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Preparing Activity: NAVFAC Superseding
 UFGS-08 51 13.00 20 (July 2006)
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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2009

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SECTION 08 51 13

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01/08

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SECTION 08 51 13

ALUMINUM WINDOWS 01/08

NOTE: This guide specification covers the requirements for residential, commercial and heavy commercial grade aluminum windows.

Note: Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

1. Windows requiring UL fire rating must be steel, and may occur in conjunction with aluminum windows which cannot be approved for this use. When steel windows are used in conjunction with aluminum, specify finish matching aluminum windows. Steel windows should be specified in Section 08 51 23 STEEL WINDOWS.

2. Aluminum windows are not acceptable for use as security windows which should be steel, specified in Section 08 51 23 STEEL WINDOWS. Security steel windows are designed and constructed to give protection against unauthorized entrance and removal of materials from warehouses and other storage type

areas; they are not designed for detention use. Guard windows for detention use are not included in this guide; where such windows are desired, consult Steel Window Institute Recommended Specifications and manufacturers' data, and specify in Section 08 51 23 STEEL WINDOWS.

3. Specify the following items of related work under other sections of the specifications:

- a. Glass and glazing and the furnishing of glazing clips and gaskets.
- b. Calking and sealants.
- c. Structural building supports at window mullions.
- d. Wood subframes for windows in frame walls.
- e. Drilling and tapping for attachment of window shades, drapery rods, and venetian blinds. The drilling and tapping of window frames to receive brackets for shades, venetian blinds, and curtain rods has been omitted from this specification. It is contemplated that this work will be done after erection of windows by the trade for the item to be installed. On projects where factory drilling for these items is required, revise this specification accordingly.
- f. Brackets and supports for window shades, drapery rods, and venetian blinds.
- g. Electrical requirements for motor driven operators.

NOTE: On the drawings, show:

- 1. Sizes and types of windows; metal and wood subframes, casings, or stools; and hardware.
- 2. Sizes, location, and swing of ventilators; direction of slide for sliding ventilators; location and details of fixed sash.
- 3. Typical window sections and details. Show glass thickness. Show special glazing.
- 4. Method of anchoring windows to adjoining construction; size and types of clips, anchors, screws, or other fasteners.
- 5. Details of nonstructural mullions and mullion covers; details of anchoring and reinforcing nonstructural mullions at windows to receive window cleaner anchors.

6. Number and locations of window cleaner anchors.
7. Locations of windows requiring special operators. Show method of operation and concealment of operators, cables and rods. Show wiring diagram for motor driven operators.
8. Locations of windows designated as forced entry resistant.

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 (2005) Standard Specification for Windows, Doors, and Unit Skylights

AAMA 1302.5 (1976) Voluntary Specifications for Forced-Entry Resistant Aluminum Prime Windows

AAMA 1503 (1998) Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

AAMA 2603 (2002) Voluntary Specification,

	Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	(2005) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 2605	(2005) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
AAMA 611	(1998) Voluntary Specification for Anodized Architectural Aluminum
AAMA 701	(2004) Voluntary Specification for Pile Weather Strip
AAMA 902	(1999) Voluntary Specification for Sash Balances
AAMA WSG.1	(1995) Window Selection Guide

ASME INTERNATIONAL (ASME)

ASME B29.400	(2001; R 2008) Combination, "H" Type Mill Chains, and Sprockets
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ASTM INTERNATIONAL (ASTM)

ASTM A 1011/A 1011M	(2008) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 276	(2008a) Standard Specification for Stainless Steel Bars and Shapes
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM B 117	(2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 221	(2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(2007) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM B 244	(1997; R 2002) Standard Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B 584	(2008a) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1593	(1999) Standard Specification for Non-rigid Vinyl Chloride Plastic Film and Sheeting
ASTM D 1972	(1997; R 2005) Standard Practice for Generic Marking of Plastic Products
ASTM D 3656	(2007) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM E 2016	(2006) Standard Specification for Industrial Woven Wire Cloth
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 413	(2004) Rating Sound Insulation
ASTM E 547	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference
ASTM E 90	(2004) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.16 (2008) Auxiliary Hardware

GREEN SEAL (GS)

GS-36 (2000) Commercial Adhesives

INTERNATIONAL WINDOW CLEANING ASSOCIATION (IWCA)

IWCA I-14.1 (2001) Window Cleaning Safety Standard

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (2004) Procedure for Determining Fenestration Product U-Factors

NFRC 200 (2004) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2008) Life Safety Code, 2006 Edition

NATIONAL WOOD WINDOW AND DOOR ASSOCIATION (NWWDA)

AAMA/NWWDA 101/I.S.2 (1997) Voluntary Guide Specifications for Aluminum, Poly(Vinyl Chloride) (PVC) and Wood Windows and Glass Doors

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA 1004 (1987; R 1998) Aluminum Tubular Frame Screens for Windows

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS 3110 (2001; Rev H) Primer, Zinc Chromate

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (1989; R 2005) Adhesive and Sealant Applications

STEEL WINDOW INSTITUTE (SWI)

SWI SWS (2005 Steel Window Specifications

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 101 (1982) Paint Specification No. 101 Aluminum Alkyd Paint Leafing (Type I) and Non-Leafing (Type II)

SSPC Paint 12 (1982; E 2000) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick

Film)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star

(1992; R 2006) Energy Star Energy
Efficiency Labeling System

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED

(2002; R 2005) Leadership in Energy and
Environmental Design(tm) Green Building
Rating System for New Construction
(LEED-NC)

1.2 CERTIFICATION

Each prime window unit must bear the AAMA Label warranting that the product complies with AAMA 101. Certified test reports attesting that the prime window units meet the requirements of AAMA 101, including test size, will be acceptable in lieu of product labeling.

1.3 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Windows; G

Fabrication Drawings

SD-03 Product Data

Windows; G

Hardware; G

Fasteners; G; (LEED)

Aluminum Windows; G

Frames; G

Aluminum Sills; G

THERMAL-BARRIER WINDOWS; G

MULLIONS; G

SHADE SCREENS; G

WINDOW CLEANERS' BOLTS; G

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Screens; G

Weatherstripping; G

Accessories; G

[Adhesives; (LEED)

Submit manufacturer's product data, indicating VOC content.]

Windows

Submit documentation for Energy Star qualifications.

[Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products

included in project.]

[**Environmental Data**]

 SD-04 Samples

 Finish Sample

 Window Sample

 SD-05 Design Data

 Structural calculations for deflection; G

 Design Analysis; G

 SD-06 Test Reports

 Minimum condensation resistance factor

[**Resistance to forced entry**]

 SD-10 Operation and Maintenance Data

Windows, Data Package 1; G

 Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Plastic Identification

 When not labeled, identify types in Operation and Maintenance Manual.

1.4 QUALITY ASSURANCE

1.4.1 Shop Drawing Requirements

Provide drawings that indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, [mullion details,] [method and materials for weatherstripping,] [method of attaching screens,] [material and method of attaching subframes,] [stools,] [casings,] [sills,] [trim,] [window cleaner anchors,] installation details, and other related items.

1.4.2 Sample Requirements

1.4.2.1 **Finish Sample** Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

1.4.2.2 **Window Sample** Requirements

NOTE: Choose one of the following options. Include the first choice for projects requiring a large number of windows. Include the second choice for

projects requiring a limited number of windows.

[Submit one full-size window of each type proposed for use, complete with AAMA Label, glazing, hardware, anchors, and other accessories. Where screens or weatherstripping is required, fit sample windows with such items that are to be used. After approval, install each sample in work, clearly identified, and record its location.]Screening must conform to **ASTM D 3656**.

