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Preparing Activity: NASA Superseding
UFGS-08 44 00.00 40 (April 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2007

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CURTAIN WALL AND GLAZED ASSEMBLIES 07/07

NOTE: This specification covers the requirements for 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:

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.

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.

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:

Field-applied thermal insulation, glass and glazing, and field-applied joint sealing

Drawings must include a complete design of the work to be performed and must indicate the following:

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

Anchorage devices embedded in other construction

Windows showing types, sizes, ventilators, dimensions, shapes, and sizes of members, and the relationship of each window sash to the curtain-wall system

Insect screens showing locations, dimensions, shapes, and sizes of members

Shade screens showing locations, dimensions, shapes, and sizes of members

Location of window cleaners' bolts

Panels showing all dimensions, edge detail, and the relationship of panels to the curtain-wall system

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

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

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

Openings to be glazed with double-glazing units

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

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 and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of

technical proponents, including their organization designation and telephone number, is on the Internet.

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

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 ADM1 (2005) Aluminum Design Manual

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800 (2005) Voluntary Specifications and Test Methods for Sealants

AAMA WSG.1 (1995) Window Selection Guide

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121 (2004) Standard Definitions for Use in the Design of Steel Structures

AISI/COS/NASPEC (2001, R 2002) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 1011/A 1011M	(2006b) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(2005) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 283/A 283M	(2003) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 424	(2006) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A 47/A 47M	(2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 501	(2001; R 2005) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM B 136	(2003) Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum
ASTM B 137	(1995; R 2004) Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum
ASTM B 209	(2006) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 209M	(2006) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 211	(2003) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 211M	(2003) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 244	(1997; R 2002) Standard Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B 316/B 316M	(2002) Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods
ASTM C 1363	(2005) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C 220	(1991; R 2004e1) Standard Specification for Flat Asbestos-Cement Sheets
ASTM C 481	(1999; R 2005) Standard Test Method Laboratory Aging of Sandwich Constructions
ASTM C 552	(2003) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 578	(2006) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2005) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 610	(2005) Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM D 1730	(2003) Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting

NATIONAL WOOD WINDOW AND DOOR ASSOCIATION (NWWDA)

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

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI 1001 (1996) Specification for Architectural Porcelain Enamel (ALS-100)

PEI CG-3 (2005) Color Guide for Architectural Porcelain Enamel

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1 (1982; E 2004) Solvent Cleaning

SSPC SP 3 (2004e1) Power Tool Cleaning

SSPC SP 7 (2000; E 2004) Brush-Off Blast Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-344 (Rev A) Lacquer (Clear Gloss)

FS HH-I-558 (Rev C) Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)

FS TT-C-494 (Rev B; Notice 1) Coating Compound, Bituminous, Solvent Type, Acid Resistant

FS TT-P-645 (Rev B) Primer, Paint, Zinc-Molybdate, Alkyd Type

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. Submittals should be kept to the minimum required for adequate quality control.

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

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority.

Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, 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

Fabrication drawings for the following items shall be in accordance with the paragraph entitled, "Fabrication," of this section.

Shop Painting Aluminum
Shop Painting Steel
Finish
Metal Accessories

Installation Drawings shall be submitted in accordance with paragraph entitled, "Drawings," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Metals for Fabrication
Paint Materials
Glazing Materials
Nonskinning Sealing Compound
Curtain Wall Frame
Aluminum Windows
Aluminum Doors and Frames
Metal Accessories
Panels
Thermal Insulation Materials
Glass and Glazing
Sealants and Calkings
Curtain-Wall Installation Materials

SD-04 Samples

Contractor shall provide the following samples:

Three 80 by 150 millimeter 3- by 6-inch samples of Exposed-to-View

Aluminum Finish.

Three samples of each type of Masonry Anchorage Devices.

Three 80 by 150 millimeter 3- by 6-inch samples of Porcelain-Enamel finish.

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section, and showing porcelain-enamel-faced panels provided under this contract shall not develop crazing, cracking, or color fading for 10 years from the date of acceptance.

