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USACE / NAVFAC / AFCEA / NASA UFGS-06 73 01 (February 2010)  
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Preparing Activity: NASA New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in Agreement with UMRL dated July 2010

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SECTION 06 73 01

FIBERGLASS REINFORCED PLASTIC (FRP) GRATING  
02/10

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NOTE: This guide specification covers requirements  
for fiberglass reinforced plastic (FRP) gratings.

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

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

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

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

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NOTE: Units of work normally included in this  
section should be FRP items which require specific  
fabrication to meet the desired project requirements.

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NOTE: Show the following information on the  
drawings:

1. Location and configuration of all FRP grates.
2. All sizes and dimensions.
3. Special fastenings, attachments or anchoring.
4. Location and special details of expansion joint covers.
5. Connection details, other than manufacturer's

standard details for grating.

8. Locate and detail removable sections of handrails.

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PART 1 GENERAL

1.1 SUMMARY

This Section includes, but is not limited to, new fiberglass reinforced plastic (FRP) grating for elevated platforms and walkways.

1.2 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 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.

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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.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05 (2005; R 2006) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D 2344/D 2344M (2000; R 2006) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

ASTM D 2863 (2009) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

ASTM D 635 (2006) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D 638	(2008) Standard Test Method for Tensile Properties of Plastics
ASTM D 696	(2008) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D 790	(2007e1) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D 953	(2009) Standard Test Method for Bearing Strength of Plastics
ASTM E 662	(2009) Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
ASTM E 84	(2010) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G 155	(2005a) Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

#### INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2009; Errata First Printing) International Building Code
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#### U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK-17-3	(2002; Rev F) Composite Materials Handbook, Vol. 3, Polymer Matrix Composites Material Usage, Design, and Analysis
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#### UNDERWRITERS LABORATORIES (UL)

UL 94	(1996; R thru 2009) Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
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### 1.3 PERFORMANCE REQUIREMENTS

#### 1.3.1 Structural Performance of Gratings

Provide gratings capable of withstanding the effects of gravity loads in accordance with [ASCE/SEI 7-05](#), [ICC IBC](#), and the following loads and stresses within limits and under conditions indicated:

[ Walkways and Elevated Platforms Other Than Exits: Uniform load of 2.873 kilopascal 60 lb/sq.ft.

][ Walkways and Elevated Platforms Used as Exits: Uniform load of 4.788 kilopascal 100 lb/sq.ft.

][ High Load Capacity (HLC)Grating for AASHTO - H-20 LOADING: 14.515 kg 32,000 lb Axle Dual Wheels; minimum 3.8 to 5.1 cm 1.5 to 2 inch thickness.

][ Automobile Traffic: 2268 kg 5000 lb vehicle

][ Forklift: [4.54] [2.72] [.907] tonne [5] [3] [1] ton capacity

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1.4 SUBMITTALS

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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.

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

SD-02 Shop Drawings

Installation Drawings, Templates, and Directions[; G][; G, [\_\_\_\_\_]]

SD-03 Product Data

FRP Grating[; G][; G, [\_\_\_\_\_]]

Clips and Anchorage[; G][; G, [\_\_\_\_\_]]

SD-06 Test Reports

Bearing Strength Testing[; G][; G, [\_\_\_\_\_]]

Flexural Properties[; G][; G, [\_\_\_\_\_]]

Ultraviolet Testing[; G][; G, [\_\_\_\_\_]]

Shear Strength[; G][; G, [\_\_\_\_\_]]

Tensile Properties[; G][; G, [\_\_\_\_\_]]

Toxicity Testing[; G][; G, [\_\_\_\_\_]]

Coefficient of Lineal Thermal Expansion[; G][; G, [\_\_\_\_\_]]

Flame Spread Testing[; G][; G, [\_\_\_\_\_]]

SD-07 Certificates

Manufacturer's Sample Warranty[; G][; G, [\_\_\_\_\_]]

[ Manufacturer's Certification of State Product Approval[; G][; G, [\_\_\_\_\_]]

] Certification of Anchorage System compliance with ASCE/SEI 7-05[; G [; G, [\_\_\_\_\_]]

[ Proof of Certification from a minimum of two quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR) [; G][; G, [\_\_\_\_\_]]

] SD-08 Manufacturer's Instructions

Shipping, Handling, Erection Procedures[; G][; G, [\_\_\_\_\_]]

Care and Maintenance Instructions[; G][; G, [\_\_\_\_\_]]

SD-09 Manufacturer's Field Reports

Manufacturer's Certification of Installation[; G][; G, [\_\_\_\_\_]]

SD-11 Closeout Submittals

Manufacturer's Warranty[; G][; G, [\_\_\_\_\_]]

1.5 QUALITY ASSURANCE

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NOTE: For jobs in Iceland, in lieu of AWS welders and inspectors, use "Technological Institute of

**Iceland" certified welders and inspectors.**

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Provide items by manufacturers having a minimum of [ten][\_\_\_\_\_] years experience in the design and manufacture of similar products and systems. Additionally, if requested, provide a record of at least [five][\_\_\_\_\_] previous, separate, similar successful installations in the last [five][\_\_\_\_\_] years. Submit Manufacturer's catalog data to include two copies of manufacturer's specifications, load tables, dimension diagrams, and anchor details for the following items:

- a. FRP Grating
- b. Clips and Anchorage

Provide [three][\_\_\_\_\_] year manufacturer's limited warranty on all FRP products against defects in materials and workmanship. Submit Manufacturer's Sample Warranty prior to commencement of the work.