[Submit one full-size corner of each window type proposed for use. Where screens or weatherstripping is required, fit sample with such items that are to be used.]

1.4.3 Design Data Requirements

Submit calculations to substantiate compliance with deflection requirements. A Professional Engineer must provide calculations.

Submit **design analysis** with calculations showing that the design of each different size and type of aluminum window unit and its anchorage to the structure meets the requirements of paragraph 1.9.1 "Minimum Antiterrorism Performance Criteria". Calculations verifying the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the window components and anchorage devices to the structure, as determined by the **design analysis**, in the shop drawings.

1.4.4 Test Report Requirements

Submit test reports for each type of window attesting that identical windows have been tested and meet the requirements specified herein for conformance to **AAMA 101** including test size, [and] **minimum condensation resistance factor** (CRF) [, and **resistance to forced entry**].

1.5 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

1.6 PROTECTION

Protect finished surfaces during shipping and handling using the manufacturer's standard method. Do not apply coatings or lacquers to surfaces to which calking and glazing compounds must adhere.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor. Using materials harvested and manufactured within a 500 mile radius from the project site contributes to the

following LEED credit: MR5. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option if Contractor is choosing local materials in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option for USACE projects. Army projects must include option only if pursuing this LEED credit.

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [800] [_____] kilometer [500] [_____] mile radius from the project site, if available from a minimum of three sources.] [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Window materials may be locally available.]

1.7.2 Environmental Data

NOTE: ASTM E 2129 provides for detailed documentation of the sustainability aspects of products used in the project. This level of detail may be useful to the Contractor, Government, building occupants, or the public in assessing the sustainability of these products.

[Submit Table 1 of ASTM E 2129 for the following products: [____].]

1.7.3 Plastic Identification

NOTE: The marking system indicated below is intended to provide assistance in identification of products for making subsequent decisions as to handling, recycling, or disposal.

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D 1972. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.

- a. Type 1: Polyethylene Terephthalate (PET, PETE).
- b. Type 2: High Density Polyethylene (HDPE).
- c. Type 3: Vinyl (Polyvinyl Chloride or PVC).
- d. Type 4: Low Density Polyethylene (LDPE).
- e. Type 5: Polypropylene (PP).
- f. Type 6: Polystyrene (PS).
- g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

1.8 FIELD MEASUREMENTS

Take field measurements prior to preparation of the drawings and fabrication.

1.9 PERFORMANCE REQUIREMENTS

1.9.1 Minimum Antiterrorism Performance Criteria

Windows must meet the minimum antiterrorism performance criteria as specified in the paragraphs below.

1.9.1.1 Glazing

Glazing must have laminated glass as specified in Section 08 81 00 GLAZING.

1.9.1.2 Aluminum Window Frames

NOTE: The blank in Para 1.9.1.2 Aluminum Window Frames should be the value of the equivalent 3-sec duration design loading obtained from Figure 1 of ASTM F 2248 for the explosive weight and standoff distance combination that is being designed for in this project.

Restrict aluminum framing members deflections of edges of glazing they support to $L/160$ under an equivalent 3-second duration loading of [____] pascal pounds per square foot (psf), where L denotes the length of the glazing supported edge. (L is to be based on edge length of glazing in frame and not on the distance between anchors that fasten frame to the structure.)

The glazing frame bite for the window frames must be adequate to accept the width of structural silicone sealant or glazing tape as specified in paragraph "Provisions for Glazing" below.

1.9.1.3 Window Frame Anchors

NOTE: The blank in Para 1.9.1.3 Window Frame Anchors should be the value of 2 times the loading just determined in paragraph 1.9.1.2. Aluminum Window Frames.

Fasten window frames to the supporting structure with anchors designed to resist forces generated by a 3-second duration load of [____] pascal pounds per square foot (psf) acting on the entire window unit.

1.9.2 Wind Loading Design Pressure

Design window components, including mullions, hardware, and anchors, to withstand a wind-loading design pressure of at least [____] pascal pounds per square foot (psf).

1.9.3 Tests

Test windows proposed for use in accordance with AAMA/NWDA 101/I.S.2 for the particular type and quality window specified.

Perform tests by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Submit the results

of the tests as certified laboratory reports required herein.

Minimum design load for a uniform-load structural test must be 2400 pascal
50 psf.

[Test projected windows in accordance with the applicable portions of the
AAMA WSG.1 for air infiltration, water resistance, uniform-load deflection,
and uniform-load structural test.]

[Test double-hung windows in accordance with the applicable portions of the
AAMA WSG.1 for air infiltration, water resistance, uniform-load deflection,
and uniform-load structural test.]

1.10 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete
window assembly including hardware, weatherstripping, and subframe assembly
details.

1.11 WINDOW PERFORMANCE

NOTE: Structural performance, air infiltration and
water penetration are standard performance
requirements for all aluminum window types.
"Thermal Performance" and "Sound Attenuation" are
optional to designer, and must be omitted or revised
as needed to meet project requirements.

Aluminum windows must meet the following performance requirements. Perform
testing requirements by an independent testing laboratory or agency.

1.11.1 Structural Performance

Structural test pressures on window units must be for positive load
(inward) and negative load (outward) in accordance with ASTM E 330. After
testing, there will be no glass breakage, permanent damage to fasteners,
hardware parts, support arms or actuating mechanisms or any other damage
which could cause window to be inoperable. There must be no permanent
deformation of any main frame, sash or ventilator member in excess of the
requirements established by AAMA 101 for the window types and
classification specified in this section.

1.11.2 Air Infiltration

Air infiltration must not exceed the amount established by AAMA 101 for
each window type when tested in accordance with ASTM E 283.

1.11.3 Water Penetration

Water penetration must not exceed the amount established by AAMA 101 for
each window type when tested in accordance with [ASTM E 547] [ASTM E 331].

1.11.4 Thermal Performance

NOTE: A U-factor of up to 4.3 W/m²K (0.75 Btu/hr-ft²
-F) may be acceptable for particular climate zones

in the United States for aluminum window products and thermally improved aluminum window products. Solar heat gain coefficient (SHGC) ratings should be equal to or less than $2.3 \text{ W/m}^2\text{K}$ ($0.40 \text{ Btu/hr-ft}^2\text{-F}$). Selection and use of the window products in this category should be used only in cooling dominated climates and be dependent upon qualifying for the Southern climate zone as determined by the DOE Energy Star Windows program. Certain products that have aluminum frames and/or thermally improved aluminum frames may qualify per the Energy Star Windows program for the Central and Northern Climate Zones.

Thermal transmittance for thermally broken aluminum windows with insulating glass must not exceed a U-factor of $4.3 \text{ W/m}^2\text{K}$ $0.75 \text{ Btu/hr-ft}^2\text{-F}$ determined according to NFRC 100, and a solar heat gain coefficient (SHGC) of $2.3 \text{ W/m}^2\text{K}$ $0.40 \text{ Btu/hr-ft}^2\text{-F}$ determined according to NFRC 200. Provide window units that comply with the U.S. Department of Energy, Energy Star Window Program for the Southern Climate Zone.][$2.3 \text{ W/m}^2\text{K}$ $0.40 \text{ Btu/hr-ft}^2\text{-F}$ determined according to NFRC 100, and a solar heat gain coefficient (SHGC) of $3.1 \text{ W/m}^2\text{K}$ $0.55 \text{ Btu/hr-ft}^2\text{-F}$ determined according to NFRC 200. Provide window units that comply with the U.S. Department of Energy, Energy Star Window Program for the Central Climate Zone.][$2.0 \text{ W/m}^2\text{K}$ $0.35 \text{ Btu/hr-ft}^2\text{-F}$ determined according to NFRC 100. Provide window units that comply with the U.S. Department of Energy, Energy Star Window Program for the Northern Climate Zone.]

