
USACE / NAVFAC / AFCEA / NASA UFGS-08 56 53 (April 2006)

Preparing Activity: NAVFAC Replacing without change
UFGS-08581 (August 2001)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2010

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04/06

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SECTION 08 56 53

BLAST RESISTANT TEMPERED GLASS WINDOWS

04/06

NOTE: This guide specification covers the requirements for blast resistant tempered glass windows.

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

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

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

NOTE: Specific details are expanded upon in MIL-HBK-1013/1, Design Guidelines for Physical Security of Fixed Land-Based Facilities.

NOTE: TO DOWNLOAD UFGS GRAPHICS

Go to <http://www.wbdg.org/ccb/NAVGRAPH/graphdoc.pdf>.

NOTE: On the drawings, show:

1. Locations of each type of glass, using same terminology as in the specification.
2. Frame and rabbet details, indicating method of glazing.
3. Sizes and types of windows; metal and wood subframes, casings, or stools, if any; and hardware.

4. Sizes, location, and swing of ventilators; direction of slide for sliding ventilators; location and details of fixed sash.

5. Typical window sections and details. Show glass thickness. Show special glazing, if any.

6. Method of anchoring windows; size and types of clips, anchors, screws, or other fasteners.

7. Details of nonstructural mullions and mullion covers; detail of anchoring and reinforcing nonstructural mullions at windows to receive window cleaner anchors.

8. Number of window cleaner anchors required and locations.

9. Locations of windows designated as forced entry resistant, if any.

PART 1 GENERAL

1.1 REFERENCES

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

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

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

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

ALUMINUM ASSOCIATION (AA)

AA DAF-45

(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603	(2002) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	(2005) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA/WDMA/CSA 101/I.S.2/A440	(2008; Update 1 2008; Update 2 2008; Update 3 2009) North American Fenestration Standard/Specification for Windows, Doors, and Skylights

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2009) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test
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ASME INTERNATIONAL (ASME)

ASME A39.1	(1995) Safety Requirements for Window Cleaning
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ASTM INTERNATIONAL (ASTM)

ASTM C 1048	(2004) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 920	(2010) Standard Specification for Elastomeric Joint Sealants

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2004) Glazing Manual
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1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

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

submittal is sufficiently important or complex in context of the project.

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

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

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

SD-02 Shop Drawings

Window units[; G][; G, [____]]

Submit drawings indicating elevations of windows, full-size sections, thickness of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, complete details of setting methods and materials for each type of glazing material, details of hardware, [mullion details,] [method and materials for weatherstripping,] [support conditions for the glass,] [material and method of attaching subframes,] [stools,] [casings,] [sills,] [trim,] [window cleaner anchors,] installation details, and other related items.

SD-03 Product Data

Window units[; G][; G, [____]]

Hardware

Setting materials

Weatherstripping

Submit window frame data for each type and finish.

SD-04 Samples

Window units

Submit when factory-finished color coating is provided.

SD-08 Manufacturer's Instructions

Glass

Submit glass manufacturer's instructions for setting and sealing materials and for installation of each type of glazing material specified.

SD-10 Operation and Maintenance Data

Window units, Data Package 1; [; G][; G, [____]]

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

1.3 QUALITY ASSURANCE

1.3.1 Label

Each prime window unit shall bear the AAMA Label warranting that the product complies with AAMA/WDMA/CSA 101/I.S.2/A440. Certificates of Compliance attesting that the prime window units meet the requirements of AAMA/WDMA/CSA 101/I.S.2/A440 will be acceptable in lieu of product labeling.

1.3.2 Glass and Glazing

Provide materials that are certified to meet ANSI Z97.1 by an independent testing laboratory.

1.3.3 Independent Testing

Testing shall be performed by an independent testing laboratory (certified by the Contracting Officer) and test report shall be signed by a registered professional engineer and shall include results from tests in the calculations.

