150 percent: ASTM E330/E330M at 75 and 150 percent of positive and negative test loads.
10. Window Washing tieback test: pull window washing tieback out, up, down, left and right to 600lbs load. No damage to adjacent system or surfaces is allowed.

C. Preconstruction Adhesion and Compatibility Testing: Submit to structural glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.
   1. Compatibility: Test materials or components using ASTM C1087.
   2. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
   3. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
   4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

## PART 2 PRODUCTS

### 2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the Owner.

### 2.2 ACCEPTABLE MANUFACTURERS

A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.

B. Substitutions: Comply with General Conditions and Division 1 Section “Product Requirements” using form in Division 1 Section “Substitution Request Form”.

### 2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 1 Section "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
      a. Curtain wall system shall be designed for axial, flexural, shear and torsional stresses and any combination thereof due to wind, thermal and gravity loads.
      b. "Allowable stresses" for aluminum curtain wall elements shall not exceed minimum standards published in the Aluminum Association's Aluminum Construction Manual "Specifications for Aluminum Structures", Latest Edition, and other applicable codes and regulations.
      c. Coordinate with design requirements for this Project.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.
      f. Deflection exceeding specified limits.
      g. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
      h. Sealant failure.
      i. Air infiltration and water penetration exceeding specified limits.

C. Structural Loads:
   1. Wind Loads:
      a. Wind loads on curtain wall system shall be referred to as the "Design Wind Pressure" in this section.

b. Design Wind Pressure: Shall be in accordance with the building code, refer to the General Notes in the Structural Drawings.
c. Wind pressures act perpendicular to flat surfaces, regardless of the surface orientation for wind pressures acting on corners and other changes in plane.
    1) Both surfaces shall be assumed to experience their inward and outward design pressures simultaneously.
    2) Design for simultaneous occurrence of inward design pressure on one surface, and outward design pressure on the adjoining surface, is not required.
d. Performance criteria at "Design Wind Pressure" for metal members supporting glass and panels shall be as follows:
    1) Perpendicular to the plane of the wall, net deflection of framing members shall not exceed L/175 of clear span, or 3/4", whichever is less for spans up to 13'-6" and L/240 + 0.250" for spans greater than 13'-6" per AAMA TIR-A11.
        a) Span is defined as the distance between anchor centerlines.
        b) For cantilevers, span is defined as the distance between anchor centerline and end of cantilever.
        c) Where a sealant joint occurs between a framing member and a stiff building element, framing member deflection shall not exceed 1/2 of the normal joint width, or less if required by sealant manufacturer.
        d) Where a framing member runs continuously past a deflecting support, the support deflection shall be added to the member deflections.
    2) In the plane of the wall, deflection of framing members shall not reduce the glass or panel bite below 75% of the design dimension, and shall not reduce the glass or panel edge clearance below 25% of the design dimension or 1/8", whichever is greater.
        a) Restrict deflection further, if required, for assembly and fit of components.
    3) At the connection points of framing members to anchors, combined movement of anchor relative to building structure, and framing member relative to anchor, shall not exceed 1/8" in any direction.
    4) Stresses shall not exceed the allowable values established by the specifications listed under "Reference Standards".
        a) In no case shall allowable values exceed the yield stress.
        b) Where permitted by code, an increase in allowable stress for wind or seismic load is generally acceptable, but not in combination with any reduction applied to combined loads.
        c) An increase in allowable working stress is not permitted for thin metal legs bent about the weak axis or for welds.
    5) Glass, sealants and interior finishes shall not be assumed to contribute to framing member strength, stiffness or lateral stability.
    6) Compression flanges of flexural members may be assumed to receive effective lateral bracing only from anchors to the building structure, and horizontal glazing rails or interior trim, which are in contact with the compression flange.
        a) Points of contraflexure shall not be regarded as lateral braces or as the end points of an unbraced length; unbraced length shall be the actual distance between effective lateral braces as defined above.
    7) Where a framing member reaction is resisted by a continuous element, the maximum assumed effective length of the resisting element shall be four (4) times the bearing length, but not more than one foot.
e. Performance criteria at 1.5 times "Design Wind Pressure" for metal members supporting glass and panels shall be as follows:
    1) Net permanent deflection of framing members shall not exceed 1/1000 times span.
    2) There shall be no failure or gross permanent distortion of framing members, anchors or connections, or any other portion of the entire system.
    3) At connection points of framing members to anchors, combined movement of anchor relative to building structure, and framing member relative to building structure, and framing member relative to anchor, shall not exceed 3/16" in any direction, nor 1/8" set after load is removed.

2. Periodic Maintenance-Equipment Loads: As indicated on Drawings.
   a. Tie-Back Requirements: Curtain wall system shall be designed to support window washing equipment load of 600 lbs. in any direction.
      1) Deflection of members supporting window washing equipment loading shall not result in any permanent set.
3. Seismic Loads: As indicated on Structural Drawings.
4. Metal panel copings, ledges, setbacks, and parapet caps:
   a. Metal panel copings, ledges, setbacks, and parapet caps shall be designed to resist the full design wind load as applied to the curtain wall in combination with a 250-pound point load.
   b. Metal panel copings, ledges, setbacks, and parapet caps shall not permanently deform under applied load. Temporary deflection shall not harm adjacent components of the wall including aluminum and glass.
5. Canopies:
   a. Canopies shall be designed to resist the full design wind load as applied to the curtain wall in combination with a 250-pound point load.
   b. Canopies shall not permanently deform under applied load. Temporary deflection shall not harm adjacent components of the wall including aluminum, seals and glass.
6. Personnel Restraint Track: Comply with OSHA regulations and all applicable codes and regulations.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
   1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m).
   2. Deflection Perpendicular to Wall Plane: Perpendicular to the plane of the wall, net deflection of framing members shall be per AAMA TIR-A11-96 and shall not exceed 1/240 + 1/4" for spans of 13'-6" or greater or1/175 times span or 3/4" for spans less than 13'-6" whichever is less. Span is defined as the distance between anchor centerlines. For cantilevers, span is defined as two times the distance between anchor centerline and end of cantilever. Where a sealant joint occurs between a framing member and a relatively stiff building element, framing member deflection shall not exceed 1/2 of the nominal joint width or less if required by sealant manufacturer. Where a framing member runs continuously past a deflecting support, the support deflection shall be considered in the analysis."
   3. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
      a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
      b. Horizontal Supporting Glass: Design horizontal supporting members to support full dead load of glass limiting deflection to 1/8" or 25% of edge clearance, whichever is less.
         1) Limitation to 1° from horizontal.
   4. Cantilever Deflection: Limited to 2l/175 at unsupported cantilevers.
   5. Sills and copings (sheet, plate or extruded) shall be designed to support a 250 lb. point load and to return to original position without being damaged.
   6. Sloped Glazing Plane: Limited to 1/450 of clear span or 1/4" whichever is smaller.

E. Structural: Test in accordance with ASTM E330/E330M as follows:
   1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).

G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1-17 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
   2. Maximum Water Leakage: In accordance with AAMA 501.1-17. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.
   3. Provisions shall be made to drain to exterior of wall, water entering at joints or glazing reveals, any condensation occurring within the assemblies, and adjacent wall systems secondary, and similar conditions.
      a. Provide internal gutters and weep system to collect and drain water leakage and condensation to the exterior.
         1) Stick built curtain walls and punched windows shall have an isolated gutter cavity at each glass perimeter, so that leakage is confined to and weeped from the opening of leakage origin.
         2) Unitized curtain walls shall have continuous spliced gutters at horizontal stack joints, with sealed end caps at termination conditions.
         3) Horizontal ribbon windows shall have a continuous gutter and weep holes at the glass sill, and a continuous gutter at the glass head that drains directly to exterior or directs leakage from spandrel above to the window sill.
      b. Provide continuous subsill below windows with interlocking mullions.
      c. Coordinate gutter and weep systems with drainage provisions of other sections.
      d. Give special attention to the connection of drainage members at columns, spandrel beams and other areas of limited access.
      e. The use of carbon steel components for gutter and drainage assemblies is prohibited; provide stainless steel components.

