

BuildingName  
The Description of the Project  
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**SPECIFICATION DIVISION 8**

NUMBER            SECTION DESCRIPTION

**DIVISION 08 OPENINGS**

SECTION 085113 - ALUMINUM WINDOWS

**END OF CONTENTS TABLE**



**DIVISION 08 OPENINGS**  
**SECTION 085113 - ALUMINUM WINDOWS**

*REVISED JUNE 2011 TO TIGHTEN PERFORMANCE REQUIREMENTS TO MEET ASHRAE.*

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard General Conditions, Supplemental General Conditions, Division 01 Specification Sections, and other applicable Specification Sections, apply to this Section.

*INSERT SPECIAL WINDOW TYPES SUCH AS SOUND INSULATING WINDOWS, SOLAR SHADING WINDOWS OR EMERGENCY ACCESS/EGRESS WINDOWS IF REQUIRED FOR SPECIAL PROJECT APPLICATIONS.*

*REVISE LIST BELOW TO SUIT PROJECT.*

- B. Related Sections:
1. Division 07 Section: Air Barriers.
  2. Division 07 Section: Flashing and Sheet Metal.
  3. Division 08 Section "Aluminum-Framed Entrances and Storefronts."
  4. Division 08 Section "Glazed Aluminum Curtain Walls."

**1.2 SUMMARY**

- A. Section includes:
1. Architectural Performance Class AW aluminum window units and related work as indicated on the Drawings.

*WINDOW TYPES LISTED BELOW ARE COMMONLY USED AT THE UNIVERSITY. CONSULT MANUFACTURER'S LITERATURE AND AAMA 101 FOR ADDITIONAL TYPES.*

*DELETE WINDOW TYPES THAT ARE NOT REQUIRED.*

- a. Casement windows.
  - b. Double-hung windows.
  - c. Top-hinged windows.
  - d. Projected windows.
  - e. Fixed windows.
2. Delegated Design: Aluminum windows designed by the manufacturer to comply with specified performance requirements and design criteria, including structural analysis data signed and sealed by the qualified Professional Engineer
- B. Work Provided Under This Section But Specified Under Other Sections:

1. The Work of this Section and applicable portions of the work of the following Sections, that are related to this Section, shall be performed by a Prime contractor providing window products, to establish single source responsibility for aluminum windows and associated components.
  - a. Division 07 Section "Joint Sealants."
  - b. Division 08 Section "Glazing."

### 1.3 SUBMITTALS

*USUALLY RETAIN ALL BELOW.*

- A. Product data for each type of window required, including:
  1. Construction details and fabrication methods.
  2. Profiles and dimensions of individual components.
  3. Data on hardware, accessories, and finishes.
  4. Recommendations for maintenance and cleaning of exterior surfaces.

*USUALLY RETAIN ALL BELOW.*

- B. Shop drawings for each type of window required. Include information not fully detailed in manufacturer's standard product data and the following:

*DELETE REQUIREMENTS FROM THE LIST BELOW THAT ARE NOT REQUIRED.*

1. Layout and installation details, including anchors.
  2. Elevations at 1/4-inch = 1 foot scale and typical window unit elevations at 3/4-inch = 1 foot scale.
  3. Full-size section details of typical composite members, including reinforcement and stiffeners.
  4. Location of weep holes.
  5. Panning details
  6. Hardware including operators.
  7. Glazing details.
  8. Accessories.
- C. Delegated-Design Submittal: For windows indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.

*EDIT FOR OTHER COLOR SELECTIONS.*

*EDIT FOR FINISHES SELECTED. DELETE FINISHES THAT ARE NOT USED.*

- D. Samples for Initial Color Selection: Submit samples of each specified finish as indicated below.
  1. Fluoropolymer Coatings: Submit samples consisting of actual coating chips and displaying manufacturer's range of colors for initial selection, including black and 3 additional non-metallic color choices closely approximating dark bronze anodized finish. Photographs or color printing are not acceptable.

2. Anodized Coatings: Submit pairs of samples of the specified finish on 4-inch-long sections of aluminum extrusions. Include sample sets showing the full range of variations in color normally expected.
- E. Energy Performance Certificates: For windows, accessories, and components, from manufacturer.
    1. Basis for Certification: NFRC-certified energy performance values for each window type.
  - F. Test reports: Provide certified test reports from a qualified independent testing agency indicating that each type and size of window unit has been tested in accordance with specified test procedures and complies with each performance requirement indicated. Test results based on use of down-sized test units will not be accepted.
  - G. Manufacturer's certification of compliance with requirements of the specified performance requirements of this Section.
  - H. Field quality-control reports are submitted by Owner's Independent testing Agency.
  - I. Signed original warranty documents from the window manufacturer indicating the specified terms and conditions for each window and component.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.
- B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.
  1. Applicable standards of the American Architectural Manufacturers Association (AAMA), including but not limited to:
    - a. AAMA/WDMA/CSA 101/I.S.2/A440 Voluntary Performance Specification for Windows, Skylights and Glass Doors - A North American Fenestration Standard.
    - b. AAMA 1503- Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
    - c. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
    - d. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.
    - e. AAMA 901 Voluntary Specification for Rotary & Linear Operators in Window Applications.
    - f. AAMA 902 Voluntary Specification for Sash Balances.
    - g. AAMA 910 Voluntary Life Cycle Specifications and Test Methods for AW Class Architectural Windows and Doors.
    - h. AAMA 505 Dry Shrinkage Performance and Composite Thermal Cycling Test Procedure.