Submit installation drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Submit Certification of Anchorage System compliance with ASCE/SEI 7-05. Deliver such items to Contracting Officer and the Project site prior to commencement of installation.

[ Ensure Manufacturer is certified to the ISO 9001-2008 standard.[ Submit Manufacturer's Certification of State Product Approval.][ Submit Proof of Certification from a minimum of two quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR)]

11.6 PRODUCT DELIVERY AND STORAGE

Submit Manufacturer's recommendations for shipping, handling, erection procedures, and care and maintenance instructions upon completion of installation. Deliver manufactured materials in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Ensure all adhesives, resins and their catalysts and hardeners are crated or boxed separately, and noted as such to facilitate their movement to a dry indoor storage facility.

Carefully handle all materials to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 21 and 30 degrees celsius 70 and 85 degrees Fahrenheit until they are required.

PART 2 PRODUCTS

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**NOTE: Product selections should be based on  
esthetic values, reliability and cost. Delete  
alternate requirements where they occur.**

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2.1 PRODUCT REQUIREMENTS

Provide gratings composed of continuous roving fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as

necessary to meet the design requirements and dimensions as specified.

Provide resin of isophthalic polyester with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties conforming to the specified requirements.

Submit documentation for the following product tests prior to commencement of work:

- a. **Bearing Strength Testing** conforming to **ASTM D 953** and "Structural Performance Requirements" specified above.
- b. **Flexural Properties** conforming to **ASTM D 790**
  - (1) Minimum Flexural Strength - **206 MPa 30,000 psi**
  - (2) Minimum Flexural Modulus - **12.4 GPa 1.8 x 10 to power 6 psi**
- c. **Ultraviolet Testing** conforming to **ASTM G 155**, and **ASTM G 53**
- d. **Shear Strength** conforming to **ASTM D 2344/D 2344M**
  - (1) Minimum Shear Strength - **31 MPa 4,500 psi**
- e. **Tensile Properties** conforming to **ASTM D 638**
  - (1) Minimum Tensile Strength - **206 MPa 30,000 psi**
- f. **Toxicity Testing** conforming to **MIL-HDBK-17-3**
- g. **Coefficient of Lineal Thermal Expansion** conforming to **ASTM D 696**
  - (1) Required Value - **8.0 by 10 power minus 6 cm/cm/degree C in/in/degree F**
- h. **Flame Spread Testing** conforming to **ASTM D 2863**, **ASTM E 662**, and **UL 94**

Ensure all surfaces of FRP items and fabrications are [smooth] [non-slip grit], resin-rich, free of voids and without dry spots, cracks, and un-reinforced areas. Completely cover all glass fibers with resin to protect against their exposure due to ultraviolet, wear, or weathering.

Provide grating products with a flame spread rating of 25 or less per **ASTM E 84** Tunnel Test. Test gratings for burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10 millimeters per **ASTM D 635**.

#### 2.1.1.1 Molded **FRP Grating**

Provide grating made as one piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane with a rectangular mesh pattern providing unidirectional strength and reinforced with continuous roving of equal number of layers in each direction, with the top layer of reinforcement no more than 1/8 inch below the top surface of the grating to provide maximum stiffness and prevent resin chipping of unreinforced surfaces having percentage of glass (by weight) not exceed 35 percent, so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements.



After molding, ensure no dry glass fibers are visible on any surface of bearing bars or cross bars, and that all bars are smooth and uniform with no evidence of fiber orientation irregularities, inter-laminar voids, porosity, resin rich or resin starved areas.

- [ Non-slip surfacing to be manufactured with a concave, meniscus profile on the top of each bar providing maximum slip resistance.
- ] Grating bar intersections are to be filleted to a minimum radius of [1/16 inch](#) to eliminate local stress concentrations and the possibility of resin cracking at these locations.

Grating to be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with [ASTM E 84](#).

#### 2.1.2 Fasteners

General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners, [clips and anchorage](#) for exterior use. Select fasteners for type, grade, and class required.

### 2.2 GRATING FABRICATION

Verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work.

Ensure all field and shop fabricated grating cuts are coated with vinyl ester resin to provide maximum corrosion resistance in accordance with the manufacturer's instructions.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions.[ Submit [\_\_\_\_\_] copies of [manufacturer's certification of installation](#) to the Contracting Officer.] Verify all measurements and take all field measurements necessary before fabrication. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, to be included. Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack. Comply with recommendations of referenced bar grating standards, including installation clearances and standard anchoring details.

- a. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- b. Attach non-removable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

### 3.2 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous FRP items securely in place. Include for anchorage not otherwise specified or indicated.

### 3.3 MANUFACTURER'S WARRANTY

Submit original and [\_\_\_\_\_] copies of manufacturer's signed Warranty.

-- End of Section --