H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
   1. Design Displacement: As indicated on Drawings.
      a. Live Load Vertical Floor Deflection: 0" up at all locations, and 0.50" down at all locations, additive to any accommodation for erection and fabrication.
      b. Building Lateral Deflection: Not less than Story Height divided by 400 in all directions under service wind loads, as measured between equivalent points on typical adjacent floors.
      c. Axial Lengthening and Shortening of Building Columns: 0.125” each story.
      d. Connections shall permit movement in the plane of the panel for "story drift" and shall be properly designed sliding connections using slotted or oversized holes or may be connections which will permit movement by bending of steel or other connections providing equivalent sliding and ductility capacity.
   2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement and 1.5 times the design displacement.
   3. Codes and regulations of other governing agencies applicable to curtain wall system shall apply to work of this section.
      a. When applicable Codes or specified requirements differ, the more stringent conditions which provide the most unfavorable conditions shall govern.
      b. Code Compliance: Washington D.C.

I. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

J. Seismic Performance: Shall withstand the effects of seismic forces and movements as required by the building code and per the Structural drawings:
   1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement and 1.0 times the design displacement.
   2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.7 at design displacement and 1.0 times the design displacement.

K. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
   1. Thermal Transmittance (U-factor):
      a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.38 Btu/sq. ft. x h x deg F (2.16 W/sq. m x K) as determined in accordance with NFRC 100.
   2. Solar Heat Gain Coefficient (SHGC):
      a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.40 as determined in accordance with NFRC 200.
   3. Air Leakage:
      a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) when tested in accordance with ASTM E283.
   4. Condensation Resistance Factor (CRF):
      a. Fixed Glazing and Framing Areas: CRF for the system of not less than 80 as determined in accordance with AAMA 1503.

L. Anchorage and Structural Support Framing:
   1. Anchors and supports indicated and/or noted on drawings are schematic and do not necessarily indicate the exact and/or required scope, type, shape or profile.
      a. Additional anchorage and structural support framing shall be added or complemented as required.
   2. Points of Support for Assemblies: Shall be properly braced in three orthogonal directions (vertical, transverse and longitudinal) to resist loads from any direction, including, but not necessarily limited to, the "positive and negative wind pressures" and "seismic loads".
   3. Anchorage and Support Framing: Shall be designed to accommodate thermal and building movements without harmful effect to curtain wall system, including glass and glazing materials, and sealant applications.
   4. Anchors (bracing, inserts, clips, bolts, etc.): Shall be designed for same loads as curtain wall and checked at 1.5 x "Design Wind Pressure" in addition to all other forces to ensure that the stresses do not exceed the yield point or elastic buckling, whichever is lower.
   5. Holes: Shall not be burned or field drilled in any structural steel members unless approved in writing by Architect.

M. Critical Dimensions: The following critical dimensions shall be utilized without modification.
   1. Wall Assembly Depth: Provide a complete wall system as shown and specified with components and systems located within the area from the exterior face to the depth noted as wall assembly depth, beam or edge of slab shown, without encroachment or displacement of the interior construction and finishes shown.
      a. Anchorage zone is detailed using depth as indicated on the drawings..
      b. Wall zone is defined by manufacturer’s glazed aluminum curtain wall system depth.
      c. Combined wall zone and anchorage zone is wall assembly depth.

N. Fire, Smoke and Draft Barrier: Provide a continuous fire, smoke and draft barrier as an integral component of the glazed aluminum curtain wall systems to prevent the passage of air and smoke from one floor to another, within the glazed aluminum curtain wall work.
   1. Comply with the requirements of the authorities having jurisdiction, including testing and certification requirements.
   2. Design the barrier system to accept floor fire safing as an integral part of the system.
   3. Design the barrier to sustain the impact from a fire hose stream in accordance with the requirements of the local authorities having jurisdiction.

4. Design the barrier system to withstand the loading from wind pressurization created by drainage openings and weep holes.
5. Install continuous sealant above fire safing to effectively seal and prevent air loss between floors.
6. Comply with UL Des CW-S 2001, to Provide a 2-hour fire integrity rating at spandrel glass areas and UL Des CW-S 2002 at metal panel areas.

O. Glass Replacement Requirements:
1. Glazing details shall permit glass replacement after initial construction, shall permit reuse of original gaskets, shall permit replacement glass of same nominal size as original glass, and shall not require cutting of framing members or removal of interior finishes.

P. Snap Components Requirements:
1. Snap engaged components shall be secured against migration, and shall not serve any primary structural function, such as retention of glass or panels.
2. Snap engaged plastic components are not permitted, except as nonstructural thermal improvement for interior trim.
3. Joints in continuous snap covers and other continuous trim shall have splice sleeves of same material and finish as cover or trim.

Q. Dead load of glass and panels shall not be carried through thermal breaks.

R. Thermal breaks in sill or gutter shall be capped with sealant, including 6” (15.2 cm) sealant return at jambs.

S. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
   b. Low Exterior Ambient-Air Temperature: 20 deg F (minus 7 deg C).
3. Buckling, opening of joints, glass breakage, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement of components will not be permitted.
4. Fabrication, assembly and erection procedures shall take into account the ambient temperature range at the time of respective operation.
5. Thermal performance shall be based on following criteria:

| | | Dry Bulb | Wet Bulb |
|---|---|---|---|
| a. | Summer Outside Air Temperature | 95° F | 76° F |
| b. | Winter Outside Air Temperature | 10° F | – |
| c. | Summer Inside Air Temperature | 74° F | 61.8° F |
| d. | Winter Inside Air Temperature | 70° F | 58.3° F |
| e. | Summer Outside Air Velocity | 5 MPH | |
| f. | Winter Outside Air Velocity | 15 MPH | |
| g. | Summer and Winter Inside Air Velocity | 0 MPH | |

T. Structural-Sealant Joints:
1. Designed to carry gravity loads of glazing.

U. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

## 2.4 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing spandrel panels, entrances and accessories, from single manufacturer.

## 2.5 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   1. Construction: Thermally improved.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Front .
   4. Finish: As per Division 9 Section “High Performance Architectural Coatings”.
   5. System: Unitized system.
   6. Aluminum:
      a. Extrusions: Provide shapes and thicknesses indicated and required to fulfill performance requirements; not less than 1/8” thick, unless otherwise indicated.
         1) Tolerances: Finish, fabricate and assemble materials in accordance with standard commercial tolerances except for cross-sectional dimensions, for which one-half of commercial tolerances shall apply.
            a) Comply with applicable commercial tolerances published in Alcoa Aluminum Handbook.
      b. Sheets and Plates: Provide sizes and minimum gauges indicated and required to fulfill performance requirements; not less than 3/16” thick.
         1) Tolerances: Fabricate and assemble material in accordance with industry standard commercial tolerances except for flatness, for which the following tolerances shall apply.

Longitudinal or Transverse Distant Feet
Center to Center of Buckles or Edge Wave ★

| 0 to 2’ | 2’ to 3’ | 3’ to 4’ | 4’ to 6’ | Over 6’ |
|---|---|---|---|---|
| 3/32” | 3/16” | 1/4” | 5/16” | 3/8” |

★ Also applicable to overall length or width of sheet if only one longitudinal and/or transverse buckle or edge wave is present.

   7. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
      a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
      b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
      c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

B. Stainless Steel: Shall conform to American Iron and Steel Institute's "Steel Products Manual" and the following:
   1. Annealed AISI Types 301, 302, 304 and 316: ASTM A167.
   2. AISI Type 430: ASTM A176.
   3. Tempered AISI Type 301 and Similar: ASTM A666.
   4. Tubing, AISI Type 430: ASTM A268.
   5. Tubing, AISI Types 304 and 316: ASTM A269.
   6. Hot-Rolled and Cold Finished Bars: ASTM A276.
   7. Plate, Sheet and Strip, AISI Types 201 and 202: ASTM A666.
   8. Rolled Shapes, Plates and Bars: ASTM A572.
   9. Cold-Rolled Sheet and Strip: ASTM A606.
   10. Hot-Rolled Sheet and Strip: ASTM A607.

C. Weeps:
1. Type: Weep holes shall be baffled against water infiltration which will not degrade under sunlight, water and fungus conditions, complete with attachments.
2. Size: Conform to weep hole size, profiles and arrangements.
3. Weep Baffles: PVC coated open cell reticulated urethane foam; 30-40 pores per inch.
4. Weeps in snap covers shall be 3/8" oblong openings.

D. Shim Types:
1. Stainless steel 300 series.
2. Hot-dipped galvanized steel, ASTM A36 or ASTM A283 quality.
3. High impact polystyrene.
   a. Do not use at structural connections.
4. For Structural Connection: Use only metal shims.
5. U-Shaped Shims: Do not use at structural connections, slip connections or other locations where shims can become loose.
6. Fiber Shims: Not acceptable.