1.4 DELIVERY, STORAGE, AND HANDLING

- a. Deliver products to the site in unopened containers, labeled plainly with manufacturers' name and brands. Deliver window assemblies in an undamaged condition. Exercise care in handling and hoisting windows during transportation and at the job site. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows.
- b. Finished surfaces shall be protected during shipping and handling using the manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which sealants, caulking, or glazing compounds must adhere.

1.5 ENVIRONMENTAL CONDITIONS

Do not start glazing work until the outdoor temperature is above 4 degrees C 40 degrees F and rising unless approved provisions are made to warm the glass and rabbet surfaces. Provide sufficient ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work if moisture collects on window assemblies or during

rainy weather.

PART 2 PRODUCTS

2.1 WINDOW UNITS

Primed window frames shall conform to AAMA/WDMA/CSA 101/I.S.2/A440 and the requirements specified herein. Provide windows of types, grades, performance classes, combinations, and sizes indicated or specified. Provide windows to accommodate hardware, glass, weatherstripping and accessories. Each window shall be a complete factory-assembled unit with glass factory or field installed.

2.2 WEATHERSTRIPPING

Weatherstripping shall conform to AAMA/WDMA/CSA 101/I.S.2/A440.

2.3 GLASS

Use ASTM C 1048 and ANSI Z97.1 Grade B (tempered), Style I (uncoated), Type 2, Class [1 (transparent)] [2 (heat absorbing)].

2.4 SETTING MATERIALS

Provide types required for the applicable setting method specified in the GANA Glazing Manual, unless specified otherwise herein. Do not use metal sash putty, non-skinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be [gray,] [black] or neutral color.

2.4.1 Elastomeric Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Use for channel or stop glazing [and] [metal] sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes. Color of sealant shall be [as selected] [gray] [black] [white] [_____].

2.4.2 Sealing Tapes, Beads or Gaskets

Gaskets or beads shall be at least 9.5 mm 3/8 inch wide with a Shore "A" durometer hardness of 50 and conform to ASTM C 509.

2.4.3 Setting Blocks and Edge Blocks

Use neoprene of 70 to 90 Shore "A" durometer hardness, chemically compatible with sealants used, and of sizes recommended by the glass manufacturer.

2.4.4 Accessories

Use accessories as required to provide a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

2.5 WINDOW ASSEMBLIES

Window units shall conform to AAMA/WDMA/CSA 101/I.S.2/A440.

2.5.1 Provisions for Glazing

NOTE: Edge clearances, face clearances, and bites shall be maintained as shown below:

Minimum Clearance and Bite Requirements

Glass Thickness	"A" Minimum Edge Clearance	"B" Nominal Bite	"C" Minimum Face Clearance
(mm)	(mm)	(mm)	(mm)
6.0	6.0	13.0	3.00
8.0	8.0	13.0	4.75
10.0	8.0	13.0	4.75
12.0	9.5	13.0	6.00
16.0	9.5	13.0	6.00
19.0	9.5	13.0	8.00
22.0	13.0	16.0	8.00
25.0	13.0	19.0	9.50

Minimum Clearance and Bite Requirements

Glass Thickness	"A" Minimum Edge Clearance	"B" Nominal Bite	"C" Minimum Face Clearance
(in)	(in)	(in)	(in)
1/4	1/4	1/2	1/8
5/16	5/16	1/2	3/16
3/8	5/16	1/2	3/16
1/2	3/8	1/2	1/4
5/8	3/8	1/2	1/4
3/4	3/8	1/2	5/16
7/8	1/2	5/8	5/16
1	1/2	3/4	3/8

Provide windows and rabbets suitable for specified glass thickness. [Minimum edge clearance shall be ____]. Nominal bite shall be ____]. Minimum face clearance shall be ____]. Provide sash for glazing and for securing glass with [metal beads] [glazing clips] [glazing channels] and glazing compound.

2.5.2 Sealant, Gaskets, and Beads

Sealant, gaskets, and beads shall be continuous around the perimeter of the glass.