2. Standards of ASTM International which are referenced in other Articles in this Section.
3. National Fenestration Rating Council (NFRC) Documents and Rating System, including, but not limited to:
  - a. NFRC 100 Procedure for Determining Fenestration Product U-factors.
  - b. NFRC 200 Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
  - c. NFRC 500-2010 Procedure for Determining Fenestration Product Condensation Resistance Values.

**THE WIND PRESSURES ACTING ON THE WALLS MUST BE CALCULATED BY THE STRUCTURAL ENGINEER AND INDICATED ON THE DRAWINGS AT CORNERS AND CENTERS OF WALLS FOR PROPER WALL, WINDOW AND CURTAIN WALL DESIGNS, AS APPLICABLE.**

- C. Delegated Design: A qualified Professional Engineer registered in Michigan, employed by the window manufacturer, shall design aluminum windows, and all accessories, for this project. The windows shall be manufactured, assembled and installed to withstand the structural load requirements as specified in this Section, and according to the Building Code. Expected loads calculated for the building, based on the wind load data indicated on the Drawings. Refer to Part 2 Performance Requirements for additional information.
- D. Installer Qualifications: Engage an experienced Installer who has completed installation of aluminum windows similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in-service performance.
- E. Single-Source Responsibility: Obtain aluminum window units from one source and by a single manufacturer.
- F. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed specified performance requirements and of documenting this performance by certification and labeling.
- G. Manufacturer's Preconstruction Testing Agency Qualifications: Qualified according to ISO/IEC 17025 and accredited by ICC-ES for preconstruction testing indicated.
- H. Product Options: The drawings indicate the size, profiles, and dimensional requirements, and aesthetic effects of aluminum windows and are based on products of a specific manufacturer. Aluminum windows by indicated approved manufacturers will be considered, provided deviations in dimensions and profiles are minor and do not alter the aesthetic effect as judged by the Owner and Architect. The burden of proof of equality is on the proposer.
- I. Tested Units: Provide window units that were successfully tested by a qualified independent testing laboratory, for the window manufacturer, to demonstrate compliance with specified standards.
- J. Field Testing: The Owner's independent Testing Laboratory will validate testing of windows installed in the building.

1.5 MANUFACTURER TESTING

*REVISE EXAMPLE TEST METHODS AND SEQUENCE IN SUBPARAGRAPH BELOW TO SUIT PROJECT AND COORDINATE WITH TESTS REQUIRED IN "PERFORMANCE REQUIREMENTS" ARTICLE. CONSULT MANUFACTURERS AND TESTING AGENCIES FOR GUIDANCE ON APPROPRIATE REQUIREMENTS FOR PROJECT.*

- A. Preconstruction Testing Program: Perform tests specified in "System Performance Requirements" Article on manufacturer's laboratory samples in the following order:
  - 1. Structural-performance preloading at 50 percent of the specified wind-load design pressure when tested according to ASTM E 330.
  - 2. Air infiltration when tested according to ASTM E283.
  - 3. Water penetration under static pressure when tested according to ASTM E 331.
  - 4. Structural performance at design load when tested according to ASTM E 330.
  - 5. Repeat air filtration when tested according to ASTM E 283.
  - 6. Repeat water penetration under static pressure when tested according to ASTM E 331.
  - 7. Structural performance at maximum 150 percent of positive and negative wind-load design pressures when tested according to ASTM E 330.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Check actual window openings by accurate field measurements before fabrication and show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the Work.
  - 1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

*GLASS WARRANTY IS SPECIFIED IN THE GLAZING SECTION.*

*NOTE THAT STANDARD WARRANTY IS FREQUENTLY 5 YEARS, WITH 10 YEARS BEING AN OPTION AVAILABLE AT ADDITIONAL CHARGE.*

1.7 WARRANTY

- A. Assembly Warranty: Provide a complete parts and labor warranty for a minimum of 10 years from the date of Substantial Completion according to the following terms.
  - 1. Manufacturer agrees to repair or replace components of aluminum windows that do not comply with requirements or that fail in materials or workmanship within specified warranty period. 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. Water penetration through fixed glazing and framing areas.
- d. Failure of operating components.
- e. Glazing failure, including gasket shrinkage.
- f. Glass defects and failure as specified in the Glazing Section.

**RETAIN APPLICABLE WARRANTIES FOR PROJECT.**

- B. Fluoropolymer Finish Warranty: Manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied fluoropolymer finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No.8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

**VERIFY AVAILABLE WARRANTIES AND WARRANTY PERIODS FOR FINISHES WITH MANUFACTURERS LISTED IN PART 2 ARTICLES. FLUOROPOLYMER FINISHES ARE ELIGIBLE FOR 10 YEAR WARRANTIES.**

- 2. Warranty Period: 10 years from date of Substantial Completion.
- C. Anodized Finish Warranty: Manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied anodized finishes within specified warranty period. Any metal forming or welding must be done prior to finishing.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta-E Hunter units (square root of the sum of square Delta L, Delta a, and Delta b) as determined by ASTM D 2244.
    - b. Chalking in excess of a No.8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, flaking, or blistering.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Acceptable Window Manufacturers:

**SELECT WINDOW DESIGN BASED ON PERFORMANCE WITHIN THE LISTED MANUFACTURERS. THE FOLLOWING MANUFACTURERS OFFER FIXED AND OPERABLE WINDOW UNITS THAT MEET SPECIFIED PERFORMANCE LEVELS. VERIFY PERFORMANCE LEVELS FOR VARIOUS UNIT TYPES AND SIZES IN**



*THE PROJECT BECAUSE NOT ALL PRODUCT LINES AND SIZES FROM THE MFRS BELOW MEET THE PERFORMANCE SPECIFICATIONS.*

*REVIEW NFRC WEBSITE FOR LISTING OF WINDOWS CERTIFIED TO MEET PERFORMANCE STANDARDS.*

1. Graham Architectural Products.
2. Kawneer Company, Inc.
3. Wausau Window and Wall Systems.
4. Traco.

B. Acceptable Fluoropolymer Coating Manufacturers:

1. PPG Industries.
2. Valspar Corp.
3. Akzo Nobel.

## 2.2 PERFORMANCE REQUIREMENTS

*PRIMARY ENERGY PERFORMANCE REQUIREMENTS INCLUDE THERMAL TRANSMITTANCE (U-FACTOR), SOLAR HEAT GAIN COEFFICIENT, AND AIR INFILTRATION AS DEFINED BY ASHRAE/IESNA 90.1-2007. RELATED AND ADDITIONAL ENERGY PERFORMANCE CONSIDERATIONS INCLUDE CONDENSATION RESISTANCE AND VISIBLE LIGHT TRANSMITTANCE. OPTIONS IN SUBPARAGRAPHS BELOW ARE EXAMPLES ONLY. REVISE VALUES TO SUIT BUILDING ENVELOPE AS DEFINED BY ASHRAE/IESNA 90.1-2007. REVIEW PERFORMANCE WITH RESPECT TO U OF M DESIGN GUIDELINES FOR DESIGN AND CONSTRUCTION SID-D "ENERGY AND WATER CONSERVATION" AND RELATED STANDARDS. COORDINATE WITH DIVISION 08 SECTION "GLAZING".*

A. Provide aluminum windows engineered, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading without failure, as demonstrated by testing manufacturer's standard window assemblies representing types, classes, grades, and sizes required for Project according to test methods indicated.

*CONSULT WITH STRUCTURAL ENGINEER TO DETERMINE PROPER PERFORMANCE GRADE, WHICH IS BASED UPON WIND SPEED AND EXPOSURE CATEGORY.*

B. Provide aluminum windows that comply with AAMA/WDMA/CSA 101 Performance Class AW and Performance Grade [ ].

*ALWAYS RETAIN PARAGRAPH BELOW.*

C. Factory testing indicated in paragraphs below shall demonstrate compliance with requirements indicated in AAMA 101 for air infiltration, water penetration, structural, and thermal performance for type, grade, and performance class of window units required. Where required design pressure exceeds the minimum for the specified window grade, comply with requirements of AAMA 101, Section 3, "Optional Performance Classes," for higher than minimum performance class.

D. Air infiltration: Maximum 0.4 cfm per square foot at 6.24 psf pressure differential when tested in accordance with ASTM E283.

E. Water Penetration:

1. No uncontrolled water leakage at 12.00 psf static pressure differential, with water application rate of 5 gallons/hr/sq ft when tested in accordance with both ASTM E331 and ASTM E547. Repeat static water test after application of design test pressures.

**NOTE THAT THE FOLLOWING INFORMATION AS DETERMINED BY PROJECT'S STRUCTURAL ENGINEER MUST BE SHOWN ON DRAWINGS.**

F. Structural:

1. Structural Loads: As indicated on Drawings.
2. Uniform Load Deflection Test
  - a. No deflection of any unsupported span L of test unit (framing rails, muntins, mullions, etc.) in excess of L/175 at both a positive and negative load of design test pressure psf) when tested in accordance with ASTM E330.
3. Uniform Load Structural Test:
  - a. Unit to be tested at 1.5 times design test pressure, both positive and negative, acting normal to plane of wall in accordance with ASTM E330.
  - b. No glass breakage; permanent damage to fasteners, hardware parts, or anchors; damage to make windows inoperable; or permanent deformation of any main frame or ventilator member in excess of 0.2 percent of its clear span.

G. Thermal:

1. Thermal Transmittance (U-factor) Fixed glazing and Framing Areas: U-factor of not more than 0.55 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Thermal Transmittance (U-factor) Operable Window Glazing and Framing Areas: U-factor of not more than 0.55 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
3. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
4. Condensation Resistance: Provide units tested for thermal performance according to AAMA 1503 showing a condensation resistance factor (CR) of 60.

**SELECT ABOVE OR BELOW. ABOVE PUTS RESPONSIBILITY ON DESIGNER AND NEEDS TO BE CONFIRMED BASED UPON BUILDING OCCUPANCY FACTORS AND SHOULD BE VERIFIED WITH MECHANICAL ENGINEER. BELOW PUTS RESPONSIBILITY ON MANUFACTURER.**

**CRF CALCULATOR TOOL IS AVAILABLE AT:**

**[HTTP://AAMANET.ORG/CRFCALCULATOR/1/334/CONDENSATION-RESISTANCE-FACTOR-TOOL](http://AAMANET.ORG/CRFCALCULATOR/1/334/CONDENSATION-RESISTANCE-FACTOR-TOOL)**

5. Condensation Resistance: Provide units tested for thermal performance according to AMMA 1503 showing a condensation resistance factor (CRF) such that there shall be no formation of condensation in any form on glazing and framing.

