Preparing Activity: NAVFAC Superseding
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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 08 44 00

CURTAIN WALL AND GLAZED ASSEMBLIES

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SECTION 08 44 00

CURTAIN WALL AND GLAZED ASSEMBLIES
05/19

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.

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 item(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.

Include a complete schedule of system types and sizes and all window units for the work to be performed and 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

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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 Reference Identifier (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	(2020) Aluminum Design Manual
AA ASD1	(2017; Errata 2017) Aluminum Standards and Data
AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2017) Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure
AAMA 501.2	(2015) Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped

	Glazing Systems
AAMA 501.4	(2018) Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift
AAMA 501.5	(2007) Test Method for Thermal Cycling of Exterior Walls
AAMA 501.6	(2018) Recommended Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from Window Wall, Curtain Wall and Storefront Systems
AAMA 501.7	(2017) Recommended Static Test Method for Evaluating Windows, Window Wall, Curtain Wall and Storefront Systems Subjected to Vertical Inter-Story Movements
AAMA 609 & 610	(2015) Cleaning and Maintenance Guide for Architecturally Finished Aluminum
AAMA 800	(2016) Voluntary Specifications and Test Methods for Sealants
AAMA 2603	(2020) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	(2017a) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 2605	(2020) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
AAMA CW-10	(2015) 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	(2017) North American Fenestration Standard/Specification for Windows, Doors, and Skylights

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2007) 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 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

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	(2021) Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys - Classification
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A240/A240M	(2023) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A242/A242M	(2013; R 2018) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A424/A424M	(2009a; R 2016) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A501/A501M	(2021) Standard Specification for Hot-Formed Welded and Seamless Carbon

	Steel Structural Tubing
ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588/A588M	(2019) Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A606/A606M	(2023) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1008/A1008M	(2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1011/A1011M	(2023) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B85/B85M	(2018) Standard Specification for Aluminum-Alloy Die Castings
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B136	(2023) Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum
ASTM B137	(1995; R 2021) Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum
ASTM B152/B152M	(2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B211/B211M	(2019) Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B244	(2009; R 2021) 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 B308/B308M	(2010; R 2020) Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B316/B316M	(2020) Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods
ASTM B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C220	(1991; R 2015) Standard Specification for Flat Asbestos-Cement Sheets
ASTM C481	(1999; R 2011) Standard Test Method Laboratory Aging of Sandwich Constructions
ASTM C542	(2005; R 2017) Standard Specification for Lock-Strip Gaskets
ASTM C547	(2022a) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	(2022) Standard Specification for Cellular Glass Thermal Insulation
ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C578	(2022) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2022) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C592	(2022a) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type

	Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C610	(2017; R 2023) Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C665	(2023) Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C864	(2005; R 2015) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1048	(2018) Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
ASTM C1087	(2016) Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
ASTM C1135	(2015) Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants
ASTM C1184	(2023) Standard Specification for Structural Silicone Sealants
ASTM C1363	(2019) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C1401	(2014) Standard Guide for Structural Sealant Glazing
ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D1730	(2009; R 2020) Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
ASTM D2244	(2021) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

ASTM D3656/D3656M	(2013) Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E119	(2022) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E136	(2022) Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C
ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E330/E330M	(2014; R 2021) Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E331	(2000; R 2023) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E546	(2014; R 2020) Standard Test Method for Frost Point of Sealed Insulating Glass Units
ASTM E576	(2014; R 2020) Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position
ASTM E783	(2002; R 2018) Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
ASTM E1105	(2015; R 2023) Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

ASTM E1300	(2016) Standard Practice for Determining Load Resistance of Glass in Buildings
ASTM E1332	(2016) Standard Classification for Rating Outdoor-Indoor Sound Attenuation
ASTM E1886	(2019) Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
ASTM E1996	(2017) Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
ASTM E3061	(2017) Standard Test Method for Analysis of Aluminum and Aluminum Alloys by Inductively Coupled Plasma Atomic Emission Spectrometry (Performance-Based Method)
ASTM F1642/F1642M	(2017) Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings
ASTM F2248	(2012) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass
ASTM F2912	(2017) Standard Specification for Glazing and Glazing Systems Subject to Airblast Loadings

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2020) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2020) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
NFRC 500	(2010) Procedure for Determining Fenestration Product Condensation Resistance Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2023) Standard Fire Test Method for Evaluation of Fire Propagation

Characteristics of Exterior Wall Assemblies Containing Combustible Components

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI 1001	(1996) Specification for Architectural Porcelain Enamel (ALS-100)
PEI CG-3	(2005) Color Guide for Architectural Porcelain Enamel

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 12/NACE No.5	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating

STEEL WINDOW INSTITUTE (SWI)

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

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(2018; with Change 2, 2022) DoD Minimum Antiterrorism Standards for Buildings

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification 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; G[, [_____]]

Installation Drawings

Shop-Painting Aluminum; G[, [_____]]

Shop-Painting Steel; G[, [_____]]

