

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 M.S.U. ISSUES

- A. All windows shall be thermally broken aluminum or other metal requiring no painting or regular maintenance. Windows shall be operable to provide ventilation during maintenance or equipment shutdowns. In existing buildings, new windows shall maintain the exterior appearance of the building as much as possible, to maintain the building character.
- B. The manufacturer will be expected to supply spare parts for future repairs and maintenance. The quantity will vary with the type of unit but the following is typical of units with these parts:
 - 1. 3 screens of each size operable window.
 - 2. 2 units of IG – glass of each size window.
 - 3. 4 sash balancers (double hung only).
 - 4. 1 dozen roller assemblies (sliding windows only.)
 - 5. 3 stock lengths of bead trim.
- C. Insect screens shall be used on all ventilating sashes. Screens shall be hinged at the top or side, and clipped at the opposite side to facilitate removal from interior only.
- D. All glazed openings and sash units shall be designed to accept and support insulating glass. Windows will be glazed before installation wherever possible, and designed to permit glass replacement from the inside.
- E. Movable portions will be weather stripped at the exterior and interior of all meeting surfaces. Sash types not employing positive compression closure, such as horizontal sliding windows, shall use fin-pile combination weather stripping.
- F. A full size sample window shall be provided to the owner for inspection prior to specification release. Submit 12” by 12” samples of all glass types used, with attached label listing building, glass manufacturer, supplier, color and model name, thickness, type glass, general contractor, and date. The M.S.U. Glass Shop, Physical Plant Department, will retain samples.

1.2 SUMMARY

- A. This Section includes the following types of aluminum-framed windows:
 - 1. Awning windows.
 - 2. Casement windows.
 - 3. Double-hung windows.
 - 4. Fixed windows.
 - 5. Horizontal-sliding windows.
 - 6. Top-hinged inswinging windows.
- B. Related Sections include the following:

1. Division 08 Section AUTOMATIC ENTRANCES
2. Division 08 Section ALUMINUM ENTRANCES AND STOREFRONTS
3. Division 08 Section HOLLOW METAL DOORS AND FRAMES
4. Division 08 Section GLAZING for glazing requirements for aluminum windows, including those specified to be factory glazed.
5. Division 26 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized window operators.

1.3 DEFINITIONS

- A. HC: Heavy Commercial.
- B. Performance grade number, included as part of the AAMA/NWWDA product designation code, is actual design pressure in pounds force per square foot used to determine structural test pressure and water test pressure.
- C. Structural test pressure, for uniform load structural test, is equivalent to 150 percent of design pressure.
- D. Minimum test size is smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:
 1. Minimum size required by gateway performance requirements for determining compliance with AAMA/NWWDA 101/I.S.2 for both gateway performance requirements and optional performance grades.
- B. AAMA/NWWDA Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.
 1. Performance Class: HC.
 2. Performance Grade: Minimum for performance class indicated.
 3. Performance Grade: Minimum 45.
 4. Exception to AAMA/NWWDA 101/I.S.2: In addition to requirements for performance class and performance grade, design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length one inch, whichever is less, at design pressure based on the following:
 - a. Testing performed according to AAMA/NWWDA 101/I.S.2, Uniform Load Deflection Test.

- C. Condensation-Resistance Factor: Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45, where windows are indicated to be "thermally improved."
- D. Thermal Transmittance: Provide aluminum windows with a whole-window U-value maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503, ASTM E 1423, or NFRC 100.
 - 1. U-Value: .35 Btu/sq. ft. x h x deg F.
- E. Solar Heat-Gain Coefficient: Provide aluminum windows with a whole-window SHGC maximum of .60, determined according to NFRC 200 procedures.
- F. Awning Windows: Comply with AAMA/NWWDA 101/I.S.2 for the following tests:
 - 1. Hardware Load Test.
 - 2. Torsion Test.
 - 3. Horizontal Concentrated Load Test on Latch Rail.
 - 4. Vertical Concentrated Load Test on Latch Rail.
 - 5. Torsion Load Test on Intermediate Frame Rails.
 - 6. Vertical Concentrated Load Test on Intermediate Frame Rails.
 - 7. Balance Arm Load Test.
- G. Casement Windows: Comply with AAMA/NWWDA 101/I.S.2 for the following tests:
 - 1. Vertical Deflection Test.
 - 2. Hardware Load Test.
 - 3. Torsion Test.
- H. Double-Hung and Horizontal-Sliding Windows: Comply with AAMA/NWWDA 101/I.S.2 for the following tests:
 - 1. Operating Force.
 - 2. Deglazing: When tested according to ASTM E 987.
- I. Top-Hinged Inswinging Windows: Comply with AAMA/NWWDA 101/I.S.2 for the following tests:
 - 1. Hold Open Arm or Stay Bar Load Test.
 - 2. Torsion Test.
 - 3. Horizontal Concentrated Load Test.
 - 4. Vertical Concentrated Load Test.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:
 - 1. Head, jamb, and sill details.
 - 2. Mullion details, including reinforcement and stiffeners.
 - 3. Joinery details.
 - 4. Expansion provisions.
 - 5. Flashing and drainage details.
 - 6. Weather-stripping details.
 - 7. Thermal-break details.
 - 8. Glazing details.
 - 9. Window cleaning provisions.
- C. Samples for Verification: For aluminum window components required, prepared on Samples of size indicated below.
 - 1. Main Framing Member: 12-inch- long, full-size sections of extrusions with factory-applied color finish.
 - 2. Hardware: Full-size units with factory-applied finish.
 - 3. Weather Stripping: 12-inch- long sections.
 - 4. Architect reserves the right to require additional samples that show fabrication techniques, workmanship, and design of hardware and accessories.
- D. Qualification Data: For Installer.
- E. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.
- G. Maintenance Data: For operable window sash, operating hardware, weather stripping, window system operators, and finishes, for each type of window, to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- B. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.
- C. Fenestration Standard: Comply with AAMA/NWWDA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Provide AAMA-certified aluminum windows with an attached label.