E. Separators:
1. At Expansion Connections: Use DuPont "Eel Slip", plastic, Teflon shims, Penn Fibre's "Nylatron", or other approved type, of thickness required to meet design requirements.
   a. Slip pads are required at all surfaces which are subject to movement.
2. Between Dissimilar Materials and at Dynamic Connections: Use rigid high-impact polystyrene with smooth surfaces each side, of thickness required to meet design requirements.
3. Do not use polystyrene in close proximity of field welds.

F. Window Washing Anchors: Lockwell Scaffold Loc or equal; concealed mounted in framing components; spaced not to exceed 30'-0" o.c., horizontally and 50'-0" center to center or every third floor, whichever is less, vertically.

G. Dissimilar Materials: Where encountered, use only stainless steel 300 series.

H. Top of Tower Parapet Coping: Ensure that thickness of metal coping is no less than 3/16" to serve as a ground for the lightning protection system in Division 16.

I. Terminator at Aluminum Composite Panel System: Extruded aluminum.

J. Framing Gaskets: As recommended by manufacturer for joint type.

K. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.

L. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

M. Entrance Door Systems: Comply with Division 8 Section "Aluminum-Framed Entrances and Storefronts".

## 2.6 METAL PANELS

A. Metal Panels General:
1. Type: Aluminum cladding elements as detailed on the drawings.
   a. Cladding Elements: Formed edge flanges as detailed.
   b. Backside Stiffener Members: As required to maintain flatness.
2. Cladding elements, when supported in the same manner as intended in the building, shall be capable of carrying the design load without suffering any permanent deformation or damage.
3. Exterior Faces Flatness: Cladding elements shall be of such flatness that, when measured at room temperature, the maximum slope of the surfaces at any point, measured from the nominal plane of the surface in its final installed position shall not exceed:
   a. 0.25% for surfaces having finish of high reflectivity.
   b. 0.35% for surfaces having a finish of medium reflectivity.
   c. 0.5% for surfaces having a finish of low reflectivity.
4. Cladding Material Inspection:

a. Inspect for physical tolerances including length, width, squareness, and camber on one sheet of each box that is shipped.
b. Inspect for flatness tolerances on each coil until the tension leveling setup is achieved and afterward, on one sheet of each box.
c. The acceptable limits shall be as follows:
   1) Evaluate deviation of panel from the flat surface at each corner and center of each side to 0.065" maximum deviation on any corner or side.
      a) This would approximate a 0.35% off-flat condition.
      b) Long edges and center buckle in sheets are unacceptable conditions.
   2) Lay sheet on flat table good side down.
      a) Evaluate deviation of panel from the flat surface at each corner and center of each side to 0.090" maximum deviation on any corner or side.
      b) This would approximate a 0.05% off-flat condition.
      c) Long edge and center buckle of sheets are unacceptable conditions.
   3) Stand sheet on edge (i.e. free standing).
      a) Using a straight edge, check coil set and canoe shape to 1/4" maximum canoe and 3/8" maximum coil set.

B. Metal Panel Types: Refer to Drawings and Division 7 Section “Composite Metal Panels”.

## 2.7 CUSTOM PERFORATED METAL PANELS

A. Perforated Metal Panels:
1. Type: Applied elements external to the Curtain Wall System.
2. Fabricated using aluminum plates, bars, tubes and pipes as shown in elevations and details.
3. Wherever possible, panels shall be factory attached to louver frames using concealed 300 Series stainless steel fasteners.
4. Pattern: Refer to the Drawings for the perforation pattern.
5. Finish: Refer to Division 9 Section “High Performance Architectural Coatings”

## 2.8 CUSTOM DECORATIVE GRILLS

A. Perforated Metal Panels:
1. Type: Applied elements on face of aluminum wall louvers.
2. Fabricated using aluminum plates, bars, tubes and pipes as shown in elevations and details.
3. Wherever possible, grilles shall be factory attached to louver frames using concealed 300 Series stainless steel fasteners.
4. Pattern: Refer to the Drawings.
5. Finish: Refer to Division 9 Section “High Performance Architectural Coatings”

## 2.9 SUN CONTROL

A. Sunshades: Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to curtain wall with mechanical fasteners.
1. Orientation: Horizontal and Vertical
2. Projection from Wall: As indicated on Drawings.
3. Outriggers: As indicated on Drawings.
4. Finish: Match adjacent glazed aluminum curtain wall.
5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
6. Steel Reinforcement: As required by manufacturer.
7. Finish: Refer to Division 9 Section “High Performance Architectural Coatings”

## 2.10 GLAZING

A. RE Division 9 Section “Finish and Material Schedule”.

B. Glazing: Comply with Division 8 Section "Glazing."

C. Glazing Gaskets: Comply with Division 8 Section "Glazing.".

D. Glazing Sealants: Comply with Division 8 Section "Glazing."

E. Structural Glazing Sealants: ASTM C1184, chemically curing silicone formulation that is compatible with system components with which it comes into contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.
   1. Color: As selected by Architect from manufacturer's full range of colors.

F. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.
   1. Color: Match structural sealant.

## 2.11 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:
   1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
   2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.12 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding fasteners and accessories compatible with adjacent materials, Fabricated from 300 Series stainless steel.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Exposed Fasteners: Will be permitted only where approved by Architect.
      a. When exposed fasteners are accepted, use 300 Series stainless steel with countersunk flat head or button head Phillips Drive, finished to match adjacent metal and finish.
   4. Finish exposed portions to match framing system.
   5. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
   1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
   2. Shall be of type, size, alloy, quantity and spacings as required to meet structural design requirements.
   3. Bolts and Other Fastening Devices: Type 304 non-magnetic stainless steel.
      a. Self-drilling, self-threading fasteners or screws in plugs are not permitted.
   4. Anchor Bolts: Self-locking type complete with nylon inserts.
      a. Liquid or other setting types of locking compounds are not permitted.

C. Concealed Flashing: Dead-soft, 0.030” or thicker stainless steel, ASTM A240/A240M, Type 300 Series or 0.040” or thicker aluminum sheet.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

E. Perimeter Fire-Containment Systems (Safing Insulation): Specified in Division 7 Section "Fire-Resistive Joint Systems"
   1. Type/Thickness: As specified and indicated on drawings or required to meet code requirements.
      a. Comply with UL Des CW-S 2001 at spandrel glass areas and UL Des CW-S-2002 at metal panel areas, to provide a 2-hour fire integrity rating.
   2. Support Brackets: Galvanized steel type required at 12" on centers to support safing insulation.
      a. Reduce spacings of brackets as required to assure positive retention of insulation.

## 2.13 METAL PROTECTION MATERIALS

A. General:
   1. Materials used as permanent or temporary protection for metals shall conform with the following standards and coating systems.
   2. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying primer.

B. Corrosion-Inhibiting Paint for Carbon Steel:
   1. For Concealed Parts Not Subject to Moisture: 2 shop coats minimum 1 mil thickness each coat of zinc chromate primer complying with FS TT-P-645 or zinc-rich paint.
   2. For Exposed Parts Subject to Moisture: Zinc-rich paint conforming to SSPC-PS 1, SSPC-PS 2 or SSPC-PS 3.

C. Prime Paint:
   1. Protection against galvanic action shall be provided wherever dissimilar metals are in contact.
   2. Provide minimum dry film thickness of one mil for zinc chromate and 30 mils for bituminous paint.
   3. Pretreatment: SSPC-Paint 27 if required for specified painting system.
   4. Bituminous Paint: FS TT-C-494.
   5. Cold-Applied Asphalt Mastic: SSPC-Paint 12.
   6. Zinc-Rich Paint: MIL-P-38336.
   7. Zinc-Chromate Primer: FS TT-P-645.

D. Galvanizing of Carbon Steel:
   1. ASTM A653: Hot-dip for steel sheets.
   2. ASTM A123: Hot-dip for shapes, plates, bars and strip.
   3. ASTM B633: Electro-galvanizing.

E. Dissimilar Metals: Separate dissimilar metals with bituminous paint, or a suitable sealant, or a nonabsorptive plastic or elastomeric tape, or a gasket between the surfaces.
   1. Do not use coatings containing lead.