SD-03 Product Data

Glazed Curtain Wall System; G[, [_____]]

Metals For Fabrication; G[, [_____]]

Nonskinning Sealing Compound; G[, [_____]]

Metal Accessories; G[, [_____]]

Curtain-Wall Framing Members; G[, [_____]]

Aluminum Doors and Frames; G[, [_____]]

Laminated Panels; G[, [_____]]

Thermal Insulation Materials; G[, [_____]]

Masonry Anchorage Devices; G[, [_____]]

[Recycled Content of Aluminum Doors and Frames; S

][Recycled Content of Aluminum Curtain-Wall Framing Members; S

][Recycled Content of Aluminum Windows; S

] Sample Warranties; G[, [_____]]

SD-05 Design Data

[Anodic Finish; G[, [_____]]

][Pigmented Organic Coating; G[, [_____]]

] Exposed-to-View Aluminum Finish; G[, [_____]]

Seismic Calculations; G[, [_____]]

Structural Calculations for Deflection; G[, [_____]]

****
NOTE: Provide Design Analysis when blast design is required by UFC 4-010-01, DoD Minimum Antiterrorism Requirements for Building
****

[Design Analysis; G[, [_____]]

] SD-06 Test Reports

****
NOTE: Provide Standard Airblast Test Reports when required by UFC 4-010-01, DoD Minimum Antiterrorism Requirements for Building.
****

[NFPA 285 Factory Test Results; G[, [_____]]

][Standard Airblast Test; G[, [_____]]

] Field Water Spray Test Results; G[, [_____]]

Air Infiltration Test Results; G[, [_____]]

Water Penetration Test Results; G[, [_____]]

SD-07 Certificates

Energy Performance Certificates; G[, [_____]]

****
NOTE: Require Engineer Qualifications when blast design is required by UFC 4-010-01, DoD Minimum Antiterrorism requirements for buildings.
****

[Engineer Qualifications; G[, [_____]]

] Qualifications for the Curtain-Wall Installer; G[, [_____]]

SD-08 Manufacturer's Instructions

Glazed Curtain Wall System; G[, [_____]]

Insulating Glass; G[, [_____]]

Preventive Maintenance and Inspection; G[, [_____]]

SD-11 Closeout Submittals

Warranty; G[, [_____]]

1.3 QUALITY ASSURANCE

1.3.1 Engineer Qualifications for Blast Design

All blast design calculations must be performed by or under the direct supervision of a registered engineer with a minimum of 5 years experience performing blast design. The [engineer] performing the blast design must be able to demonstrate experience on similar size projects using similar design methods to meet the requirements outlined in this specification.

1.3.2 Qualification of Welders

Welding must 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.

1.3.3 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. Installer must be approved by the Manufacturer as a Certified Installer and have a minimum of 5 years experience installing curtain wall systems, and have completed projects similar in size to this project.

1.3.4 Testing Requirements

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

The components listed below must 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.

[1.3.5 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.
****

1.3.5.1 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 must be as indicated.

1.3.5.2 Performance Test

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

1.3.5.3 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 must remain property of the Contractor.]

]1.3.6 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. [NFPA 285 Factory Test Results]

b. [_____]

c. [_____]

1.3.6.1 Deflection and Structural Tests

Curtain wall framing members must not 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 must not exceed 1/360 of the span. Framing members must not 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. Provide Structural Calculations for Deflection.

1.3.6.2 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.

****

Water penetration must not 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 575 Pa 12 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.[Test curtain wall systems in areas subject to hurricanes and typhoons in accordance with AAMA 501.1 Dynamic Testing.]

1.3.6.3 Air Infiltration Test

Air infiltration through the wall, when tested in accordance with ASTM E283, must 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, at a static air pressure differential of 300 Pa 6.2 psf.

1.3.6.4 Delamination Test

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

1.3.6.5 Sealant Adhesion and Compatibility Testing

ASTM C1401, submit to structural glazing sealant manufacturer, for testing indicated below. Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.

a. Compatibility: Test materials or components using ASTM C1087.

b. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.

c. Submit no fewer than [8] [_____] pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

d. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

e. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

f. Testing will not be required if data based on previous testing of current sealant products match those submitted.

1.3.6.6 Energy Performance Tests

Energy Performance Certificates for Glazed Aluminum Curtain Wall, Accessories, and Components from Manufacturer Confirming NFRC- Certified Energy Performance Values for Each Glazed Aluminum Curtain Wall.

The thermal transmittance of opaque panels must not exceed specified U-value, when tested in accordance with ASTM C1363. Certify and Label Energy Performance according to NFRC as follows:

****

NOTE: Thermal Transmittance (U-Factor) and SHGC are contingent upon the composition of the glazing for the project. Coordinate with glazing selections.

