Manufacturer:

**Oldcastle BuildingEnvelope®**

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SECTION: 08 46 00 WINDOW WALL (TCR-225)

This guide specification has been prepared by **Oldcastle BuildingEnvelope®** in printed and electronic media as an aid to specifiers in preparing written construction documents for WINDOW WALL. TCR-225 is a thermally broken aluminum window wall system for multi-story cladding, shop fabricated, factory pre-finished and assembled, with an optional integrated floor slab cover. The basis of design includes pour and debridge members reducing energy transfer from exterior to interior. All glass dead-load is transferred to the horizontal structural framing by means of a setting block or aluminum setting chair.

Section 01 40 00 is intended for use along with this section; coordinate requirements accordingly.

Sealants are referenced to Section 07 92 00, Joint Sealants.

Glass and glazing are referenced to Section 08 80 00, Glass and Glazing.

Firestopping is referenced to Section 07 84 00, Firestopping.

Where a storefront, sloped glazing system, skylight, curtain wall or door(s) integrates with the TCR-225 window wall system, carefully coordinate all sections to function together.

Refer to AAMA Window Wall Design Guide Manual.

Edit entire master to suit project requirements. Modify or add items as necessary. Delete items which are not applicable. This section may include performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This section uses the term “Architect.” Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Editor notes are included as green boxes within the text of this section to assist the specifier in knowledgeable decision-making. Editor notes should be removed as you complete the document specific to your project needs.

1. **GENERAL**
	* + 1. **SUMMARY**
				1. Related Requirements: Related Documents: Conditions of the Contract, Division 1 - General Requirements, and Drawings apply to Work of this Section.

Editor Note: Edit this paragraph to briefly describe the contents of the section. After editing section, refer back to this paragraph to verify no conflicts exist.

* + - * 1. Section Includes:

Aluminum window wall systems, complete with reinforcing, shims and anchors.

Accessories necessary to complete Work.

* + - * 1. Products Furnished But Not Installed Under this Section: Inserts and anchoring devices that are to be built into structure.

Editor Note: This document incorporates CSI (Construction Specifications Institute) Manual of Practice principles of cross-referencing to Division 1 sections and other sections. The cross references must be edited to retain only those other sections used. Other guide specifications for Oldcastle BuildingEnvelope®, including those of skylights are available as follows:

 Section 08 41 13 Aluminum Entrances and Storefronts

 Section 08 41 26 All-Glass Entrances and Storefronts

 Section 08 43 13 Aluminum-Framed Storefront

 Section 08 44 23 Structural-Sealant-Glazed Curtain Wall

 Section 08 44 33 Sloped Glazed Assemblies

 Section 08 46 00 Window Wall Assemblies

 Section 08 51 13 Aluminum Windows

 Section 08 63 00 Metal-Framed Skylights

* + - * 1. Related Sections:

 1. Section 01 43 39 Mockup

 2. Section 05 50 00 Metal Fabricators

 3. Section 06 10 00 Rough Carpentry

 4. Section 07 92 00 Joint Sealants

 5. Section 08 42 20 Entrances

 6. Section 08 45 00 Translucent Wall and Roof Assemblies

 7. Section 08 51 00 Metal Windows

 8. Section 08 71 00 Door Hardware

 9. Section 08 81 00 Glass Glazing

 10. Section 08 85 00 Glazing Accessories

 11. Section 08 88 00 Special Function Glazing

 12. Section 08 91 19 Fixed Louvers

Editor Note: List reference standards that are included within the text of this section. Edit the following as required for project conditions.

* + - 1. **REFERENCES**
				1. Aluminum Association (AA):

 1. DAF-45 Designation System for Aluminum Finishes

* + - * 1. American Architectural Manufacturers Association (AAMA):

 1. 501.2 Field Check of Metal Curtain Walls for Water Leakage

 2. 2605 Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels

 3. 606.1 Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum

 4. 607.1 Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

 5. 608.1 Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum

 6. 701.2 Specifications for Pile Weather-stripping

 7. 1503 Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

 8. CW-DG-1-96 Aluminum Curtain Wall Design Guide Manual

 9. CWG-1-89 Installation of Aluminum Curtain Walls

 10. Manual #10 Care and Handling of Architectural Aluminum From Shop to Site

 11. TIR-A8 Structural Performance of Composite Thermal Barrier Framing Systems

* + - * 1. American National Standards Institute (ANSI):

 1. Z97.1 Specifications and Methods of Test for Safety Glazing Material Used in Buildings

* + - * 1. American Society for Testing and Materials (ASTM):

 1. A36 Structural Steel

 2. A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

 3. A525 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

 4. A526 Sheet Steel, Zinc Coated (Galvanized) by the Hot-Dip Process, Commercial Quality

 5. B209 Aluminum and Aluminum-Alloy Sheet and Plate

 6. B221 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

 7. B308 Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded

 8. C716 Installing Lock-Strip Gaskets and Infill Glazing Materials

 9. C920 Elastomeric Joint Sealants

 10. E283 Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors

 11. E330 Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

 12. E331 Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

 13. E2188 Standard Test Method for Insulating Glass Unit Performance

 14. E2190 Standard Specification for Insulating Glass Unit Performance and Evaluation

* + - * 1. Canadian Standards Association (CSA)

 1. G40.21 Structural Quality Steel

* + - * 1. Consumer Product Safety Commission (CPSC):

 1. 16 CFR 1201 Safety Standard for Architectural Glazing Materials

* + - * 1. Federal Specifications (FS):

 1. TT-P-645A Primer, Paint, Zinc Chromate, Alkyd Type

* + - * 1. Glass Association of North America (GANA):

 1. Glazing Manual

* + - * 1. Steel Structures Painting Council (SSPC):

 1. SP2 Hand Tool Cleaning

 2. SP3 Power Tool Cleaning

 3. Paint 12 Cold-Applied Asphalt Mastic (Extra Thick Film)

Editor Note: Use this article carefully; restrict statements to identify system performance requirements or function criteria only. Delete paragraphs not appropriate to project.

