
USACE / NAVFAC / AFCEC / NASA UFGS-08 44 00 (August 2011)

Preparing Activity: NAVFAC Superseding
UFGS-08 44 00 (May 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2014

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CURTAIN WALL AND GLAZED ASSEMBLIES

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NOTE: This guide specification covers the requirements for complete glazed curtain wall system exclusive of doors, entrances, and store fronts, commercial aluminum curtain walls designed to accommodate fixed-glass lights, window sashes, panels, louvers, and other curtain-wall accessories. Curtain-wall systems may be classified by visual characteristics as follows:

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

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

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

Curtain-wall systems may be classified by visual characteristics as follows:

1. Mullion type has dominant vertical lines. Vertical mullions are usually 45 millimeter 1-3/4 inches or more wide and usually extend 100 millimeter 4 inches or more beyond the exterior face of the curtain wall. Mullions are usually not more than 1525 millimeter 5 feet on center.
2. Grid type has equally dominant vertical and horizontal lines. Vertical and horizontal mullions are usually 45 millimeter 1-3/4 inches or more wide and usually extend 100 millimeter 4 inches or more

beyond the exterior face of the curtain wall. The area enclosed by the mullions is usually not more than 3 square meter 32 square feet.

3. Spandrel type has dominant horizontal lines, and the supports are not a primary element of expression. The sheathed type has a nonlinear pattern, and the supports are not a primary element of expression.

Related work specified in this section as required by the project includes:

1. Field-applied thermal insulation, glass and glazing, and field-applied joint sealing and expansion joints.
2. Methods of securing framing to structure and details of fastenings, anchors, and auxiliary shapes,
3. Openings to be glazed with double-glazing units.

Drawings shall include a complete schedule of system types and sizes and all window units for the work to be performed and must indicate the following::

1. Arrangement of curtain-wall framing showing all dimensions, shapes, and sizes of the members, floor elevations, connections, and the relation of the curtain-wall framing to other building components
2. Windows showing types, sizes, ventilators, dimensions, shapes, and sizes of members, and the relationship of each window sash to the curtain-wall system
3. Insect screens showing locations, dimensions, shapes, and sizes of members; shade screens and baffles showing locations, dimensions, shapes, and sizes of members; location of window cleaners' bolts
4. Panels showing all dimensions, edge detail, and the relationship of panels to the curtain-wall system, openings to be glazed with double-glazing units
5. Doors and frames showing the door size, thickness, and hand. Arrangement of frames including dimensions, shapes, and sizes of members and connections; and the relationship of doors and frames to the curtain-wall system
6. Metal accessories, such as aluminum sills at the bottom of curtain walls, aluminum coping at the top of curtain walls, and exterior architectural louvers showing all dimensions, shapes, and sizes of members, connections, and the relationship of each metal accessory item to the curtain-wall system

7. Field-applied thermal-insulation systems showing the location, method of attachment, nominal thickness, and name of insulation

8 Joints to be sealed with field-applied sealing compound showing the kind of materials that will be in contact with the sealing compound; locations, dimensions of joints, name of backup material, and name of sealing compound, for each type of sealing compound

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 ADM	(2010) Aluminum Design Manual
AA ASD1	(2013) Aluminum Standards and Data
AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2005) Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure
AAMA 501.4 & 501.6	(2009) Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts & Recommended

	Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from a Wall System
AAMA 609 & 610	(2009) Cleaning and Maintenance Guide for Architecturally Finished Aluminum
AAMA 611	(1998; R 2004) Voluntary Specification for Anodized Architectural Aluminum
AAMA 800	(2010) Voluntary Specifications and Test Methods for Sealants
AAMA CW-10	(2004) Care and Handling of Architectural Aluminum from Shop to Site
AAMA MCWM-1	(1989) Metal Curtain Wall Manual
AAMA/WDMA/CSA 101/I.S.2/A440	(2011) Standard/Specification for Windows, Doors, and Skylights

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard
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AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2004) Standard Definitions for Use in the Design of Steel Structures
AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures
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AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.10/A5.10M	(2012) Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys - Classification
AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2013) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
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ASTM A1011/A1011M	(2014) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A242/A242M	(2013) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A27/A27M	(2013) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A424/A424M	(2009a) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A47/A47M	(1999; R 2014) Standard Specification for Ferritic Malleable Iron Castings
ASTM A501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A572/A572M	(2013a) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588/A588M	(2010) Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A606/A606M	(2009a) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or

	Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B108/B108M	(2012; E 2012) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B136	(1984; R 2013) Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum
ASTM B137	(1995; R 2009) Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum
ASTM B152/B152M	(2013) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B211	(2012) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B211M	(2012; E 2012) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B221	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B244	(2009; R 2014) 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 B26/B26M	(2012) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B316/B316M	(2010) Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods
ASTM B85/B85M	(2013) Standard Specification for Aluminum-Alloy Die Castings
ASTM C1036	(2010; E 2012) Standard Specification for Flat Glass
ASTM C1048	(2012; E 2012) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT

Coated and Uncoated Glass

ASTM C1363	(2011) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C220	(1991; R 2009) Standard Specification for Flat Asbestos-Cement Sheets
ASTM C481	(1999; R 2011) Standard Test Method Laboratory Aging of Sandwich Constructions
ASTM C542	(2005; R 2011) Lock-Strip Gaskets
ASTM C547	(2012) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	(2013) Standard Specification for Cellular Glass Thermal Insulation
ASTM C553	(2013) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C578	(2014) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2013) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C592	(2013) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C610	(2011) Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C612	(2014) Mineral Fiber Block and Board Thermal Insulation
ASTM C665	(2012) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C864	(2005; R 2011) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D1730	(2009) Standard Practices for Preparation

	of Aluminum and Aluminum-Alloy Surfaces for Painting
ASTM D3656/D3656M	(2013) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM E119	(2012a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E136	(2012) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E330/E330M	(2014) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E331	(2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E34	(2011) Chemical Analysis of Aluminum and Aluminum-Base Alloys
ASTM E546	(2008) Frost Point of Sealed Insulating Glass Units
ASTM E576	(2008) Frost Point of Sealed Insulating Glass Units in the Vertical Position
ASTM E774	(1997) Classification of the Durability of Sealed Insulating Glass Units
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E90	(2009) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)	
NAAMM AMP 500	(2006) Metal Finishes Manual
PORCELAIN ENAMEL INSTITUTE (PEI)	
PEI 1001	(1996) Specification for Architectural Porcelain Enamel (ALS-100)
PEI CG-3	(2005) Color Guide for Architectural Porcelain Enamel

STEEL WINDOW INSTITUTE (SWI)

SWI AGSW (2002) Architect's Guide to Steel Windows

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4 (2007; E 2004) Brush-Off Blast Cleaning

SSPC SP 1 (1982; E 2004) Solvent Cleaning

SSPC SP 3 (1982; E 2004) Power Tool Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201 Safety Standard for Architectural Glazing
Materials

1.2 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, 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, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army 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

Glazed curtain wall system

Submit for curtain wall system, accessories, and mock-up. [Tentative approval of drawings shall be received before fabrication of mock-up. Final approval of drawings will be deferred pending approval of mock-up and accessories.] Drawings shall indicate in detail all system parts including elevations, full-size sections, framing, jointing, panels, types and thickness of metal, flashing and coping details, field connections, weep and drainage system, finishes, sealing methods, glazing, glass sizes and details, firestopping insulation materials, and erection details.

Installation Drawings

Shop-Painting Aluminum

Shop-Painting Steel

SD-03 Product Data

Glazed curtain wall system

Include descriptive literature, detailed specifications, and available performance test data.

Preventive Maintenance and Inspection

Metals For Fabrication

Nonskinning Sealing Compound

Metal Accessories

Curtain-wall Framing Members

Aluminum Doors and Frames

Curtain Wall Frame

Panels

Thermal Insulation Materials

Sealants and Caulkings

Curtain-Wall Installation Materials

Masonry Anchorage Devices

Sample warranties

SD-05 Design Data

Calculations

Finish

Exposed-to-View Aluminum Finish

Porcelain-Enamel

Seismic Calculations

SD-08 Manufacturer's Instructions

Glazed curtain wall system

Insulating glass

SD-11 Closeout Submittals

WARRANTY

1.3 REQUIREMENT FOR DESIGN DATA

Submit structural and thermal calculations for complete wall assembly.

1.4 QUALITY ASSURANCE

1.4.1 Testing Requirements

**NOTE: Revise this paragraph as necessary to cover
project requirements.**

The components listed below shall be tested in accordance with the requirements below, and meet performance requirements specified.

- a. Joint and Glazing Sealants: Perform tests as required by applicable publications referenced.
- b. Preformed Compression Gaskets and Seals: ASTM C864.
- c. Preformed Lock-strip Gaskets: ASTM C542, modified as follows: Heat age specimens seven days at 70 degrees C 158 degrees F, in zipped or locked position under full design compression. Unzip, cool for one hour, re-zip, and test lip seal pressure, which must be minimum 0.045 kilograms per linear millimeter 2.5 pounds per linear inch on any extruded or corner specimen.
- d. Spandrel Glass: Fallout resistance test, ASTM C1048.
- e. Porcelain Enamel: Acid resistance, color retention, and spall resistance tests, PEI 1001.
- f. Anodized Finishes: Stain resistance, coating weight, and coating thickness tests, ASTM B136, ASTM B137, and ASTM B244, respectively.
- g. Insulating Glass: ASTM E546 or ASTM E576 at [minus 29 degrees C 20 degrees F] [____], no frost or dew point.

1.4.2 Mockup

NOTE: Size of project and system specified will determine whether mock-ups are necessary. Complete information should be given concerning extent, details, and purpose of mock-ups. Where mock-ups have been previously tested for another project or for commercial production, they may serve the purpose. When testing of a mock-up is required, the unit should be erected at a testing laboratory or other location where adequate testing equipment is available.

1.4.2.1 Construction

Construct at [job site] [manufacturer's plant] [approved testing laboratory] full size typical wall unit which incorporates horizontal and vertical joints, framing, window units, panels, glazing, and other accessories as detailed and specified. Mock-up wall unit size and design shall be as indicated.

1.4.2.2 Performance Test

Conduct after approval of visual aspects has been obtained. Finished work shall match approved mock-up.

1.4.2.3 Approved Mock-Up

After completion and approval of test results [[transport mock-up to job site and] install, where directed, for reference during construction.] [Approved mock-up shall remain property of the Contractor.]