****

a. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system must have U-factor of not more than [0.29 Btu/sq. ft. x h x deg F] [0.36 Btu/sq. ft. x h x deg F] [0.38 Btu/sq. ft. x h x deg F] [0.41 Btu/sq. ft. x h x deg F] [0.46 Btu/sq. ft. x h x deg F] [0.50 Btu/sq. ft. x h x deg F] as determined according to NFRC 100.

b. SHGC: Fixed glazing and framing areas as a system must have a SHGC of no greater than [0.22] [0.25] [0.26] [0.29] [0.40] [0.45] as determined according to NFRC 200.

c. Condensation Resistance: Fixed glazing and framing areas as a system must have an NFRC-certified condensation resistance rating of no less than [45] [55] [65] [80] as determined according to NFRC 500.

1.3.6.7 Window Tests

****

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

****

Windows must 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 must not exceed 0.4 percent; there must 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.

1.3.6.8 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] must 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.

****
NOTE: Use bracketed option when required by Fire Code Analysis. Coordinate with other exterior wall component specifications.
****

b. Curtain Wall Systems: Material for firestopping the opening between the edge of the floor slab and back of the curtain wall system, must not have 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.[When required, entire curtain wall system must conform to NFPA 285.]

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 must 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 E119time-temperature curve for a period equivalent to the fire rating of the floor system and must also be rated noncombustible when tested in accordance with ASTM E136.

1.3.6.9 Noise Reduction

Test according to ASTM E90, with ratings determined by ASTM E1332, as follows: Outdoor-Indoor Transmission Class: Minimum [26] [30] [34] [_____]. Sound Transmission Class: Minimum [31] [34] [37] [40] [_____].

1.4 FIELD TESTS

Testing must be performed by a testing agency regularly engaged in testing of architectural products, not affiliated with the curtain wall installer, and experienced with these test methods. Notify the Contracting Officer a minimum of seven calendar days prior to performing field tests.

1.4.1 Field Water Spray Tests

Engage a qualified testing agency to perform tests and inspection. Perform test on [one bay of at least 30 feet long by one story][a representative area of glazed curtain wall]. Perform water-spray test before interior finishes have begun, in accordance with AAMA 501.2. Test area must not show evidence of water penetration. Perform a minimum of [2] [3] [_____] tests. Submit Field Water Spray Test Results.

1.4.2 Air Infiltration

ASTM E783 at 1.5 times the rate specified for laboratory testing under factory test paragraph, but not more than 0.06 cfm/sq.ft at a static air pressure differential of 6.24 lbf/sq.ft. Perform a minimum of [2] [3] tests in representative areas. Submit Air Infiltration Test Results.

1.4.2.1 Water Penetration

ASTM E1105 at a minimum [uniform] [and] [cyclic] static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and must not evidence water penetration. Submit Water Penetration Test Results.

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. Requests to the Contractor for alternate bids is not allowed. The Contractor is not allowed to substitute one metal for another unless complete details are shown for each type of metal components permitted.

Design must meet the requirements of UFC 1-200-02, "High Performance and Sustainable Building Requirements" which invokes the requirements within UFC 3-101-01, "Architecture". UFC 1-200-02 and UFC 3-101-01 make references throughout to various ASHRAE documents governing energy efficiency and requirements for the components of building envelope design including moisture control, thermal performance, fenestrations and glazing.

For further guidance and information on the design of Curtain Walls for moisture control, thermal comfort, energy savings, and sustainability, see the

"Whole Building Design Guide, Building Envelope Design Guide - Curtain Walls".
****

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.

Submit installation drawings for curtain wall system, accessories[, and mock-up].[Tentative approval of drawings must be received before fabrication of mock-up. Final approval of drawings will be deferred pending approval of mock-up and accessories.] Drawings must 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.

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 Tolerances

****
NOTE: The finished wall system requires the coordination and efforts of many different manufacturers, suppliers, and construction trades. Contractor submittal requirements must 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.

1.5.4 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.
****

Members may not 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. After deflection under full design load, members may not 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 must 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 must be increased to [_____] kilopascals pounds per square foot.

[1.5.5 Seismic Calculations

When tested to AAMA 501.4 and AAMA 501.6, system must 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.

]1.5.6 Thermal Cycling and Vertical Inter-Story Movement Calculations

a. Thermal Cycling: AAMA 501.5. Repeat the Air Infiltration Test, ASTM E283, and the Water Penetration Test Under Static Pressure, ASTM E331.

b. Inter-Story Drift: AAMA 501.4 and AAMA 501.7 at 100 percent of design displacement. Repeat the Air Infiltration Test, ASTM E283 and the Water Penetrated Test Under Static Pressure, ASTM E331.

1.6 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 must be dry locations with adequate ventilation, free from heavy dust, not subject to combustion products or sources of water, and must allow for 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.

1.6.1 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 must not chip, peel, or flake due to temperature or weather, must protect against discoloration and surface damage from transportation, and storage, and must be resistant to alkaline mortar and plaster. Do not cover [aluminum] [stainless steel] surfaces that will be in contact with sealants after installation.