**INSERT PROJECT SPECIFIC DESIGN VALUES BELOW.**

- a. Indoor design temperature:
  - 1) Winter: []
  - 2) Summer: []
- b. Indoor humidity:
  - 1) Winter: []
  - 2) Summer: []
- 6. Thermal Movements: Provide window units that allow thermal movement resulting from the following maximum change (range) in ambient temperature when engineering, fabricating, and installing aluminum windows to prevent buckling, opening of joints, and overstressing of components, connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime sky heat loss.
  - a. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- H. Operable window units shall successfully pass operating force and deglazing test requirements of AAMA 101 and life-cycle test requirements specified in AAMA 910.

**INCLUDE BELOW IF PROJECT CONTAINS THE FOLLOWING OPERABLE WINDOW TYPES**

- 1. Projected casement window units shall successfully pass the following test requirements as specified in AAMA 101:
  - a. Torsion test on an unglazed ventilator.
  - b. Horizontal and vertical concentrated load tests on latch rail of each ventilator.
  - c. Torsion load test on intermediate frame rails.
  - d. Vertical concentrated load test on intermediate frame rails over each ventilator.
  - e. Balance arm load test.
- 2. Projected awning window units shall successfully pass the following test requirements as specified in AAMA 101:
  - a. Hold-open arm or stay-bar load test.
  - b. Torsion test.
  - c. Horizontal concentrated load test.
  - d. Vertical concentrated load test.
- I. Labeling: Per ANSI/ASHRAE 90.1-2007, provide a permanent nameplate, installed by the manufacturer, listing the U-factor, SHGC, and air leakage rate. The label may be the NFRC energy performance label or the AAMA performance label.

**2.3 DESIGN REQUIREMENTS**

**INCLUDE THE PARAGRAPH BELOW TO CONTROL THE RELATIONSHIP OF VISION AND SPANDREL PANELS WHEN BOTH ARE INCLUDED IN THE PROJECT.**

- A. Uniform Glass Plane Requirement: Within the same wall opening, fabricate windows to align the exterior surface planes of vision glass with spandrel panels.
  - 1. Maximum out-of-plane dimension for vision and spandrel panels: 1/8-inch.
  - 2. Where applicable, align metal filler panels in the same plane as adjacent spandrel panels.

**2.4 MATERIALS**

- A. Aluminum Extrusions: Provide alloy and temper recommended by the window manufacturer for the strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength and of the following thickness and depth at any location for main frame and sash members.

*BELOW ARE 2 COMMONLY USED SIZES. 2-1/4-INCH DIMENSION IS NOT RECOMMENDED FOR VENTILATORS OVER 15 SQUARE FEET IN AREA, OR WITH VERTICAL DIMENSION GREATER THAN 78-INCHES.*

- 1. Main Frame Depth: 2-1/4 inches.
- 2. Main Frame Depth: 3-1/4 inches.

*DELETE BELOW FOR SINGLE- AND DOUBLE-HUNG UNITS, OR FOR OTHER TYPES IF NOT REQUIRED.*

- a. Provide ventilator members of depth matching main frame.

- B. Fasteners: Provide aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.

*RETAIN THE PARAGRAPH BELOW.*

- 1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125 inch thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard, noncorrosive pressed-in splined grommet nuts.

*GENERALLY RETAIN THE PARAGRAPH BELOW. MODIFY AS APPROPRIATE IF USE OF EXPOSED FASTENERS IS PERMITTED.*

- 2. Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match the finish of the member or hardware being fastened, as appropriate.

- C. Anchors, Clips, and Window Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with the requirements of ASTM A 123; provide sufficient strength to withstand design pressure indicated.

*CONSIDER INCLUDING BELOW FOR STRUCTURAL STRENGTH, OR TO CLOSE OFF OPENINGS THROUGH CONSTRUCTION*

- 1. Provide continuous structural anchor clips.

- D. Sealant: For sealants required within fabricated window units, provide type recommended by the manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating. Comply with Division 07 Section "Joint Sealants" of the Specifications for selection and installation of sealants.

**2.5 HARDWARE**

- A. General: Provide the manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended.

*DELETE BELOW IF NO PROJECTED WINDOWS.*

- B. Cam Handles: Provide manufacturer's standard cam-action sweep lock/handle of solid white bronze.
  - 1. Finish: Polished (chrome white).
  - 2. Finish: Oxidized (dark bronze).

*DELETE BELOW IF NO DOUBLE HUNG WINDOWS.*

- C. Handles: Provide manufacturer's standard stainless steel wire pull.
  - 1. Stainless Steel Finish: Satin, natural.
  - 2. Aluminum Finish: Match window frame.