## 2.14 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from exterior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components to resist water penetration as follows:
   1. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Factory-Assembled Frame Units:
   1. Rigidly secure nonmovement joints.
      a. Reinforce members and joints with steel plates, bars, rods or angles for rigidity and strength needed to fulfill performance requirements.
      b. Use concealed stainless steel fasteners for jointing which cannot be welded.
      c. Reinforce aluminum mullions and assemblies as required to support loads from window washing equipment.
   2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
   3. Seal joints watertight unless otherwise indicated.
      a. Separate dissimilar metals or alloys with heavy coating of bituminous paint or other suitable permanent separation required to prevent galvanic action.
   4. Install glazing to comply with requirements in Division 8 Section "Glazing."
   5. Install structural glazing.
      a. Set glazing into framing in accordance with sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
      b. Set glazing with proper orientation so that coatings face exterior or interior as specified.
      c. Apply structural silicone sealant to completely fill cavity, in accordance with sealant manufacturers written instructions with the framing and glazing in a fully supported position.
      d. Brace or stiffen framing and glazing in such a manner to prevent undue stresses on the glass edge seal and structural joints or movement of the glazing, until sealant is fully cured in accordance with manufacturer's recommendations.
      e. After structural sealant has completely cured, insert backer rod between lites of glass as recommended by sealant manufacturer.
      f. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.
      g. Clean and protect glass as indicated in Division 8 Section "Glazing."
      h. Retain bracing or stiffening until erected to prevent racking of units during transportation and erection.

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## 2.15 FINISHES

A. Curtain Wall Exterior Finish:
   1. Coating as specified in Division 9 Section “High Performance Architectural Coatings”
   2. Locations of color numbers are indicated on drawings.

B. Curtain Wall Interior Finish:
   1. Coating as specified in Division 9 Section “High Performance Architectural Coatings.”
   2. Locations of color numbers are indicated on drawings.

## 2.16 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Surfaces shall be free of frost, condensation, dirt, grime or other foreign materials which will hinder or create conditions which prevent proper installation or performance of curtain wall.
   2. Review with Architect field dimensions which are in conflict with approved shop drawings.

### 3.2 PREPARATION

A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

### 3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.
   1. Do not erect members which are warped, bowed, deformed or otherwise damaged to such extent as to impair strength or appearance.
   2. Remove and replace members damaged in the process of erection.

C. Fit joints to produce hairline joints free of burrs and distortion.
   1. Cutting and trimming components of the glazed aluminum curtain wall during erection is prohibited.
      a. Do not cut through structural steel or concrete reinforcing.
   2. Set units level, plumb and true to line, with uniform joints.
      a. Support on metal shims and secure in place by bolting to clip angles and similar supports anchored to supporting structure.
      b. Use only types of equipment, ropes, wedges, etc. and other items during erection which will not stain or mark finish of units.

D. Rigidly secure non-movement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
   1. Remove all slag, and thoroughly clean welds and adjoining burned areas of prime coated surfaces.
   2. Repaint with one coat of zinc-rich paint for welds.
   3. Grind exposed welds smooth, using only clean wheels and compounds which are free of iron or iron compounds.
      a. Restore finish of components after welding and grinding.
   4. Solder and braze only to fill or seal joints (not to form structural joints) and in accordance with component manufacturer’s recommendations.
      a. Grind smooth and restore finish.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

K. Install glazing as specified in Division 8 Section "Glass and Glazing".
   1. Weep holes, gutters and drainage channels shall remain free of dirt, rubbish, sealants and other materials prior to closing of the wall.
   2. Glazing rabbets shall be clean, dry and free of materials which will affect the proper bond and seal of glazing materials or affect the proper drainage of glazing rabbets.

L. Install sealants as specified in Division 7 Section "Joint Sealants."
   1. Where sealants are installed by several trades, i.e. glazed aluminum curtain wall, glazing, aluminum panel installation, dimension stone cladding, prior to commencing such work, coordinate sealant work with adjacent sealant work of other installers, relative to scheduling and sequencing of work and compatibility of materials used by each trade.
   2. Seal joints in glazed aluminum curtain wall in a concealed manner.
      a. Exposed sealants of metal to metal joint are not permitted.

M. Install insulation materials as specified in Division 7 Section "Building Insulation."
   1. Comply with requirements of Division 7 Section “Building Insulation”, unless otherwise indicated.
   2. Comply with UL Des CW-S 2001 at spandrel glass areas and UL Des CW-S-2002 at metal panel areas, to provide a 2-hour fire integrity rating.

N. Install perimeter fire-containment systems (safing insulation) as specified in Division 7 Section "Fire-Resistive Joint Systems."
   1. Clean debris from behind glazed aluminum curtain wall during erection and provide temporary closures to prevent accumulation of debris.
   2. Install safing insulation with securely anchored metal flanges or make equivalent provisions to prevent dislocation.
   3. Comply with UL Des CW-S 2001 at spandrel glass areas and UL Des CW-S-2002 at metal panel areas, to provide a 2-hour fire integrity rating.

O. Install metal flashing and accessories required for watertight installation.
   1. Install metal flashings in 8’ lengths joined with flat locked soldered seams.
   2. Provide expansion joints not over 25’ on centers with loose lock filled with sealant
      a. Stagger flashing joints so as not to align with joints in exterior.
      b. Stagger sill flashing so that joint does not align with expansion or stack joint in mullions.
   3. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

P. Install weatherseal sealant according to Division 7 Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

## 3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Division 8 Section "Glazing."

## 3.5 INSTALLATION OF STRUCTURAL GLAZING

A. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

B. Set glazing into framing in accordance with sealant manufacturer's and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.

C. Set glazing with proper orientation, so that coatings face exterior or interior as specified.

D. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.

E. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer's and framing manufacturer's written instructions and in compliance with local codes.

F. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.

G. Allow structural sealant to cure in accordance with manufacturer's recommendations.

H. Clean and protect glass as indicated in Division 8 Section "Glazing."

## 3.6 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass, as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

## 3.7 ERECTION TOLERANCES

A. Erection Tolerances: The following tolerances are not accumulative and represent maximum deviations for total building height and length dimensions.
1. Amount of total deviation or misalignment in any direction for vertical members: 1/8" maximum in 26'-0" or a maximum of 1/4" in 52'-0".
2. Amount of total deviation or misalignment in any direction for horizontal members: 1/8" maximum in a 25' run.
3. Maximum offset from true alignment between two abutting members will be 1/32".
   a. Edge projection will not be permitted.
4. Maximum joint gap or opening between removable glazing stop, filler or closure and its adjacent member will be 1/16" or a maximum 1/16" cumulative opening at both ends of removable members (1/32" at each end).
5. Spandrels, Column Covers, Panels, Doors, Door Facings, Parapets, Roof and Access Doors: Deviation from flat for faces of panels shall not exceed 1/16” in 10’ at any location and 1/8” total for the entire face.
6. Where tolerances dictated by the window washing system equipment supplier exceed those specified above, comply with the more restrictive requirement.
7. Allowances for the cumulative effect of all tolerances (fabrication, assembly, thermal, building, and erection) and including the work of other sections, shall be made to ensure a weatherproof installation.
   a. The documentation and distribution of this information to the applicable installation and inspection personnel are essential to ensure compliance with Contract Documents.

B. Tolerances for Glass Framing Members:
1. Squareness: Not more than 1/8" difference in the length of the diagonals of an opening.
2. Corner Offset: Limited to maximum 1/32".
3. Bow: Should not exceed 1/16" for every 6 ft. of framing length.

## 3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
1. Contractor shall be responsible for the following:
   a. Coordinate with ITL so they can properly schedule any inspections and tests.
   b. Furnish casual labor required to facilitate testing.
   c. Inform ITL and Architect at least one day prior when work is to be performed.
   d. Provide material samples and access to materials as required for testing.
   e. Contractor is responsible for expense of testing or inspection resulting as consequence of the following:
      1) Work not evidencing compliance with Contract Documents.
      2) Testing to verify adequacy of work done without prior notice, improper supervision, or contrary to standard construction practice.
2. Contractor shall provide ITL with the following:
   a. Complete set of shop and erection drawings.

b. Cutting lists, order sheets, material bills, shipping bills and mill test reports.
c. Information as to time and place of fabrication and shipment of material to shops.
d. Representatives sample pieces requested for testing.
e. Full and ample means of assistance for testing materials.
f. Proper facilities, including scaffolding, temporary work platforms, hoisting facilities, etc., for inspection of work in shop and field.