Performance specifying permits system manufacturers the latitude to adjust or redesign proprietary systems to achieve specified requirements. Rely on this article as the "anchor" for window wall system specifying and minimize the material and component statements so not to conflict with performance criteria.

Edit system requirements carefully and include only applicable performance criteria. Make sure there is no conflict with proprietary information listed in part 2.

* + - 1. **SYSTEM REQUIREMENTS**
				1. General Standard: In addition to requirements shown or specified, comply with applicable provisions of Window Wall Design Guide Manual for design, materials, fabrication and installation of component parts.
				2. Design Requirements:

 [1. Operable vent with minimal sight line viewed from the exterior.]

 2. System manufacturer shall provide window wall systems, including necessary modifications to meet specified requirements and maintaining visual design concepts.

 3. Fabricate glazing systems for interior or exterior glazing.

 4. Perimeter conditions shall allow for installation tolerances, expansion and contraction of adjacent materials, and sealant manufacturer's recommended joint design.

 5. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or building structural movement, glazing, anchorage or moisture disposal. Proposed window wall system shall be designed to accommodate such movements. It is the responsibility of the project design team to provide this information to the window wall contractor.

 6. Requirements shown by details are intended to establish basic dimension of unit, sight lines and profiles of members.

 7. Do not assume glass, sealants, and interior finishes contribute to framing member strength, stiffness, or lateral stability.

 8. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.

 9. Allow for expansion and contraction due to structural movement without detriment to appearance or performance.

 10. System shall drain water to the sill can for collection and drainage.

 11. Provide acceptable color range and profile appearance at components exposed to view.

 12. Provide continuous EPDM air seal gaskets. Primary air / water seal gasket to be EPDM. Provide silicone sheet material acting as splice from unit to unit to provide continuous gutter around each head/sill can.

 13. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

14. Proper compatibility and adhesion analysis of substrates to be provided by sealant manufacturer Product Data: For each type of product.

Editor Note: Coordinate performance requirements with section 01 40 00.

* + - * 1. Performance Requirements.

Air infiltration: Air leakage shall not exceed 0.06 cfm per square foot (0.0003 m3/s-m2) of surface area when tested in accordance with ASTM E283 at differential static pressure of 6.24 psf (300 Pa).

Water Resistance (static): No uncontrolled leakage when tested in accordance with ASTM E331 at test pressure of 12.0 psf (575 Pa) as defined in AAMA 501.

 Water Resistance (dynamic): No uncontrolled leakage when tested in accordance with ASTM E331 at test pressure of 12.0 psf (720 Pa) as defined in AAMA 501.

 Uniform Load: A static air design load of \_\_\_\_\_ psf (\_\_\_\_\_ Pa) shall be applied in a positive and negative direction in accordance with ASTM E 330. At structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

Editor Note: Coordinate wind loads with applicable building code, or appropriate wind loads may be determined by using ASCE 7, "Minimum Design Loads for Buildings and Other Structures".

Boundary layer wind tunnel testing may be necessary for determining design wind loads when building shape is other than rectangular in plan, site location has unusual wind conditions, or building is critically located with respect to other nearby buildings.

Edit following paragraph accordingly. Coordinate provisions with Section 01 40 00

* + - * 1. Structural Requirements:

 1. Wind loading:

1. Basic zones: \_\_\_\_\_\_ psf

b. Corner zones: \_\_\_\_\_\_ psf

 [c. Parapet zones: \_\_\_\_\_\_\_ psf]

 2. Deflection under uniform loading: When tested in accordance with ASTM E330 at design pressure, maximum deflection of exterior member shall not exceed L/175 for spans up to 13’-6” (4.115m), or L/240 + 1/4” (6.4mm) for spans greater than 13’-6” (4.115m), or maximum 3/4” (19.1mm) over individual glass lite.

 3. Parallel to wall deflections: For horizontal framing members which support glass, deflection of those members in the direction parallel to the plane of the wall should not exceed an amount which will reduce the glass bite below 75% of the design dimension nor an amount which would infringe upon necessary glazing clearances below. Deflection should also be limited in the vertical direction to provide at least 1/8” (3mm) minimum clearance between the member and the top of the fixed glazed pane, glass or other fixed part immediately below. Clearance between the member and an operable window or door below should be at least 1/16” (1.5mm).

 4. Compression flanges of flexural members may be assumed to receive effective lateral bracing only from:

 a. Anchors to building structure.

 b. Horizontal glazing rails or interior trim.

 c. Interlocking channels with continuous locking mechanism in front and back of member.

 d. Intermittent internal anti-buckling clips.

 5. Do not regard points of contra-flexure as lateral braces or as end points of un-braced length; un-braced length is actual distance between effective lateral braces as defined above.

* + - * 1. Thermal Requirements: Framing systems shall accommodate expansion and contraction movement due to surface temperature differential of 180°F (82.2°C) without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance or other detrimental effects.
				2. Thermal Transmittance (U-factor):

 1. When tested to AAMA 1503, the thermal transmittance (U-Factor) shall not be more than 0.38 based upon 1” (25mm) Low-E glass (e = 0.018).