*RETAIN THE NEXT PARAGRAPH WITH CASEMENT AND PROJECTED WINDOWS. SPECIAL EGRESS TYPE FOUR-BAR FRICTION HINGES ARE ALSO AVAILABLE FOR CASEMENT WINDOWS WHERE WINDOWS ARE ALSO USED FOR EMERGENCY EGRESS.*

- D. Four-Bar Friction Hinges: Comply with AAMA 904.
  - 1. Provide concealed four-bar friction hinges with adjustable slide shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.

*RETAIN FOR LARGE VENTS IN CASEMENT WINDOWS. VERIFY WITH WINDOW MANUFACTURERS.*

- E. Butt Hinges: Provide heavy-duty 5-knuckle butt hinges with nylon bushings complying with AAMA 904. Finish and color to match frames.

*RETAIN ROTARY OPERATORS BELOW IF DESIRED FOR AWNING, AND CASEMENT TYPE WINDOWS.*

- F. Gear-Type Rotary Operators: Comply with AAMA 901 for rotary operators. Comply with ASTM E 405, Method A, when subjected to operating moments and closing torques indicated in AAMA 101.
  - 1. Operator shall operate all ventilators simultaneously, securely closing them at both jambs without use of additional manually controlled locking devices.

*DELETE TWO PARAGRAPHS BELOW IF NO CASEMENT WINDOWS.*

- G. Single Point Locks: Provide manufacturer's standard cam-action lift lock of solid white bronze. Color to match ventilator frame.

*BELOW FOR LARGE CASEMENTS REQUIRING TWO LATCHING POINTS (NOTE THAT CASEMENT WIDTH MUST BE OVER 2.5 FEET FOR MULTI-POINT LATCH).*

- H. Two-Point Locks: Provide manufacturer's standard 2-point, cam-action lift lock of solid white bronze. Color of exposed parts to match ventilator frame.

*DELETE BELOW IF NO SINGLE- OR DOUBLE-HUNG WINDOWS.*

- I. Cam Action Lock: Sweep lock and keeper on the meeting rail.

*SELECT BELOW FOR HOUSING PROJECTS.*

- J. Limit Device: Heavy-duty, concealed arm, custodial-key operated limit device designed to restrict occupant operation of ventilator, but permit full operation with custodial key. Provide Truth 99 series or equivalent by window manufacturer. Provide in residential applications, and where indicated.

*INCLUDE BELOW WITH EITHER LIMIT DEVICE SPECIFIED ABOVE. MODIFY VALUE BELOW TO SUIT PROJECT.*

1. Set devices to limit opening to 6 inches, clear, from window frame member to vent frame.

*RETAIN THE NEXT PARAGRAPH WITH DOUBLE-HUNG WINDOWS.*

- K. Counterbalancing Mechanism: Comply with AAMA 902.

*RETAIN ONLY ONE OF THE TYPES OF SASH BALANCES BELOW.*

1. Sash Balance Type: Concealed spiral type of size and capacity to hold sash stationary at any open position.
2. Sash Balance Type: Concealed tape spring type of size and capacity to hold sash stationary at any open position.

## 2.6 ACCESSORIES

- A. General: Provide the manufacturer's standard accessories that comply with indicated standards.

*DELETE OPTIONAL OR ACCESSORY ITEMS IN THIS ARTICLE THAT ARE NOT REQUIRED. COORDINATE ITEMS RETAINED WITH PROVISIONS CONTAINED IN THE "MATERIALS" ARTICLE.*

- B. Panning and Trim: Provide panning and trim as shown with anchors as required to securely fasten trim and panning items to window units and adjacent substrates. Provide concealed anchors where possible. Provide units of profile and dimensions indicated, but not less than 0.062-inch-thick extruded aluminum. Miter and cope corners, and dress smooth. Finish to match window units.

*ANCHOR CLIPS REFERENCED BELOW ARE FOR 2-PIECE SNAP-ON TRIM. DELETE BELOW IF ONLY ADHESIVELY APPLIED "L"-SHAPED TRIM IS INCLUDED.*

1. Interior Trim: Provide 2-piece extruded aluminum box type trim with continuous anchor clips for trim exceeding 36 inches in length.

*DELETE BELOW IF NO ADHESIVELY APPLIED "L"-SHAPED TRIM.*

2. Interior Trim: Anchor "L"-shaped trim pieces with continuous adhesive tape strip applied to surface in contact with adjacent wall/partition substrate only.

**COORDINATE BELOW WITH WINDOW SCHEDULE**

- C. Insect Screens: Provide insect screens for each operable exterior sash or ventilator. Locate screens on the inside or outside of the window sash or ventilator, depending upon window type. Design windows and hardware to accommodate screens in a tight-fitting removable arrangement, with a minimum of exposed fasteners and latches.

**RETAIN ONLY ONE OF THE NEXT TWO PARAGRAPHS IF SCREENS ARE REQUIRED. COMBINE THE PARAGRAPHS IF THE CONTRACTOR IS TO HAVE AN OPTION IN SELECTING SCREEN FRAME MATERIAL.**

- 1. Screen Frames: Fabricate frames of tubular-shaped extruded or formed aluminum members of 0.040-inch minimum wall thickness, with mitered or coped joints and concealed mechanical fasteners. Finish frames to match window units.
  - a. Provide removable PVC spline-anchor concealing the edge of the screen frame.
- 2. Wire Fabric Insect Screen: Provide 18 by 16, mesh of 0.011-inch-diameter black anodized aluminum wire, complying with FS RR-W-365, Type VII.