2.5.3 Weatherstripping

Provide for ventilating sections of windows to ensure a weathertight seal meeting the infiltration requirements specified in [AAMA/WDMA/CSA 101/I.S.2/A440](#). Provide factory-applied weatherstripping that can be replaced by field repair mechanics. Use molded vinyl, molded or molded-expanded neoprene for weatherstripping for compression contact

surfaces. Do not use neoprene or polyvinyl chloride weatherstripping where it will be exposed to direct sunlight.

2.5.4 Fasteners

Provide flathead, cross-recessed type, exposed head screws and bolts with standard threads for use on windows, trim, and accessories. Screw heads shall finish flush with adjoining surfaces. Self-tapping sheet-metal screws are not acceptable for material more than 1.59 mm 1/16 inch thick.

2.5.5 Drips and Weep Holes

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

2.5.6 Combination Windows

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

2.5.7 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation.

2.5.8 Hardware

The item, type, and functional characteristics shall be the manufacturer's standard for the particular window type and shall conform to AAMA/WDMA/CSA 101/I.S.2/A440. Provide hardware that functions after the window assembly has withstood the application of the design blast pressure causing the development of a static design resistance, r_u , uniformly applied over both glazing and frame as defined in paragraph entitled "Certificates of Compliance" of this section. Equip operating ventilators with a lock or latching device which can be secured from the inside.

2.5.9 Anchors

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

2.5.10 Window-Cleaner Anchors

NOTE: Windows having sills more than 13.7 meters 45 feet above grade, adjoining balconies, or adjoining roofs should be shown and specified as requiring window-cleaner anchors, unless window cleaning methods at the activity make use of these anchors on lower windows. Coordinate window cleaning procedures and requirements with the using activity

in making the decision as to the need for window cleaner anchors. No removable or tilting-type sash may be provided instead of the anchors.

Provide double-head anchors for windows [indicated] [specified]. Anchors shall be stainless steel of size and design conforming to ASME A39.1. Provide two anchors for each single window [and each adjacent glass window unit]. Fasten anchors 1120 mm 44 inches above the window sill in accordance with ASME A39.1.

2.5.11 Finishes

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

Exposed aluminum surfaces shall be factory finished with an [anodic coating] [or] [organic coating]. [Color shall be [_____] [as indicated].] Windows [for each building] shall have the same finish.

2.5.11.1 Anodic Coating

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

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45. Finish shall be [_____] .

2.5.11.2 Organic Coating

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

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

2.6 SOURCE QUALITY CONTROL

2.6.1 Window Assembly Structural Test

2.6.1.1 Test Sample Number

At least two sample window assemblies for each type of window provided shall be tested, under an increasing uniform static load. Number of samples, beyond two, is left up to the vendor. However, it is noted that the acceptance criteria encourages a larger number of test samples.

2.6.1.2 Test Procedure

NOTE: To assure receiving the desired blast resistance protection, window assemblies provided by Contractor must be exactly as specified. If deviations from the specified requirements are sought by the Contractor, the Contractor must perform acceptance testing for the provided blast resistant window assemblies.

Test windows (glass panes and support frame) shall be identical in type, size, sealant, gasket or bead and construction to those furnished by the window manufacturer. The frame assembly in the test setup shall be secured by boundary conditions that simulate the adjoining walls of the structure for intended installation. The simulation securing boundary conditions shall be verified and attested by an attending Professional Engineer. Using either a vacuum or a liquid-filled bladder, an increasing uniform load shall be applied to the entire window assembly (glass and frame) until failure occurs in either the glass or frame. Failure shall be defined as either breaking of glass or loss of frame resistance. The failure load, r_f , shall be recorded to three significant figures. The load should be applied at a rate of 0.5 ru per minute where ru is the static design resistance:

Glass Size

Static Design Resistance

[____by____] mm

[____] kPa

Glass Size

Static Design Resistance

[____by____] inch

[____] psi

2.6.1.3 Acceptance Criteria

The static load capacity (r_s) of a glass pane for the specified acceptance test procedure is:

$$r_s = 0.876 r_u \quad (1)$$

The window assembly (frame and glass) is considered acceptable when the arithmetic mean of all the samples tested, r - such that:

$$r- \Rightarrow r_s + s_A \quad (2)$$

where: r_s = static load capacity of the glass pane for certification testing
 s = sample standard deviation

A = acceptance coefficient (Table 1)

- a. Arithmetic mean/standard deviation: For n test samples, \bar{r} is defined as:

$$\bar{r} = \text{sum from } i = 1 \text{ thru } n \text{ for } r_{fi} \text{ divided by } n \quad (3)$$

where r_{fi} is the recorded failure load of the i th test sample.