* + - * 1. Condensation Resistance (CRF):

 1. When tested to AAMA 1503, the condensation resistance factor (CRF) shall not be less than 71 based upon 1” (25mm) Low-E (e = 0.018) glass

* + - * 1. Seismic Interstory Drift: When tested to AAMA 501.4, system must meet design displacement of 0.010 x the story height, ultimate displacement of 0.015 x the story height, and fall out displacement of 0.025 x the story height.
				2. Interstory Live Load Movement: In accordance with AAMA 501.7 test method, system will

 accommodate +/- 3/8" Interstory vertical movement.

* + - * 1. Sound Transmission:

 1. When tested to ASTM E90-09, the Sound Transmission Class (STC) shall not be less than 39 based upon 1” (25mm) insulating laminated glass (1/4” (6mm) laminate, 1/2”

 (12.7mm) air space,1/4” (6mm) laminate).

 2. When tested to ASTM E90-09, the Sound Transmission Class (STC) shall not be less than 33 based upon 1” (25mm) insulating glass (1/4” (6mm) clear tempered, 1/2” (12.7mm) air

 space, 1/4” (6mm) clear tempered.)

* + - * 1. Outdoor Indoor Transmission:

 1. When tested to ASTM E90-09, the Outdoor Indoor Transmission Class (OITC) shall not be less than 32 based upon 1” (25mm) insulating laminated glass (1/4” (6mm) laminate, 1/2”

 (12.7mm) air space,1/4” (6mm) laminate).

 2. When tested to ASTM E90-09, the Outdoor Indoor Transmission Class (OITC) shall not be less than 28 based upon 1” (25mm) insulating glass (1/4” (6mm) clear tempered, 1/2” (12.7mm) air

 space, 1/4” (6mm) clear tempered.)

* + - * 1. Laboratory Testing: Refer to Section 01 40 00 for requirements.]
				2. Interface:

 1. Furnish inserts and anchoring devices, which need to be preset and built into structure to appropriate trade.

 2. Supply on timely basis to avoid delay in Work.

 3. Instruct other trades of proper location and position.

 4. Furnish setting drawings, diagrams, templates and installation instructions.

 5. Anchor design to accommodate minimum 1” (25.4mm) building structure tolerance in all directions Include full-size isometric details of each type of vertical-to-horizontal intersection of Window Walls, showing the following:

Include submittal requirements below, which are consistent with scope of project and extent of work of this section. Only request submittals that are absolutely necessary.

* + - 1. **SUBMITTALS**
				1. General: Submit in accordance with Section 01 33 00
				2. Product Data:

Submit manufacturer's descriptive literature and product specifications for each manufactured product.

Include information for factory finishes, hardware, accessories and other required components.

Editor Note: Retain item below when manufacturer's standard colors are specified for pigmented finishes; coordinate with finish article.

[Include color charts for finish indicating manufacturer's standard colors and range available for selection.]

* + - * 1. Shop Drawings:

 1. Submit drawings indicating elevations, details, dimensions, member profiles, joint locations, arrangement of units, member connections, and thickness of various components.

 2. Include the following items:

 a. Details of special shapes.

 b. Reinforcing.

 c. Drainage details [and flow diagrams].

 d. Anchorage and fasteners.

 e. Interfacing with building construction.

 f. Provisions for system expansion and contraction

 [g. Thermal breaks.]

 3. Indicate glazing details, methods, [locations of various types and thickness of glass,] [emergency breakout locations,] and internal sealant requirements.

 4. Clearly indicate locations of exposed fasteners and joints for Architect's acceptance.

 5. Clearly show where and how manufacturer's system deviates from Contract Drawings and the~~se~~ Specifications.

* + - * 1. [Mock-up Drawings: Submit drawings for mock-ups; refer to Section 01 43 39 for mock-up requirements.]

Editor Note: Retain data within brackets in first subparagraph when pigmented finish is specified; coordinate with article 2.05.

* + - * 1. Samples:

Submit manufactures samples indicating quality of finish in required colors and range.

Where normal texture or color variations are expected, include additional samples illustrating range of variation.

[Submit samples of structural glazing gaskets, 12 inch (305mm) lengths.]

[Submit samples of sealants for color selection.]

Editor Note: The following paragraph permits option to submit results of pre-tested, existing fixed window designs. Retain when applicable.

* + - * 1. [Test Reports: Submit certified copies of previous test reports by an independent laboratory substantiating performance of system. Include other supportive data as necessary.]

Editor Note: Retain data within brackets in paragraph below for structural silicone glazed system.

* + - * 1. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.
				2. Warranty: Submit specified warranties.

Editor Note: Include quality assurance requirements consistent with size and scope of project and extent of work of this section. Edit following article accordingly.

* + - 1. **QUALITY ASSURANCE**

Editor Note: Oldcastle BuildingEnvelope® is unique in the industry in single source responsibility. First, system design, extrusion, fabrication, and finishing occur under strict tolerances, assuring uniformity of profile and finishes between systems. Second, Oldcastle BuildingEnvelope® products include a full array of storefront, window wall, curtain wall, all glass entrances, sliding mall fronts, sloped glazing, and flush faced aluminum framed doors, as well as all the monumental and unit skylight products, allowing the designer and specifier a single source of responsibility when combining products from any of these categories.

* + - * 1. Single Source Responsibility: To ensure quality of appearance and performance, obtain materials for systems from either a single manufacturer or from manufacturer(s) approved by systems manufacturer.
				2. Manufacturer Qualifications: Manufacturer should be experienced with products covered under this Section and capable of providing a window wall system capable of meeting or exceeding the performance criteria noted in this Section.
				3. Engineer Qualifications: Professional Engineer registered and licensed in State where Project is located.
				4. Installer Qualifications: Installer should have successful experience in installation of products covered in this Section on similar projects in scope and size If requested by Owner, installer shall provide a reference list of similar completed projects.