- D. Compression-Type Glazing Strips and Weatherstripping: Unless otherwise indicated, and at manufacturer's option, provide compressible stripping for glazing and weatherstripping such as molded PVC gaskets complying with ASTM D 2287, or molded expanded EPDM gaskets complying with ASTM C 509, Grade 4.

**SLIDING-TYPE WEATHERSTRIPPING BELOW IS FOR DOUBLE-HUNG WINDOW UNITS.**

- E. Sliding-Type Weatherstripping: Provide woven-pile weatherstripping of nylon pile and resin-impregnated backing fabric. Comply with AAMA 701.2.
  - 1. Provide stripping with integral centerline barrier fin of semirigid plastic sheet of polypropylene.
  - 2. Provide weatherstripping locked in to extruded grooves in the sash.
  - 3. Provide sliding-type weatherstripping where sash rails slide vertically along the unit frame. Provide compression-type weatherstripping at the head and sill of each operating sash.

**CONSIDER INCLUDING BELOW.**

- F. Insulation: Blanket or batt type meeting ASTM C 665, Type III, Class A, fiberglass.

**2.7 FABRICATION**

- A. General: Fabricate aluminum window units to comply with indicated standards. Include a complete system for assembly of components and anchorage of window units.
  - 1. Provide units that are reglazable without dismantling sash or ventilator framing.
  - 2. Prepare window sash or ventilators for glazing except where preglazing at the factory is indicated.

*REVISE BELOW TO SUIT PROJECT.*

3. Provide units that are capable of being reglazed from the building interior, except at spandrels or other inaccessible conditions.

*INCLUDE THERMAL BREAK CONSTRUCTION FOR ALL PROJECTS.*

- B. Thermal-Break Construction, General: Fabricate window units with an integral, concealed low-conductance thermal barrier, located between exterior materials and window members, in a manner that eliminates direct metal-to-metal contact; and that complies with the following:
1. Products comprising the system shall have been in use for not less than 5 years.
  2. Systems shall have been tested to demonstrate resistance to thermal conductance and condensation, and to show adequate strength and security of glass retention.
  3. Systems shall be capable of transferring shear during bending under design loads by promoting composite action between the exterior and interior extrusions.
- C. Weepholes: Provide weepholes and internal passages to conduct infiltrating water to the exterior.

*DELETE THE PARAGRAPH BELOW IF THERE ARE NO LINES WHERE VENT FRAMES LAP THE WRONG WAY TO SHED WATER.*

- D. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.

*DELETE THE NEXT PARAGRAPH IF SUBFRAMES ARE NOT REQUIRED. SUBFRAMES PROVIDE A NEAT, SEALABLE PERIMETER FOR RENOVATION WORK. THEY ARE USUALLY NOT REQUIRED FOR WINDOWS IN NEW SURROUNDING CONSTRUCTION.*

- E. Subframes: Provide subframes with anchors for window units, where shown, of profile and dimensions indicated but not less than 0.062-inch-thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units.

*MODIFY PARAGRAPHS BELOW TO SUIT PROJECT REQUIREMENTS.*

1. Provide subframes at all wall openings to receive window units.
2. Locate subframes at sill, head and jambs of openings.

*DELETE THE PARAGRAPH BELOW IF MULLIONS ARE NOT REQUIRED.*

- F. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, in the manner indicated.

*DELETE THE NEXT PARAGRAPH IF GLAZING STOPS ARE NOT REQUIRED (AT STRUCTURAL-GLAZED TYPE WINDOW SYSTEMS FOR EXAMPLE).*



- G. Glazing Stops: Provide screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system indicated. Finish glazing stops to match window units.

*DELETE THE PARAGRAPH BELOW IF PREGLAZING IS IMPRACTICAL. GLASS SIZES LARGER THAN 60 TO 100 UNITED INCHES MAY BE DIFFICULT TO HANDLE WITHOUT DAMAGE. IT IS ALSO POSSIBLE THAT THE INSTALLATION OR ANCHORAGE SYSTEM WILL NOT PERMIT PREGLAZING. VERIFY WITH WINDOW MANUFACTURER.*

- H. Preglazed Fabrication: Preglaze window units at the factory. Comply with glass and glazing requirements of the Division 08 Section "Glazing" of these specifications and AAMA 101.

## **2.8 FINISHES, GENERAL**

- A. Comply with referenced AAMA Voluntary Specifications for detailed finish requirements.

*DELETE BELOW IF NO CURTAIN WALL*

*TYPICALLY SPECIFY FINISHES IN CURTAIN WALL SECTION.*

- B. Finish aluminum windows to match other adjacent glazed aluminum curtain wall components, when applicable. Refer to Division 08 Section "Glazed Aluminum Curtain Walls" for finish requirements.

*DELETE 2 ARTICLES BELOW IF SPECIFIED IN CURTAIN WALL SECTION.*

## **2.9 FLUOROPOLYMER ALUMINUM FINISHES**

*RETAIN FINISHES IN PARAGRAPHS BELOW TO SUIT PROJECT. FLUOROPOLYMER FINISH IS PREFERRED BY THE U OF M.*

*IF RETAINING MORE THAN ONE, INDICATE LOCATION OF EACH ON DRAWINGS BY TYPE. COORDINATE WITH DESIGNATIONS IN THIS SECTION. ALUMINUM-FRAMING SYSTEMS ARE AVAILABLE WITH DUAL FINISHES, ALLOWING DIFFERENT INTERIOR AND EXTERIOR COLOR FINISHES.*

*IF SPECIFIC PRODUCTS ARE REQUIRED, NAME COATING MANUFACTURERS AND PRODUCTS.*

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to metal surfaces to comply with coating and resin manufacturers' written instructions.