1.11.5 Condensation Index Rating

NOTE: Determination of the resistance of the window unit to the formation of condensation in any form, referred to as the Condensation Index, must be accomplished using the NFRC-approved software tool, THERM. Use the following criteria to evaluate and determine compliance with the condensation specifications:

a. Interior environmental temperature of 21.1 C ($\pm 0.25 \text{ C}$) (70.0 F ($\pm 0.5 \text{ F}$)).

b. Exterior environmental temperature of -17.8 C ($\pm 0.25 \text{ C}$) (0.0 F ($\pm 0.5 \text{ F}$)).

c. A 35% RH providing a dew point temperature of approximately 5.0 C (41 F).

Others for consideration:

a. 30% RH = dew point of 2.8 C (37 F).

b. 40% RH = dew point of 7.2 C (45 F).

Determine the Condensation Index as follows:

a. calculate the average interior ambient surface temperature for each individual thermocouple location.

b. Calculate the wetted area assigned to each individual surface thermocouple sensor as described (proposed from NFRC Test Procedure).

c. Calculate the percent area for each individual surface thermocouple based on the total calculated wetted surface area of all 20 pre-determined thermocouple locations.

d. Identify the thermocouple temperatures that are less than the dew point temperature of the standard dew point temperature of 5.0 C (41 F) (if that is the dew point temperature assigned as the standard).

e. Calculate the percentage of area that has surface temperatures less than the dew point temperature and subtract that from the total percentage of area (100%).

f. That number would reflect the amount of interior window area that would exhibit condensation at the prescribed conditions. This number would be the Condensation Index (CI).

For products that cannot be simulated, use the following procedures to determine the Condensation Index:

Use the current wiring diagrams and temperature measurement locations as specified in the NFRC Test Procedure. These are pre-specified locations for temperature measurement on the interior surfaces of the glass and frame members. The surface temperatures must be area-weighted in the same manner as for U-factor calculation purposes. The window product should not have a Condensation Index less than 85, meaning that 14% or less of the product will exhibit condensation on the interior area-wetted exposed surfaces. Of the 14% area permitted to exhibit condensation, no greater than 5% of the interior surfaces of the frame members must have condensation in any form. The window product Condensation Index must meet the criteria prescribed in the following table:

Minimum Recommended Condensation Index Ratings

Relative Humidity	20%	25%	30%	35%	40%	45%	50%
Dew Point @ 21.1 C (70.0 F)	-3.3C (26F)	0.6C (33F)	2.8C (37F)	5.0C (41F)	7.2C (45F)	9.4C (49F)	10.0C (50F)

Outside Design Temperature

-34 C (-30 F)	85	85	85	85	90	95	95
-29 C (-20 F)	85	85	85	85	90	95	95
-23 C (-10 F)	85	85	85	85	85	90	95
-18 C (0 F)	85	85	85	85	85	90	95
-12 C (+10 F)	85	85	85	85	85	90	95
-07 C (+20 F)	85	85	85	85	85	90	95
-01 C (+30 F)	85	85	85	85	85	85	90

Note: The table is based on 21.1 C (70.0 F) and an exterior (outside) wind velocity of 24 km/h (15 mph). The Condensation Index value in the table indicates the percentage of area-weighted surface area that must have a temperature greater than the Dew Point Temperature indicated for the percent Relative Humidity.

Example

A thermal performance evaluation on a window unit indicates that 12% of the determined exposed interior surface area has a temperature less than the standard dew point temperature of 5.0 C (41 F). Take 100% of the interior determined exposed surface area and subtract 12% from it. This gives a CI number of 88. This window would have very good resistive qualities to the formation of condensation.

The condensation index rating must be [85] [_____] as determined using NFRC approved software THERM.

1.11.6 Life Safety Criteria

NOTE: Designer must indicate on the drawings which windows serve as rescue and/or secondary means of escape.

Provide windows that conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

1.11.7 Sound Attenuation

NOTE: Aluminum environmental control windows have a "built-in" sound attenuation. This paragraph will be used only when sound attenuation is a design parameter.

The window unit must have a minimum STC of [[41] [_____] with the window glazed with two pieces of 6 mm 1/4 inch thick laminated glass] [[34] [_____] with the window glazed with 13 mm 1/2 inch air space between two pieces of 6 mm 1/4 inch thick glass] when tested in accordance with ASTM E 90 and ASTM E 413.

1.12 QUALIFICATION

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of [_____] years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.13 MOCK-UPS

NOTE: Requesting mock-up samples of aluminum windows is not required for most projects. Size of project and scope of quality control should be carefully evaluated before requiring Contractor to provide a costly mock-up. Delete paragraph if mock-ups are not required.

Before fabrication, full-size mock-up of [each type of aluminum window] [one window unit] [_____] complete with glass and AAMA certification label for structural purposes and NFRC Temporary and Permanent Label for certification of thermal performance rating will be required for review of window construction and quality of hardware operation.

1.14 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOWS

NOTE: Designation system consists of three part product nomenclature representing Product Type, Performance Class and Performance Grade (example DH-C30). Product Type is an abbreviation for window type (A for awning, C for casement, DH for double hung, etc.). Class represents the product's intended use (R for residential, LC for light commercial, C for commercial, HC for heavy commercial, and AW for architectural). Performance Grade represents the design pressure to which the window is constructed.

AAMA 101 establishes minimum Performance Grade for each Class: 15 for residential (corresponding to a design pressure of 720 Pa 15 psf); 25 for light commercial (corresponding to a design pressure of 1200 Pa 25 psf); 30 for commercial (corresponding to a design pressure of 1440 Pa 30 psf); 40 for heavy commercial (corresponding to a design pressure of 1920 Pa 40 psf); and 40 for architectural (corresponding to a design pressure of 1920 Pa 40 psf).

AAMA 101 also includes criteria for specifying

windows required to meet higher design pressures if minimum pressure is inadequate. These windows are designated as Optional Performance Grade and should be specified in increments of 240 Pa 5 psf above the minimum Performance Grade.

NOTE: Consult AAMA 1503 "Voluntary Test Method for Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections" and select the minimum Condensation Resistance Factor (CRF) required for the particular project conditions.

NOTE: Consult AAMA 101 to calculate design pressure(s) applicable to the project. Adjust "design factors" because naval facilities are typically less than 100 miles from hurricane oceanline.

NOTE: Use of materials with recycled content, calculated on the basis of post-industrial and post-consumer percentage content, contributes to the following LEED credit: MR4. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Designer must verify that products meeting the indicated minimum recycled content are available, preferably from at least three sources, to ensure adequate competition. If not, write in suitable recycled content values that reflect availability and competition. Use second option if Contractor is choosing recycled content products in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION.

NOTE: Window properties are critical to energy performance and visual satisfaction. Specify low U value (rate of heat transfer) to reduce winter heat loss and summer heat gain.

In southern states, windows must have a U factor of 0.75 or lower and a SHGC of 0.40 or lower; in the middle states, windows must have a U factor of 0.40 or lower and SHGC of 0.55 or lower; and in northern states, windows must have a U factor of 0.35 or lower with any SHGC.

Energy-efficient windows contribute to the following LEED credits: EA Prerequisite 2; EA1.