B. Test Area: Perform tests on an area at least two frames wide by at least one story high. For the Unitized curtain wall, the test area shall capture a vertical split bullion, a horizontal stack joint.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls. Perform tests in advance of installation of any interior finishes. GC to coordinate locations and provide adequate water (hose bib) and access.
1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
   a. Testing Areas: One bay wide but not less than 20’ nor more than 30’ x 1 story high, encompassing a minimum of 1 horizontal stack joint and 4 vertical stack joints.
      1) Location: Where approved by Architect.
   b. Perform a minimum of 5 field water tests.
   c. First Test: Take at initial installation.
   d. Second Test: Take at 10% completion.
   e. Third Test: Take at 25% completion.
   f. Fourth Test: Take at 50% completion.
   g. Fifth Test: Take at 80% completion.
2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
   a. Perform a minimum of three tests in areas as directed by Architect.
3. Water Penetration by Uniform Static Air Pressure Difference (ASTM E1105)
   a. Perform a minimum of 3 field water tests by static test method at 15 psf for 15 minutes in accordance with AAMA 503 and ASTM E1105
   b. First Test: Take at initial installation.
   c. Second Test: Take at 50% completion.
   d. Third Test: Take at 80% completion.
   e. Testing Areas: One bay wide but not less than 15’ nor more than 20’ x 1 story high, encompassing a minimum of 1 horizontal stack joint and 2 vertical stack joints.
      1) Location: Where approved by Architect.

D. Structural-Sealant Adhesion: Test structural sealant in accordance with recommendations in ASTM C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
1. Test a minimum of six areas on each building facade.
2. Repair installation areas damaged by testing.
3. Corrective work and retesting shall be paid by Contractor with no additional cost to Owner, including testing fees, Architect's and Consultant's fees.

E. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

F. Notify Architect, Owner’s Consultants and Owner, in writing, a minimum of 14 days prior to conducting field testing.
1. Remove interior finishes to allow for observation during testing.
2. Replace interior finishes after conclusion of testing.

G. Test Reports and Photographs: Required for field testing.

H. Prepare test and inspection reports.

## 3.9 ADJUSTMENTS, CLEANING, PROTECTION

A. Adjustment: After repeated operation of completed installation, readjust operable window operators and other hardware for optimum condition and safety.

B. Damage to Finish:
   1. Factory-applied finishes which are scratched, abraded, or damaged during transport, delivery, storage or erection, shall be removed or repaired as directed by and to the satisfaction of the Architect.
   2. Repair work to the factory-applied finish shall match the sample approved by Architect.

C. Protection:
   1. Coat exposed stainless steel surfaces at ground level with strippable paper.
   2. Provide board protection at ground level work and near construction chutes.
   3. Temporary coating and coverings provided at Contractor's option to protect work during shipment, storage, erection and construction, shall avoid development of no-uniformity or other deleterious effects in work.
   4. Remove protection requested by Architect for inspections of finishes and replace.
   5. Confirm compatibility of protective coatings or residue of strippable coating, with manufacturer(s) or elastomeric sealants to be applied in field.

D. Cleaning:
   1. Upon completion of work, remove protective coverings from exposed surfaces, and clean surfaces of excess sealants and discoloration.
      a. Cleaning shall be in accordance with requirements of the applicable manufacturers of materials.
      b. Cleaners shall be compatible with materials and glazed aluminum curtain wall components and shall be acceptable to the manufacturers of related materials.
   2. Remove mortar, plaster, fireproofing and other deleterious material from surfaces of aluminum immediately.
   3. Care shall be exercised when cleaning the exterior portions of the building to protect other Work and sealant to metal joint work.
   4. Debris caused by or incidental to the installation work shall be promptly removed.
   5. Weep holes and drainage channels shall be checked and left unobstructed, free of dirt, rubbish and sealants.
   6. The finished installation of the work included herein shall be free of defects.
      a. Before final completion and acceptance of the building, the Contractor shall repair and/or replace at the Contractor's own expense any and all defective work, to the satisfaction of the Owner and Architect.

E. The completed glazed aluminum curtain wall system shall be secure, watertight, airtight, rattle-free and in full compliance with Contract Documents.

## PART 4 MOCK-UP TEST PANELS

### 4.1 MOCK-UP PANEL CONSTRUCTION

A. General:
   1. Full-size mock-up test panels of typical Project conditions shall be constructed for required testing specified in this section.
   2. Mock-ups shall accurately represent typical Project conditions using materials, colors, finishes, anchorage, etc., approved by Architect.
   3. Each mock-up test panel shall be constructed by the appropriate trade and coordinated with curtain wall requirements for compliance with approved shop drawings and Contract Documents.
   4. The mock-ups shall, as nearly as possible, simulate the actual installation, including reasonable representations of profiles of adjacent building elements.
   5. Thermal insulation is required as part of mock-up unit to be installed just prior to thermal test.
   6. Provide extra items and material as may be required for replacements.
   7. Do not start construction of mock-up test panels before receiving approved shop drawings from Architect.

B. Notification:
   1. Notify Architect and Owner, in writing, a minimum of 30 days prior to construction of mock-up test panels.

2. Do not proceed until approved by Architect and Owner.

C. Air Chamber:
1. Construct the air chamber with observation ports of sufficient size and number to permit thorough examination of all interior surfaces and joints of the test assembly during the actual test periods in accordance with safety requirements of testing agency.
2. The interior of air chamber shall be made accessible so that close inspection of test assembly can be conducted during and following the water penetration and structural performance tests in accordance with safety requirements of testing agency.
3. Chamber Temperature: Not less than 40° and not higher than 80°.

D. As-Built Drawings:
1. "As-built" drawings of mock-up panels shall be complete with actual dimensions and thicknesses of all components including actual measured sizes of glass panels, to 1/32" of width and height and .001" for thickness.
2. "As-built" drawings shall be submitted with test reports.
3. Reference copies of "as-built" drawings shall be available to Architect and Owner during testing.

## 4.2 TEST MOCK-UPS

A. General:
1. Furnish labor and materials to build and test mock-ups as shown on Drawings.
   a. Mock-ups shall accurately represent project conditions including joints, sealants, glass, glazing, anchors and finishes.
   b. Install sufficient thermal insulation and staffing insulation to demonstrate details of installation.
   c. If thermal test is required, install all thermal insulation.
   d. Delay installation of any such safing and thermal insulation until the air, water and structural design load tests are successfully completed.
2. Each mock-up shall be glazed with one consistent set of gaskets.
   a. Use of multiple gasket profiles and/or thicknesses at the contractor's discretion is not permitted.
3. Prior to tests, remove and reglaze glass units selected by the Architect, using the details and procedures intended for glass replacement on the actual building.
   a. Reglazed units must satisfy all test criteria.
   b. Contractor may submit for approval a request to waive this requirement for glass supported by structural silicone.
4. Provide at least one extra glass unit for each type and size on mock-ups.
   a. Glass that breaks during testing shall be replaced with new glass and the tests continued.
   b. Repeated glass breakage shall constitute failure.
5. Do not start construction of mock-up test panels before receiving approved mock up shop drawings from Architect.
   a. Each mock-up test panel shall be constructed by the appropriate trade and coordinated with curtain wall requirements in compliance with approved shop drawings and Contract Documents.
   b. Deviations from or additions to details shown on shop drawings are subject to approval.
6. Testing laboratory shall conduct and report all tests, shall state in the report whether test specimen conforms to requirements of Contract Documents, and shall note deviations from mock-up drawings.
   a. Contractor shall provide to laboratory 'as-built' mock-up drawings within two weeks of completion of testing, for attachment to laboratory report.
7. If failures occur, revise and retest mock-ups.
   a. Modifications must be realistic in terms of project conditions, must maintain standards of quality and durability and are subject to prior approval.
8. If failures necessitate retests, contractor shall pay the additional laboratory fees and other fees and expenses, including architect's and consultant's fees.
9. Testing facilities acceptable, subject to availability of equipment and qualified personnel to perform specified tests. Other laboratories may be submitted for approval.

a. Construction Research Laboratory, Miami, Florida.
b. Architectural Testing Inc. York, Pennsylvania.
c. Mid America Testing, St. Louis, Missouri.