1.6.2 Identification

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

1.7 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.navfac.navy.mil/portal/page/portal/navfac/navfac_forbusinesses_pp/smallbusiness/contracting/navfac.
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 must

require the manufacturer to execute their warranties in writing directly to the Government.

1.7.1 Sample Warranties

Provide curtain wall and glazing assembly 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.

b. Manufacturer's Warranty: Submit, for acceptance, the Manufacturer's standard warranty document executed by authorized company official. The manufacturer's warranty is in addition to, and not a limitation of, other rights the Government 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. Deterioration includes, but is not limited to, color fading more than 5 Delta E units when tested according to ASTM D2244, chalking in excess of a No. 8 rating when tested according to ASTM D4214, cracking, peeling, or chipping.

e. Beneficiary: Issue warranty to the Government.

f. Warranty Period: [5] [10] [_____] 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.

1.8 INTERPRETATION OF AWS CODE

****
NOTE: Coordinate the requirements of Section 05 05 23.16 STRUCTURAL WELDING. 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, means 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 means "Approval by the Contracting Officer" and references to the "Building Commissioner" means the

"Contracting Officer."

1.9 PERFORMANCE REQUIREMENTS

****

NOTE: Structural performance, air infiltration and water penetration are standard performance requirements for all aluminum curtain wall types.

Design must meet the requirements of UFC 1-200-02, "High Performance and Sustainable Building Requirements" which invokes the requirements within UFC 3-101-01, "Architecture". UFC 1-00-02 and UFC 3-101-01 make references throughout to various ASHRAE documents governing energy efficiency and requirements for the components of building envelope design including fenestrations and glazing.

"Antiterrorism Performance Requirements" and "Sound Attenuation" sections below are optional to designer, and must be omitted or revised as needed to meet project requirements.

Applicability of UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings

The antiterrorism (AT) standards contained in UFC 4-010-01 DO NOT establish the Design Basis Threat (DBT) or the Level of Protection (LOP) for DoD buildings. Installation Antiterrorism Plans may define a DBT for the installation. Use UFC 4-020-01 (Security Engineering: Facilities Planning Manual) to establish and/or validate the DBT and LOP for individual projects. The process outlined in UFC 4-020-01 will determine if the minimum AT standards are adequate or if additional protective measures are required. Where a specific DBT and LOP are identified, additional guidance is included in Appendix B (Best Practices) of UFC 04-010-01. For buildings that are outside an installation perimeter, use UFC 4-020-01 to establish the DBT and LOP. The DBT and LOP will result in a representative standoff distance for the appropriate construction - window systems (glazing, frame, connections) in this instance.

A Structural Analysis will need to be performed to determine if the most stringent loading on window assembly is from antiterrorism blast loads or windborne debris in high wind regions.

****

[1.9.1 Antiterrorism Performance Requirements

Curtain Wall assembly must meet the antiterrorism performance criteria specified in the paragraphs below and UFC 4-010-01. One of the following methods must validate conformance to the performance requirements.

1.9.1.1 Computational Design Analysis Method

Submit design analysis with calculations showing that the design of each different size and type of aluminum curtain wall and its anchorage to the structure meets the antiterrorism standards required by paragraph ANTITERRORISM PERFORMANCE REQUIREMENTS, unless conformance is demonstrated by Standard Airblast Test results. Calculations verifying the structural performance of each curtain wall proposed for use, under the given loads, must be prepared and signed by a registered Professional Engineer. The curtain wall components and anchorage devices to the structure, as determined by the design analysis, must be reflected in the shop drawings.

Design curtain wall assembly to the criteria listed herein. Computational design analysis must include calculations verifying the structural performance of each curtain wall assembly proposed for use, under the given static equivalent loads.

Design curtain wall frames, mullions, sashes, and glazing to the criteria listed herein. Computational design analysis must include calculations verifying the structural performance of each window system proposed for use, under the given static equivalent loads.

****

NOTE: The blanks in the following paragraph should be the value of the equivalent 3-second duration design loading obtained from Figure 1 of ASTM F2248 for the explosive weight and standoff distance combination (based on the established DBT/LOP) that is being designed for in this project. This section must be completed by an engineer experienced in blast-resistant design.

****

Glazing resistance must be greater than equivalent 3-second duration loading of [_____] Pascal pounds per square foot (psf) for type [_____] window [per Window Schedule indicated on the drawings] [and [_____] Pascal psf for the remaining window types]. The glazing frame bite for the window frames must be in accordance with ASTM F2248.

Aluminum/Steel window framing members must restrict deflections of the edges of glazing they support to L/60 under two times (2X) the glazing resistance per the requirements of ASTM F2248 and ASTM E1300.