Metals for Fabrication
Paint Materials
Glazing Materials
Nonskinning Sealing Compound
Curtain-Wall Framing Members
Aluminum Windows
Aluminum Doors and Frames
Metal Accessories
Panels
Thermal Insulation Materials
Glass and Glazing
Sealants and Calkings
Curtain-Wall Installation Materials

SD-08 Manufacturer's Instructions

Preventive Maintenance and Inspection information shall be provided by the Contractor in accordance with paragraph entitled, "Manufacturer's Information," of this section.

1.3 INTERPRETATION OF AWS CODE

NOTE: If Section 05 05 23 WELDING, STRUCTURAL is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 05 05 23 WELDING, STRUCTURAL 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."

1.4 QUALIFICATIONS FOR THE CURTAIN-WALL INSTALLER

A written description of the proposed curtain-wall system installer shall be submitted 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.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Allowable Design Stresses

Aluminum-alloy framing member allowable design stresses shall be in accordance with the requirements of AA ADM1 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/COS/NASPECSG570 pertaining to structural members formed from the specified structural-steel sheet or strip.

1.5.2 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 millimeter (30 to 49 feet) 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 mph) 100 mile-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 millimeter (40 feet) 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 mph) 100 mile-per-hour wind velocity, and for a height zone of 9100 millimeter (30 feet) 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 millimeter (30 feet) 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 millimeter (30 feet) 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.

1.5.3 Structural Capacity

Curtain-wall system, including framing members, windows, doors and frames, metal accessories, panels, and glazing shall be designed 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/NWWDA 101/I.S.2, 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.

1.5.4 Provisions for Thermal Movement

Curtain-wall systems, including framing members, windows, doors and frames, metal accessories, and other components incorporated into the curtain wall, shall be designed 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.

1.5.5 Water Penetration

No water penetration shall occur when the curtain-wall system is tested for water penetration under static pressure in accordance with AAMA WSG.1.

1.5.6 Air Infiltration

Air infiltration through the curtain-wall system except curtain-wall areas containing louvers, when tested for air infiltration in accordance with AAMA WSG.1, shall not exceed 1.7 liter per second per 0.092 square meter (0.06 cubic foot per hour per square foot) 0.06 cubic foot per hour per square foot of fixed curtain-wall area plus the air infiltration for operable windows within the test area herein specified.

1.6 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.

1.7 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 METALS FOR FABRICATION

2.1.1 Aluminum-Alloy Extrusions

Extrusions shall conform to ASTM B 221M ASTM B 221.

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 shall have mechanical properties equal to or exceeding those of 6063-T5.

2.1.2 Aluminum-Alloy Sheets and Plates

Unless otherwise specified, sheets and plates shall conform to ASTM B 209M ASTM B 209, Alloy 3003-H16.

Sheets and plates to receive a clear anodic coating shall conform to ASTM B 209M ASTM B 209, 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 shall have mechanical properties equal to or exceeding those of 5005-H16.

2.1.3 Structural Steel

Hot-rolled shapes, plates, and bars shall conform to ASTM A 36/A 36M.

Hot-formed tubing shall conform to ASTM A 501.

Sheet and strip for cold-formed, light-gage, structural members shall conform to ASTM A 1011/A 1011M.

2.1.4 Metals for Fasteners

Aluminum-alloy bolts and screws shall be made from rod conforming to [ASTM B 211M](#), [ASTM B 211](#), Alloy 2024-T351.

Aluminum-alloy nuts shall be made from rod conforming to [ASTM B 211M](#), [ASTM B 211](#), Alloy 6061-T6.

Aluminum-alloy washers shall be made from sheet conforming to [ASTM B 209M](#) [ASTM B 209](#), Alloy 2024-T4.

Aluminum-alloy rivets shall be made from rod or wire conforming to [ASTM B 316/B 316M](#), Alloy 6053-T61.

Steel fasteners shall be made from corrosion-resistant chromium-nickel Type 302, 303, 304, 305, or 316 with the form and condition best suited for the work.

2.2 PAINT MATERIALS

Shop paint for aluminum shall conform to [FS TT-P-645](#) or [FS TT-C-494](#), Type II.

Shop paint for steel shall conform to [FS TT-P-645](#).

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, shall be accurately fitted and rigidly assembled.