*TYPICALLY, ONLY USE THREE-COAT FLUOROPOLYMER FINISH WITH METALLIC FINISHES.*

- B. High-Performance Organic Finish: Three coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

**BELOW IS TYPICAL COLOR CHOICE.**

- C. Color and Gloss: Non-metallic solid color, dark bronze; low gloss, as selected by the Owner.
- D. Field Touch-Up Materials: Fluoropolymer coating produced specifically for field touch-up work by same manufacturer as shop applied coating.

**2.10 ANODIC ALUMINUM FINISHES**

**USUALLY RETAIN ONLY ONE OF THE FINISH SYSTEMS SPECIFIED BELOW. IF MORE THAN ONE IS REQUIRED, INDICATE THE LOCATION OF EACH ON DRAWINGS OR INSERT A DESCRIPTION OF THE LOCATION OF EACH SEPARATE FINISH.**

- A. Class I Clear Anodized Finish: Anodic Coating: Class I Architectural, clear film thicker than 0.7 mil, complying with AAMA 611.

**RETAIN THE PARAGRAPH ABOVE IF CLEAR FINISH IS REQUIRED, OR THE PARAGRAPH BELOW IF A COLOR ANODIZED FINISH IS DESIRED.**

- B. Class I Color Anodized Finish: Class I Architectural, film thicker than 0.7 mil with integral color or electrolytically deposited color, complying with AAMA 611.

**SELECT COLOR BELOW OR MODIFY WHEN APPROVED BY THE OWNER.**

- 1. Color: Dark bronze.
- C. Finish Appearance: Variations in appearance of butting or adjacent anodized aluminum elements are acceptable if within 1/2 the range indicated in approved samples. Noticeable variation in the same element is not acceptable.

**PART 3 - EXECUTION**

**3.1 EXAMINATION AND PREPARATION**

- A. Inspect openings before beginning installation. Verify that rough or masonry opening is correct and the sill plate is level.

**EDIT PARAGRAPHS TO SUIT PROJECT FROM THE OPTIONS BELOW.**

- 1. Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.
- 2. Metal surfaces shall be dry; clean; free of grease, oil, dirt, rust and corrosion, and welding slag; without sharp edges or offsets at joints.

**3.2 INSTALLATION**

**DELETE THE NEXT PARAGRAPH IF THERE IS NO CURTAIN WALL OR ALUMINUM STOREFRONT WORK CONTAINING ALUMINUM WINDOW UNITS.**

- A. Refer to the Division 08 Sections "Glazed Aluminum Curtain Walls" or "Aluminum-Framed Entrances and Storefronts" for installation requirements of aluminum window units in [glazed curtain walls] [aluminum entrances and storefronts.

**COORDINATE THE NEXT THREE PARAGRAPHS AND DRAWINGS IF ALL WINDOW UNITS ARE INCLUDED IN GLAZED CURTAIN WALL WORK.**

- B. Comply with manufacturer's specifications and recommendations for installation of window units, hardware, operators, and other components of the work.
- C. Set window units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.
1. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with the requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA 101.
- D. Set sill members and other members in a bed of joint sealant or gaskets, as shown, to provide weathertight construction. Refer to the Division 07 Section "Joint Sealants" for compounds, fillers, and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the work.
1. Compounds, joint fillers, and gaskets to be installed after installation of window units are specified as work in the "Joint Sealants" section.

**ALWAYS RETAIN BELOW FOR NEW CONSTRUCTION. FOR WINDOW REPLACEMENT PROJECTS MODIFY OR DELETE BELOW DEPENDING UPON EXISTING CONDITIONS.**

- E. Refer to the Division 07 Section "Air Barrier" for coordination with air barrier terminations around windows.
- F. Loosely pack cavities around window perimeter between existing construction and window frame or subframe members with fiberglass insulation; pack accessible cavities of window frame with fiberglass, according to window manufacturer's instructions.

### **3.3 FIELD QUALITY CONTROL**

**RETAIN PARAGRAPHS BELOW TO DESCRIBE TESTS AND INSPECTIONS PERFORMED BY THE INDEPENDENT TESTING AGENCY EMPLOYED BY THE OWNER. RETAIN "FIELD QUALITY-CONTROL REPORTS" PARAGRAPH IN "SUBMITTALS" ARTICLE. EDIT TO SPECIFY PROJECT SPECIFIC TESTING REQUIREMENTS.**

- A. Testing Agency: Owner will engage a qualified testing agency for witnessing field testing, determining that the tests are performed correctly and making the final determination whether the aluminum windows have successfully passed the tests.