Provide prime windows that comply with AAMA 101 and the requirements specified herein. In addition to compliance with AAMA 101, window framing members for each individual lite of glass must not deflect to the extent

that deflection perpendicular to the glass lite exceeds L/175 of the glass edge length when subjected to uniform loads at specified design pressures. Provide **Structural calculations for deflection** to substantiate compliance with deflection requirements. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified. [Windows must contain a minimum of [5] [10] [_____] percent post-consumer recycled content, or a minimum of [20] [40] [_____] percent post-industrial recycled content.] [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Window materials may contain post-consumer or post-industrial recycled content.] Design windows to accommodate hardware, glass, weatherstripping, screens, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum. Provide windows with insulating glass and thermal break necessary to achieve a minimum Condensation Resistance Factor (CRF) of [_____] when tested in accordance with **AAMA 1503**. Glazed systems (including frames and glass) will be **Energy Star** labeled products as appropriate to climate zone and as applicable to window type, with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of [_____] determined according to **NFRC 200** procedures. Glazed systems must have a U-factor maximum of [_____] **Btu per square foot x hr x degree FW per square m x K** in accordance with **NFRC 100**.

NOTE: Performance Grades represent design pressure values for which products have been tested. Specify an Optional Performance Grade where a higher than minimum Performance Grade is desired due to severe weather conditions and wind loadings. Optional Performance Grade windows must be tested in compliance with AAMA 101. Testing must substantiate requirements for uniform loading (structural), water resistance, and air infiltration.

2.1.1 Awning Windows (AP)

Type AP- [R15] [C30] [HC40] [[C] [HC] [AW] - [_____] (Optional Performance Grade)]. Conceal operating mechanism within the frame members or enclose within a metal casing not less than **1.59 mm 0.0625 inch** thick sheet aluminum.

2.1.2 Casement Windows (C)

Type C- [R15] [C30] [HC40] [[C] [HC] [AW] - [_____] (Optional Performance Grade)]. Ventilators must be [rotary crank] [handle] operated. Provide ventilators over **1650 millimeters 65 inches** high with two separate locking devices or a two-point locking device operated by rods from a single lever handle. Conceal rods where possible. [Provide casement windows in combination with [fixed] [projected] windows specified below.]

2.1.3 Double Hung Windows (DH)

NOTE: Tilt-in windows most likely will not meet ATFP pressure requirements and should not be specified if force protection is required.

Type DH- [R15] [C30] [HC40] [[C] [HC] [AW] - [_____] (Optional Performance Grade)]. Test and rate sash balance to conform with **AAMA 902**.

Windows must be the high-performance classification double-hung type meeting or exceeding AAMA/NWDA 101/I.S.2 for Type DH-A2-HP and the requirements specified, complete with accessories, fittings, and trim.

Design windows, mullions, hardware, and anchors to withstand the wind loading specified.

2.1.3.1 Window Materials

Window Frames and sash members, mullions, mullion covers, screen frames, and glazing beads must be extruded aluminum shapes fabricated from aluminum conforming to ASTM B 221M ASTM B 221 and SMA 1004, 6063-T5 aluminum alloy.

Joint-sealing compound must be a gun grade, nonsag, single-component butyl or acrylic sealant conforming to ASTM C 920.

Weatherstripping will be woven wool pile weatherstripping 5.3 millimeter 0.210 inch thick, conforming to AAMA 701, or polypropylene multifilament fiber weatherstripping installed in an integral weatherstripping groove in the sash or frame, and flexible polyvinylchloride weatherstripping installed in the sill member.

2.1.3.2 Subframes

Form subframe members from steel sheets conforming to ASTM A 1011/A 1011M, Grade 36, steel shapes conforming to ASTM A 36/A 36M, or steel tubing conforming to ASTM A 501.

2.1.3.3 Window Construction

Frames, sash, and head members must have a minimum thickness of 1.57 millimeter. 0.062 inch. Sills must have a minimum thickness of 2.36 millimeter, 0.093 inch, fabricated with an integral stiffening rib, and have weep holes not more than 600 millimeter 2 feet on center.

Fabricate horizontal sash members, muntins, and meeting rails of extruded tubular-aluminum sections. Minimum depth of horizontal sash members and meeting rails must be 26.9 millimeter. 1-1/16 inches. Provide sash lift that is the full width of the window, extruded as an integral part of the sash.

Frames must have a minimum depth of 75 millimeter 3 inches and will be provided with integral stiffening ribs, fins, drip at head, and weatherstripping grooves.

Mechanically join or weld frame and sash members to form rigid flush watertight joints. Joints must be hairline not exceeding 0.39 millimeter 1/64 inch and will be sealed with factory-applied joint compound where required to provide a watertight joint.

Provide expansion between component parts of the window to preclude absorption of thermal stresses in each unit.

2.1.3.4 Hardware for Double-Hung Windows

Locking hardware must be nickel-silver castings conforming to ASTM B 584, Alloy C97600, or AISI Series 300, 18-8 corrosion-resistant steel, or a combination of the two, furnished in contemporary design, smoothly

finished, free of defects, and suitable for the intended purpose.

Sash lifts must be continuous extrusions, integral with sash frames. Upper sashes will have matching continuous-extrusion pulls.

Provide double-hung windows with at least one lock and keeper. Fit windows over 900 millimeter 3 feet wide with two locks and keepers.

Each sash must operate on two adjustable, replaceable spring or spiral balances meeting the requirements of AAMA 902. Balances must be enclosed in aluminum cases and will be adjustable without removal of the sash from the frame and without the use of special tools.

Furnish meeting rails, 1800 millimeter 6 feet or higher above the finished floor, with pulldown sockets and pole-operated sash locks. Poles must be tubular or solid steel or aluminum conforming to BHMA A156.16, and will include a cast bronze pole hanger for each pole operator. Provide one pole operator of the required length for each room requiring pole operation. Poles must have a clear lacquer, urethane, or baked-enamel finish.

2.1.3.5 Glazing Requirements

[Design windows for field-applied inside glazing, using snap-on, screwless extruded-aluminum beads. Width of the stop bead must be as required for the glass thickness.]

[Design windows for field-applied outside glazing, using snap-on, screwless, extruded-aluminum beads. Width of the stop bead must be as required for glass thickness.]

[Design windows for field-applied outside glazing, using glazing clips and glazing compound as specified in Section 08 81 00 GLAZING.]

2.1.3.6 Weatherstripping Materials

Install double weatherstripping in jambs, meeting rails, sills, and heads of all windows.

2.1.4 Single-Hung and Double-Hung Windows

NOTE: Double-hung or single-hung windows are typically used for living quarters and also for facilities with window air-conditioners.

Aluminum single-hung (H) and double-hung (H) windows must conform to AAMA 101 [H-R15] [H-LC25] [H-C30] [H-HC40] [H-AW40] type which operate vertically with the weight of sash offset by a counterbalancing mechanism mounted in window to hold the sash stationary at any open position. Provide windows with a tilt-in sash. Provide single-hung and double-hung windows with locking devices to secure the sash in the closed position. Counterbalancing mechanisms must be easily replaced after installation.

2.1.5 Horizontal Sliding Windows (HS)

Type HS- [R15] [C30] [HC40] [[C] [HC] [AW] - [___] (Optional Performance Grade)].

2.1.1.6 Projected Windows (AP)

Type AP-[R15][C30][HC40][[C][HC][AW]-[___] (Optional Performance Grade)]. Provide projected windows with concealed four bar friction hinges only.

Windows must be high-performance classification projected aluminum sash complete with fins, closures, accessories, fittings, and trim, meeting or exceeding AAMA/NWWDA 101/I.S.2 for Type P-A2-HP and the requirements specified.

Design windows, mullions, hardware, and anchors to withstand the wind loading specified.

Outswinging vents must have not less than a 1800 millimeter 6-foot clearance above the finished grade.

2.1.1.6.1 Materials

Frames, ventilators, mullions, mullion covers, glazing beads, and fittings must be extruded aluminum shapes fabricated from aluminum conforming to ASTM B 221M ASTM B 221, 6063-T5 alloy, AAMA/NWWDA 101/I.S.2. Aluminum sheet and plate will be 5005 alloy, temper as required.