Editor Note: Depending on scope of work, mock-ups may not be required; retain and edit following article accordingly. Ensure section 01 43 39 includes details for each mock-up required.

* + - * 1. [Mockups: Build mockups (predetermined) for aesthetic review prior to installation.]

Editor Note: Depending on scope of work, pre-installation conference may not be required. Retain article below when applicable and edit accordingly.

* + - * 1. Pre-Installation Conference

Conduct pre-installation conference in accordance with Section 01 31 19.

[Conference Purpose and Agenda: Arrange with Architect and representatives of window wall manufacturer.

a. Discuss following items:

 1) Weather conditions under which work will be done.

 2) Anticipated frequency and extent of joint movement.

 3) Joint design

 4) Glazing procedures.]

* + - 1. **DELIVERY, STORAGE, AND HANDLING**
				1. Comply with requirements of Sections 01 65 00 and 01 66 00.
				2. Protect finished surfaces to prevent damage.
				3. Do not use adhesive papers or sprayed coatings, which become firmly bonded when exposed to sun.
				4. Do not leave coating residue on surfaces.
				5. [Ensure labels indicate glass thickness, unit location, glass strength and orientation of units in vertical position.]
				6. Protect glass edges and corners to prevent chipping, cracking and other similar damages.]
				7. Replace damaged units.
			2. **PROJECT CONDITIONS**
				1. Ensure ambient and surface temperatures and joint conditions are suitable for installation of materials.
			3. **WARRANTY**

Editor Note: When warranties are required, verify with Owner's counsel that special warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

* + - * 1. Special Finish Warranty, Factory-Applied Finishes: Manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

Editor Note: Retain first subparagraph below for factory-painted finishes. Coordinate color fading and chalking limits with finishes in Part 2.

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.

Editor Note: Coordinate “Warranty Period” Subparagraph below with “Aluminum Finishes” Article AAMA2604 is intended to represent five years of performance AAMA2605 is intended to represent 10 years of performance. Some manufacturers also offer 20-year warranty. Verify available warranties and warranty periods for finishes.

Standard Warranty Period: [5] years from date of manufacture and transferred to Owner on date of Substantial Completion.

* + - * 1. Special Finish Warranty, Anodized Finishes: Manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

Editor Note: Retain first subparagraph below for anodized finishes. Coordinate color fading and chalking limits with finishes in Part 2.

Deterioration includes, but is not limited to, the following:

Color fading more than 5 Delta E units when tested in accordance with ASTM D2244Water penetration through fixed glazing and framing areas.

Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.

Cracking, peeling, or chipping.

Editor Note: Coordinate “Warranty Period” Subparagraph below with “Aluminum Finishes” Article. Five years is standard for Class I anodized finishes, although a few manufacturers offer a 10 or 20-year warranty. Class II anodized finishes often carry less than a five year warranty. Verify available warranties and warranty periods for finishes.

Standard Warranty Period: [1] year from date of manufacture and transferred to Owner on date of Substantial Completion.

Extended Warranty period available upon request.

1. **PRODUCTS**
	* + 1. **PERFORMANCE REQUIREMENTS**

Editor Note: Retain "Delegated Design" Paragraph below if Contractor is required to assume responsibility for design.

* + - * 1. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design window walls.
				2. General Performance: Comply with performance requirements specified, as determined by testing of window walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

Window walls must 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.

* + - * 1. Structural Loads:

Editor Note: Usually, indicate on Drawings design loads determined by Project's structural engineer. Verify requirements of authorities having jurisdiction. See the Evaluations for additional information.

Wind Loads: As indicated on Drawings.

Other Design Loads: [**As indicated on Drawings**] <**Insert loads**>.

* + - * 1. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

Editor Note: Based on Project conditions, more stringent deflection criteria than specified in "Deflection Normal to Wall Plane" and "Deflection Parallel to Glazing Plane" subparagraphs below may be required; see "Seismic Performance" Article in the Evaluations.

Deflection Normal to Wall Plane: Limited to [**L/180 of clear span**] [**1/175 of clear span for spans of up to 13 ft. 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 ft. 6 inches (4.1 m)**]

Editor Note: Deflection criteria in "Deflection Parallel to Glazing Plane" Subparagraph below is based on GANA's "Glazing Manual."

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)**].

Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

Editor Note: Retain "Cantilever Deflection" Subparagraph below if required.

Cantilever Deflection: Limited to 2L/175 at unsupported cantilevers.

Editor Note: ASTM E330/E330M test method evaluates structural performance of window walls and not structural performance of contiguous construction.

* + - * 1. Structural: Test in accordance with ASTM E330/E330M as follows:

When tested at positive and negative wind-load design pressures, window walls, do not evidence deflection exceeding specified limits.

When tested at [**150**] percent of positive and negative wind-load design pressures, window walls and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding [**0.2**] percent of span.

Editor Note: Minimum test duration in accordance with ASTM E330/E330M is 10 seconds, which is historically U.S. practice.

Test Durations: As required by design wind velocity, but not less than [**10**] seconds.

Editor Note: Retain "Water Penetration under Static Pressure" Paragraph below for static-pressure method, which is most frequently specified. For water-penetration tests, AAMA 501 states that a static-air-pressure differential of 20 percent of wind-load design pressure provides satisfactory performance in most parts of the United States. Locations where high winds and heavy rains occur simultaneously require higher test-pressure differences. Both static and dynamic testing may be required or desired for certain designs, particularly those incorporating special water-drainage features, such as rain screen walls.

* + - * 1. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

No evidence of interior water penetration through fixed glazing and framing areas, when tested in accordance with a minimum static-air-pressure of 12 lbf/sq. ft. (575 Pa).