1.4.3 Factory Tests

NOTE: The overall performance requirements and tests will vary with the design and geographical location of the building as well as with the type of construction and components specified. Only those tests which are necessary to establish compliance with specifications should be included in the project specification. Refer to AAMA Curtain Wall Manual for detailed testing methods and the recommended minimum performance requirements and safety factors.

Perform the following tests except that where a curtain wall system or component of similar type, size, and design as specified for this project has been previously tested, under the conditions specified herein, the resulting test reports may be submitted in lieu of testing the components listed below:

- a. [_____]
- b. [_____]

c. [_____]

1.4.3.1 Deflection and Structural Tests

No curtain wall framing member shall deflect, in a direction normal to the plane of the wall, more than 1/175 of its clear span or 20 mm 3/4 inch, whichever is less, when tested in accordance with ASTM E330/E330M, except that when a plastered surface will be affected the deflection shall not exceed 1/360 of the span. No framing member shall have a permanent deformation in excess of 0.2 percent of its clear span when tested in accordance with ASTM E330/E330M for a minimum test period of 10 seconds at 1.5 times the design wind pressures specified.

1.4.3.2 Water Penetration Test

NOTE: The test method of ASTM E331 is that of determining resistance of the curtain wall to water penetration under uniform static air pressure difference. When testing under dynamic conditions is required, AAMA Specification 501.1 should be referenced. The availability of facilities for conducting dynamic testing is very limited and should be checked before specifying this type of test.

No water penetration shall occur when the wall is tested in accordance with ASTM E331 at a differential static test pressure of 20 percent of the inward acting design wind pressure as specified, but not less than 0.19 kPa 4 psf. Make provision in the wall construction for adequate drainage to the outside of water leakage or condensation that occurs within the outer face of the wall. Leave drainage and weep openings in members and wall open during test.

1.4.3.3 Air Infiltration Test

Air infiltration through the wall, when tested in accordance with ASTM E283, shall not exceed 0.005 cms per sq. m 0.06 cfm per square foot of fixed wall area, plus the permissible allowance specified for operable windows within the test area.

1.4.3.4 Delamination Test

Adhesively bonded metal-faced [[_____] faced] panels shall show no evidence of delamination, warpage or other deterioration or damage when subjected to the six "Accelerated Aging Cycles" specified in ASTM D1037.

1.4.3.5 Thermal Conductance Tests

The thermal transmittance of opaque panels shall not exceed specified U-value, when tested in accordance with ASTM C1363. The average calculated thermal transmittance of the complete wall assembly including panels, windows, and all other components shall not exceed a U-value of [_____]. Determine U-values of components in accordance with ASTM C1363.

1.4.3.6 Window Tests

**NOTE: Insert appropriate Section number and title
in blank below using format per UFC 1-300-02.**

Windows shall meet the requirements specified in [_____] except where the requirements of this section differ, this section governs. Provide windows that meet the same requirements for deflection and structural adequacy as specified for framing members when tested in accordance with ASTM E330/E330M, except permanent deformation shall not exceed 0.4 percent; there shall be no glass breakage, and no permanent damage to fasteners, anchors, hardware, or operating devices. Provide windows that have no water penetration when tested in accordance with ASTM E331.

1.4.3.7 Fire Resistance Tests

NOTE: The exception to the smoke developed requirement as given in this paragraph does not apply to hospitals and confinement (correctional) facilities; insulation for these facilities must have a smoke developed rating not exceeding 150.

Insulation [provided in the curtain wall system] [field applied in conjunction with the curtain wall system] shall have a flame spread rating not exceeding 75 and a smoke developed rating not exceeding 150 when tested in accordance with ASTM E84, except as specified otherwise herein.

- a. Insulation: Insulation [contained entirely within panel assemblies which meets the flame spread and smoke developed ratings of 75 and 150 respectively] [isolated from the building interior by masonry walls, masonry cavity walls, or encased in masonry cores] is not required to comply with the flame spread and smoke developed ratings specified.
- b. Curtain Wall Systems: Material for firestopping the opening between the edge of the floor slab and back of the curtain wall system, shall have not less than the flame spread and smoke developed ratings specified for insulation which is neither isolated from the building interior nor encased in masonry cores.
- c. Curtain Wall Panels: Provide panels for fire resistive curtain walls that have a fire resistive rating of [_____] hours when tested in accordance with ASTM E119.
- d. Firestopping Materials and Devices: Firestopping material and attachment devices shall be an effective barrier against the spread of fire, smoke, and gases for a period of [_____] hours when exposed to the conditions of the standard ASTM E119 time-temperature curve for a period equivalent to the fire rating of the floor system and shall also be rated noncombustible when tested in accordance with ASTM E136.

1.4.3.8 Sound Transmission Loss Test

Sound transmission loss (TL) of the wall shall be less than [_____] db, when tested in accordance with ASTM E90 for the frequency range from [125] [_____] to [400] [_____] Hz.

1.5 GLAZED CURTAIN WALL SYSTEM REQUIREMENTS

NOTE: This specification is intended for use with glazed curtain walls for low rise buildings and multi-story buildings. Since aluminum shapes are usually extruded and most other metal shapes are rolled-formed or brake-formed, the project drawings and details must show the materials and shapes desired. The Contractor should not be requested to submit alternate bids or be allowed to substitute one metal for another unless complete details are shown for each type of metal components permitted.

Provide system complete with framing, mullions, trim, [framed pre-assembled units,] panels, windows, glass, glazing, sealants, insulation, fasteners, anchors, accessories, concealed auxiliary members, and attachment devices for securing the wall to the structure as specified or indicated.

1.5.1 Source

Furnish curtain wall system components by one manufacturer or fabricator; however, all components need not be products of the same manufacturer.

1.5.2 Design

NOTE: Refer to AAMA Curtain Wall Design Guide Manual "Testing, Types and Systems" for an explanation of the various curtain wall systems. The systems included in this guide specification are the standard architectural type as opposed to custom type. Generally the custom type of system is more expensive and should only be considered for special projects. When a system other than those listed is required this paragraph must be adjusted accordingly.

[Stick system] [Unit system] [Unit and mullion system] [[_____] system] with [mullions,] [horizontal rails,] [panels,] [window units,] [screens] [framed pre-assembled units with [integral] [nonintegral] spandrel panels [_____]]. Fully coordinate system accessories directly incorporated, and adjacent to contiguous related work and insure materials compatibility, deflection limitations, thermal movements, and clearances and tolerances as indicated or specified.

1.5.3 Thermal Movement

NOTE: The ambient temperature range appropriate to the geographic location of the project site should be inserted.

Fabricate, assemble, and erect system with adequate allowances for expansion and contraction of components and fastenings to prevent buckling damage, joint seal failure, glass breakage, undue stress on fastenings or other detrimental effects. For design purposes, base provisions for

thermal movement on assumed ambient temperature range of from [_____] degrees C F to [_____] degrees C F.

1.5.4 Tolerances

NOTE: The finished wall system requires the coordination and efforts of many different manufacturers, suppliers, and construction trades. Contractor submittal requirements should include sufficient detail to insure coordination between them.

Design and erect wall system to accommodate tolerances in building frame and other contiguous work as indicated or specified. Provide with the following tolerances:

- a. Maximum variation from plane or location shown on approved shop drawings: one millimeter per 12 meters 1/8 inch per 12 feet of length up to not more than 13 mm 1/2 inch in any total length.
- b. Maximum offset from true alignment between two identical members abutting end to end in line: 2 mm 1/16 inch.

1.5.5 Structural Requirements

NOTE: When mullions are used to support window cleaning rigs, the loads on the mullion members created by the rigs must be considered in the mullion design and the appropriate figures listed in blank spaces.

No member shall deflect in a direction parallel to the plane of the wall, when carrying its full design load, more than an amount which will reduce the edge cover or glass bite below 75 percent of the design dimension. No member after deflection under full design load, shall have a clearance between itself and the top of the panel, glass, sash, or other part immediately below it less than 3 mm 1/8 inch; the clearance between the member and an operable window or door shall be minimum 2 mm 1/16 inch. [Design system members serving as guide rails for window cleaning equipment to carry mid-span concentrated load of [_____] kilograms pounds normal to plane of wall and [_____] kilograms pounds applied horizontally, parallel to wall plane without deflection which would affect adjacent surfaces.] Design entire system to withstand the indicated wind and concentrated loads, and the following wind loads acting normal to the plane of the wall:

- a. On the first [_____] stories above grade [_____] kPa psf acting inward, and the same load acting outward.
- b. On the next [_____] stories above grade [_____] kPa psf acting inward, and the same load acting outward.
- c. On corner areas, extending [_____] meters feet from the building corners on the [_____] stories, on all facades, the outward-acting (negative) design load shall be increased to [_____] kilopascals pounds per square foot.

[1.5.6 Seismic Calculations

When tested to AAMA 501.4 & 501.6, system shall meet design displacement of 0.010 times the story height and ultimate displacement of 1.5 times the design displacement. Provide with the following tolerances:

- a. Phase I: 3 stroke cycles using .005 times the story height - no damage or failure.
- b. Phase II: 3 stroke cycles using .010 times the story height - no damage or failure.

]1.6 QUALIFICATION OF WELDERS

Welding shall be performed by certified welders qualified in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.7 DELIVERY AND STORAGE

Inspect materials delivered to the site for damage; unload and store with a minimum of handling in accordance with recommendations contained in AAMA CW-10. Storage spaces shall be dry locations with adequate ventilation, free from heavy dust, not subject to combustion products or sources of water, and shall permit easy access for inspection and handling. Deliver caulking and sealing compounds to the job site in sealed containers labeled to show the designated name, formula or specifications number; lot number; color; date of manufacturer; shelf life; and curing time when applicable.

1.7.1 Protective Covering

Prior to shipment from the factory, place knocked-down lineal members in cardboard containers and cover finished surfaces of [aluminum] [stainless steel] with protective covering of adhesive paper, waterproof tape, or strippable plastic. Covering shall not chip, peel, or flake due to temperature or weather, shall protect against discoloration and surface damage from transportation, and storage, and shall be resistant to alkaline mortar and plaster. Do not cover [aluminum] [stainless steel] surfaces that will be in contact with sealants after installation.

1.7.2 Identification

Prior to delivery, mark wall components to correspond with shop and erection drawings placement location and erection.