- D. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.
- E. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to aluminum windows including, but not limited to, the following:
 - 1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review required testing and inspecting procedures.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Failure to meet performance requirements.
 - 2. Structural failures including excessive deflection.
 - 3. Water leakage, air infiltration, or condensation.
 - 4. Faulty operation of movable sash and hardware.
 - 5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 6. Insulating glass failure.
- B. Warranty Period: Five years from date of Substantial Completion.
- C. Warranty Period for Installation and quality of workmanship: Five years from date of Substantial Completion.
- D. Warranty Period for Metal Finishes: Ten years from date of Substantial Completion.
- E. Warranty Period for Glass: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS.

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Awning Windows:
 - a. EFCO Corporation
 - b. Graham Architectural Products Corp.
 - c. Kawneer Company Inc.
 - d. Litex Incorporated
 - e. Peerless
 - f. TRACO

- g. Wausau Window and Wall Systems.
 - h. Wojan Window and Door Corporation
2. Casement Windows:
- a. Boyd Aluminum Manufacturing.
 - b. Custom Window Company.
 - c. EFCO Corporation.
 - d. Graham Architectural Products Corp.
 - e. Kawneer Company, Inc.
 - f. Litex Incorporated
 - g. Peerless
 - h. TRACO.
 - i. Winco Manufacturing Co.
 - j. Wojan Window and Door Corporation
3. Double-Hung Windows:
- a. Boyd Aluminum Manufacturing.
 - b. Custom Window Company.
 - c. EFCO Corporation.
 - d. Graham Architectural Products Corp.
 - e. Kawneer Company, Inc.
 - f. Litex Incorporated
 - g. Peerless
 - h. TRACO.
 - i. Winco Manufacturing Co.
 - j. Wojan Window and Door
4. Fixed Windows:
- a. Boyd Aluminum Manufacturing.
 - b. Custom Window Company.
 - c. EFCO Corporation.
 - d. Graham Architectural Products Corp.
 - e. Kawneer Company, Inc.
 - f. Litex Incorporated
 - g. Peerless
 - h. TRACO.
 - i. Winco Manufacturing Co.
 - j. Wojan Window and Door
5. Horizontal-Sliding Windows:
- a. Boyd Aluminum Manufacturing.
 - b. Custom Window Company.
 - c. EFCO Corporation.
 - d. Graham Architectural Products Corp.
 - e. Kawneer Company, Inc.
 - f. Litex Incorporated

- g. Peerless
 - h. TRACO.
 - i. Winco Manufacturing Co.
 - j. Wojan Window and Door
6. Top-Hinged Inswinging Windows:
- a. Boyd Aluminum Manufacturing.
 - b. Custom Window Company.
 - c. EFCO Corporation.
 - d. Graham Architectural Products Corp.
 - e. Kawneer Company, Inc.
 - f. Peerless
 - g. TRACO.
 - h. Winco Manufacturing Co.
 - i. Wojan Window and Door

2.2 MATERIALS, GENERAL

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, not less than 16,000-psi minimum yield strength, and not less than 0.062-inch thickness at any location for the main frame and sash members.
- B. Fasteners: Nonmagnetic stainless steel, warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components. Cadmium-plated steel fasteners are not permitted.
 - 1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125 inch thick, reinforce interior with nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
 - 2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
- C. Anchors, Clips, and Accessories: Nonmagnetic stainless steel; providing sufficient strength to withstand design pressure indicated. Cadmium-plated steel anchors, clips, and accessories are not permitted.
- D. Reinforcing Members: Nonmagnetic stainless steel providing sufficient strength to withstand design pressure indicated. Cadmium-plated steel reinforcing members are not permitted.
- E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action, and completely concealed when aluminum window is closed.
 - 1. Weather-Stripping Material: Elastomeric cellular preformed gaskets complying with ASTM C 509.