10. Mock-ups are subject to observation by Owner, Architect and their consultants during construction and testing.
    a. Provide a minimum of two weeks' notice before beginning construction of mock-ups.
    b. Provide materials and personnel for prompt continuous construction of mock-ups.
    c. Contractor shall coordinate chamber availability, shipping schedules and mock-up construction schedules directly with the laboratory.
    d. The interior of air chamber shall be made accessible so that close "hands on" inspection of test assembly can be conducted during and following the water penetration and structural performance tests in accordance with safety requirements of testing agency. Chamber temperature shall be not less than 40 degrees F and not higher than 80 degrees F.
11. The testing laboratory shall not perform any of the following functions:
    a. Act as consultant to a contractor for this project.
    b. Modify Contract Documents requirements.
    c. Modify mock-up configuration.
    d. Dismantle mock-ups until notified that no further testing is required. Once notified to proceed with dismantling, the laboratory shall document and record as built conditions observed during dismantling of specimen and note any discrepancies between the as tested wall and the as built mock-up shop drawings.
12. Undocumented tests are not permitted.
    a. All test results, including static water and air infiltration pre-testing of specimen and chamber during the de-bugging of the chamber and all remedial work, shall be documented in the laboratory report.
13. Typical mock-up design pressures as indicated on the drawings or as stated in the specifications as based upon the wind tunnel report.
14. Testing procedures shall be completed with schematic diagrams describing location of deflection gauges for "Structural Performance Testing".
15. Do not start testing before written notification and testing procedures have been reviewed and accepted by Architect.

B. Photographs:
    1. Before starting the required testing, take a minimum of (6) six photos of each side of the completed test assembly.
    2. Take a sufficient number of photos to adequately document all required testing.
    3. Photo Type/Size: High resolution digital images.

C. Testing shall utilize suitable instruments and gauges calibrated and positioned to indicate actual face pressure of glass, and to record deflections of glass, mullions and other aluminum components.
    1. Water volume shall be calibrated.

## 4.3 MOCK-UP TESTS

A. Testing Sequence:
    1. Preload at 50% of inward typical design pressure.
    2. Air infiltration at 6.24 psf per ASTM E283-19; 0.06 CFM/SF allowed.
    3. Water infiltration test (static) at 15 psf per ASTM E331-00(2009). No uncontrolled water allowed.
    4. Water infiltration test (dynamic) at 15 psf per AAMA 501.1-17. No uncontrolled water allowed.
    5. Structural test (Static) per ASTM E330-14 at (50%) and (100%) of inward Typical design load.
    6. Structural test (Static) per ASTM E330-14 at (50%) and (100%) of outward Typical design load.
    7. Repeat air infiltration test at 6.24 psf (See Step 2. above).
    8. Repeat water infiltration test (Static) at 15 PSF (See Step 3. above).
    9. Structural test (Static) per ASTM E330-14 at (50%) and (100%) of inward Corner design load.
    10. Structural test (Static) per ASTM E330-14 at (50%) and (100%) of outward Corner design load.
    11. Repeat air infiltration test at 6.24 psf (See Step 2. above).
    12. Repeat water infiltration test (Static) at 15 PSF (See Step 3. above).

13. Interstory Vertical Movement Test per AAMA 501.7-17 with ±3/8" movement* from benchmark over 3 complete cycles. No failure or distortion of any kind is allowed.
14. Repeat air infiltration test at 6.24 psf (See Step 2. above).
15. Repeat water infiltration test (Static) at 15 PSF (See Step 3. above).
16. Thermal Cycle Test per AAMA 501.5-07.
    a. Low exterior ambient temperature of -20°F for two hours after establishing temperature.
    b. High exterior ambient temperature of 180F for two hours after establishing temperature.
    c. Interior temperature shall be maintained at 70F (+/- 3degF)
    d. Components used within the system shall withstand thermal movements without buckling, distortion, cracking, failure of glass, and failure of joint seals or undue stress on the finished surfaces, materials, or fixing assemblies.
17. Repeat air infiltration test at 6.24 psf (See Step 2. above).
18. Repeat water infiltration test (Static) at 15 PSF (See Step 3. above).
19. Concentrated load on Building Maintenance Unit Tieback: Apply 600 lb. force to anchor in the following directions, holding each test for 10 seconds.
    a. Side load (parallel to the plane of the wall) in all four directions (left, right, up, down).
    b. Outward load (perpendicular to the plane of the wall).
    c. No failure or gross permanent distortion of any kind is allowed.

B. Air leakage test shall conform to ASTM E283-19.
   1. Different static test pressure shall be 6.24 PSF.
   2. Chamber leakage shall accurately be determined, not estimated.
   3. Air infiltration of fixed wall are shall not exceed 0.06 CFM/ft² of projected exterior surface.

C. Condensation is acceptable during water infiltration tests.
   1. Water leakage is acceptable only if all of the following conditions are satisfied:
      a. Water is contained and drained to exterior.
      b. There is no wetting of any surface that would be visible to building occupants.
      c. There would be no staining or other damage to completed building or its furnishings.
   2. This definition of water leakage governs over other definitions which may appear in ASTM or AAMA test procedure referenced documents.

D. Where test sequence or test failure requires successive water infiltration tests, the only means used to drain water from internal cavities shall be gravity drainage through weep system for a minimum of 15 minutes.
   1. Air pressure, removal of parts or other means of draining water shall not be used.

E. Static water infiltration test shall conform to ASTM E331-00-(2009).
   1. Differential test pressure shall be 15 PSF.
   2. There shall be no unacceptable water leakage as defined herein.
   3. Sources of water leakage shall be identified.

F. Dynamic water infiltration test shall conform to AAMA 501.1.-17 except as otherwise specified herein.
   1. There shall be no unacceptable water leakage as defined herein.
   2. Sources of water leakage shall be identified.

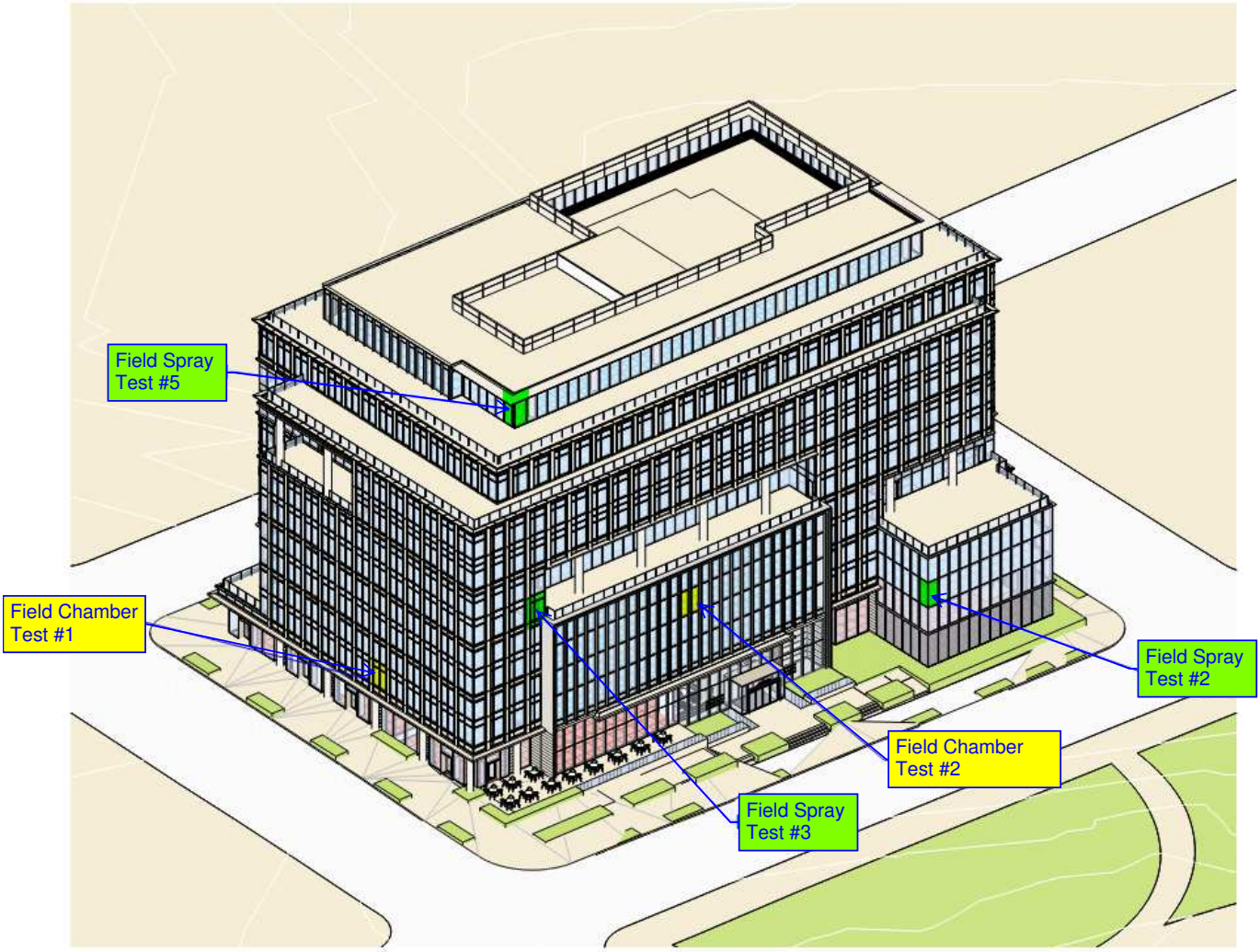
G. Structural tests shall conform to ASTM E330-14.
   1. Deflection gages shall be set to zero prior to each application of pressure at 50, 75, 100 and 150 percent of design pressures.
   2. Deflection gage readings shall be recorded after each application of pressure.
   3. Deflection measurements are not required for initial preload.
   4. Specified deflection and set limitations apply to one application of pressure, not to cumulative effects of two or more loadings.