Editor Note: Retain "Water Penetration under Dynamic Pressure" Paragraph below if required for preconstruction laboratory mockup testing; most manufacturers do not include test data in product literature for dynamic-pressure testing. This test may be available in some areas for field quality-control testing; verify with qualified testing agency.

* + - * 1. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

No evidence of interior water penetration through fixed glazing and framing areas, when tested in accordance with a minimum air-pressure of 12 lbf/sq. ft. (575 Pa).

Editor Note: AAMA 501.1's definition of water leakage allows up to 1/2 oz. (15 mL) of water to accumulate on an interior stop or stool integral to assembly in a 15-minute period.

Maximum Water Leakage: [**In accordance with AAMA 501.1**] [**No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation**]. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

Editor Note: Retain "Interstory Drift" Paragraph below if required by Project. Wind and seismic events may create overturning moments that cause differential lateral displacement (deflection) of multistory buildings. See the Evaluations for further information.

* + - * 1. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

Design Displacement: [As indicated on Drawings] <Insert design displacement>.

Editor Note: Revise "Test Performance" Subparagraph below to suit Project.

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].

Editor Note: Retain "Seismic Performance" Paragraph below for projects requiring seismic design. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Window walls must withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7] <Insert requirement>.

Editor Note: AAMA 501.6 in "Seismic Drift Causing Glass Fallout" Subparagraph below is a dynamic racking test method focusing on seismic safety (glass fallout).

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 of 0.010 times the story height and 1.5 times the design displacement, 0.015 times the story height, and 0.025 times the story height.

Editor Note: AAMA 501.7 in "Vertical Interstory Movement" Subparagraph below focuses on changes in serviceability resulting from vertical displacement.

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 1.5 times the design displacement].

Editor Note: The IECC and ASHRAE/IES 90.1 require that all fenestration be certified and labeled by manufacturer for energy performance for thermal transmittance (U-factor), Solar Heat-Gain Coefficient (SHGC), air leakage, and visible transmittance (VT). Energy performance for fenestration products is typically determined for the whole fenestration product or system, which includes the framing, glazing, and the spacer. Coordinate the values selected for energy performance with the glazing selections in Section 088000 "Glazing," and confirm that manufacturer can meet the specified energy performance and can provide certification and labeling. Verify requirements of authorities having jurisdiction.

* + - * 1. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

Editor Note: Options in subparagraphs below are examples only; revise values to suit climate zone of building envelope as defined by the IECC. Testing for visible light transmittance (VT) is specified in Section 088000 "Glazing."

Thermal Transmittance (U-factor):

Fixed Glazing and Framing Areas: U-factor for the system of not more than [0.35 Btu/sq. ft. x h x deg F **(1.93 W/sq. m x K)**] as determined in accordance with NFRC 100 with standard glass (COG of .29) . and a U factor of 0.30 Btu/sq. ft. x h x deg F **(1.70 W/sq. m x K)**] as determined in accordance with NFRC 100 with high performance glass. (COG of .24)

Venting Windows: Whole window U-factor of not more than [**0.37 Btu/sq. ft. x h x deg F (2.10 W/sq. m x K)**] [**0.43 Btu/sq. ft. x h x deg F (2.44 W/sq. m x K)**] [**0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K)**] [**0.60 Btu/sq. ft. x h x deg F (3.40 W/sq. m x K)**] [**0.65 Btu/sq. ft. x h x deg F (3.69 W/sq. m x K)**] <Insert value> as determined in accordance with NFRC 100.

Solar Heat-Gain Coefficient (SHGC):

Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.27, 0.30, and 0.40 as determined in accordance with NFRC 200. Editor Note: Retain “Venting Windows” Subparagraph below if required.

Editor Note: Retain "Venting Windows" Subparagraph below if required.

Venting Windows: Whole-window SHGC of not more than [0.22] [0.27] [0.30] [0.40] <Insert value> as determined in accordance with NFRC 200

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 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with ASTM E283Condensation Resistance Factor (CRF):

Editor Note: Retain "Venting Windows" Subparagraph below if required.

Venting Windows: Whole-window air leakage of not more than [0.3 cfm/sq. ft. **(0.30 L/s per sq. m)**] <Insert value> at a static-air-pressure differential of [6.24 lbf/sq. ft. **(300 Pa)**] <Insert value> when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.

Condensation Resistance Factor (CRF):

Editor Note: For TCR-225 Pre-glazed Window Wall system, maximum CRF for frame 74. CRF for Glass 70.

Fixed Glazing and Framing Areas: CRF for the system of not less than 74 (Frame) and 70 (Glass) as determined in accordance with AAMA 1503

Editor Note: Retain "Venting Windows" Subparagraph below if required.

Venting Windows: Whole-window CRF of not less than [45] [52] [55] <Insert value> as determined in accordance with AAMA 1503.

* + - * 1. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

Editor Note: Differential values in "Temperature Change" Subparagraph below (for aluminum in particular) are suitable for most of the United States.

Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

Editor Note: Retain "Thermal Cycling" Paragraph below if testing is required for Project. Standard systems are usually not tested in accordance with AAMA 501.5. Manufacturers often rely on calculations and in-service performance to verify thermal-movement capabilities.

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.

High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of [**180 deg F (82 deg C)**]

Low Exterior Ambient-Air Temperature: [**0 deg F (minus 18 deg C)**]

Editor Note: Retain "Structural-Sealant Joints" Paragraph below if Project includes two-sided structural glazing.

* + - * 1. Structural-Sealant Joints:

Editor Note: Retain subparagraph below if dead-load support by structural sealant is acceptable.

Designed to carry gravity loads of glazing.