1.8 WARRANTY

NOTE: The warranty clause in this guide specification has been approved by NAVFACENGCOMHQ in accordance with the requirements of Naval Facilities Acquisition Supplement (NFAS).

NFAS can be found at the following link:

https://portal.navy.mil/portal/page/portal/navfac/navfac_forbusinesses

The paragraph in this guide specification may be used without any other HQ approval or request for waiver.

Guarantee insulating glass units not to develop material obstruction of vision as a result of dust or film formation on the inner glass surface caused by failure of the seal, other than through glass breakage, within a period of 5 years from date of acceptance of work by the Government. Replace units failing to comply with the terms of this guarantee with new units without additional cost to the Government. The Contractor shall require the manufacturer to execute their warranties in writing directly to the Government.

1.8.1 Sample Warranties

Provide curtain wall and glazing assemblies material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty to comply with the specified requirements.

- a. Project Warranty: Refer to Section 01 11 00 SUMMARY OF WORK and Section 01 33 00 SUBMITTAL PROCEDURES for project warranty provisions.
- b. Manufacturer's Warranty: Submit, for Owner's acceptance, Manufacturer's standard warranty document executed by authorized company official manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.
- c. Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel fire-rated glazed curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
- d. Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering. Determine warranty on finish by type of finish selected.
- e. Beneficiary: Issue warranty in the legal name of the project Owner.
- f. Warranty Period: [_____] years commencing on Date of Substantial Completion, covering complete curtain wall system for failure to meet specified requirements.
- g. Warranty Acceptance: Owner is sole authority who will determine acceptability of manufacturer's warranty documents.

1.9 INTERPRETATION OF AWS CODE

NOTE: If Section 05 05 23.16 STRUCTURAL WELDING is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

AWS code, when referred to herein, shall mean AWS D1.1/D1.1M, "Structural Welding Code - Steel" with the following modification:

Revise AWS code Section 1, "General Provisions," Paragraph 1.1 as follows: References to the need for approval shall mean "Approval by the Contracting Officer" and references to the "Building Commissioner" shall mean the "Contracting Officer."

1.10 QUALIFICATIONS FOR THE CURTAIN-WALL INSTALLER

Submit a written description of the proposed curtain-wall system installer giving the name of the curtain-wall manufacturer, qualifications of personnel, years of concurrent contracting experience, lists of projects similar in scope to the specified work, and other information as may be required by the Contracting Officer.

1.11 PERFORMANCE REQUIREMENTS

1.11.1 Allowable Design Stresses

Aluminum-alloy framing member allowable design stresses shall be in accordance with the requirements of AA ADM pertaining to building type structures made of the specified aluminum alloy.

Hot-rolled structural-steel member allowable design stresses and design rules shall be in accordance with the requirements of AISC/AISI 121 pertaining to the specified structural steel.

Cold-formed light-gage steel structural member allowable design stresses and design rules shall be in accordance with the requirements of AISI SG03-3 SG570 pertaining to structural members formed from the specified structural-steel sheet or strip.

1.11.2 Design Wind Load

NOTE: First measurement in the following paragraph specifies the design windload recommended in the American Insurance Association AIA CO-1 "National Building Code," Appendix K, for areas subject to severe winds and for height zones of 9140 to 14900 millimeters 30 to 49 feet.

The second measurement specifies the design windload recommended in ANSI A58.1, "Minimum Design Loads for Buildings and Other Structures," for 160 kilometer per hour 100 miles per hour wind velocity, for unprotected locations in flat, open country or near shorelines of large bodies of water and fully exposed to a long fetch of wind, and for a height zone of 12200 millimeters 40 feet.

The third measurement specifies the design windload recommended in ANSI A58.1, "Minimum Design Loads for Buildings and Other Structures," for 160 kilometer per hour 100 miles per hour wind velocity, and for a height zone of 9100 millimeters 30 feet and under.

The fourth measurement specifies the design windload recommended in the American Insurance Association's AIA CO-1 "National Building Code," Appendix K, for

areas subject to severe winds and for a height zone of less than 9100 millimeters 30 feet.

The fifth measurement specifies the design windload recommended in ANSI A58.1, "Minimum Design Loads for Buildings and Other Structures," for the Langley field area, and for a height zone of less than 9100 millimeters 30 feet.

The sixth measurement specifies the minimum design load recommended in ANSI A58.1. Langley Research Center policy does not permit use of this paragraph.

Design windload shall be [2155] [1963] [1819] [1676] [1436] [718] pascal [45] [41] [38] [35] [30] [15] pounds per square foot. Design windload shall be in accordance with ASCE 7.

1.11.3 Structural Capacity

Design curtain-wall system, including framing members, windows, doors and frames, metal accessories, panels, and glazing to withstand the specified design windload acting normal to the plane of the curtain wall and acting either inward or outward.

Deflection of any metal framing member in a direction normal to the plane of the curtain wall, when subjected to the test of structural performance, using the specified windload in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, shall not exceed 1/175 of the clear span of the member or 20 millimeter 3/4 inch, whichever value is less.

Deflection of any metal member in a direction parallel to the plane of the curtain wall, when the metal member is carrying its full design load, shall not exceed 75 percent of the design clearance dimension between that member and the glass, sash, panels, or other part immediately below it.

1.11.4 Provisions for Thermal Movement

Design curtain-wall systems, including framing members, windows, doors and frames, metal accessories, and other components incorporated into the curtain wall, to allow for expansion and contraction of the component parts at an ambient temperature of 38 degrees C 100 degrees F without causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

1.12 DRAWINGS

Installation Drawings shall include the following information for curtain wall assemblies.

Curtain-wall locations in building, layout and elevations, dimensions, shapes and sizes of members, thickness of metals, types and locations of shop and field connections, details of anchorage to building construction, glazing provisions, and other pertinent construction and erection details.

Location and details of anchorage devices that are to be cast-in-place in concrete and masonry construction.

Panel dimensions, thicknesses and kinds of materials, edge details, details

of installation in curtain-wall framing, and other pertinent construction and erection details.

1.13 MANUFACTURER'S INFORMATION

Preventive Maintenance and Inspection shall consist of the aluminum manufacturer's recommended cleaning materials and application methods, including detrimental effects to the aluminum finish when improperly applied.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum

Shall be free from defects impairing strength or durability of surface finish. Provide standard alloys shall conform to standards and designations of AA ASD1. Special alloys, not covered by the following ASTM specifications, shall conform to standards and designations recommended by the manufacturer for the purpose intended.

2.1.1.1 Wrought Aluminum Alloys

Shall be those which include aluminum alloying elements not exceeding the following maximum limits when tested and additional in accordance with ASTM E34. These limits apply to both bare products and the core of clad products. The cladding of clad products shall be within the same limits except that the maximum zinc limit may be 2.5 percent in order to assure that the cladding is anodic to the core. Special wrought alloys with a silicon content not more than 7.0 percent will be acceptable for limited structural uses where special appearance is required:

<u>ALLOY</u>	<u>PERCENT</u>
Silicon	1.5
Magnesium, Manganese, and Chromium combined	6.0
Iron	1.0
Copper	0.4
Zinc	1.0

Within the chemical composition limits set forth above, wrought aluminum alloys shall conform to the following:

- a. Extruded bars, rods, shapes and tubes: ASTM B221M ASTM B221.
- b. Sheet and Plate: ASTM B209M ASTM B209.

2.1.1.2 Cast Aluminum Alloys

Provide those in which the alloying elements are silicon, magnesium, manganese, or a combination of these. Other elements shall not exceed the following limits:

<u>ALLOY</u>	<u>PERCENT</u>
Iron	1.2
Copper	0.4
Nickel	0.4
Titanium	0.2
Others (total)	0.5

Within the chemical composition limits set forth above, cast aluminum alloys shall conform to the following:

- a. Sand castings: ASTM B26/B26M.
- b. Die casting: ASTM B85/B85M.
- c. Permanent mold castings: ASTM B108/B108M.

2.1.1.3 Welding Rods and Electrodes

Provide welding rods and bare electrodes shall conform to AWS A5.10/A5.10M as recommended by the manufacturer of the aluminum base metal alloy being used.

2.1.1.4 Finish

Anodized finish on aluminum surfaces shall match in appearance or fall within the two extremes of color range of the approved samples. The following designation of finishes refer to standard finishes as defined in the NAAMM AMP 500. Aluminum used for framing shall have a color anodized finish designation AA-MIO-C22-A34 and AA-MIOC22-A44, meeting the requirements of AAMA 611.

2.1.1.5 Strength

Aluminum extrusions for framing members used in curtain walls and main frame and sash or ventilator members in windows shall have a minimum ultimate tensile strength of 152 MPa 22,000 psi and a minimum yield strength of 110 MPa 16,000 psi.

2.1.2 Bronze

Bronze sheets, tubes, and drawn shapes shall be commercial bronze, alloy No. 220. Extruded shapes shall be architectural bronze, alloy No. 385. Rolled or drawn rods shall be [commercial bronze, alloy No. 220] [or] [architectural bronze, alloy No. 385]. Bronze used for [_____] shall have a [_____] finish.

2.1.3 Copper

Conform to ASTM B152/B152M, hot or cold-rolled of the temper suitable for the respective forming operations.

2.1.4 Carbon Steel

Conform to the following specifications:

- a. Rolled shapes, plates, and bars: ASTM A36/A36M.
- b. Galvanized sheets: ASTM A653/A653M.
- c. Sheets for porcelain enameling: ASTM A424/A424M.
- d. Other sheets: ASTM A1011/A1011M or ASTM A1008/A1008M.

2.1.5 Stainless Steel

NOTE: Type 316 stainless steel offers additional corrosion resistance through the addition of molybdenum. It is often recommended for use in salty or highly corrosive atmospheres. Since its cost is greater than Types 302 or 304, Type 316 should be specified only when the project requirements justify the additional cost.

Conform to ASTM A167, Type 302 or 304, and finish in accordance with the NAAMM AMP 500 conform to Metal Finishes Manual as follows:

- a. Concealed flashings: Dead soft fully annealed, [2 D finish] [[_____] finish].
- b. Exposed work: [No. 4 finish] [[_____] finish] to match approved sample.

2.1.6 Weathering High-Strength Low-Alloy Steel

NOTE: Water draining or dripping from weathering steel surface for the first two or three years while the oxide coating is developing, will contain oxide particles which may stain or streak adjacent materials. Permanent provisions must be made through design, detailing, and the selection of materials and colors to accommodate or divert this run-off water. Refer to weathering steel manufacturer's recommendations for suggested methods to prevent staining.