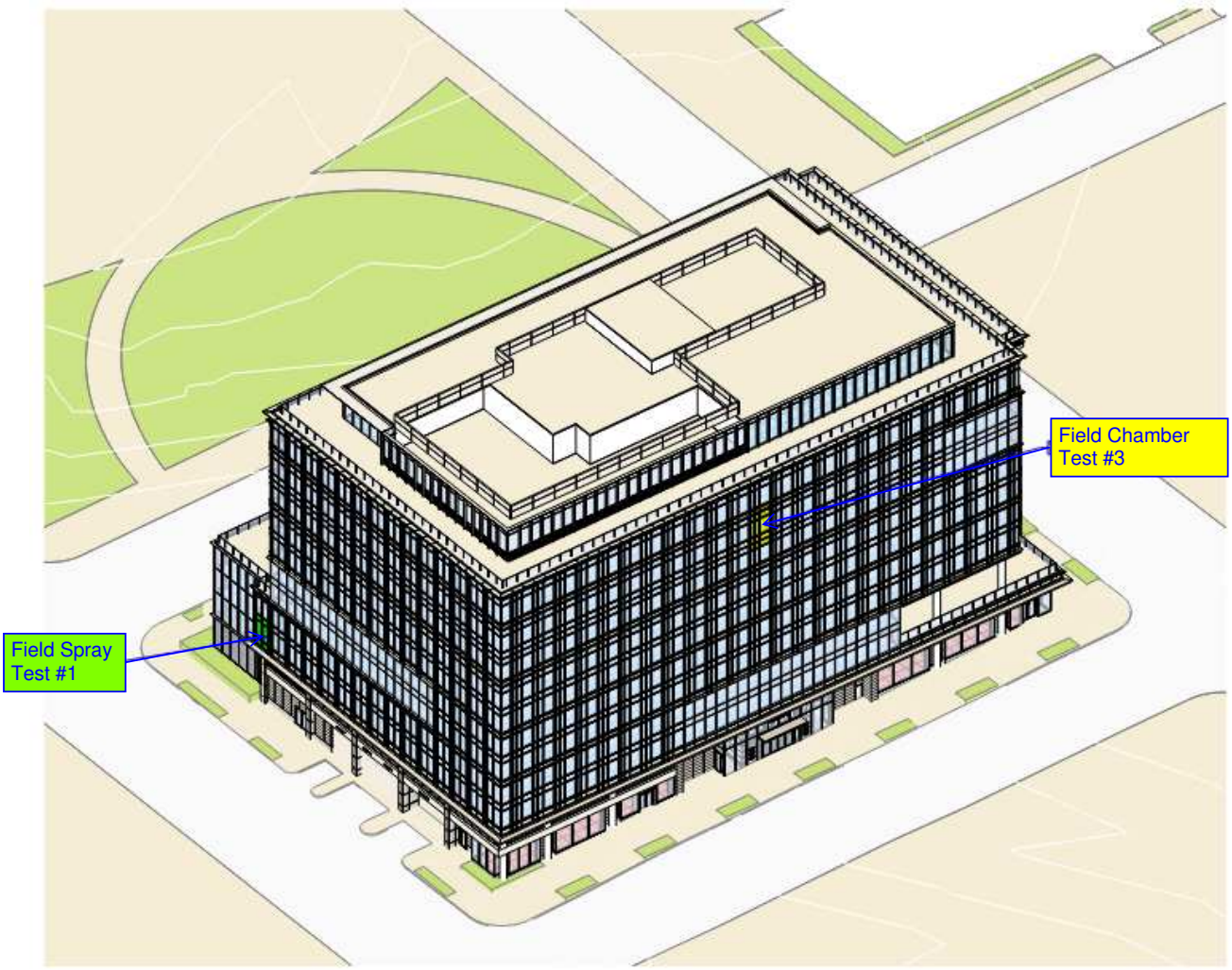
## PART 5 MOCK-UP TEST PANELS

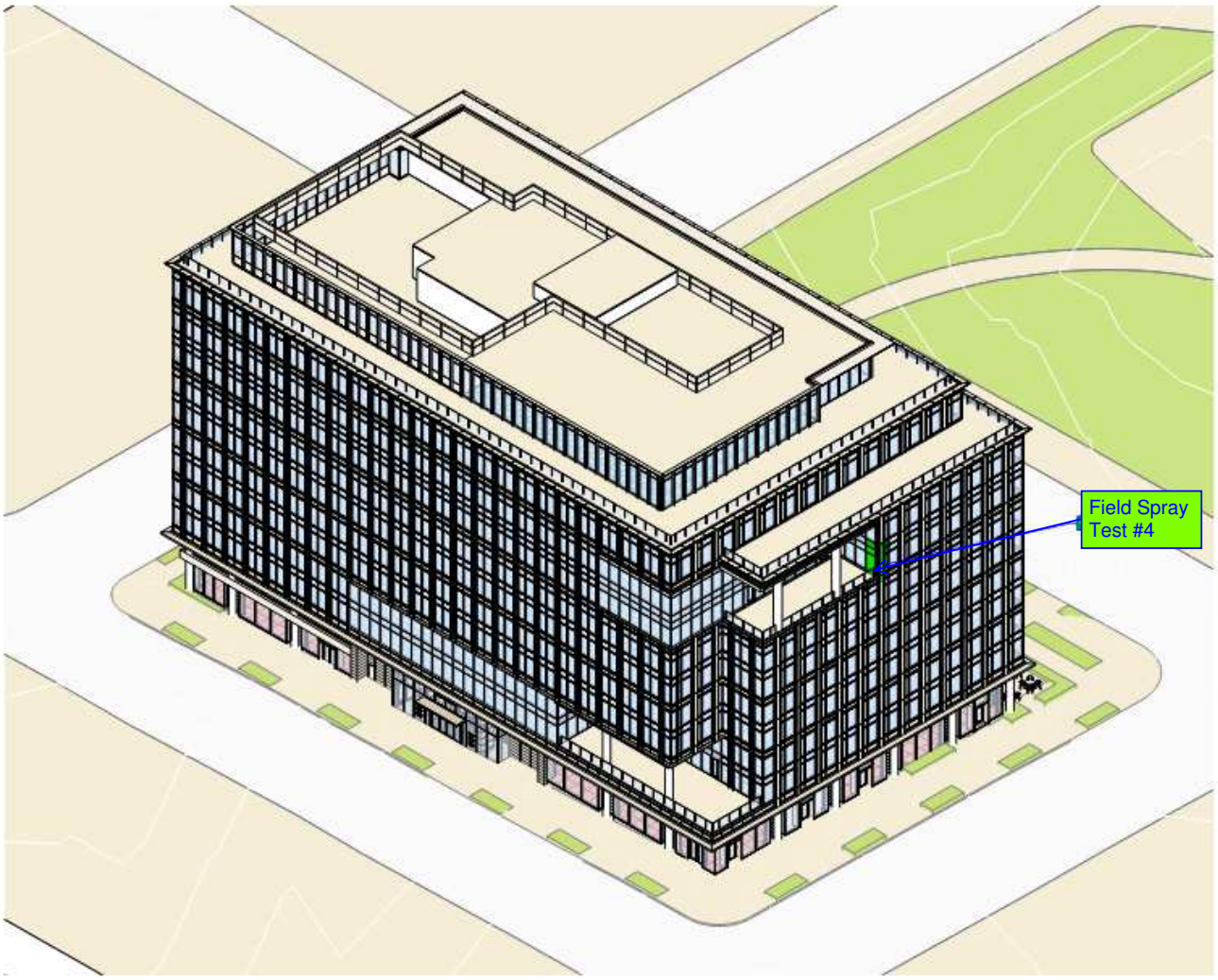
### 5.1 MOCK-UP PANEL SCOPE DRAWINGS

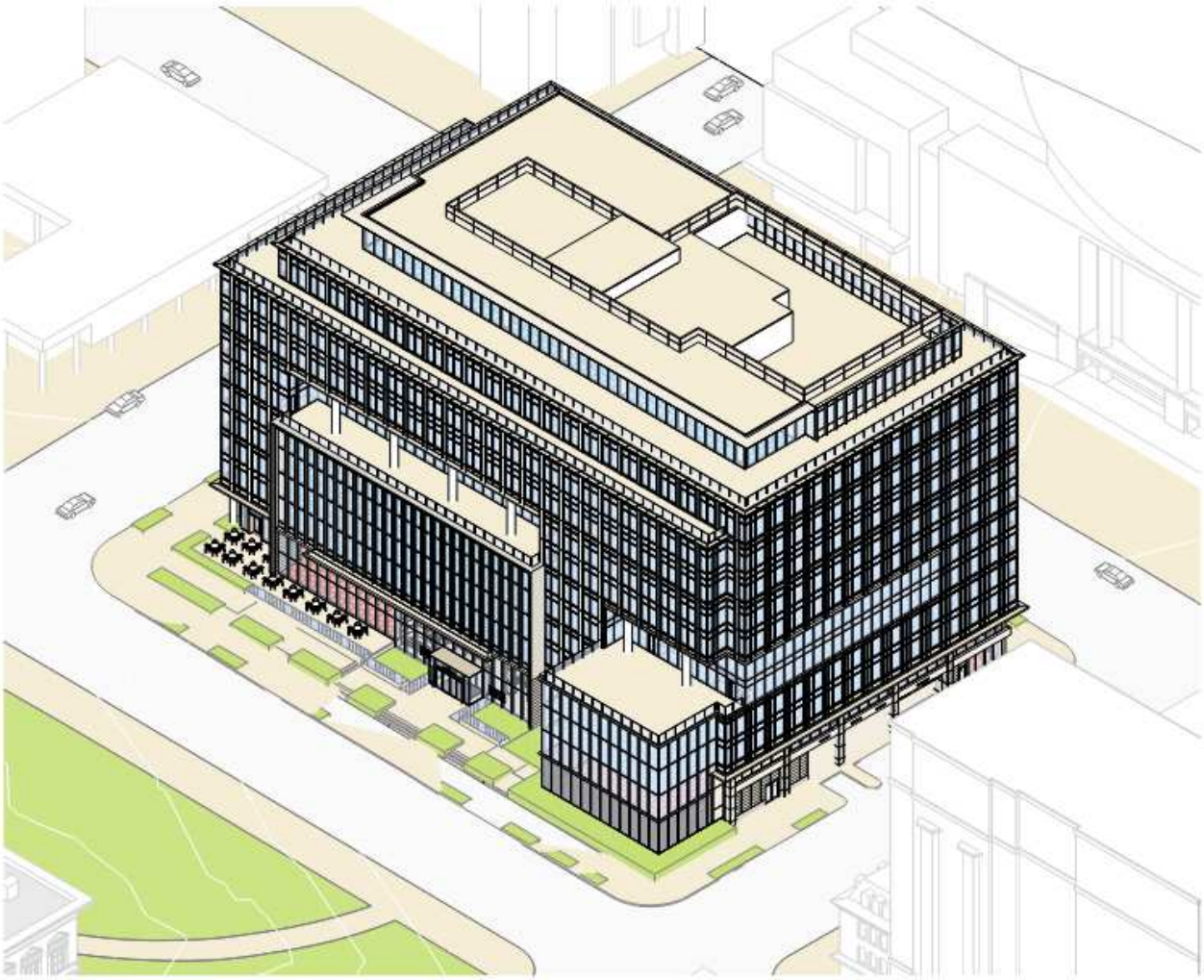