Editor Note: Retain "Structural Sealant" Paragraph below if Project includes two-sided structural glazing.

* + - * 1. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed window walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant occurs before adhesive failure.

Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.

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.

Editor Note: Retain “Basis-of-Design Product” Paragraph below for proprietary method specification. Add product attributes, performance characteristics, material standards, and descriptions as applicable. Do not use the phrase “or equal” or “approved equal”, or similar phrases. The use of such phrases will cause ambiguity in the specifications because of the different various interpretations among the different parties of the construction process and readers of the specifications. Such phrases require comprehensive and complete requirements (legal, procedural, regulatory, and responsibility) for determining “or equal.”

* + - 1. **Manufacturers**
				1. Basis-of-Design Product:

Subject to compliance with requirements, provide **Oldcastle BuildingEnvelope®,** a CRH Company

**TCR-225 Window Wall**

Frame Profile: Mullions; **2-1/4 by 5 inches (57.15 by 127 mm)**.

Editor Note: Retain Paragraph below for alternate manufacturers/products as specified in the contract documents. Coordinate below with bid documents, if any, and Division 1 alternates section. Consult with **Oldcastle BuildingEnvelope®** for recommendations on alternate manufacturers and products that meet the design criteria and project requirements. **Oldcastle BuildingEnvelope®** recommends that other manufacturers requesting approval to bid their product as an equal, must submit their request in writing 10 days prior to close of bidding.

* + - * 1. Subject to compliance with requirements, provide a comparable product by the following:

Manufacturer: (\_\_\_\_\_\_\_\_\_\_\_\_\_)

Series: (\_\_\_\_\_\_\_\_\_\_\_\_)

Frame Profile: (\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

* + - * 1. Substitutions: Refer to Substitutions Section for procedures and submission requirements.

Pre-Contract (Bidding Period) Substitutions: Submit written requests 10 days prior to bid date.

Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid window wall installation and construction delays.

Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.

Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for window wall system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of window walls for a period of not less than 10 years. (Company Name).

Test Reports: Submit test reports verifying compliance with each test requirement required by the project.

Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

* + - * 1. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.
				2. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

Construction: Thermally broken

Mullion Profile; [**as indicated**] **2-1/4 by 5 inches (57.15 by 127 mm)**.

Glazing System: 1-inch (25-mm) IGU retained mechanically with gasket on [**four**] [**two sides and structural silicone sealant on two**] sides.

Glazing Plane: Front.

Finish: [**Clear anodic**] [**Color anodic**] [**Baked-enamel or powder-coat**] [**High-performance organic**] [**Superior-performance organic**] finish.

Glazing Thickness: **1 inch (25.4 mm)**.

Fabrication Method: Field-fabricated stick system / Shop fabricated pre-glazed system.

Aluminum: ASTM B221, Alloy 6063-T6 extrusions for structural framing members (mullions) and pressure plates, and Alloy 6063-T5 for nonstructural applications such as trims and face caps; ASTM B209, Alloy 5005-H16 for sheets; or other alloys and temper recommended by manufacturer for type of use and finish indicated.

Framing Member Thickness: Minimum 0.094 inch (2.4 mm).

Glazing Stop and Similar Component Thickness: Minimum 0.050 inch (1.27 mm).

Steel Reinforcement: As required by manufacturer.

ASTM A36 for carbon steel.

Shapes and sizes to suit installation.

Shop coat steel components after fabrication with alkyd-type zinc-chromate primer complying with FS TT-P-645.

* + - * 1. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

Include snap-on aluminum trim that conceals fasteners.

* + - * 1. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

Editor Note: Retain paragraph below if architectural aluminum panels are required in window wall.

* + - * 1. [Spandrel Panels and Exterior Column Covers [Soffits and Metal Ceilings]:

Type: Aluminum sheet, 1/8 inch (3mm) thick, suitably reinforced on concealed surface for surface flatness, or prefabricated sandwich panels at manufacturer's option.

Anchorage: Allow for expansion and contraction, to minimize oil canning and distortion.]

* + - 1. **GLAZING**
				1. Glazing: Comply with Section 088000 "Glazing."

Editor Note: Retain "Basis-of-Design Product" Subparagraph below to require a specific product.

Basis-of-Design Product: Subject to compliance with requirements, provide **Oldcastle BuildingEnvelope®,** a CRH Company; **[TCR-225™].**

Editor Note: Retain first option in "Glazing Gaskets" Paragraph below for dry glazing system based on manufacturer's standard systems or retain second option and specify gaskets in Section 088000 "Glazing." Silicone glazing gaskets are available in custom colors from some manufacturers.

* + - * 1. Glazing Gaskets: [**Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.**] [**Comply with Section 088000 "Glazing."**]

Editor Note: Retain first option in "Glazing Sealants" Paragraph below for products based on manufacturer's standard systems or retain second option and specify sealants for glazing systems in Section 088000 "Glazing."

* + - * 1. Glazing Sealants: [**As recommended by manufacturer.**] [**Comply with Section 088000 "Glazing."**]

Editor Note: Subparagraph below applies to LEED 2009 NC, CI, and CS; LEED v4; IgCC; ASHRAE 189.1; and Green Globes.

Sealant has a VOC content of 250 g/L or less.

Editor Note: Retain "Structural Glazing Sealants" and "Weatherseal Sealants" paragraphs below for two-sided structural-sealant-glazed window wall systems.

* + - * 1. Structural Glazing Sealants: ASTM C1184 chemically curing silicone formulation that is compatible with system components with which it comes in contact; specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in window wall system indicated.

Color: [**Black**] [**Gray**] [**As selected by Architect from manufacturer's full range of colors**].