Weathering steel shall be a high-strength, low-alloy steel conforming to ASTM A242/A242M, ASTM A588/A588M, ASTM A606/A606M, and ASTM A1011/A1011M as applicable to the shapes and thicknesses required. In addition, the steel shall be capable of developing a tightly adhered protective oxide coating when left unpainted and subjected to atmospheric exposure. Provide steel that conforms to the manufacturer's published mechanical properties and chemical composition. [Protect weathering steel used for [_____] on the unexposed side with a shop coat of paint.] Perform cleaning, surface preparation, handling, bolting, riveting, and welding of weathering steel in strict accordance with the specification and recommendations of the steel manufacturer.

2.1.7 High-Strength, Low-Alloy Steel

Conform to ASTM A572/A572M for structural shapes, plates, and bars.

2.1.8 Metal Fasteners

Provide fasteners as specified in paragraph entitled "Fastener Metals for Joining Various Metal Combinations" in "Part 2 - Products" of the AAMA MCWM-1. [Fastener metals used in connection with weathering steel shall be of type recommended by the weathering steel manufacturer.] Use metals for fasteners shall be chemically and galvanically compatible with contiguous materials.

2.1.9 Porcelain Enamel

Apply to all areas of each unit over base metal surfaces of [metal facing panels,] [adhesively bonded panels, metal-faced,] in compliance with PEI 1001. Apply colored enamel to exposed faces as follows:

- a. Color: [____].
- b. Texture: [____].
- c. Gloss: [____].
- d. Thickness of coating: [____].

2.1.10 Joint Sealants and Accessories

NOTE: This specification permits the three listed compounds to be used at the Contractor's option. Each is acceptable for intended purpose. Do not use silicone type sealants in horizontal surfaces where water occurs over the joint. For projects where it is desirable to limit sealant types, revised text accordingly.

Provide manufacturer's standard colors as closely matching the adjacent surfaces as possible.

2.1.10.1 Elastomeric, Single or Multiple Component

ASTM C920, [Type S, single component] [Type M, multiple component]. Use Grade NS, nonsag type in joints on vertical surfaces and use Grade P, self-leveling or flow type, in joints on horizontal surfaces.

2.1.10.2 Single Component Silicone Rubber Base

ASTM C920, Type S, Grade NS (Silicone).

2.1.10.3 Solvents and Primers

Provide material which is quick drying, colorless, nonstaining, compatible with compound used, as recommended by sealant manufacturer. Where primer is specified or recommended by sealant manufacturer, tests related to that material shall include primer.

2.1.10.4 Backing Material

Provide material which is nonstaining, nonabsorbent, and compatible with sealing compound. Closed cell resilient urethane, polyvinylchloride or polyethylene foam; closed-cell sponge of vinyl or rubber; closed cell neoprene or butyl rod; or polychloroprene tubes or beads.

2.1.10.5 Bond Preventive Materials

Provide polyethylene tape with pressure-sensitive adhesive; aluminum foil or waxed paper.

2.1.10.6 Preformed Sealing Compound

Provide nonskinning type conforming to AAMA 800. Tapes, beads, ribbons or other shapes as required.

2.1.11 Glass and Glazing

[Materials are specified under Section 08 81 00 GLAZING.] [Conform to ASTM C1036, except ASTM C1048 for spandrel glass. All glazing material must be certified as meeting 16 CFR 1201.

]2.1.11.1 Glass Sizes and Clearances

Sizes indicated are nominal. Verify actual sizes required by measuring frames. Coordinate dimensions for glass and glass holding members to meet applicable minimum clearances as recommended by glass manufacturer. Do not nip to remove flares or to reduce oversized dimensions.

2.1.11.2 Clear Primary Float Glass

Provide Type I, Class I, quality q3, [6 mm 1/4 inch thick] [_____].

2.1.11.3 Heat-Absorbing Glass

Clean cut, Type [I] [II], Class [2], style [A] [B], [_____] in color, thickness [[_____] mm inch] [as indicated].

2.1.11.4 Insulating Glass

Fused glass, banded, or unbanded. Banded type, ASTM E774, Class [A] [_____] shall have perimeter banded or sealed, and encased in a nonferrous metal or stainless steel frame. Unbanded type shall have perimeter sealed by manufacturer's standard organic sealant. Do not field cut.

2.1.11.5 Spandrel Glass [With Adhered Backing]

ASTM C1048, kind FT or HS, condition B, Type I, [_____] thickness [[_____] mm inch] [as indicated].

2.1.11.6 Glass Setting Materials

- a. Sealants and preformed sealing compounds: Shall be as specified under paragraph entitled "Joint Sealant and Accessories."
- b. Preformed compression gaskets and seals: ASTM C864, color [black] [_____]. Gaskets used for [_____] shall have durable compatible, and colorfast coating.

- c. Preformed lock-strip type gaskets: ASTM C542, factory formed, color [black] [_____]. Provide separate filler or locking strips, approximately 10 Shore "A" Durometer points harder than gasket body, and insure permanent and continuous pressure of sealing lips. Butt or miter grooves 45 degrees.
- d. Setting blocks, edge blocks, and spacer shims: Fabricate from neoprene or other materials recommended by glass manufacturer compatible with compounds, sealants, or gaskets used. Unless otherwise recommended by the glass manufacturer, shore "A" Durometer hardness for setting and edge blocks shall be 90 plus or minus 5; for spacer shims, 50 plus or minus 5.

2.1.12 Firestopping Material

NOTE: Refer to AAMA TIR-A3-1975, "Fire Resistive Design Guidelines for Curtain Wall Assemblies," for other recommended materials and methods used for firestopping the opening between the curtain wall and floor edges.

[Portland cement concrete of same design and strength as floor slab] [As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE] [Mineral fiber manufactured from asbestos-free materials, and conforming to ASTM C612 or ASTM C665, meeting fire resistance requirements specified].

2.1.13 Tempered Hardboard

AHA A135.4, Class 1, [_____] mm inch thick.

2.1.14 Screens

ASTM D3656/D3656M, Class 2, 18 by 14 mesh, color [charcoal] [grey] [_____].

2.1.15 Paint and Finishes

2.1.15.1 Primer

NOTE: Zinc chromate, strontium chromate and lead coatings are not allowed.

Zinc-molybdate, alkyd type.

2.1.16 Panels

NOTE: Double glazing and thermal breaks in wall and window framing systems will result in considerable reduction of heat transmission through wall system. Refer to ASHRAE Handbook of Fundamentals, and AAMA Curtain Wall Manual, "Design for Energy Conservation in Aluminum Curtain Walls" for additional information on heat transmission losses and condensation on interior surfaces.

NOTE: When other types of panels are required the text must be modified accordingly. When nonmetallic panels such as stone, precast concrete, tile or other materials are required, they must be included in the project specification. All panels which are a part of the wall system, regardless of the material or type, must be included as a part of the curtain wall specification.

Maximum U-value [____]. Where, in order to meet the requirements specified, the proposed panel assembly is thicker than indicated, make corresponding adjustments in accessories and other work such as door, window and louver frames, flashing, coping, and trim products at no extra cost to the Government. Unless otherwise indicated, design for installation from outside the building. Provide vapor barrier on interior face of insulation. Seal edges of panels with cores of absorptive material to prevent entrance of water and allow venting of the core space to outside air.

2.1.16.1 Metal Facing Panels, Single Thickness

Metal facing panels shall be single thickness. Panel facing shall be [flat sheet] [textured] [impressed-relief] [____] type, made of [porcelain enamel] [aluminum] [bronze] [stainless steel] and, with [backside stiffeners] [or] [edge flanges] spaced as required to meet flatness specified. Where indicated, backup panels with [____].

2.1.16.2 Adhesively Bonded Panels

NOTE: The same metal should be used on both the exposed and nonexposed faces of the panels, particularly in the case of aluminum, in order to minimize differential thermal expansion between the faces and thus reduce potential warping or buckling of the panel.

Adhesively bonded panels shall be sandwich type, metal faced both sides, and bonded to form stable and composite unit. Nonexposed face shall be [galvanized steel] [____]. Exposed face shall be [porcelain enamel] [aluminum] [bronze] [stainless steel] [weathering steel] [____] of thickness indicated, with continuous laminated backing or internal stiffening ribs or breaks spaced as required to meet flatness specified. The nonexposed face shall be [galvanized steel] [____] of the thickness indicated. Maximum slope of exposed face surface at any point, measured from nominal plane, shall not exceed the following:

- a. 1.0 percent for high reflectivity finish.
- b. 1.25 percent for medium reflectivity finish.
- c. 1.5 percent for low reflectivity finish.

2.1.16.3 Nonmetallic Panels

- a. Provide panels that are glass-faced on the side that will be exposed to view. Glass shall be spandrel glass with ceramic coating on its nonweathering surface and [smooth] [_____] finish on the exposed surface [; backing shall be adhesively bonded to nonweathering surface]. Backing shall be [_____] and include [galvanized steel] [_____] on surface nearest the building. Color of glass when viewed from the surface that will be exposed after installation shall be [_____] . Where indicated, back up glass panels with [_____] .
- b. Adhesively bonded insulated panels shall be nonmetallic faced, sandwich type, [_____] [tempered hardboard] on exposed face and on nonexposed face. Apply coating of [epoxy] [polyester] [_____] followed by application of [inert aggregate] [_____] to exposed face in the [factory] [field]. [Inert aggregate] [_____] shall be [natural stone chips] [crushed marble] [_____] [with minimum and maximum sizes of [_____] and [_____]]. Color of [_____] shall be [_____] .
- c. Nonmetallic panels, [_____] surfaced: [_____] [tempered hardboard] [_____] board base with applied [factory] [or] [field] finish of [_____] resins and decorative natural stone chips] [_____] . Apply [epoxy] [polyester] coating of [_____] followed by application of [inert aggregate] [_____] to exposed face in the [factory] [field]. [Inert aggregate] [_____] shall be [natural stone chips] [crushed marble] [_____] [with minimum and maximum sizes of [_____] and [_____]]. Color of [_____] shall be [_____] .

2.1.17 Metal Windows

NOTE: Insert appropriate Section number and title
in blank below using format per UFC 1-300-02.

[Fixed] [Operating] [Fixed and operating]. Comply with requirements of [_____] , [Steel] [Aluminum] Windows [_____] [AAMA/WDMA/CSA 101/I.S.2/A440] [SWI AGSW] as modified herein. Provide inside glazing with removable metal glazing beads [except for windows having structural gaskets]. Comply with glass clearance dimensions and sealant dimensions recommended by glass manufacturer.