****

NOTE: Connection Design: For mullion and framing members designed using dynamic analysis or shown to work through airblast testing, all connections between mullions and/or framing members and all connections of storefront systems to the supporting structure must be designed for the full dynamic capacity of the attached member or the maximum calculated dynamic reaction with a load factor equal to 1.0. Use ultimate capacity of fasteners as recommended by the fastener manufacturer with a capacity reduction factor of 0.75. Use Load and Resistance Factor Design (LRFD) with appropriate reduction (phi) factors per material specific code for design of connections components into supporting structure. All dynamic and static material strength

increase factors for the connection components must be equal to 1.0. All connection designs must be performed checking all conventional failure mechanisms. See Engineering Technical Report (PDC TR-10-02) titled Blast Resistant Design Methodology for Window Systems Designed Statically and Dynamically at USACE Protective Design Center (Website link: https://pdc.usace.army.mil/library/tr/10-02) for additional information. Calculations/Design Analysis for the connection design as stated above must be completed by an engineer experienced in blast-resistant design.

****

****

NOTE: Use the first bracketed requirement below if the maximum air blast pressure is greater than one half the magnitude of the load resistance of the blast resistant glazing.

Use the second bracketed requirement below if the maximum air blast pressure is less than one half the magnitude of the load resistance of the blast resistant glazing.

****

[Anchor curtain wall frames to the supporting structure with anchors designed to resist [two times (2X)] [one time (1x)] the glazing resistance in accordance with ASTM F2248 and ASTM E1300.

]1.9.1.2 Dynamic Design Analysis Method

****

NOTE: The blanks in the following paragraph should be the value of the peak positive pressure and impulse for the explosive weight and standoff distance combination (based on the established DBT/LOP) that is being designed for in this project. Choose the first bracketed items, low hazard rating/very low level of protection for inhabited building occupancy as defined in UFC 4-010-01 (Table B-1). Choose the second bracketed items, very low hazard rating/low level of protection for primary gathering/billeting building occupancy as defined in UFC 4-010-01 (Table B-1). Dynamic analysis is preferred because it typically yields a more appropriate and economical / efficient design. The values for input into the blanks in the following paragraph related to 'ductility ratio' and 'maximum support rotation' (for the appropriate level of protection – very low, low) for steel and aluminum framing/mullions can be found in Engineering Technical Report (PDC TR-10-02) titled Blast Resistant Design Methodology for Window Systems Designed Statically and Dynamically at USACE Protective Design Center (Website link: https://pdc.usace.army.mil/library/tr/10-02). This section must be completed by an engineer experienced

in blast-resistant design.
****

Design curtain wall assembly using a dynamic analysis to prove the system will provide performance equivalent to or better than a [low];[very low]; [_____] hazard rating in accordance with ASTM F2912 for the peak positive pressure of [_____] kilopascals (kPa) pounds per square inch (psi); and peak positive phase impulse of [_____] kilopascal-millisecond (kPa-msec) pounds per square inch - millisecond (psi-msec). Use a triangular blast load using the applicable pressure and impulse indicated above. The allowable response limits of [aluminum]; [steel] frame elements are as follows: Maximum ductility ratio of [_____] and maximum support rotation of [_____] degrees.

1.9.1.3 Standard Airblast Test Method

For Antiterrorism curtain wall, in lieu of a Design Analysis, include in a test report results of airblast testing, whether by arena test or shock tube providing information in accordance with ASTM F1642/F1642M, as prepared by the independent testing agency performing the test. Demonstrate in the test results the ability of each curtain wall proposed for use to withstand the airblast loading parameters and achieve the hazard level rating specified in paragraph STANDARD AIRBLAST TEST METHOD. Demonstrate in the test results the ability of each curtain wall proposed for use to withstand the airblast loading parameters and achieve [low]; [very low] hazard level rating or better when rated per the requirements of ASTM F2912.

****
NOTE: The blanks in the following paragraph should be the value of the peak positive pressure and impulse for the explosive weight and standoff distance combination (based on the established DBT/LOP) that is being designed for in this project. Choose the first bracketed items, low hazard rating/very low level of protection for inhabited building occupancy as defined in UFC 4-010-01. Choose the second bracketed items, very low hazard rating/low level of protection for primary gathering building occupancy as defined in UFC 4-010-01. This section must be completed by an engineer experienced in blast-resistant design.
****

As an alternative to the 'Computational Design Analysis Method' and 'Dynamic Design Analysis Method' indicated above, curtain wall assembly may be tested for evaluation of hazards generated from airblast loading in accordance with ASTM F1642/F1642M by an independent testing agency regularly engaged in blast testing. For proposed window systems that are of the same type as the tested system but of different size, the test results may be accepted provided the proposed window size is within the range from 25 percent smaller to 10 percent larger in area and aspect ratio of the original qualified tested glazing systems in accordance with ASTM F2912. Proposed window system/assembly of a size outside this range requires testing to evaluate their hazard rating or are certified by the 'Dynamic Design Analysis Method' indicated above. Testing may be by shock tube or arena test. Perform the test on the entire proposed window system/assembly, which must include, but not be limited to, the glazing, its framing/support system, operating devices, and all anchorage devices.