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

2.4.2 Shop-Painting Aluminum

Aluminum surfaces that will come in contact with dissimilar metals, masonry, concrete, or wood shall be shop primed.

Aluminum surfaces shall be prepared for painting in accordance with [ASTM D 1730](#), Type B, Method 2 or 3.

Aluminum surfaces shall be given 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

Surfaces of concealed steel shall be shop primed.

Scale, rust, and other deleterious materials shall be removed. Heavy rust and loose mill scale shall be removed in accordance with [SSPC SP 3](#) or [SSPC SP 7](#). Oil, grease, and similar contaminants shall be removed in

accordance with SSPC SP 1.

Steel surfaces shall be given two coats of paint; the second coat shall have a color different from the first coat. Paint shall be applied 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 RABBIT 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 5 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 millimeter		All sizes	16 millimeter
	25 to 40 millimeter		All sizes	20 millimeter

<u>MATERIAL</u>	<u>NOMINAL THICKNESS</u>	<u>MAXIMUM SIZE</u>	<u>MINIMUM RABBET DEPTH</u>
<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
	All thicknesses	Up to 24 square feet	5/8 inch
	All thicknesses	24 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 shall 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 lacquer coating: Medium-matte chemical etch and a clear methacrylate lacquer coating applied in two coats with interim drying

to provide a continuous minimum dry-film thickness of 0.6 mil. Lacquer shall be nonyellowing and shall conform to **FS A-A-344**. Finish shall be AA C22-RIX, in accordance with **AA DAF-45**.

Frosted finish with lacquer coating: Medium-matte chemical etch and a clear methacrylate lacquer coating applied in two coats with interim drying to provide a continuous minimum dry-film thickness of 0.015 millimeter. Lacquer shall be nonyellowing and shall conform to **FS A-A-344**. Finish shall be AA C22-RIX, in accordance with **AA DAF-45**.

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 DAF-45**.

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 DAF-45**.

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 DAF-45**.

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 DAF-45**.

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 DAF-45**.

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 DAF-45**.

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.

Aluminum-finish color and appearance shall match 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.

The anodic coating on aluminum shall be tested for thickness in accordance with ASTM B 244.

Anodically coated aluminum shall be tested for the weight of the coating in accordance with ASTM B 137.

The resistance of anodically coated aluminum to staining by dyes shall be tested in accordance with ASTM B 136.

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 must 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 shall be 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. Frames shall be designed and constructed to receive window sash and louvers of the type specified when required.

Vertical mullions shall be prepared 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. Nonskinning sealing compound shall be applied 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 WINDOWS

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

Aluminum windows are specified in Section 08 51 13.00 40 ALUMINUM WINDOWS.

2.7 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.

2.8 METAL ACCESSORIES

2.8.1 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.

2.8.2 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 shall be 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.

2.8.3 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.

2.9 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. Locations and dimensions of panels must be indicated on the drawings.

2.9.1 Panel Type

NOTE: Panel thickness must be coordinated 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.

2.9.2 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 A 424, 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-3 Ivory (Munsell number by 8.7/3.4) and shall 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.

2.9.3 Facing Backing

Nominal 3 millimeter 1/8-inch thick, flat non-asbestos-cement sheets, flexible smooth-one-side surface finish, conforming to ASTM C 220, Type F.

2.9.4 Core Insulation

[Core shall be expanded perlite conforming to ASTM C 610.]

[Core shall be rigid urethane conforming to ASTM C 591, Type 2.]

[Core shall be preformed block polystyrene conforming to ASTM C 578, Type II.]

[Core shall be cellular glass conforming to ASTM C 552.]

[Core shall be mineral fiberboard conforming to FS HH-I-558, Form A, Class 2.]

2.9.5 Interior Metal Facing

[Facing shall be 0.7 millimeter 24-gage galvanized-steel sheets conforming to ASTM A 526/A 526M, coating Z275. G90.]

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

2.9.6 Panel Fabrication

Panel materials shall be securely bonded together to form a stable and durable composite unit. Panels with core insulation of absorptive material shall have edges sealed and shall provide venting to the outside air. Panels shall conform to the following:

Flatness: Exterior surfaces shall be 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, shall 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 C 481, 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 C 1363, 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.