2.1.17.1 Frames

Frames for fixed glazed panels and window units shall be [aluminum] [bronze] [stainless steel] [steel].

2.1.17.2 Operating Windows

Operating windows shall be [double-hung] [projected] [horizontally pivoted] [vertically pivoted] [top-hinged inswinging] [horizontal sliding] [casement] [_____] type. [Operating windows shall be complete with hardware, weatherstripping, and accessories.] Hardware shall comply with [AAMA/WDMA/CSA 101/I.S.2/A440] [SWI AGSW] modified as follows:

- a. Metal and finish for hardware shall be [_____] .
- b. [_____] .

2.1.17.3 Window Construction

Weld or mechanically join and seal corners of frames and ventilators for water-tight construction. Remove excess metal from welded joints and dress smooth on exposed and contact surfaces so that no objectionable discoloration or roughness will be visible after finishing. Apply sealing compound in interior surfaces of corners and frame intersections.

2.1.18 Insect Screens

NOTE: Where metal accessories mentioned herein
occur in connection with metal curtain walls, the
kind and gage of metal should be shown or specified.

NOTE: Insert appropriate Section number and title
in blank below using format per UFC 1-300-02.

Provide insect screens for ventilators of [_____] windows [_____] in accordance with [_____] [Steel] [Aluminum] Windows [_____] [AAMA/WDMA/CSA 101/I.S.2/A440] [SWI AGSW]. Screens for double-hung windows shall be [full length, top-hung type] [double vertical sliding type] [half-length fixed type]. Screens for [projected] [casement] [_____] windows shall be [_____] type. Mount screens on [inside] [outside] of windows. Screens shall be rewirable, easily removable from inside the building, and interchangeable for same size ventilators of similar type windows. Provide hardware, guides, stops, clips, bolts, and screws as necessary for a secure and tight attachment to window. [Where sliding or hinged wickets are required in screens to permit operation of window hardware, the frame around the wicket opening shall be of similar material and strengths as the screen frames.]

- a. Frames: Construct screen frames of similar material and finish as specified for the windows to which attached. Screen frame construction shall consist of closed tubular shapes standard with the manufacturer, either extruded or roll formed. Frames must be mitered, electrically flash welded, then dressed smooth; or have internal reinforcing or blocks at corners and mechanically connected corners. Screen frames shall have removable splines of aluminum, stainless steel, or vinyl.
- b. Screening: Weave of screening shall be parallel with frames and sufficiently tight to present a smooth appearance. Conceal edges of screening in spline channel of frames.
- c. Hardware: Screen hardware shall be manufacturer's standard type and finish, unless otherwise indicated.

2.1.19 Metal Accessories

[Gravel stops and fascias,] [Flashings,] [Metal sills,] [Metal stools,] [Louvers,] [Venetian blind pockets,] [Closures,] [and soffits] [_____] Fabricate accessories of sizes and shapes indicated from similar materials and finish as specified for wall system.

2.2 METALS FOR FABRICATION

2.2.1 Aluminum-Alloy Extrusions

Extrusions shall conform to ASTM B221M ASTM B221.

**NOTE: Delete the following paragraph when
integral-color anodic coating is not required.**

Extrusions to receive an integral-color anodic coating shall be the alloy and temper recommended by the aluminum producer for the specified finish with integral-color anodic coating and have mechanical properties equal to or exceeding those of 6063-T5.

2.2.2 Aluminum-Alloy Sheets and Plates

Unless otherwise specified, sheets and plates shall conform to ASTM B209M ASTM B209, Alloy 3003-H16.

Sheets and plates to receive a clear anodic coating shall conform to ASTM B209M ASTM B209, Alloy 5005-H16.

**NOTE: Delete the following paragraph when
integral-color anodic coating is not required.**

Sheets and plates to receive an integral-color anodic coating shall be the alloy and temper recommended by the aluminum producer for the specified coating and have mechanical properties equal to or exceeding those of 5005-H16.

2.2.3 Structural Steel

Hot-rolled shapes, plates, and bars shall conform to ASTM A36/A36M.

Hot-formed tubing shall conform to ASTM A501.

Sheet and strip for cold-formed, light-gage, structural members shall conform to ASTM A1011/A1011M.

2.2.4 Metals for Fasteners

Provide aluminum-alloy bolts and screws made from rod conforming to ASTM B211M, ASTM B211, Alloy 2024-T351.

Provide aluminum-alloy nuts made from rod conforming to ASTM B211M, ASTM B211, Alloy 6061-T6.

Provide aluminum-alloy washers made from sheet conforming to ASTM B209M ASTM B209, Alloy 2024-T4.

Provide aluminum-alloy rivets made from rod or wire conforming to ASTM B316/B316M, Alloy 6053-T61.

Provide steel fasteners made from corrosion-resistant chromium-nickel Type 302, 303, 304, 305, or 316 with the form and condition best suited for the

work.

2.3 NONSKINNING SEALING COMPOUND

Sealing compound shall be nonskinning, gun-grade type conforming to AAMA 800.

2.4 FABRICATION

2.4.1 Workmanship

Metal Accessories shall be accurately formed; joints, except those designed to accommodate movement, accurately fitted and rigidly assembled.

Insofar as practical, fitting and assembly of the work shall be done in the manufacturer's plant. Mark work that cannot be permanently factory-assembled before shipment to ensure proper assembly at the site.

2.4.2 Shop-Painting Aluminum

Shop prime aluminum surfaces that will come in contact with dissimilar metals, masonry, concrete, or wood.

Prepare aluminum surfaces for painting in accordance with ASTM D1730, Type B, Method 2 or 3.

Give aluminum surfaces one shop coat of paint applied to dry, clean, surfaces to provide a continuous minimum dry-film thickness of 1.5 mils. 0.038 millimeter.

2.4.3 Shop-Painting Steel

Shop prime surfaces of concealed steel.

Remove scale, rust, and other deleterious materials. Remove heavy rust and loose mill scale in accordance with SSPC SP 3 or SSPC 7/NACE No.4. Remove oil, grease, and similar contaminants in accordance with SSPC SP 1.

Give steel surfaces two coats of paint; the second coat shall have a color different from the first coat. Apply paint to dry, clean, surfaces to provide a continuous minimum dry-film thickness of 0.038 millimeter 1.5 mils for the first coat and 0.025 millimeter 1 mil for the second coat.

2.4.4 Depth of Glazing Rabbets

Depth of glazing rabbets for openings to receive glass materials or panels shall be as follows:

NOTE: Select as required to suit the glass
materials and panels used. Delete inapplicable
items.

<u>MATERIAL</u>	<u>NOMINAL THICKNESS</u>	<u>MAXIMUM SIZE</u>	<u>MINIMUM RABBET DEPTH</u>
Single-glass lights	Double strength	Up to 0.46 square meter	10 millimeter
	Double strength	Over 0.46 square meter	15 millimeter
	3 millimeter	Up to 0.46 square meter	10 millimeter
	3 millimeter	0.46 to 2.32 square meter	15 millimeter
	3 millimeter	2.32 to 6.5 square meter	16 millimeter
	4.5 millimeter	Up to 2.32 square meter	15 millimeter
	4.5 millimeter	Over 2.32 square meter	16 millimeter
	5.5 millimeter	All sizes	16 millimeter
	6 millimeter	Up to 9.3 square meter	16 millimeter
	6 millimeter	Over 9.3 square meter	20 millimeter
	8 millimeter	All sizes	20 millimeter
	10 millimeter	All sizes	22 millimeter
	15 millimeter	All sizes	22 millimeter
	20 millimeter	All sizes	22 millimeter
Double-glazing units	All thicknesses	Up to 2.23 square meter	16 millimeter
	All thicknesses	2.23 to 6.5 square meter	20 millimeter
Panels	Up to 25 mm	All sizes	16 millimeter
	25 to 40 mm	All sizes	20 millimeter

<u>MATERIAL</u>	<u>NOMINAL THICKNESS</u>	<u>MAXIMUM SIZE</u>	<u>MINIMUM RABBET DEPTH</u>
Single-glass lights	Double strength	Up to 5 square feet	3/8 inch
	Double strength	Over 5 square feet	1/2 inch
	1/8 inch	Up to 5 square feet	3/8 inch
	1/8 inch	5 to 25 square feet	1/2 inch
	1/8 inch	25 to 70 square feet	5/8 inch
	3/16 inch	Up to 25 square feet	1/2 inch
	3/16 inch	Over 25 square feet	5/8 inch
	7/32 inch	All sizes	5/8 inch
	1/4 inch	Up to 100 square feet	5/8 inch
	1/4 inch	Over 100 square feet	3/4 inch
	5/16 inch	All sizes	3/4 inch
	3/8 inch	All sizes	7/8 inch
	1/2 inch	All sizes	7/8 inch
	3/4 inch	All sizes	7/8 inch
Double-glazing units	All thicknesses	Up to 25 square feet	5/8 inch
	All thicknesses	25 to 70 square feet	3/4 inch
Panels	Up to 1 inch	All sizes	5/8 inch
	1 to 1-1/2 inches	All sizes	3/4 inch

2.4.5 Finish

Exposed-to-View Aluminum Finish of surfaces must be:

NOTE: Delete the following finishes that are not required. Where more than one is required, the location of each must be indicated on the drawing.

Frosted finish with Class II clear anodic coating: Medium-matte chemical etch and Architectural Class II (0.01 to 0.018 millimeter thickness) anodic coating producing a natural aluminum color. Finish shall be AA C22-A31 in accordance with AA DAF45.

Frosted finish with Class I clear anodic coating: Medium-matte chemical etch and Architectural Class I (0.018 millimeter and greater thickness)

anodic coating producing a natural aluminum color. Finish shall be AA C22-A41 in accordance with AA DAF45.

Polished frosted finish with Class II clear anodic coating: Smooth specular-buffed mechanical, followed by a medium-matte chemical etch and Architectural Class II (0.01 to 0.018 millimeter thickness) anodic coating producing a natural aluminum color. Finish shall be AA M21-C22-A31 in accordance with AA DAF45.

Frosted finish with Class II clear anodic coating: Medium-matte chemical etch and Architectural Class II (0.4- to 0.7-mil thickness) anodic coating producing a natural aluminum color. Finish shall be AA C22-A31 in accordance with AA DAF45.