- F. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.
 - 1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi rigid, polypropylene sheet or polypropylene-coated material.
- G. Replaceable Weather Seals: Comply with AAMA 701/702.
- H. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING

- A. Glass and Glazing Materials: Refer to Division 8 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

2.4 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows and sized to accommodate sash or ventilator weight and dimensions. Cadmium-plated hardware is not permitted. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid bronze or nonmagnetic stainless steel.
- B. Counterbalancing Mechanism: Comply with AAMA 902.
 - 1. Sash Balance: Concealed ultra-lift spring type capable of lifting 70 percent of sash weight of size and capacity to hold sash stationary at any open position.
- C. Sill Cap/Track: Extruded-aluminum with natural anodized finish track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
- D. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
- E. Roller Assemblies: Low-friction design.
- F. Push-Bar Operators: Provide telescoping-type, push-bar operator designed to open and close ventilators with fixed screens.
- G. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.
 - 1. Operation Function: All ventilators move simultaneously and securely close at both jambs without using additional manually controlled locking devices.
- H. Four- or Six-Bar Friction Hinges: Comply with AAMA 904.

1. Locking mechanism and handles for manual operation.
2. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.

I. Awning Windows: Provide the following operating hardware:

1. Operator: Push-bar operator located on jamb at sill.
2. Hinges: Concealed four- or six-bar friction hinges located on each jamb near top rail; two per ventilator.
3. Lock: Lift-type throw, cam-action lock with keeper; two per ventilator.
4. Limit Device: Concealed friction adjuster, or support arms with adjustable, limited, hold-open limit device; located on jamb of each ventilator.

J. Casement Windows: Provide the following operating hardware:

1. Hinge: Heavy-duty, concealed, four- or six-bar friction hinge with adjustable-slide friction shoe; designed to permit ventilator operation for inside cleaning of outside glass face; two per ventilator.
2. Lock: Lift-type throw, cam-action lock with keeper; two per ventilator.
3. Limit Device: Concealed friction adjuster or support arms with adjustable, limited, hold-open limit device.

K. Double-Hung Windows: Provide the following operating hardware:

1. Sash Balances: Minimum, two per sash; ultra-lift as required.
2. Handles: Applied sash lift bar on bottom rail of forward placed operating sash; two per sash.
3. Sash Lock: Cam-action sweep lock and keeper on meeting rail; two per sash.

L. Horizontal-Sliding Windows: Provide the following operating hardware:

1. Sash Rollers: Stainless steel, lubricated ball-bearing rollers with nylon tires.
2. Sash Lock: Cam-action sweep sash lock and keeper at meeting rails.
3. Removable Lift-Out Sash: Design windows and provide with hardware to permit removal of sash from inside for cleaning.

M. Top-Hinged Inswinging Windows: Provide the following operating hardware:

1. Hinge: Exposed, applied butt hinges located at corners; two per ventilator.
2. Lock: Internal, key-operated, limited-access locks located not more than 48 inches o.c. at jambs and sill.
3. Hold-Open Device: Automatic-locking hold-open arms; designed to permit sash operation for inside cleaning of outside glass face; two per ventilator.

2.5 INSECT SCREENS

- A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches for each operable exterior sash or ventilator.

- B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints, concealed fasteners and removable PVC spline/anchor concealing edge of frame.
 - 1. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than 0.040-inch wall thickness.
 - 2. Finish: Match aluminum window members.
- C. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch- diameter, coated aluminum wire.
 - 1. Wire-Fabric Finish: Charcoal gray.

2.6 FABRICATION

- A. General: Fabricate aluminum windows, in sizes indicated, that comply with AAMA/NWWDA 101/I.S.2 for performance class and performance grade indicated. Include a complete system for assembling components and anchoring windows.
- B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
 - 1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.
 - 2. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
- D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.
 - 1. Horizontal-Sliding Windows: Provide operable sash with a double row of sliding weather stripping in horizontal rails and single- or double-row weather stripping in meeting or jamb stiles, as required to meet specified performance requirements. Provide compression-type weather stripping at perimeter of each movable panel where sliding-type weather stripping is not appropriate.
- E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- F. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 8 Section "Glazing" and with AAMA/NWWDA 101/I.S.2.

2.7 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- D. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
- E. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - 1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603.
- F. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - 2. Fluoropolymer Three-Coat System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; operational clearances and other conditions affecting performance of work.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.

2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches of opening.
 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components; Drawings; and Shop Drawings.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/L.S.2.

3.3 ADJUSTING

- A. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.4 PROTECTION AND CLEANING

- A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085113