Joint sealing compound must be a gun grade, nonsag, single-component butyl or acrylic sealant conforming to ASTM C 920.

Weatherstripping must be [extruded flexible polyvinylchloride, weatherstripping grade, conforming to ASTM D 1593, Type I, with a tensile strength of at least 15200 kilopascal 2,200 pounds per square inch (psi) and a tear strength of not less than 48200 newton per meter 275 pounds per inch] [closed-cell rubber conforming to ASTM D 1056, Type 2, Grade B Grade 1].

2.1.1.6.2 Steel Subframes

Subframe members must be the size and weight indicated, formed from steel sheets conforming to ASTM A 1011/A 1011M, steel shapes conforming to ASTM A 36/A 36M, or steel tubing conforming to ASTM A 501. Coat members as specified under "Dissimilar Materials" herein.

2.1.1.6.3 Construction

Windows must be unequal-leg type, double-contact weathering, with 16 millimeter 5/8-inch anchorage and a combined depth of frame and ventilator of not less than 45 millimeter 1-3/4 inches. Frames must be not less than 40 millimeter 1-1/2 inches deep, and the ventilator will be not less than 41 millimeter 1-5/8 inches deep. Minimum web thickness for solid sections must be 3 millimeter 1/8 inch, and the minimum web thickness for solid-ventilator hardware rails must be at least 5 millimeter 3/16 inch. Tubular sections must have a minimum web thickness of 2.4 millimeter 3/32 inch, and flanges will be not less than 3 millimeter 1/8 inch thick.

Provide allowance for expansion between component parts for window assemblies.

Provide integral drip holes or weepholes for exterior in-sill sections at not more than 600 millimeter 2 feet on center.

Use tubular sections in horizontal meeting rails longer than 1240 millimeter

48-7/8 inches.

Corners of window frame assemblies must be coped, double mortised-and-tenoned, and riveted, or mitered and welded.

Miter and weld corners of ventilator frames; mortise and tenon construction is not permitted.

Welds must be continuous across the web member and up the abutting flanges on the unexposed surface. Welds must be dressed smooth and flush on exposed and contact surfaces and will exhibit no discoloration, pitting, or surface defects.

Corner joints must be accurately fitted, flush, watertight hairline joints not exceeding 0.4 millimeter 1/64 inch in width. Apply joint-sealing compound to the unexposed surface of all mortise and tenon joints.

Support ventilators on two aluminum side arms at least 5 millimeter 3/16 inch thick by 25 millimeter 1 inch wide fitted with nylon friction shoes. Secure arms to vent and frame with 10 millimeter 3/8-inch corrosion-resistant steel pivot pins with corrosion-resistant steel bushings or 10 millimeter 3/8-inch aluminum pivot pins with nylon bushings. Control ventilator movement by friction shoes sliding in the channel guides of the fixed frame. Assembly will permit removal of the ventilator after installation and will provide an adjustable stop to permit a maximum opening angle of 55 degrees for project-out vents and 30 degrees for project-in vents. An adjustable tension device hold the window open in any position and consist of a fixed- or adjustable-tension corrosion-resistant steel helical spring enclosed in an aluminum or corrosion-resistant steel housing and operating through the friction shoe.

Attach ventilator hardware and balance-arm assembly to ventilator and frame members with corrosion-resistant steel screws threaded into serrated corrosion-resistant steel grommet inserts.

2.1.6.4 Hardware

Operating hardware must be nickel-silver castings conforming to ASTM B 584, Alloy C97600, or AISI Series 18-8 corrosion-resistant steel. Hardware will be a modern design, smoothly finished, free of defects, and suitable for the intended purpose.

Provide cam-action locking handles and strikes for projected-out vents; cam-action locks and provide keepers for projected-in vents. Equip pole-operated projected-in vents with suitable design cam-action locks or spring-catch fasteners.

Strikes and contact surfaces for lock fasteners must be corrosion-resistant steel, nickel silver, or a similar abrasion-resistant metal.

Projected-type ventilators 1070 millimeter 42 inches and wider and not pole operated must be furnished with two sets of cam-action locking handles.

Provide pole operators for projected-type ventilators located 1800 millimeter 6 feet or higher above the finished floor. Pole must be tubular steel, solid wood, or aluminum conforming to BHMA A156.16, and will include a cast aluminum or bronze pole hanger, for each pole operator. Provide one pole operator of the required length for each room requiring pole operation. Poles must have a clear lacquer, urethane, or baked-enamel

finish.

2.1.6.5 Hardware for Multiple-Sash Operation

Provide hardware and controls for manually operated multiple-sash operation where indicated and complete with brackets, bolts, clips, anchors, and fittings as required for a complete and operable installation.

Hardware fittings and controls for mechanical operators must conform to SWI SWS and the following:

Shaft brackets must be steel with adjustable, brass roller bearings. Spacing of shaft brackets will not exceed 2440 millimeter. 8 feet.

Pipe shafts must be not less than 33 millimeter 1-5/16-inch outside diameter.

Worm-and-gear assemblies must be cast iron or steel with machine-cut teeth ball bearing mounted in oil-bath, enclosed housings. Gear housings will be factory-lubricated and sealed.

Operators, shafts, connecting arms, brackets, and control handles must receive a factory-applied rust-inhibiting primer coat conforming to SAE AMS 3110 applied to a dry-film thickness of not less than 0.051 millimeter. 2 mils.

[Operation must be by means of a hand chain. Chain will be cadmium-plated alloy steel conforming to ASME B29.400.]

[Operation must be by vertical shaft and miter gear with a detachable operating handle. Miter-gear box will be an oil-bath, enclosed housing.]

[Operator must be a worm-and-gear torsion lever type.]

[Operator must be a worm-and-gear torsion rack-and-pinion type. Racks will be die-cut steel bars meshing with a die-cut steel pinion.]

[Operator must be a screw type assembled in an enclosed housing and containing a threaded phosphor-bronze gear and cast-iron miter gear mounted on antifriction thrust bearings.]

The completed installation must operate smoothly without binding and with no noticeable difference in the opening angle between windows in the entire length of the run. Provide windows that open and close simultaneously with not more than a 25 millimeter 1-inch difference in opening between the first and the last window at the end of the run and with not more than 5 degrees difference in the angle between connecting arms at the maximum window opening.

2.1.6.6 Glazing Provisions

[Design windows for inside glazing, using snap-on, screwless, extruded or roll-formed aluminum, or AISI series-300 corrosion-resistant steel beads. Fixed glazing stops and stop beads must be 20 millimeter 3/4 inch high by 1.5 millimeter 1/16 inch thick. Width of the stop bead will be as required for the glass thickness.]

[Design windows for outside glazing using snap-on, screwless, extruded or roll-formed aluminum, or AISI series-300 corrosion-resistant steel beads.

Fixed glazing stops and stop beads must be 20 millimeter 3/4 inch high by 1.5 millimeter 1/16 inch thick. Width of the stop bead will be as required for the glass thickness.]

[Design windows for outside glazing, using glazing clips and glazing compound as specified in Section 08 81 00 GLAZING.]

2.1.6.7 Weatherstripping

[Windows must have double continuous extruded weatherstripping set in integrally formed pockets in the sash.]

[Windows must have single continuous extruded weatherstripping set in integrally formed pockets in the sash.]

2.1.6.8 Aluminum Sills

Sills will be the profiles and dimensions indicated, the same alloy and finish as windows, at least 3 millimeter 1/8 inch thick, and furnished the full width of the window opening.

Securely anchor sills in place with concealed anchors not more than 460 millimeter 18 inches on center.