Editor Note: Weatherseal sealants in "Weatherseal Sealants" Paragraph below provide weather resistance for structural-glazed sealants. Delete paragraph if not required or where structural sealant is also weatherseal sealant.

* + - * 1. 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 in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed window wall manufacturers for this use.

Color: Match structural sealant.

* + - 1. **MATERIALS**
				1. Sheet and Plate: ASTM B209 (ASTM B209M).
				2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
				3. Structural Profiles: ASTM B308/B308M.

Editor Note: Retain "Steel Reinforcement" and "Steel Reinforcement Primer" paragraphs below for internal steel reinforcement of aluminum framing members; revise to suit Project.

* + - * 1. Steel Reinforcement:

Structural Shapes, Plates, and Bars: ASTM A36/A36M.

Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.

Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

* + - * 1. 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.

Editor Note: Retain "Recycled Content of Aluminum Components" Paragraph below to specify recycled content if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

* + - * 1. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] [**50**] percent.
			1. **ACCESSORIES**
				1. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.

Reinforce members as required to receive fastener threads.

Non-magnetic stainless steel or cadmium-plated steel coated with yellow or silver iridescence plating, compatible with materials being fastened.

300 series stainless steel for exposed locations. Cadmium-plated steel with 0.0005-inch (0.0127-mm) plating thickness with color chromate coating for concealed locations.

Provide nuts or washers of design having the means to prevent disengagement; deforming of fastener threads is unacceptable.

Provide concealed fasteners wherever possible.

Editor Note: Retain subparagraph below for exposed fasteners if any.

Use countersunk flathead exposed fasteners with countersunk Phillips screw heads [**, finished to match framing system**] [**fabricated from 300 series stainless steel**].

* + - * 1. 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.

Editor Note: Retain "Concrete and Masonry Inserts" Subparagraph below if applicable or revise to suit Project.

* + - * 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M, 2.0 oz. (591 mL) minimum coating or shop coat steel assemblies after fabrication with alkyd-type zinc-chromate primer complying with FS TT-P-645.

Expansion Anchor Devices: Toothed-steel, drilled-in, expansion bolt anchors.

* + - * 1. Concealed Flashing: [**Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials**] [**Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, complying with ASTM A240/A240M, of type recommended by manufacturer**].
				2. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12, containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
			1. **FABRICATION**
				1. Form or extrude aluminum shapes before finishing.

Editor Note: Retain first paragraph below for welding.

* + - * 1. 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.
				2. Fabricate components that, when assembled, have the following characteristics:

Profiles that are sharp, straight, and free of defects or deformations. Remove burrs and ease edges.

Accurately fitted joints with ends coped or mitered.

Physical and thermal isolation of glazing from framing members.

Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

Editor Note: Revise first subparagraph below to suit Project. Window Walls are glazed from either the exterior or the exterior. Verify glazing requirements for Window Wall systems with manufacturers listed in Part 2 articles.

Provisions for field replacement of glazing from [**exterior**] [**interior**] [**interior for vision glass and exterior for spandrel glazing or metal panels**].

Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

Editor Note: Retain subparagraph below for curved components if any

Components curved to indicated radii.

* + - * 1. Fabricate components to resist water penetration as follows:

Editor Note: System in first subparagraph below uses internal drainage method to protect against both water leakage and excessive air leakage.

Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within window wall to exterior.

Editor Note: System in subparagraph below uses pressure-equalization method to protect against both water leakage and excessive air leakage.

Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum window wall secondary seal weeped and vented to exterior.

* + - * 1. Window Wall Framing: Fabricate components for assembly using [manufacturer's standard assembly method] [shear-block system] [screw-spline system] [head-and-sill-receptor system with shear blocks at intermediate horizontal members]

Editor Note: Retain "Factory-Assembled Frame Units" Paragraph below for unitized system. Revise to suit Project.

* + - * 1. Factory-Assembled Frame Units:

Shop fabricate to greatest extent practicable to minimize field cutting, splicing, and assembly. Disassemble only to extent necessary for shipping and handling limitations.

Rigidly secure nonmovement joints.

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.

Seal joints watertight unless otherwise indicated.

Editor Note: Retain first subparagraph below if frame units are factory glazed.

Install glazing to comply with requirements in Section 088000 "Glazing."

Editor Note: Retain first subparagraph below if Project includes factory glazed, two-sided structural silicone glazing.

Install structural glazing.

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.

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

Apply structural silicone sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions with the framing and glazing in a fully supported position.

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 written instructions.

After structural sealant has completely cured, insert backer rod between lites of glass as recommended by sealant manufacturer.

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

Clean and protect glass as indicated in Section 088000 "Glazing."

Editor Note: Retain subparagraph below if recommended by manufacturer.

Retain bracing or stiffening until erected to prevent racking of units during transportation and erection.

* + - * 1. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

Editor Note: Insert integral stabilization requirements for descent-control equipment used for maintenance if any.

* + - * 1. <Insert requirements>.
			1. **ALUMINUM FINISHES**

Editor Note: Retain finishes in paragraphs below to suit Project. If retaining more than one, indicate location of each on Drawings or by inserts. Aluminum-framing systems are available with dual finishes, allowing different interior and exterior color finishes. See "Aluminum Finishes" Article in the Evaluations for additional information.

Retain one of two options in "Clear Anodic Finish" Paragraph below. Verify availability with manufacturers.

* + - * 1. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker, etched, medium matte.

Editor Note: Retain one of two options in "Color Anodic Finish" Paragraph below. Verify availability with manufacturers.

* + - * 1. Color Anodic Finish: AAMA 606.1 and AAMA 608.1, AA-M12C22A42/A43/A44, Class I, 0.070 mm or thicker; etched, medium matte.