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

Thermal insulation materials are specified in UFGS [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] [_____].

2.11 GLASS AND GLAZING

NOTE: Delete the paragraph heading and the following paragraph when glass and glazing is not required as a part of the curtain-wall system.

Glass and glazing, to include Glazing Materials, are specified in Section 08 81 00 GLAZING.

2.12 SEALANTS AND CALKINGS

NOTE: Delete the paragraph heading and the following paragraph when sealants and calkings are

not required for installation of curtain wall.

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

2.13 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. Concrete inserts must be indicated on the drawings.

2.13.1 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 A 47/A 47M, Grade [32510] [35018] [Grade 22010] or ASTM A 27/A 27M, Grade U-60-30, and shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.13.2 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 A 47/A 47M, Grade [32510] [35018] or ASTM A 27/A 27M, Grade U-60-30, and shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

Carbon steel bolts with wedge-shaped heads, nuts, washers, and shims shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.13.3 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 A 283/A 283M, Grade C, hot-dip galvanized in accordance with ASTM A 123/A 123M. Length of the insert body less anchorage lugs shall be 155 millimeter 4-1/2 inches minimum and shall be provided with a knockout cover.

2.13.4 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.

2.13.5 Toggle Bolts

Toggle bolts shall be the tumble-wing type.

2.13.6 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.

2.13.7 Machine Screws

Screws for concealed work shall be corrosion-resistant steel, slotted or cross-recessed type, roundhead.

Screws for exposed-to-view work shall be corrosion-resistant steel, cross-recessed, flathead.

2.13.8 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 shall be covered mild-steel electrodes conforming to AWS A5.1/A5.1M, E60 series.

PART 3 EXECUTION

3.1 GENERAL

Curtain walls and accessories shall be installed in accordance with the approved drawings and as specified.

3.2 MATERIALS EMBEDDED IN OTHER CONSTRUCTION

Materials to be embedded in cast-in-place concrete and masonry shall be installed prior to the installation of the curtain wall. Setting drawings, templates, and instructions for installation shall be provided.

3.3 FASTENING TO CONSTRUCTION-IN-PLACE

Anchorage devices and fasteners shall be provided for fastening work to construction-in-place. Fasteners shall be provided as specified.

3.4 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).

Devices shall be set in masonry or concrete-in-place construction in accordance with the manufacturer's printed instructions. Drilled holes shall be left rough and free of drill dust.

3.5 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, field welds and scarred surfaces on steel work and on adjacent ferrous-metal surfaces shall be cleaned and painted. Paint shall be the same as that used for shop painting.

3.6 INSTALLATION TOLERANCES

Curtain walls shall be installed 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

3.7 PLACING CURTAIN-WALL FRAMING MEMBERS

Members shall be installed plumb, level, and within the limits of the installation tolerances specified.

Members shall be connected to building framing. Supporting brackets shall provide adjustments for the accurate location of curtain-wall components. Adjustable connections shall be rigidly fixed after members have been positioned.

3.8 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 be not less than 3 millimeter 1/8 inch. Excess sealing compound on both sides of the curtain wall opening shall be removed with a glazing knife at a slight angle over the rabbet leg or applied stop. Applied stops shall be installed on the exterior side of the curtain wall and shall be secured with screws.

3.9 CLEANING

3.9.1 General

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

3.9.2 Aluminum Surfaces

Before final acceptance, exposed-to-view aluminum surfaces shall be washed with clean water and soap and rinsed with clean water. Acid solutions, steel wool, or other harsh abrasives shall not be used. Stains that remain after washing shall be removed or the finish shall be restored in accordance with the aluminum producer's recommendations.

3.9.3 Porcelain-Enamel Surfaces

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

Surfaces shall be washed with clean water and soap and rinsed with clean water. Acid solutions, steel wool, or other harsh abrasives shall not be used.

3.10 INSPECTION AND ACCEPTANCE PROVISIONS

3.10.1 Finished Curtain-Wall System Requirements

Curtain-wall work will 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.

3.10.2 Repair of Defective Work

Defective work shall be removed and replaced with curtain-wall materials that meet the specifications at no expense to the Government.

-- End of Section --