2.1.7 Top-Hinged Windows (TH)

Type TH- [C30] [HC40] [[C] [HC] [AW] - [____] (Optional Performance Grade)]. Top-hinged windows must be [inswinging] [outswinging].

2.1.8 Vertically Pivoted Windows (VP)

NOTE: Pivoting windows most likely will not meet
ATFP pressure requirements and should not be
specified if force protection is required.

Type VP- [R15] [C30] [HC40] [[____] (Optional Performance Grade)]. [Provide window with remotely operated venetian blind mounted between an access sash and the main sash.]

2.1.9 Fixed Windows (F)

Type F- [R15] [C30] [HC40] [[C] [HC] [AW] - [____] (Optional Performance Grade)].

2.1.10 Forced Entry Resistant Windows

NOTE: Conventional aluminum windows offer nominal resistance to forced entry by unskilled or opportunistic intruders. While there is no way to make a window absolutely "burglar proof," windows complying with AAMA 1302 can provide reasonable assurance that entry, or attempted entry, will leave ample evidence of "forced entry." It establishes only a pass/fail condition when specific concentrated loads are applied to sash or ventilator in attempt to open or remove sash or ventilator from window frame and specifies no measured time delay.

It provides moderate degree of security against unskilled or opportunistic intruder at little or no additional cost. When forced entry resistant windows are specified, coordinate glazing requirements and specify impact resistant glass and glazing materials in Section 08 81 00, "Glazing."

For projects requiring security windows, specify steel security windows in Section 08 51 23, "Steel Windows." Protection in high crime areas against skilled professional intruders requires a more sophisticated approach to physical security. Consult Design Manual 13.1 "Physical Security" for recommendations.

In addition to meeting the requirements of AAMA 101, windows designated for resistance to forced entry must conform to the requirements of AAMA 1302.5.

2.1.11 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

2.1.12 Calking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

2.1.13 Weatherstripping

AAMA 101.

2.1.14 Sash Poles

Seamless aluminum tube, 1.59 mm 0.0625 inch minimum wall thickness, 25 mm one inch diameter, [] m feet long, with cast aluminum hook and protective cover or tip on the lower end. Finish must match windows.

2.2 FABRICATION

Fabrication of window units must comply with AAMA 101.

2.2.1 Provisions for Glazing

NOTE: Specify glass thickness and vinyl gaskets in Section 08 81 00, "Glazing." Inside glazing is preferred, especially for windows above first floor and other locations where access is difficult. Windows designed for inside glazing may not be available in double-hung type; check manufacturers' literature. Where project requires insulating glass, show sash members, glazing beads, and hardware of sufficient size and weight to receive and support glass of thickness specified. Allow 3 mm 1/8 inch minimum between each side of insulating glass and metal frame and between edges of glass and frame for glazing compound and expansion. Drawings should clearly indicate method for securing insulating glass in place.

NOTE: Include the bracket option for minimum glazing frame bite requirements when personnel density is greater than one person per 40 square meters 430 square feet and minimum ATFP standoff distances are met. This does not include guard type facilities, single and duplex detached family housing. These requirements are specified in Department of Defense Antiterrorism Standards for Buildings.

Design windows and rabbets suitable for glass thickness shown [or specified]. [For minimum antiterrorism windows, adhere glazing to its supporting frame using structural silicone sealant or adhesive glazing tape. The width of the structural silicone sealant bead must be at least equal to, but not larger than two times the thickness designation of the glass to which it adheres. The width of the adhesive glazing tape will be at least equal to two times, but not more than four times the thickness designation of the glass to which it adheres.]Design sash for[inside][outside][single][double] glazing and for securing glass with[metal beads,][glazing clips,][glazing channels,] or glazing compound.

2.2.2 Weatherstripping

Provide for ventilating sections of all windows to ensure a weather-tight seal meeting the infiltration requirements specified in AAMA 101. Provide easily replaceable factory-applied weatherstripping. Use molded vinyl, molded or molded-expanded neoprene or molded or expanded Ethylene Propylene Diene Terpolymer (EPDM) compression-type weatherstripping for compression contact surfaces. Use treated woven pile or wool, or polypropylene or nylon pile bonded to nylon fabric and metal or plastic backing strip weatherstripping for sliding surfaces. Do not use neoprene or polyvinylchloride weatherstripping where they will be exposed to direct sunlight.

2.2.3 Fasteners

Fabricated from 100 percent re-melted steel. Use fasteners as standard with the window manufacturer for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 2 mm 1/16 inch thick.

2.2.4 Adhesives

NOTE: Adhesives are potential sources of VOCs in indoor air. Using interior low-VOC products contributes to the following LEED credit: EQ4. Include VOC submittal if pursuing this LEED credit, and coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION.

[Comply with applicable regulations regarding toxic and hazardous materials, GS-36, [SCAQMD Rule 1168], and as specified in Section 07 92 00 JOINT SEALANTS.]

2.2.5 Drips and Weep Holes

Provide continuous drips over heads of top ventilators. Where fixed windows adjoin ventilators, drips must be continuous across tops of fixed windows. Provide drips and weep holes as required to return water to the outside.

2.2.6 Combination Windows

Windows used in combination must be the same class and grade and will be factory assembled. Where factory assembly of individual windows into larger units is limited by transportation considerations, prefabricate, match mark, transport, and field assemble.

2.2.7 Mullions and Transom Bars

NOTE: Specify the design pressure used to specify
the Performance Grade or the Optional Performance
Grade for the adjoining windows.

NOTE: Include the bracketed paragraph included
under the "WINDOWS" heading for static loads when
minimum measures of antiterrorism/force protection
(ATFP) are required and delete the first bracketed
sentence in the following paragraph.

[Provide mullions between multiple window units which meet the design pressure of [720] [1440] [1920] [_____] Pa [15] [30] [40] [_____] psf.
]Provide mullions with a thermal break. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form a weathertight joint.[Where window cleaner anchors are required, reinforce mullions and anchor to adjoining construction so as to provide safe and adequate support.] Provide mullion covers on the interior and exterior to completely close exposed joints and recesses between window units and to present a neat appearance.[Provide special covers over structural support at mullions as indicated.]

2.2.8 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation.[Furnish extruded aluminum subframe receptors[and subsill] with each window unit.]

2.2.8.1 Hardware

AAMA 101. The item, type, and functional characteristics must be the manufacturer's standard for the particular window type. Provide hardware of suitable design and of sufficient strength to perform the function for which it is used. Equip all operating ventilators with a lock or latching device which can be secured from the inside.

2.2.8.2 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 150 mm 6 inches from each end and at midpoint.

2.2.8.3 Window-Cleaner Anchors

NOTE: Window-cleaner anchors should be shown and specified for windows having sills more than [1800 mm] [6 feet] above grade, adjoining balconies, or adjoining roofs, unless window cleaning methods at activity make use of anchors unnecessary. Coordinate window cleaning procedures and requirements with using activity. When requested by using activity, removable or tilting-type sash may be provided instead of anchors. Removable or tilting-type sash may be specified as Contractor option when these units are desired by using activity and are economically competitive with double-hung sash equipped with anchors. When appropriate, add the following at end of paragraph entitled "Window-Cleaner Anchors":

"Removable or tilting-type sash may be provided in lieu of double-hung windows equipped with window cleaner anchors. Design sash so that both sides of glass can be readily cleaned from interior without dismantling any part of window or screens. Provide removable and tilting-type sash with tamper-proof hardware to prevent sash removal by unauthorized personnel."

Provide double head anchors for windows[indicated][specified]. Anchors must be stainless steel of size and design required for the window type and application, conforming to ASTM A 276. Provide two anchors for each single window[and each adjacent fixed glass window unit]. Fasten anchors 1120 mm 44 inches above the window sill utilizing appropriate methods for the window type and application in accordance with industry safety standards.