Frosted finish with Class I clear anodic coating: Medium-matte chemical etch and Architectural Class I (0.7-mil and greater thickness) anodic coating producing a natural aluminum color. Finish shall be AA C22-A41 in accordance with AA DAF45.

Polished frosted finish with Class II clear anodic coating: Smooth specular-buffed mechanical, followed by a medium-matte chemical etch and Architectural Class II (0.4- to 0.7-mil thickness) anodic coating producing a natural aluminum color. Finish shall be AA M21-C22-A31 in accordance with AA DAF45.

NOTE: It is recommended that a sample of the required color be on display where it may be seen by bidders during the bidding period.

Polished frosted finish with integral-color anodic coating: Smooth specular buffed mechanical, followed by nonetching inhibitive alkaline cleaning, medium-matte chemical etch, and Architectural Class I (0.018 millimeter 0.7-mil and greater thickness) anodic coating producing an integral-color finish. Color shall be:

[Light bronze] [Medium bronze] [Dark bronze] [Black]

NOTE: The following paragraph must be included.

Match aluminum-finish color and appearance to that of the sample approved for use in the project within the aluminum producer's standard color range.

NOTE: Delete the following paragraphs when an anodic coating is not required.

Test the anodic coating on aluminum for thickness in accordance with ASTM B244.

Test anodically coated aluminum for the weight of the coating in accordance with ASTM B137.

Test the resistance of anodically coated aluminum to staining by dyes in accordance with ASTM B136.

2.5 CURTAIN-WALL FRAMING MEMBERS

NOTE: Size and arrangement of all framing members must be indicated on the drawings. Curtain-wall system manufacturer's stock sizes and shapes should be used. Frame depth shall be coordinated with the window sash, panels, single-glass lights, double-glazing units, and louvers and other metal accessories that are to be incorporated into the curtain-wall system.

2.5.1 General

Framing members shall be the section dimensions and arrangement indicated and designed to accommodate windows, panels, and other materials to be incorporated into the curtain-wall system.

[Curtain-wall framing shall be the vertical mullion type with the vertical mullions extending the indicated distance beyond the exterior face of the curtain wall.

] [Curtain-wall framing shall be the grid type with both the vertical and horizontal mullions extending the indicated distance beyond the exterior face of the curtain wall.

] 2.5.2 Construction

Framing members shall be aluminum-alloy extrusions with a wall thickness not less than 3.1 millimeter 0.125 inch. Glazing rabbet legs shall be an integral part of the frame with the leg depth not less than the minimum depth specified for the thickness and size of the glass material or panel to be installed in the curtain-wall frame. Design and construct frames to receive window sash and louvers of the type specified when required.

Prepare vertical mullions for anchorage to the building construction at the bottom, at each intermediate floor elevation, and at the top.

[Corners of frames shall be mortise-and-tenon construction except that the corners of the vertical and horizontal mullions in grid frames shall be coped-and-welded construction. Welds shall be on the unexposed surfaces. Corner joints shall be accurately fitted and flush, with watertight hairline joints not exceeding 0.4 millimeter 1/64 inch in width. Apply nonskinning sealing compound to the unexposed surfaces of all mortise-and-tenon joints.

] [Corners of frames shall be coped and welded construction. Welds shall be on the unexposed surfaces. Corner joints shall be accurately fitted and flush, with watertight hairline joints not exceeding 0.4 millimeter 1/64 inch in width.

] 2.6 ALUMINUM DOORS AND FRAMES

NOTE: Delete the paragraph heading and the following paragraph when aluminum doors and frames are not a part of the curtain-wall system.

Aluminum doors and frames are specified in Section 08 11 16 ALUMINUM DOORS AND FRAMES.

2.7 METAL ACCESSORIES

2.7.1 Sills

NOTE: Delete the paragraph heading and the following paragraphs if sills are not required. Sills must be detailed on the drawings.

Sills shall be the shapes and dimensions indicated and fabricated of aluminum-alloy extrusions having a wall thickness not less than 3 millimeter. 0.125 inch.

Sills shall run continuously under the curtain wall and permit the lower curtain wall frame member to interlock without fastenings.

2.7.2 Coping

NOTE: Delete the paragraph heading and the following paragraphs if coping is not required. Coping must be detailed on the drawings.

Coping shall be the shapes and dimensions indicated and welded mitered inside and outside corner sections, concealed cover plates, and other components as required for the installation.

Coping-system components shall be aluminum-alloy extrusions with wall thicknesses of 1.2 millimeter 0.05 inch, minimum.

2.7.3 Exterior Architectural Louvers

NOTE: Delete the paragraph heading and the following paragraph when exterior architectural louvers are not required.

Exterior architectural louvers are specified in Section 05 72 00 DECORATIVE METAL SPECIALTIES.

2.8 PANELS

NOTE: Delete the paragraph heading and the following paragraphs when panels are not required. Only metal-faced laminated panels are specified. If another panel type is used, revise the specifications to suit the project. Indicate locations and dimensions of panels on the drawings.

2.8.1 Panel Type

NOTE: Coordinate panel thickness with the
curtain-wall framing used in the work.

Panels shall be metal-faced laminated both sides, consisting of exterior metal facing, facing backing, insulating core, facing backing, and interior metal facing. Facing-panel dimensions shall be as indicated.

2.8.2 Exterior Metal Facing

Facing shall be Porcelain-Enamel on steel. Base metal shall be steel sheets for porcelain enameling, 0.25 to 0.38 millimeter 0.010 to 0.015 inch thick, of the quality and type best suited for the work, stretcher level standard of flatness, conforming to ASTM A424/A424M, and properly precleaned and treated for adherence of the porcelain enamel.

Porcelain-enamel processing, corrosion protection, weather resistance, color retention of red, yellow, and orange porcelain enamels, continuity of coating, and surface appearance shall meet or exceed the requirements specified in PEI 1001.

NOTE: PEI designates color of porcelain enamel by the munsell color system (hue, value/chroma). 47 standard colors are shown in PEI CG-3, "Color Guide for Architectural Porcelain Enamel." The following paragraph illustrates the method of specifying the color of porcelain enamel and must be revised as required to suit the project.

Color of porcelain-enamel exposed-to-view surfaces shall be PEI CG-3Ivory (Munsell number by 8.7/3.4) and match the color of the approved samples.

NOTE: Select one of the following paragraphs.

Gloss of exposed-to-view surfaces shall be [high] [medium] [low] reflectivity.

2.8.3 Facing Backing

Nominal 3 millimeter 1/8-inch thick, flat non-asbestos-cement sheets, flexible smooth-one-side surface finish, conforming to ASTM C220, Type F.

2.8.4 Core Insulation

- [Core shall be expanded perlite conforming to ASTM C610.
-] [Core shall be rigid urethane conforming to ASTM C591, Type 2.
-] [Core shall be preformed block polystyrene conforming to ASTM C578, Type II.
-] [Core shall be cellular glass conforming to ASTM C552.]

[Core shall be mineral fiberboard conforming to [ASTM C612] [ASTM C553] [ASTM C592] [ASTM C547]].

2.8.5 Interior Metal Facing

[Facing shall be 0.7 millimeter 24-gage galvanized-steel sheets conforming to ASTM A653/A653M, coating Z275. G90.

] [Facing shall be as specified for exterior metal facing.

] 2.8.6 Panel Fabrication

Securely bond panel materials together to form a stable and durable composite unit. Panels with core insulation of absorptive material shall have edges sealed and provide venting to the outside air. Provide panels that conform to the following:

Flatness: Provide exterior surfaces of such flatness that, when measured at room temperature, the maximum slope of the surface at any point, measured from the nominal plane of the surface, that do not exceed the following:

1.0 percent for surfaces having a finish of high reflectivity

1.25 percent for surfaces having a finish of medium reflectivity

1.5 percent for surfaces having a finish of low reflectivity

Structural requirements: Panels of the maximum size required by the work, when supported in the manner intended, shall withstand the windload specified without permanent deformation or damage.

Accelerated aging: Panels shall show no evidence of delamination, warpage, or other deterioration or damage after completion of six accelerated aging cycles in accordance with ASTM C481, Cycle A.

Thermal transmittance: U-factor of a panel, when a panel not less than 1 square meter 10 square feet in area and of identical construction is tested in accordance with ASTM C1363, shall be as follows:

NOTE: Before selecting the U-factor, the panel thickness and insulation-core material must be determined.

Not more than [0.57] [0.85] [1.14] [1.42] [1.70] [2.27] [2.56] watt/square meter-degrees C [0.10] [0.15] [0.20] [0.25] [0.30] [0.40] [0.45] Btu/hr-square foot-degree F.

2.9 THERMAL INSULATION MATERIALS

NOTE: Delete the paragraph heading and the following paragraph when thermal insulation materials are not required. Location of the curtain-wall system to be insulated, type of thermal insulation material to be used, and the nominal thickness of the insulation material shall be

indicated. Select the appropriate insulation system(s) Section Reference and delete those which are not applicable.

Thermal insulation materials are specified in [Section 07 21 16 MINERAL FIBER BLANKET INSULATION] [Section 07 21 13 BOARD AND BLOCK INSULATION] [Section 07 21 23 LOOSE FILL THERMAL INSULATION] [Section 07 24 00 EXTERIOR INSULATION AND FINISH SYSTEMS] [_____].

2.10 SEALANTS AND CAULKINGS

NOTE: Delete the paragraph heading and the following paragraph when sealants and caulking are not required for installation of curtain wall.

Sealants and caulking are specified in Section 07 92 00 JOINT SEALANTS.

2.11 CURTAIN-WALL INSTALLATION MATERIALS

NOTE: Delete the following installation materials that are not applicable.

Concrete inserts should be used for fastening the specified work to cast-in-place concrete construction when the anchorage device will be subjected to direct pullout loadings. Indicate concrete inserts on the drawings.

2.11.1 Threaded Concrete Inserts

Galvanized ferrous castings with enlarged bases with not less than two nailing lugs, length as indicated, internally threaded 20 millimeter 3/4-inch diameter machine bolt shall conform to ASTM A47/A47M, Grade [32510] [35018] [Grade 22010] or ASTM A27/A27M, Grade U-60-30, and hot-dip galvanized in accordance with ASTM A153/A153M.