Anchorage of the window support system must replicate the method of installation to be used for the project. The minimum airblast loading parameters for the test must be as follows: peak positive pressure of [_____] kilopascals (kPa) pounds per square inch (psi) and peak positive phase impulse of [_____] kilopascal-millisecond (kPa-msec) pounds per square inch - millisecond (psi-msec). The hazard rating for the proposed window systems, as determined by the rating criteria of ASTM F2912, to provide performance equivalent to or better than a [low]; [very low]; [_____] hazard rating (i.e. the "No Break", "No Hazard", "Minimal Hazard", "Very Low Hazard" and "Low Hazard" ratings are acceptable. "High Hazard" ratings are unacceptable. Results of window systems previously tested by test protocols other than ASTM F1642/F1642M may be accepted provided the required loading, hazard level rating, and size limitations stated herein are met.

[1.9.1.4 Wind-Borne Debris /Hurricane Performance Requirements

****
NOTE: See UFC 3-301-01 Structural Engineering for Wind Load design criteria and applicability of wind-borne debris requirements.
****

Provide impact resistant or protected curtain wall systems in buildings with an impact-resistant covering meeting the Windborne-Debris-Impact-Resistant Performance requirements of ASTM E1996 for project wind zone when tested in accordance with ASTM E1886, based upon testing of specimens not less than the size required for project and utilizing installation method identical to that specified for project as follows:

a. Project Wind Zone: [Wind Zone 1] [Wind Zone 2] [Wind Zone 3] [Wind Zone 4].

b. Large-Missile Test: For glazing located within 9.1 m 30 feet of grade.

c. Small-Missile Test: For glazing located more than 9.1 m 30 feet above grade.

]]1.9.2 Allowable Design Stresses

Aluminum-alloy framing member allowable design stresses must 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 must 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 must be in accordance with the requirements of AISI SG03-3 SG570 pertaining to structural members formed from the specified structural-steel sheet or strip.

1.9.3 Design Wind Load

****
NOTE: First bracketed valve 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 bracketed valve 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 bracketed valve 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 bracketed valve 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 bracketed valve 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 bracketed valve specifies the minimum design load recommended in ANSI A58.1. Langley Research Center policy does not permit use of this paragraph.

****

Design windload must be [2155] [1963] [1819] [1676] [1436] [718] pascal [45] [41] [38] [35] [30] [15] pounds per square foot. Design windload must be in accordance with ASCE 7-16.

1.9.4 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, must 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, must

not exceed 75 percent of the design clearance dimension between that member and the glass, sash, panels, or other part immediately below it.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum

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

****

NOTE: Use materials with recycled content where appropriate for use. Verify suitability, availability within the region, cost effectiveness and adequate competition before specifying product recycled content requirements.

****

[Provide Aluminum [Doors][Frames][Curtain-wall Framing Members][Window Frames] with a minimum recycled content of 20 percent. Provide data identifying percentage of [recycled content of aluminum doors and frames][recycled content of aluminum curtain-wall framing members][recycled content of aluminum windows].

]2.1.1.1 Wrought Aluminum Alloys

Must be those which include aluminum alloying elements not exceeding the following maximum limits when tested and additional in accordance with ASTM E3061. These limits apply to both bare products and the core of clad products. The cladding of clad products must 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:

ALLOY	MAXIMUM PERCENT
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 must conform to the following:

a. Extruded bars, rods, shapes and tubes: ASTM B221M ASTM B221 and

ASTM B308/B308M and ASTM B429/B429M.

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 must not exceed the following limits:

ALLOY	MAXIMUM PERCENT
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 must 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 conforming to AWS A5.10/A5.10M as recommended by the manufacturer of the aluminum base metal alloy being used.

2.1.1.4 Strength

Aluminum extrusions for framing members used in curtain walls and main frame and sash or ventilator members in windows must 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 must be commercial bronze, alloy No. 220. Extruded shapes must be architectural bronze, alloy No. 385. Rolled or drawn rods must be [commercial bronze, alloy No. 220] [or] [architectural bronze, alloy No. 385]. Bronze used for [_____] must 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 A240/A240M. Conform to 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 must 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 must 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 must be of type recommended by the weathering steel manufacturer.] Metals for fasteners must 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, revise text accordingly.
****

Provide manufacturer's standard colors to closely match adjacent surfaces. For interior application of joint sealants comply with applicable regulations regarding reduced VOC's as specified in Sections 07 92 00 JOINT SEALANTS and 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

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, manufacturer's data related to that material must include primer.

2.1.10.4 Structural Sealant

ASTM C1184 and ASTM C1401. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant must occur before adhesive failure. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.1.10.5 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.

2.1.10.6 Bond Preventive Materials

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

2.1.10.7 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.