- B. Testing Activities: Testing and inspecting of representative areas of window shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements. Owner will determine locations and timing of testing.
- C. Test Area: One window at corner and center of wall, per each wall elevation, including surrounding wall construction, at heads, jambs and sills.
  - 1. Perform at least three tests, prior to 35, and 70 percent completion, and before installation of interior walls and finishes.
- D. Windows will be considered defective if they do not pass tests and inspections.
- E. If test area fails to meet the specified air infiltration or water penetration requirements, Contractor shall submit description of proposed remedial work for Owner and Architect's information.
  - 1. Remedial work shall be incorporated into the test specimen for retesting.
  - 2. Cost of retesting shall be responsibility of Contractor.
- F. Remedial work which results in successful retesting of test specimen shall be incorporated in installed system for entire Project.
- G. For each area which fails field testing, 1 additional area of equal size shall be tested for both air infiltration and water penetration.
  - 1. Cost of testing of additional areas shall be responsibility of Contractor.
- H. When installation is 50 percent complete, Owner and Architect will select 1 additional location for testing in accordance with AAMA 501, as specified above.
  - 1. For each area which fails field testing, 1 additional area of equal size shall be tested for both air infiltration and water penetration.
  - 2. Cost of testing of additional areas shall be responsibility of Contractor.
- I. Testing agency shall submit copies of inspection and test reports to Owner, Architect and Contractor within 48 hours after date of test.
- J. The Owner reserves the right to select additional test areas as required, without limitation, subject to correction and remediation as specified herein.

**3.4 COMMISSIONING**

- A. Perform the commissioning activities as outlined in the Division 01 Section "Full Project Commissioning" or "Project Commissioning for Small Projects" and other requirements of the Contract Documents.

**3.5 ADJUSTING, CLEANING, PROTECTION**

- A. Adjust operating sash and hardware to provide a tight fit at contact points and at weatherstripping for smooth operation and a weathertight closure.
- B. Clean aluminum surfaces promptly after installation of windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances. Lubricate hardware and other moving parts.
- C. Clean glass of preglazed units promptly after installation of windows. Comply with requirements of the Division 08 Section "Glazing" for cleaning and maintenance.
- D. Provide final protection and maintain conditions, in a manner acceptable to aluminum window manufacturer, that ensure window units are without damage or deterioration at the time of Substantial Completion.

*REVISE BELOW TO SUIT PROJECT AND COORDINATE WITH DRAWINGS.*

**3.6 WINDOW SCHEDULE**

- A. Double-hung windows
  - a. Counterbalancing mechanism.
  - b. Cam Action Lock.
  - c. Lift Handle: Applied sash lifts on bottom rail of lower sash (2 per sash).
- B. Projected casement windows
  - 1. Hardware: Provide the following operating equipment and hardware:

*DELETE THE NEXT PARAGRAPH IF IT IS NOT REQUIRED.*

- a. Rotary Operator.
- b. Friction Hinges: 2 per ventilator.

*SELECT HINGE TYPE ABOVE OR BELOW. CONSIDER ADDING A REQUIREMENT FOR LIMIT STOPS TO PREVENT PROJECTION BEYOND WALL SURFACES WHERE THIS IS DESIRABLE.*

- c. Butt Hinges: 2 per ventilator.

*RETAIN BELOW FOR EITHER HINGE TYPE*

- 1) Provide ventilator operation that permits inside cleaning of the outside glass face from the interior.
- 2) Provide 3 hinges on units over 4 feet high or 4 feet wide.

*SELECT ONE OF THE SASH LOCKS BELOW BASED ON WINDOW SIZE / LOCATION. NOTE: MODIFY TEXT IF NECESSARY TO PROVIDE FOR 2 LOCKS ON UNITS OVER 3 FEET, 6 INCHES WIDE.*

- d. Sash Lock: Cam action lock.

*RETAIN BELOW FOR WINDOW UNITS WITH VENTILATORS OVER 6 FEET ABOVE THE FLOOR.*

- e. Sash Lock: Pole-operated cam action lock.

*SPECIFY BELOW FOR SLEEPING ROOMS.*

- f. Limit Device.

*PROVIDE INSECT SCREENS IN HOUSING PROJECTS AND FOOD PREPARATION AREAS ONLY. SCREENS ARE GENERALLY NOT REQUIRED FOR UNIVERSITY PROJECTS*

- 2. Insect screens

C. Projected awning windows

- 1. Hardware: Provide the following operating hardware and equipment:
  - a. Rotary operator
  - b. Friction Hinges: 2 per ventilator.

*SELECT HINGE TYPE ABOVE OR BELOW. CONSIDER ADDING A REQUIREMENT FOR LIMIT STOPS TO PREVENT PROJECTION BEYOND WALL SURFACES WHERE THIS IS DESIRABLE.*

- c. Butt Hinges: 2 per ventilator.

*RETAIN BELOW FOR EITHER HINGE TYPE*

- 1) Provide ventilator operation that permits inside cleaning of the outside glass face from the interior.
- 2) Provide 3 hinges on units over 4 feet high or 4 feet wide.
- d. Hold-Open Device: Automatic locking hold-open arms (2 per ventilator).

*SPECIFY BELOW FOR SLEEPING ROOMS.*

- e. Limit Device.

*PROVIDE INSECT SCREENS IN HOUSING PROJECTS AND FOOD PREPARATION AREAS ONLY. SCREENS ARE GENERALLY NOT REQUIRED FOR UNIVERSITY PROJECTS*

- 2. Insect screens

D. Fixed windows

END OF SECTION 085113