2.11.2 Wedge Concrete Inserts

Galvanized, box-type, ferrous castings with an integral loop at the back of the box and designed for 20 millimeter 3/4-inch diameter bolts with wedge-shaped heads shall conform to ASTM A47/A47M, Grade [32510] [35018] or ASTM A27/A27M, Grade U-60-30, and hot-dip galvanized in accordance with ASTM A153/A153M.

Carbon steel bolts with wedge-shaped heads, nuts, washers, and shims shall be hot-dip galvanized in accordance with ASTM A153/A153M.

2.11.3 Slotted Concrete Inserts

Galvanized pressed-steel plate, welded construction, box type with a slot designed for 20 millimeter 3/4-inch diameter square-head bolts to provide lateral adjustment shall be 3 millimeter 1/8-inch minimum thickness, conforming to ASTM A283/A283M, Grade C, hot-dip galvanized in accordance with ASTM A123/A123M. Length of the insert body less anchorage lugs shall

be 155 millimeter 6 inches minimum and provided with a knockout cover.

2.11.4 Masonry Anchorage Devices

NOTE: Masonry anchorage devices should be used only for fastening materials to solid masonry and concrete-in-place construction when the anchorage device will not be subjected to direct pullout nor to vibration. Masonry anchorage devices should be used only for nonvibratory shear loads such as for fastening sash-pole hangers, door frames, and door thresholds.

2.11.5 Toggle Bolts

Toggle bolts shall be the tumble-wing type.

2.11.6 Steel Bolts, Nuts, and Washers

Bolts shall be regular hexagon head, low-carbon steel.

Nuts shall be hexagon, regular style, carbon steel.

Plain washers shall be round, general-assembly purpose, carbon steel.

Lockwashers shall be helical spring, carbon steel.

2.11.7 Machine Screws

Provide screws for concealed work that are corrosion-resistant steel, slotted or cross-recessed type, roundhead.

Provide screws for exposed-to-view work that are corrosion-resistant steel, cross-recessed, flathead.

2.11.8 Electrodes for Welding Steel

Electrodes for welding steel by the manual shielded metal arc welding process shall meet the requirements of AWS D1.1/D1.1M and be covered mild-steel electrodes conforming to AWS A5.1/A5.1M, E60 series.

PART 3 EXECUTION

3.1 GENERAL

Install curtain walls and accessories in accordance with the approved drawings and as specified.

3.2 FABRICATION

Provide curtain wall components of the materials and thickness indicated or specified. The details indicated are representative of the required design and profiles. Acceptable designs may differ from that shown if the proposed system components conform to the limiting dimensions indicated and the requirements specified herein. Unless specifically indicated or specified otherwise, the methods of fabrication and assembly shall be at the discretion of the curtain wall manufacturer. Perform fitting and

assembling of components in the shop to the maximum extent practicable. Provide anchorage devices shall permit adjustment in three directions. Exposed fastenings used on finished surfaces shall be truss head, flat head, or oval head screws or bolts.

3.2.1 Joints

Provide welded or mechanical fasteners as indicated or specified. Match joints in exposed work to produce continuity of line and design. Bed-joints or rabbets receiving caulking or sealing material shall be minimum 20 mm 3/4 inch deep and 10 mm 3/8 inch wide at mid ambient temperature range.

3.2.2 Welding

Conform to AWS D1.1/D1.1M. Use methods and electrodes recommended by manufacturers of base metal alloys. Provide welding rods of an alloy that matches the color of the metal being welded. Protect glass and other finish from exposure to welding spatter. Ground and finish weld beads on exposed metal surfaces to minimize mismatch and to blend with finish on adjacent parent metal. If flux is used in welding aluminum, completely remove it immediately upon completion of welding operations. Do not use exposed welds on aluminum surfaces.

3.2.3 Soldering and Brazing

Provide as recommended by suppliers. Solder only for filling or sealing joints.

3.2.4 Ventilation and Drainage

Provide internal ventilation drainage system of weeps or based on principles of pressure equalization to ventilate the wall internally and to discharge condensation and water leakage to exterior as inconspicuously as possible. Flashings and other materials used internally shall be nonstaining, noncorrosive, and nonbleeding.

3.2.5 Protection and Treatment of Metals

3.2.5.1 General

Remove from metal surfaces lubricants used in fabrication and clean off other extraneous material before leaving the shop.

3.2.5.2 Galvanic Action

Provide protection against galvanic action wherever dissimilar metals are in contact, except in the case of aluminum in permanent contact with galvanized steel, zinc, stainless steel, or relatively small areas of white bronze. Paint contact surfaces with one coat bituminous paint or apply appropriate caulking material or nonabsorptive, noncorrosive, and nonstaining tape or gasket between contact surfaces.

3.2.5.3 Protection for Aluminum

Protect aluminum which is placed in contact with, built into, or which will receive drainage from masonry, lime mortar, concrete, or plaster with one coat of alkali-resistant bituminous paint. Where aluminum is contacted by absorptive materials subject to repeated wetting or treated with preservative noncompatible with aluminum, apply two coats of aluminum

paint, to such materials and seal joints with approved caulking compound.

3.3 INSTALLATION

Installation and erection of glazed wall system and all components shall be performed under direct supervision of and in accordance with approved recommendations and instructions of wall system manufacturer or fabricator.

3.3.1 Bench Marks and Reference Points

Establish and permanently mark bench marks for elevations and building line offsets for alignment at convenient points on each floor level. Should any error or discrepancy be discovered in location of the marks, stop erection work in that area until discrepancies have been corrected.

3.3.2 Verifying Conditions and Adjacent Surfaces

After establishment of lines and grades and prior to system installation examine supporting structural elements. Verify governing dimensions, including floor elevations, floor to floor heights, minimum clearances between curtain wall and structural frames, and other permissible dimensional tolerances in the building frame.

3.3.3 Panels

Install panels [in framing member openings] [into framed pre-assembled units] [_____] using [sealants] [gaskets] [gaskets and sealants] [_____] as indicated or specified.

3.3.4 Windows

Install windows in accordance with details indicated and approved detail drawings.

3.3.4.1 Sealing

Seal exterior metal to metal joints between members of windows, frames, mullions, and mullion covers. Remove excess sealant.

3.3.4.2 Ventilators and Hardware

After installing and glazing windows, adjust ventilators and hardware to operate smoothly and to be weathertight when ventilators are closed and locked. Lubricate hardware and moving parts.

3.3.4.3 Weatherstripping

Install to make weathertight contact with frames when ventilators are closed and locked. Do not cause binding of sash or prevent closing and locking of ventilator.

Provide for ventilating sections of all windows to insure a weather-tight seal meeting the infiltration tests specified. Use easily replaceable factory-applied weatherstripping of manufacturer's stock type. Use molded vinyl, molded or molded-expanded neoprene for weatherstripping for compression contact surfaces. For sliding surfaces, use treated woven pile or wool, polypropylene or nylon pile with nylon fabric and metal or plastic backing strip weatherstripping. Do not use neoprene or polyvinyl chloride weatherstripping where they will be exposed to direct sun light.

3.3.5 Joint Sealants

3.3.5.1 Surface Preparation

Surfaces to be primed and sealed shall be clean, dry to the touch, free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter. Enclose joints on three sides. Clean out grooves to proper depth. Joint dimensions shall conform to approved detail drawings with a tolerance of plus 3 mm 1/8 inch. Do not apply compound unless ambient temperature is between 4 and 32 degrees C 40 and 90 degrees F. Clean out loose particles and mortar just before sealing. Remove protective coatings or coverings from surfaces in contact with sealants before applying sealants or tapes. Solvents used to remove coatings shall be of type that leave no residue on metals.

3.3.5.2 Applications

Match approved sample. Force compound into grooves with sufficient pressure to fill grooves solidly. Sealing compound shall be uniformly smooth and free of wrinkles and, unless indicated otherwise, tooled and left sufficiently convex to result in a flush joint when dry. Do not trim edges of sealing material after joints are tooled. Mix only amount of multi-component sealant which can be installed within four hours, but at no time shall this amount exceed 19 liters 5 gallons.

3.3.5.3 Primer

Apply to masonry, concrete, wood, and other surfaces as recommended by sealant manufacturer. Do not apply primer to surfaces which will be exposed after caulking is completed.

3.3.5.4 Backing

Tightly pack in bottom of joints which are over 13 mm 1/2 inch in depth with specified backing material to depth indicated or specified. Roll backing material of hose or rod stock into joints to prevent lengthwise stretching.

3.3.5.5 Bond Prevention

Install bond preventive material at back or bottom of joint cavities in which no backstop material is required, covering full width and length of joint cavities.

3.3.5.6 Protection and Cleaning

Remove compound smears from surfaces of materials adjacent to sealed joints as the work progresses. Use masking tape on each side of joint where texture of adjacent material will be difficult to clean. Remove masking tape immediately after filling joint. Scrape off fresh compound from adjacent surfaces immediately and rub clean with approved solvent. Upon completion of caulking and sealing, remove remaining smears, stains, and other soiling, and leave the work in clean neat condition.

3.3.6 Glass

Install in accordance with manufacturer's recommendations as modified herein. [Install insulating glass units made with heat absorbing glass

with heat absorbing pane on exterior side.]

3.3.6.1 Inspection of Sash and Frames

Before installing glass, inspect sash and frames to receive glass for defects such as dimensional variations, glass clearances, open joints, or other conditions that will prevent satisfactory glass installation. Do not proceed with installation until defects have been corrected.

3.3.6.2 Preparation of Glass and Rabbets

Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying glazing compound, sealing compound, glazing tape, or gaskets. Use only approved solvents and cleaning agents recommended by compound or gasket manufacturer.

3.3.6.3 Positioning Glass

Set glass from inside the building unless otherwise indicated or specified. Maintain specified edge clearances and glass bite at perimeter. Maintain position of glass in rabbet and provide required sealant thickness on both sides of glass. For glass dimensions larger than 1270 united millimeters 50 united inches, provide setting blocks at sill and spacer shims on all four sides; locate setting blocks one quarter way in from each jamb edge of glass. Where setting blocks and spacer shims are set into glazing compound or sealant, butter with compound or sealant, place in position, and allow to firmly set prior to installation of glass.

3.3.6.4 Setting Methods

NOTE: Select methods applicable to the project conditions and details. Delete non-applicable methods. Methods listed are typical for many glass and sealant manufacturers; other suitable methods may also be included.