2.2.8.4 Window Anchors

Anchoring devices for installing windows must be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

2.2.9 Finishes

NOTE: Specify anodic and organic coatings as Contractor's option when these finishes are determined to be economically competitive in the project area, unless the project requires use of one or the other to match an existing condition.

Exposed aluminum surfaces must be factory finished with an[anodic coating][or][organic coating].[Color must be [____][as indicated].] All windows[for each building] will have the same finish.

2.2.9.1 Anodic Coating

NOTE: Specify Architectural Class I for highly corrosive industrial atmospheres where dust, gases, salts, and other destructive elements that attack metal exist. Specify Architectural Class II for all atmospheric conditions not requiring Class I.

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45 and AAMA 611. Finish must be:

- [a. Architectural Class II (0.01 to 0.0175 mm 0.4 mil to 0.7 mil), designation AA-M10-C22-[A31, clear (natural)] [A32, integral color] [A34, electrolytically deposited color] anodized.]
- [b. Architectural Class I (0.0175 mm 0.7 mil or thicker), designation AA-M10-C22-[A41, clear (natural)] [A42, integral color] [A44, electrolytically deposited color] anodized.]

2.2.9.2 Organic Coating

NOTE: When anodic and organic coatings are determined to be economically competitive in the project area, specify baked enamel finish (AAMA 2603) as an option to Architectural Class II, anodic coating or high-performance finish (AAMA 2604 or AAMA 2605) as an option to Architectural Class I, anodic coating.

Clean and prime exposed aluminum surfaces. Provide a[baked enamel finish in accordance with AAMA 2603 with total dry film thickness not less than 0.02 mm 0.8 mil][high-performance finish in accordance with [AAMA 2604][AAMA 2605] with total dry film thickness of not less than 0.03 mm 1.2 mils].

2.2.10 Screens

AAMA 101. Provide one insect screen for each operable exterior sash or ventilator. Design screens to be rewirable, easily removable from inside the building, and to permit easy access to operating hardware.

2.3 SPECIAL OPERATORS

NOTE: Remote and group operated windows will require special operators. Identify these windows on the drawings and show method of operation.

For windows having operating hardware or locking or latching devices located more than 1800 mm 6 feet above the floor, provide suitably designed

operators or locking or latching devices necessary for convenient and proper window operation.

2.3.1 Pole Operators

Poles must be of proper length to permit window operation from 1500 mm 5 feet above the floor. Provide one pole operator for each room, and one pole hanger for each pole. Locate hangers where directed.

2.3.2 Extension Crank Operators

Provide removable handles for crank-operated rotary-type operators located more than 1800 mm 6 feet above the floor. Provide one removable handle for each room.

2.3.3 Mechanical Operators

**NOTE: When motor driven operators are specified,
specify electrical characteristics in Section 26 20
00, "Interior Distribution System."**

Provide [manual] [electric motor driven] operators for group operation of continuous rows of windows [located [_____] mm feet above the floor]. Operators must be capable of opening and closing windows without appreciable deflection, vibration or rattle. Provide means of adjustment for transmission lines. Operators will control window units in groups [as recommended by the window manufacturer] [or] [as indicated].

2.4 THERMAL-BARRIER WINDOWS

Provide thermal-barrier windows, complete with accessories and fittings, where indicated.

Specify material and construction except as follows:

- a. Aluminum alloy must be 6063-T6.
- b. Frame construction, including operable sash, must be factory-assembled and factory-sealed inner and outer aluminum completely separated from metal-to-metal contact. Join assembly by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner frame. Metal fasteners, straps, or anchors will not bridge the connection between the inner and outer frame.
- c. Operating hardware for each sash must consist of spring-loaded nylon cushion blocks and pin locks designed to lock in predetermined locations.
- d. Sash must be completely separated from metal-to-metal contact by means of woven-pile weatherstripping, plastic, or elastomeric separation members.
- e. Operating and storm sash will be factory-glazed with the type of glass indicated and of the quality specified in Section 08 81 00 GLAZING.

2.5 MULLIONS

NOTE: Drawings must indicate the profile and dimensions of mullions, anchorage and reinforcing members as required for wind loading, and the type, profile, and fastening system for the mullion cover (screw-fastened or snap-on).

Provide mullions between multiple-window units where indicated.

Mullions and mullion covers must be the profile indicated, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion will include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly must include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover must be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members must be steel or aluminum shapes provided by the window manufacturer to meet the specified design loading.

2.6 SCREENS

Provide removable, rewireable, interchangeable aluminum insect screens for window openings as indicated and complete with installation hardware and fasteners.

Frames must be extruded tubular aluminum, the same alloy and finish coating as specified for windows, at least 1.5 millimeter 1/16 inch web thickness, at least 11 millimeter 7/16 inch deep by 40 millimeter 1-1/2 inches high. Corners must be mitered, welded, and dressed smooth and flush. Frames will include integral extruded grooves to receive and retain screen splines. Splines must be miter cut and provide neat close-fitting joints no wider than 0.79 millimeter. 1/32 inch.

Fabric must be 1.0 by 1.18 millimeter by 0.28 millimeter 18 by 16 mesh by 0.011 inch diameter, Alclad aluminum alloy wire screen conforming to ASTM E 2016. Screens will be held taut and smooth in frames by removable vinyl splines.

- [Projected windows must receive screens over ventilators where indicated. Provide horizontal sliding or hinged wicket screens where access to operating hardware is required. Frame wicket screens with horizontal and vertical aluminum tubular or solid frame members and equip with friction catches.]
- [Double-hung windows must receive single vertical sliding screens with integral extruded hand grips, corrosion-resistant steel friction springs, and concealed locking bolts, mounted in integral guides in the window frame.]
- [Double-hung windows must receive double vertical sliding screens with integral extruded hand grips, corrosion-resistant steel friction springs,

and concealed locking bolts, mounted in integral guides in the window frame.
]

2.7 SHADE SCREENS

Where indicated, provide hinged removable-louver design shade screens, complete with frame rails, braces, fasteners, and accessories as required for a complete installation.

Fabricate screens from enamel-coated bronze woven into louvers approximately 1.2 millimeter wide by 1.2 millimeter 0.05 inch wide by 0.05 inch thick, color as selected, spaced at 23 louvers per 25 millimeter one inch and set at an angle of 17 degrees from the horizontal. Screens must have an area open to horizontal vision of 49 percent and a free-air flow of 79 percent and will also function as an insect screen.

Frame screens in reinforced tubular aluminum rails at least 1.5 millimeter thick by 13 millimeter 1/16 inch thick by 1/2 inch wide by the height required for the screen size and must be braced with a 13 by 25 millimeter 1/2- by 1-inch extruded aluminum shapes. Encase perimeter of the screen in vinyl caps and splines designed to fit the extrusion pockets of rails and braces.

Framed screens must be full length continuous-hinge mounted in accordance with the shade-screen manufacturer's printed instructions for an insect-tight screen installation.

Frame rails must be 6063-T5 aluminum alloy and will receive an AA Architectural Class II natural anodic coating (designation AA-M12 C22 A31) in accordance with AA DAF-45. Anodic coating must not be less than 0.01 millimeter 0.4 mil in thickness when tested in accordance with ASTM B 244.

2.8 WINDOW CLEANERS' BOLTS

Provide window cleaners' bolts for all windows 2100 millimeter 7 feet or higher above finished grade, except windows located so they may be removed for cleaning or cleaned from the ground or from a lower roof level without the use of an extension ladder. Provide two bolts for each single window unit and each fixed glass unit and must be located 1120 millimeter 44 inches above the window sill.