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 Screens

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

2.1.14 Paint and Finishes

****
NOTE: Coordinate the requirements of Section 09 90 00 PAINTS AND COATINGS. If Section 09 90 00 PAINTS AND COATINGS is not included in project specification, applicable requirements therefrom should be inserted and the following text deleted.
****

See Section 09 90 00 PAINTS AND COATINGS, for field applied coatings.

2.1.15 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. Panels must comply with ASTM E84 surface burning characteristics, with a flame spread index of [25] [_____] or less and a smoke developed index of [50] [450] [_____] or less tested by a Qualified Testing Agency. Identify products with appropriate markings of Applicable Testing Agency. Tempered Hardboard must conform to AHA A135.4, Class 1, [_____] mm inch thick.

2.1.15.1 Metal Facing Panels, Single Thickness

Metal facing panels must be single thickness. Panel facing must 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 [_____].

2.1.15.2 Laminated 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.
****

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

2.1.15.2.1 Exterior Metal Facing

Facing must be Porcelain-Enamel on steel. Base metal must 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 must 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 must be PEI CG-3 [_____]. Ivory (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 must be [high] [medium] [low] reflectivity.

2.1.15.2.2 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.

2.1.15.2.3 Core Insulation

[Core must be expanded perlite conforming to ASTM C610.

][Core must be rigid urethane conforming to ASTM C591, Type 2.

][Core must be preformed block polystyrene conforming to ASTM C578, Type II.

][Core must be cellular glass conforming to ASTM C552.

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

]2.1.15.2.4 Interior Metal Facing

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

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

]2.1.15.2.5 Panel Fabrication

Securely bond panel materials together to form a stable and durable composite unit. Panels with core insulation of absorptive material must 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, must withstand the windload specified without permanent deformation or damage.

Accelerated aging: Panels must 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, must 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.

2.1.15.3 Nonmetallic Panels

a. Provide panels that are glass-faced on the side that will be exposed to view. Glass must be spandrel glass with ceramic coating on its

nonweathering surface and [smooth] [_____] finish on the exposed surface [; backing must be adhesively bonded to nonweathering surface]. Backing must be [_____] and include [galvanized steel] [_____] on surface nearest the building. Color of glass when viewed from the surface that will be exposed after installation must be [_____]. Where indicated, back up glass panels with [_____].

b. Adhesively bonded insulated panels must 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] [_____] must be [natural stone chips] [crushed marble] [_____] [with minimum and maximum sizes of [_____] and [_____]]. Color of [_____] must 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] [_____] must be [natural stone chips] [crushed marble] [_____] [with minimum and maximum sizes of [_____] and [_____]]. Color of [_____] must be [_____].

2.1.16 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.

2.1.16.1 Frames

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

2.1.16.2 Operating Windows

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

a. Metal and finish for hardware must be [_____].

b. [_____].

2.1.16.3 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.

[2.1.17 Insect Screens

****
NOTE: Where metal accessories mentioned herein occur in connection with metal curtain walls, the kind and gage of metal must 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 must be [full length, top-hung type] [double vertical sliding type] [half-length fixed type]. Screens for [projected] [casement] [_____] windows must be [_____] type. Mount screens on [inside] [outside] of windows. Screens must 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 must 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 must 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 must have removable splines of aluminum, stainless steel, or vinyl.

b. Screening: Weave of screening must 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 must be manufacturer's standard type and finish, unless otherwise indicated.

]2.1.18 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 must 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 must 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 ASTM B221M ASTM B221 6063-T5.

2.2.2 Aluminum-Alloy Sheets and Plates

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

Sheets and plates to receive a clear anodic coating must 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 must 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 must conform to ASTM A36/A36M.

Hot-formed tubing must conform to ASTM A501/A501M.

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

2.2.4 Metals for Fasteners

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

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

Provide aluminum-alloy washers made from sheet conforming to ASTM B209M, ASTM B209, ASTM B211/B211M, 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 must be nonskinning, gun-grade type conforming to AAMA 800.

2.4 FABRICATION

2.4.1 Workmanship

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

Insofar as practical, fitting and assembly of the work must 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 0.038 millimeter 1.5 mils.

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 must 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 must be as follows:

****

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

****

MATERIAL	NOMINAL THICKNESS	MAXIMUM SIZE	MINIMUM RABBET DEPTH
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

MATERIAL	NOMINAL THICKNESS	MAXIMUM SIZE	MINIMUM RABBET DEPTH
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 Anodic Finish

The following designation of finishes refer to standard finishes as defined in the NAAMM AMP 500. 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 must 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 must 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 must 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 must 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 must 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 must 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 must 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.

][2.4.6 Pigmented Organic Coating

Curtain wall framing exposed to view to be[a pigmented organic coating complying with AAMA 2603][a high-performance organic coating complying with AAMA 2604][a superior performing organic coating complying with AAMA 2605] Color: [_____].

]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 must be thermally broken and 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 must be the vertical mullion type with the vertical mullions extending the indicated distance beyond the exterior face of the curtain wall.