Apply glazing compound, glazing sealant, glazing tape, and gaskets uniformly with accurately formed corners and bevels. Remove excess compound from glass and sash. Use only recommended thinners, cleaners, and solvents. Strip surplus compound from both sides of glass and tool at slight angle to shed water and provide clean sight lines. Secure stop beads in place with suitable fastenings. Do not apply compound or sealant at temperatures lower than 4 degrees C 40 degrees F, or on damp, dirty, or dusty surfaces. After glazing, fix ventilators in sash so they cannot be operated until compound or sealant has set.

- a. Use sealant glazing to completely fill channel on edges and on both sides of glass for [____].
- b. Use sealant and tape glazing, with glazing sealant for cap bead above glazing tape against fixed exterior stops and glazing tape full height against removable interior stops for [____].
- c. Use sealant and tape glazing, with glazing sealant full height against removable exterior stops with heel bead or glazing sealant and glazing tape full height against fixed interior stops for [____].

- d. Use sealant and tape glazing, with glazing sealant cap beads above glazing tape against both exterior and interior stops for [____]. Removable stops may be on either exterior or interior side of glass.
- e. Use tape, sealant, and compound glazing, with glazing tape full height against fixed exterior stops, glazing compound as a cap bead above heel bead sealant and against removable interior stops for [____].
- f. Use tape, sealant, and gasket glazing, with glazing tape full height against fixed exterior stops, glazing sealant as a heel bead at edge of glass, and preformed vision strip gasket against removable interior snap-on stops for [____].
- g. Use compression gasket glazing, with compression gaskets both sides of glass and adjustable or snap-on interior stops for [____].
- h. Use lock-strip gasket glazing, with lock-strip glazing gaskets for [____]. Install gaskets in accordance with manufacturer's instructions using special tools and lubricants. When lock-strip type gaskets are used for glazing insulating glass units, follow glass manufacturer's recommendations regarding horizontal wall supports between vertical units, setting blocks, weep holes, and the use of supplementary wet sealants.

3.3.6.5 Void Space

Heat absorbing, insulating, spandrel, and tempered glass, and glass of other types that exceed 2540 united millimeters 100 united inches in size: Provide void space at head and jamb to allow glass to expand or move without exuding the sealant.

3.3.6.6 Insulating Glass

Provide adequate means to weep incidental water and condensation away from the sealed edges of insulated glass units and out of the wall system. The weeping of lock-strip gaskets should be in accordance with the recommendation of the glass manufacturer.

3.3.6.7 Insulating Glass With Edge Bands

Insulating glass with flared metal edge bands set in lock-strip type gaskets: Follow glass manufacturer's recommendations and add supplementary wet seal as required; when used with glazing tape, use tapered tape.

3.3.7 Firestopping

Provide firestopping [, where indicated,] in openings between wall system and floor at each story to prevent passage of flame and hot gases from floor to floor under extended fire exposure. Installed fire stopping shall remain in place under extended fire exposure despite distortions that may occur in wall system components. Securely attach anchoring or containment devices to building structure and not to wall system. Place [concrete] [mineral fiber] [____] on [steel plates attached to bottom of floor slab] [impaling chips embedded in edge of floor slab] [____].

3.3.8 Field Applied Insulation

NOTE: Where project specifications do not include a

separate section for field applied insulation, add here and delete cross-reference to other section. Where field applied insulation is specified in another section, keep cross-reference and coordinate fire rating and U-value with the other section. See paragraph entitled "Fire Resistance Tests" for fire rating requirements of insulation.

NOTE: Insert appropriate Section number and title in blank below using format per UFC 1-300-02.

Provide insulation with minimum R-value of [____], on clean, dry, properly prepared surfaces of [masonry] [concrete] [____] back-up wall in accordance with [____] INSULATION using approved accessories and methods as recommended by insulation manufacturer unless indicated or specified otherwise. Cover and protect each day's application until protection is provided by completed work.

3.4 FINISHES

3.4.1 Galvanizing

Conform to ASTM A123/A123M, ASTM A153/A153M, and ASTM A653/A653M, as applicable.

3.4.1.1 Repair of Zinc-Coated Surfaces

Repair zinc coated surfaces damaged by welding or other means with galvanizing repair paint or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved.

3.4.2 Shop Cleaning and Painting

3.4.2.1 Cleaning

Clean steel and iron work by power wire brushing or other approved manual or mechanical means, for removal of rust, loose paint, scale, and deleterious substances. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other foreign matter, with solvents until thoroughly clean. Cleaning steel embedded in concrete is not required.

3.4.2.2 Painting Steel or Iron Surfaces

[Apply one coat of primer.] [Apply primer to a minimum dry film thickness of 0.025 mm 1.0 mil.] Apply additional shop coat of specified paint, to which a small amount of tinting material has been added, on surfaces that will be concealed in the finished construction or that will not be accessible for finish painting. Accomplish painting in dry weather or under cover, and on steel or iron surfaces that are free from moisture and frost. Do not paint surfaces of items to be embedded in concrete. Recoat damaged surfaces upon completion of work. Prime coat steel immediately after cleaning. Do not apply bituminous protective coatings to items to be finish painted.

3.4.2.3 Painting Weathering Steel

Clean and paint surfaces which will not be exposed to the weather with one shop or field coat of specified primer, or other approved rust-inhibitive primer. Clean and strip-paint weathering steel contact surface to be covered by structural or compression gaskets or sealants with one coat to insure positive seal.

3.5 FIELD TESTS

Conduct field check test for water leakage on designated wall areas after erection. Conduct test on [two] [_____] wall areas, two bays wide by two stories high where directed. Conduct test and take necessary remedial action as described in AAMA 501.1.

3.6 CLEANING AND PROTECTION

3.6.1 General

At the completion of the installation, clean the work to remove mastic smears and other foreign materials.

3.6.2 Glass

Upon completion of wall system installation, thoroughly wash glass surfaces on both sides and remove labels, paint spots, putty, compounds, and other defacements. Replace cracked, broken, and defective glass with new glass at no additional cost to the Government.

3.6.3 Aluminum Surfaces

Protection methods, cleaning, and maintenance shall be in accordance with AAMA 609 & 610.

3.6.4 Other Metal Surfaces

After installation, protect windows, panels, and other exposed surfaces from disfiguration, contamination, contact with harmful materials, and from other construction hazards that will interfere with their operation, or damage their appearance or finish. Protection methods must be in accordance with recommendations of product manufacturers or of the respective trade association. Remove paper or tape factory applied protection immediately after installation. Clean surfaces of mortar, plaster, paint, smears of sealants, and other foreign matter to present neat appearance and prevent fouling of operation. In addition, wash with a stiff fiber brush, soap and water, and thoroughly rinse. Where surfaces become stained or discolored, clean or restore finish in accordance with recommendations of product manufacturer or the respective trade association.

3.6.5 Porcelain-Enamel Surfaces

**NOTE: Delete the paragraph heading and the
following paragraph when porcelain-enamel faced
panels are not required.**

Wash surfaces with clean water and soap and rinsed with clean water. Do not use acid solutions, steel wool, or other harsh abrasives.

3.7 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>
Glass	1/4 inch	6 mm

3.8 MATERIALS EMBEDDED IN OTHER CONSTRUCTION

Install materials to be embedded in cast-in-place concrete and masonry prior to the installation of the curtain wall. Provide setting drawings, templates, and instructions for installation.

3.9 FASTENING TO CONSTRUCTION-IN-PLACE

Provide anchorage devices and fasteners for fastening work to construction-in-place. Provide fasteners as specified.

3.10 SETTING MASONRY ANCHORAGE DEVICES

NOTE: Delete the paragraph heading and the following paragraph when masonry anchorage devices are not required (such as for securing sash-pole hangers, door frames, and door thresholds).

Set devices in masonry or concrete-in-place construction in accordance with the manufacturer's printed instructions. Leave drilled holes rough and free of drill dust.

3.11 FIELD-WELDING STEEL AND TOUCHUP PAINTING

NOTE: Delete the paragraph heading and the following paragraphs when field-welding of steel is not required.

Procedures of manual shielded metal arc welding, the appearance and quality of the welds made, and the methods used in correcting welding work shall conform to AWS D1.1/D1.1M.

After completion of welding, clean and paint field welds and scarred surfaces on steel work and on adjacent ferrous-metal surfaces. Paint shall be the same as that used for shop painting.

3.12 INSTALLATION TOLERANCES

Install curtain walls within the following tolerances:

Deviation in location from that indicated on the drawings	Plus or minus 6 millimeter
Deviation from the plumb or horizontal	
In 3660 millimeter of length	Not more than 3 millimeter
In any total length	Not more than 15 millimeter
Offset from true alignment at joints between abutting members in line	Not more than 1 millimeter

Deviation in location from that indicated on the drawings	Plus or minus 1/4 inch
Deviation from the plumb or horizontal	
In 12 feet of length	Not more than 1/8 inch
In any total length	Not more than 1/2 inch
Offset from true alignment at joints between abutting members in line	Not more than 1/16 inch

3.13 PLACING CURTAIN-WALL FRAMING MEMBERS

Install members plumb, level, and within the limits of the installation tolerances specified.

Connect members to building framing. Provide supporting brackets adjustments for the accurate location of curtain-wall components. Adjustable connections shall be rigidly fixed after members have been positioned.

3.14 PANEL INSTALLATION

NOTE: Delete the paragraph heading and the following paragraph when panels are not required.

Panels shall be set with a glazing-tape back bed, two-component elastomeric sealing-compound heel bead, glazing-tape bedding of the stop, and two-component elastomeric sealing-compound topping bead on both sides of the panel. Face and edge clearances shall not be less than 3 millimeter 1/8 inch. Remove excess sealing compound on both sides of the curtain wall opening with a glazing knife at a slight angle over the rabbet leg or applied stop. Install applied stops on the exterior side of the curtain wall and secured with screws.

3.15 INSPECTION AND ACCEPTANCE PROVISIONS

3.15.1 Finished Curtain-Wall System Requirements

Curtain-wall work shall be rejected for any of the following deficiencies:

NOTE: Delete any of the following paragraphs that
are not applicable.

Finish of exposed-to-view aluminum having color and appearance that are outside the color and appearance range of the approved samples.

Installed curtain-wall components having stained, discolored, abraded, or otherwise damaged exposed-to-view surfaces that cannot be cleaned or repaired.

Aluminum surfaces in contact with dissimilar materials that are not protected as specified.

3.15.2 Repair of Defective Work

Remove and replace defective work with curtain-wall materials that meet the specifications at no expense to the Government.

-- End of Section --