Editor Note: Options in "Color" Subparagraph below are examples only and may vary in color range and availability among manufacturers.

Color: [**Black**] [**Champagne**] [**Clear**] [**Dark bronze**] [**Light bronze**] [**Medium bronze**] [**As selected by Architect from full range of industry colors and color densities**].

Editor Note: Retain "High-Performance Organic Finish, Two-Coat PVDF" Paragraph below, retain AAMA 2604 with 50 percent resin content by weight in color coat or AAMA 2605 with 70 percent resin content by weight in color coat for high-performance organic coatings on extrusions and panels. If specific products are required, name coating manufacturers and products.

* + - * 1. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat.

Editor Note: Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

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

Akzo Coatings, Inc.; Trinar.

Glidden Company; Nubelar.

Morton International, Inc.; Fluoroceram.

PPG Industries Inc.; Duranar.

Valspar Corporation; Fluropon.

Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [**for seacoast and severe environments**].

Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**]. <Insert color and gloss>.

* + - * 1. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

Editor Note: Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

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

Akzo Coatings, Inc.; Trinar.

Glidden Company; Nubelar.

Morton International, Inc.; Fluoroceram.

PPG Industries Inc.; Duranar.

Valspar Corporation; Fluropon

Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [**for seacoast and severe environments**].

Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**].

* + - 1. **SOURCE QUALITY CONTROL**

Editor Note: Retain this article if Project includes two-sided structural glazing.

* + - * 1. 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.
1. **EXECUTION**
	* + 1. **EXAMINATION**
				1. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
				2. Proceed with installation only after unsatisfactory conditions have been corrected.
			2. **INSTALLATION, GENERAL**
				1. Comply with manufacturer's written instructions.
				2. Do not install damaged components.
				3. Fit joints to produce hairline joints free of burrs and distortion.
				4. Rigidly secure nonmovement joints.
				5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
				6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
				7. Seal perimeter and other joints watertight unless otherwise indicated.
				8. Metal Protection:

Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.

Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

* + - * 1. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum window wall to exterior.

Editor Note: Coordinate first paragraph below with manufacturers' written instructions.

* + - * 1. Install components plumb and level, free of warp or twist, and true in alignment with established lines and grades.
				2. Apply mullion covers only when building is closed in and no alkaline substances can be washed from building onto window-wall systems.
			1. **INSTALLATION OF OPERABLE UNITS**

Editor Note: Retain this article for operable units.

* + - * 1. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
			1. **INSTALLATION OF GLAZING**
				1. Install glazing as specified in Section 088000 "Glazing."
			2. **INSTALLATION OF STRUCTURAL GLAZING**

Editor Note: Retain this article if Project includes two-sided structural glazing that is not factory glazed.

* + - * 1. 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.
				2. 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.
				3. Set glazing with proper orientation so that coatings face exterior or interior as specified.
				4. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.
				5. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer and framing manufacturer's written instructions and in compliance with local codes.
				6. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.
				7. Allow structural sealant to cure in accordance with manufacturer's written instructions.
				8. Clean and protect glass as indicated in Section 088000 "Glazing."
			1. **INSTALLATION OF WEATHERSEAL SEALANT**

Editor Note: Retain this article if Project includes two-sided structural glazing that is not factory glazed.

* + - * 1. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.
				2. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.
			1. **FIELD QUALITY CONTROL**

Editor Note: Retain this article for testing of Window Wall during installation or for testing of field mockups.

* + - * 1. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
				2. Test Area: Perform tests on [**one bay at least 30 ft. (9.1 m), by one story**] [**representative areas of glazed aluminum window walls**] [**mockups**] <**Insert requirements**>.
				3. Field Quality-Control Testing: Perform the following test on [**representative areas of window walls**] [**mockups**].

Editor Note: Inexpensive test in "Water-Spray Test" Subparagraph below tests for deficiencies in workmanship only and is not representative of a wind-driven rain event.

Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect are tested in accordance with AAMA 501.2 and do not evidence water penetration.

Editor Note: Retain one of two subparagraphs below.

Perform a minimum of [**insert number]** tests in areas as directed by Architect.

Perform tests in each test area as directed by Architect. Perform at least three tests, prior to [**10, 35, and 70 percent completion**].

Editor Note: AAMA 503 allows a prescribed test pressure for air leakage, depending on the location and wind exposure of Project. Revise "Air Leakage" Subparagraph below to use a prescribed test pressure.

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).

Editor Note: Retain one of first two subparagraphs below.

Perform a minimum of [**insert number]** tests in areas as directed by Architect.

Perform tests in each test area as directed by Architect. Perform at least three tests, prior to [**10, 35, and 70 percent completion**].

Editor Note: When specifying test pressure note that AAMA allows a one-third reduction in test pressures for field tests. 6.24 lbf/sq. ft. (300 Pa) is industry standard minimum; however, AAMA 503 allows minimum test pressure of 4.18 lbf/sq. ft. (200 Pa). Alternatively, AAMA 503 allows a prescribed test pressure for water penetration, depending on the location and wind exposure of Project. Revise "Water Penetration" Subparagraph below to use a prescribed test pressure.

Water Penetration: ASTM E1105 at a minimum [**uniform**] [**and**] [**cyclic**] static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and do not evidence water penetration.

Editor Note: Retain "Structural-Sealant Adhesion" Paragraph below if Project includes two-sided structural glazing.

* + - * 1. Structural-Sealant Adhesion: Test structural sealant in accordance with recommendations in ASTM C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

Test a minimum of [**insert number]** areas on each building facade.

Repair installation areas damaged by testing.

Editor Note: See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

* + - * 1. Window Wall components will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.

**END OF SECTION 084600**