][Curtain-wall framing must 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 must be aluminum-alloy extrusions with a wall thickness not less than 3.1 millimeter 0.125 inch. Glazing rabbet legs must 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 must be mortise-and-tenon construction except that the corners of the vertical and horizontal mullions in grid frames must be coped-and-welded construction. Welds must be on the unexposed surfaces. Corner joints must 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 must be coped and welded construction. Welds must be on

the unexposed surfaces. Corner joints must 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 must 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 must 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 must 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 must 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 SUN CONTROL

Provide [sunshades][and][light shelves] in accordance with the following:

2.8.1 Sunshades

Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to curtain wall with mechanical fasteners.

a. Orientation: [Horizontal] [Vertical].

b. Projection from Wall: [As indicated on Drawings] [0.508] [0.635] [0.762] [0.889] [_____] meters [20] [25] [30] [35] [_____] inches.

c. Outriggers: [Straight with square edges] [Straight with rounded edge] [Curved] [Wedge] <Insert shape>.

d. Louvers:

(1) Number: [Three] [Four] [Five] [_____] louvers per unit.

(2) Shape: [Planar] [Arched] [Circular] [Airfoil] [Square].

(3) Width: [0.1524] [0.2032] [0.254] [_____] millimeter [6] [8] [10] [_____] inches.

(4) Mounting Angle: [0.635] [0.762] [0.889] [25] [30] [35] [_____] degrees.

e. Fasciae: [Rectangular] [Bullnose] [Angular] [Circular].

f. Finish: [Match adjacent glazed aluminum curtain wall] <Insert finish>.

g. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

h. Steel Reinforcement: As required by manufacturer.

2.8.2 Light Shelves

Light-reflecting assemblies consisting of manufacturer's standard support brackets or channels, and aluminum tray, designed for attachment to interior of curtain wall with mechanical fasteners.

a. Projection from Wall: [As indicated on Drawings] [0.508] [0.635] [0.762] [0.889] [_____] millimeter [20] [25] [30] [35][_____] inches.

b. Finish: [Match adjacent glazed aluminum curtain wall] [_____].

c. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

d. Steel Reinforcement: As required by manufacturer.

]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 must 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 00EXTERIOR INSULATION AND FINISH SYSTEMS][_____].

2.10 SEALANTS AND CAULKINGS

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

Sealants and caulkings 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 must 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 must 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 must 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 must 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 must 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 must be the tumble-wing type.

2.11.6 Steel Bolts, Nuts, and Washers

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

Nuts must be hexagon, regular style, carbon steel.

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

Lockwashers must 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 must 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 must 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 with adjustment capability in three directions. Exposed fastenings used on finished surfaces must 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 must 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 and drainage system of weeps 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 must 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 must be performed under direct supervision of and in accordance with approved recommendations and instructions of wall system manufacturer or fabricator.

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

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 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.

3.3.4 Fastening To Construction-In-Place

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

3.3.5 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.

3.3.6 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 must 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 must be the same as that used for shop painting.

3.3.7 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

3.3.8 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 must be rigidly fixed after members have been positioned.

3.3.9 Panel Installation

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

Panels must 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 must not be less than 3 millimeters 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.

3.3.10 Panels

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

3.3.11 Windows

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

3.3.11.1 Sealing

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

3.3.11.2 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.

3.3.11.3 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.

3.3.12 Joint Sealants

3.3.12.1 Surface Preparation

Surfaces to be primed and sealed must 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 must 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 must be of type that leave no residue on metals.

3.3.12.2 Applications

Match approved sample. Force compound into grooves with sufficient pressure to fill grooves solidly. Sealing compound must 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, not to exceed 19 liters 5 gallons at any given time.

3.3.12.3 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.

3.3.12.4 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.

3.3.12.5 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.

3.3.12.6 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.

3.3.13 Glass

Install in accordance with insulating glass manufacturer's recommendations as modified herein.[Install insulating glass units made with heat absorbing glass with heat absorbing pane on exterior side.]

3.3.13.1 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.

3.3.13.2 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.

3.3.13.3 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.

3.3.13.4 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.

3.3.13.5 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.

3.3.13.6 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 must be in accordance with the recommendation of the glass manufacturer.

3.3.13.7 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.

3.3.14 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 must 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] [_____].

3.3.15 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 in accordance with SSPC SP 12/NACE No.5. 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

Notify the Contracting Officer a minimum of seven calendar days prior to performing 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 Manufacturer's Information

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

3.6.3 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.

3.6.4 Aluminum Surfaces

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

3.6.5 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.

3.6.6 Porcelain-Enamel Surfaces

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

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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:

PRODUCTS	INCH-POUND	METRIC
Glass	1/4 inch	6 mm

3.8 INSPECTION AND ACCEPTANCE PROVISIONS

3.8.1 Finished Curtain-Wall System Requirements

Curtain-wall work which contains any of the following deficiencies, is unacceptable, and will be rejected:

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

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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.

3.8.2 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 --