## PART 5 MOCK-UP TEST PANELS SCOPE DRAWINGS

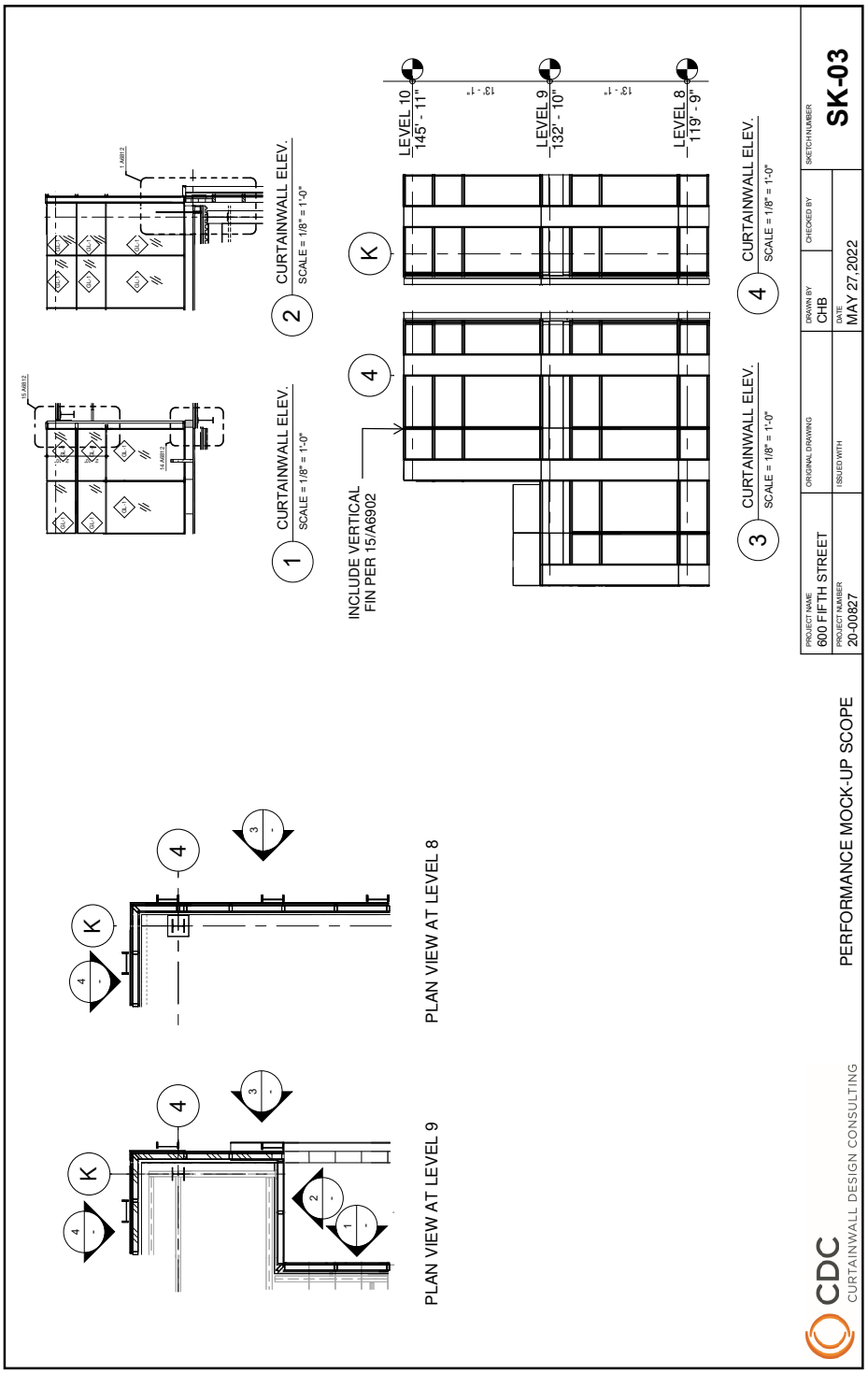
### 5.1 MOCK-UP PANEL SCOPE DRAWINGS




Field Chamber
Test #3
Field Spray
Test #1


Field Spray
Test #4






**END OF SECTION**