The sample standard deviation, s , is defined as:

$$s = \text{the square root of the quantity of the sum from } i = 1 \text{ thru } n \text{ for } (r_{fi} - \bar{r})^2 \text{ divided by } (n - 1) \quad (4)$$

The minimum value of the sample standard deviation, s , permitted to be employed in Equation (2) is:

$$s = 0.145 \bar{r} \quad (5)$$

This assures a sample standard deviation no better than observed for the general population of tempered glass.

- b. Additional sampled determination: The following equation can be used by tester to determine if additional test samples are justified. If:

$$\bar{r} \leq \bar{r}_s \text{ plus } s_B \quad (6)$$

then with 90 percent confidence, the design will not prove to be adequate with additional tests. Obtain rejection coefficient, B , from Table 1.

Table 1. Statistical Acceptance and Rejection Coefficients

Number of Window Assemblies <u>n</u>	Acceptance Coefficient <u>A</u>	Rejection Coefficient <u>B</u>
2	4.14	.546
3	3.05	.871
4	2.78	1.14
5	2.65	1.27
6	2.56	1.36
7	2.50	1.42
8	2.46	1.48
9	2.42	1.49
10	2.39	1.52
11	2.37	1.54
12	2.35	1.57
13	2.33	1.58
14	2.32	1.60
15	2.31	1.61
16	2.30	1.62
17	2.28	1.64
18	2.27	1.65
19	2.27	1.65
20	2.26	1.66
21	2.25	1.67
22	2.24	1.68
23	2.24	1.68
24	2.23	1.69

Table 1. Statistical Acceptance and Rejection Coefficients

Number of Window Assemblies	Acceptance Coefficient	Rejection Coefficient
<u>n</u>	<u>A</u>	<u>B</u>
25	2.22	1.70
30	2.19	1.72
40	2.17	1.75
50	2.14	1.77

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Set windows at proper elevation, location, and reveal. Brace properly to prevent distortion and misalignment. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install windows in a manner that will prevent entrance of water. Fasten hardware to windows.

3.1.2 Glass Setting

Items to be glazed shall be either shop or field glazed using glass of the quality and thickness specified or indicated. Preparation and glazing, unless otherwise approved, shall conform to applicable recommendations in the [GANA Glazing Manual](#). Windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops furnished with items to be glazed, to secure glass in place.

3.1.3 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to, masonry, wood, or dissimilar metals, except stainless steel or zinc, the aluminum surface shall be protected from dissimilar materials as recommended in the Appendix to [AAMA/WDMA/CSA 101/I.S.2/A440](#). Do not coat surfaces on which sealants are to adhere.

3.1.4 Anchors and Fastenings

Make provision for securing units to each other and to adjoining construction.

3.1.5 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as recommended by the manufacturer.

3.2 CLEANING

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

3.3 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of English unit measurements, and not on metric measurements commonly agreed to by the manufacturers or other parties. The English and metric units for the measurements shown are as follows:

<u>Products</u>	<u>English Units</u>	<u>Metric Units</u>
Gaskets	3/8 inch	9.5 mm
Glass	1/4 inch	6.0 mm
	5/16 inch	8.0 mm
	3/8 inch	10.0 mm
	1/2 inch	12.0 mm
	5/8 inch	16.0 mm
	3/4 inch	19.0 mm
	7/8 inch	22.0 mm
	1 inch	25.0 mm

-- End of Section --