Window cleaners' bolts must be double-head type, AISI Series 300 corrosion-resistant steel, size and design complying with IWCA I-14.1. Contact side of the bolts will be ground to fit flat against window jambs. Bolts may be factory- or field-attached before windows are set. Reinforce backs of frames to receive bolts with 6 by 150 millimeter 1/4- by 6-inch corrosion-resistant steel or aluminum plates bolted or welded to the frames at the factory. Special wall anchors must be provided on frames at the point of bolt attachment.

2.9 FINISH

NOTE: When a colored finish is required, review AA
DAF 45 to determine the proper designation.

[Aluminum windows, mullions, glazing beads, trim, and accessory fittings must be cleaned, and receive an Architectural Class II natural anodic

coating (designation AA-M-12C22A31) in accordance with AA DAF-45. Anodic coating will be not less than 0.01 millimeter. 0.4 mil.]

[Aluminum window, mullions, glazing beadings, trim, and accessory fittings must be thoroughly cleaned and will receive an Architectural Class I natural anodic coating (designation AA-M-12C22A41) in accordance with AA DAF-45. Anodic-coating thickness must be not less than 0.018 millimeter. 0.7 mil.]

Test the thickness of the anodic coating in accordance with ASTM B 244.

Anodic coating must be continuous and, without being lacquered, will be capable of withstanding 500 hours of salt-spray exposure for Class A anodic coatings and 250 hours of salt-spray exposure for Class B anodic coatings when tested in accordance with ASTM B 117.

2.9.1 Anodized Aluminum Finish

NOTE: The 0.010 mm (0.4 mil) thick anodized finish costs less than, but is more easily scratched and not as durable in appearance and performance as, the 0.02 mm (0.8 mil) thickness.

Finish exposed surfaces of aluminum windows with anodic coating conforming to AA DAF-45: [Architectural Class II, AA-M10-C22-A31, clear anodic coating, 0.010 to 0.02 mm 0.4 to 0.8 mil thick, 204-R1 Natural Color] [Architectural Class I, AA-M10-C22-A41, clear anodic coating, 0.02 mm 0.8 mil or thicker, 215-R1 Natural Color] [Architectural Class I, AA-M10-C22-A44, color anodic coating, 0.02 mm 0.8 mil or thicker]. Finish must be free of scratches and other blemishes.

2.9.2 Baked-Acrylic Resin-Based Coating

Finish exposed surfaces of aluminum windows with acrylic resin-based coating conforming to AAMA 2603, total dry thickness of 0.03 mm 1.2 mils. Finish must be free of scratches and other blemishes.

2.9.3 High-Performance Coating

Finish exposed surfaces of aluminum windows with a two-coat fluoropolymer coating system containing at least 70 percent by weight polyvinylidene fluoride, PVF2 resin, factory-applied, oven-baked, conforming to AAMA 2604, with a primer coat of 0.005 to 0.008 mm 0.20 to 0.30 mils and a color coat of minimum 0.025 mm 1.0 mil, total dry film thickness of 0.030 to 0.033 mm 1.20 to 1.3 mils. Finish must be free of scratches and other blemishes.

2.9.4 Color

NOTE: Editing of color reference sentence(s) must be coordinated with the Government. Generally the 09 06 90 COLOR SCHEDULE or drawing is used when the project is designed by an Architect or Interior designer. Select color from manufacturers standard colors or identified as a manufacturers color in this specification only when the project is very simple and has minimal finishes.

When the Government directs that color be located in the drawings a note must be added that states:
"Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal colors from other manufacturers. The word "color" as used herein includes surface color and pattern."

Prior to specifying a custom color finish, research to determine if additional cost and lead time is feasible. Note there is often a minimum order requirement; this requirement will also affect future orders.

When a manufacturer's name, stock number, pattern, and color is used, be certain that the product conforms to this specification, as edited.

Color must be[in accordance with Section 09 06 90 COLOR SCHEDULE] [as indicated on the drawings][selected from manufacturers standard colors].[[_____] Color listed is not intended to limit the selection of equal colors from other manufacturers].

PART 3 EXECUTION

3.1 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

<u>PRODUCTS</u>	<u>INCH-POUND</u>	<u>METRIC</u>
Metal Casing	0.0625 inch	1.59 mm
Aluminum Tube	0.0625 inch	1.59 mm
(Diameter)	1 inch	25 mm

3.2 INSTALLATION

3.2.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

3.2.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surface from dissimilar materials as recommended in the Appendix to [AAMA 101](#). Do not coat surfaces in contact with sealants after installation with any type of protective material.

3.2.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in masonry walls must have head and jamb members designed to recess into masonry wall not less than [11 mm](#) [7/16 inch](#).

3.2.4 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary. [Adjust double hung windows to operate with maximum applied force of 25 pounds in either direction, not including breakaway friction force.] Verify that products are properly installed, connected, and adjusted.

3.3 ADJUSTMENT AFTER INSTALLATION

After the sash is erected and glazed, lubricate and adjust ventilators for smooth weathertight operation. Wax or lubricate guides and adjust balances for the proper tension.

Weatherstripping must make weathertight contact around the entire weatherstripped area when ventilators are closed and locked. Weatherstripping must not cause the sash to bind or prevent closing and locking the ventilator.

3.3.1 Hardware Adjustments

Make final operating adjustments after glazing work is complete. Operating sash or ventilators must operate smoothly and be weathertight when in locked position.

3.3.2 Cleaning

Clean aluminum window finish and glass on exterior and interior sides in accordance with window manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring window finish and glass surfaces.

3.4 DISSIMILAR MATERIALS

Aluminum must be kept from direct contact with steel or other dissimilar materials by painting, nonabsorptive tape, gasket, or other approved system as recommended by the manufacturer and as specified.

Give aluminum surfaces in contact with steel one coat of zinc-chromate

primer applied to a dry-film thickness of not less than 0.038 millimeter, 1.5 mils, or one coat of a suitable nonhardening joint compound capable of excluding moisture from the joint during prolonged service.

Give steel surfaces in contact with aluminum one coat of zinc-chromate paint applied to a dry-coat thickness of 0.038 millimeter, 1.5 mils, and two or more coats of aluminum paint conforming to SSPC Paint 101, aluminum alkyd, Type II, applied to a dry-film thickness of 0.038 millimeter 1.5 mils for each coat and a total dry-film thickness of 0.076 millimeter. 3.0 mils.

Corrosion-resistant, aluminized, or hot-dip galvanized steel placed in contact with aluminum need not be painted.

Give aluminum surfaces placed in contact with wood, concrete, or masonry construction one coat of bituminous paint conforming to SSPC Paint 12, applied to a thickness of at least 1.5 millimeter. 1/16 inch.

3.5 FEELER-GAGE FIELD TEST

NOTE: Test is for nonweatherstripped projected
windows only.

Test windows after installation, glazing, and adjustment for metal-to-metal contact between ventilators and frames by feeler-gage tests in accordance with SWI SWS.

Windows failing to meet the requirements of the feeler-gage tests must be corrected as required to meet the tests. Retest such windows and, if they fail the tests again, be removed and replaced these windows.

3.6 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

3.7 WASTE MANAGEMENT

NOTE: Diverting waste from the landfill contributes
to the following LEED credit: MR2. Coordinate with
Section 02 42 00 CONSTRUCTION AND DEMOLITION WASTE
MANAGEMENT.

Separate corrugated cardboard and protective materials in accordance with the Waste Management Plan and place in designated areas for reuse or recycling. Place materials defined as hazardous or toxic waste in designated containers. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperature. Place used sealant tubes and containers in areas designated for hazardous materials.

-- End of Section --

