

SECTION 06 82 00

FIBERGLASS REINFORCED PLASTIC PRODUCTS AND FABRICATIONS

04/07

PART 1 GENERAL

1.1 REFERENCES

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (2002) Standard for Fixed Ladders and Safety Requirements

ASTM INTERNATIONAL (ASTM)

ASTM C 177 (2004) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

ASTM D 2344 Standard Test Method for Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short-Beam Method

ASTM D 2583 (2007) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

ASTM D 570 (1998; R 2005) Standard Test Method for Water Absorption of Plastics

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 695 Standard Test Method for Compressive Properties of Rigid 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 (2003) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D 792 (2000) Density and Specific Gravity (Relative Density) of Plastics by Displacement

ASTM E 84 (2007b) Standard Test Method for Surface Burning Characteristics of Building Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC CBC (2007) California Building Code

UNDERWRITERS LABORATORIES (UL)

UL 94 (1996; Rev thru Dec 2003) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 DESIGN REQUIREMENTS

This section contains components and connectors that require Contractor design.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are 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

Grating and Stair Treads; G AE

Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work

Platforms, Stairs, and Support Structures; G AE

Show dimensions, weight, size, location, and anchorage to supporting structure

Handrail; G, AE

Ladders; G, AE

Show dimensions, weight, size, and location of connections to adjacent supports and other Work

SD-03 Product Data

Grating and Stair Treads; G AE

Platforms, Stairs, and Support Structures; G AE

Handrail; G, AE

Catalog information and catalog cuts showing materials, design tasks, and showing load, span, and deflection; include manufacturer's specifications

Fabricator's qualification experience; G AE

Manufacturer's qualification experience; G AE

SD-04 Samples

Grating; G AE
Handrail; G, AE

Each type of grating, handrail, and handrail connection

SD-05 Design Data

Structural calculations; G AE
Platforms, Stairs, and Support Structures; G AE
Handrail; G, AE
Ladders; G, AE

For platforms, stairs, support structures, ladders and cages, handrails, and other fabrications shown

SD-06 Test Reports

Factory test reports for physical properties of product; G AE

Test data for handrails and supports may supplement load calculations providing data covers the complete system, including anchorage

Test data for all components showing load and deflection due to load, in enough detail to prove handrail is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 19.10, using design loads specified. Include test data for the following: Top rail and posts, handrail wall brackets, connections, mounts, and bases, thermal movement provisions

Independent laboratory test report; G AE

Dated within 2 years of submittal date, of fire retardant testing conducted on exact type of material proposed (not a resin test report).

SD-08 Manufacturer's Instructions

Storage and handling requirements

Manufacturer's installation instructions

1.4 QUALIFICATIONS

Designer: Calculations required for Contractor design shall be stamped by a registered engineer, licensed in state where Project will be constructed.

Fabricator's Qualification: Minimum of 5 years' experience.

Manufacturer's Qualification: Minimum of 5 years' experience in manufacturing of products meeting these specifications.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Preparation for Shipment

- a. Insofar as is practical, factory assemble items provided hereunder.
- b. Ladders shall be shipped fully shop fabricated and assembled.
- c. Package and clearly tag parts and assemblies that are of necessity shipped unassembled in a manner that will protect materials from damage, and facilitate identification and final assembly in field.

1.5.2 Storage and Handling

In accordance with manufacturer's recommendations and in such a manner as to prevent damage of any kind, including overexposure to sunlight.

PART 2 PRODUCTS

2.1 GENERAL

- a. Like Items of Materials: Where possible, provide end products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.
- b. Unless otherwise specified, all products shall be manufactured by a pultruded process using vinyl ester resin.
- c. Products shall be manufactured with ultra-violet (UV) inhibitor additives.
- d. Exterior surfaces shall have a synthetic surface veil covering.
- e. Furnish molded products as an option where permitted by specifications.
- f. Fire Retardance:
 1. Flame spread shall be less than 25 as measured by [ASTM E 84](#).
 2. Include combinations of aluminum trihydrate, halogen, and antimony trioxide, where required to meet fire retardance, in the resin system.
 3. Meet self-extinguishing requirements of [ASTM D 635](#). Confirm with [independent laboratory test report](#).
- g. Color pigment shall be dispersed in resin system.
- h. Fabricate FRP products exposed to outdoor conditions with an additional 1 mil thick UV coating to shield product from UV light.
- i. All cut ends, holes, and abrasions of FRP shapes shall be sealed with resin to prevent intrusion of moisture.

2.2 GRATING AND STAIR TREADS

2.2.1 General

- a. 100 psf minimum, unless otherwise shown.

- b. Maximum Deflection: 1/4 inch, unless otherwise shown.
- c. Stair Tread: 100 psf uniform load or concentrated load of 300 pounds on area of 4 square inches located in center of tread, whichever produces greater stress.

2.2.2 Molded Type Grating

- a. Nonskid grit affixed to top of bar surface or a concave, meniscus top to all bars, providing skid resistance.
- b. Load bars in both directions with equal stiffness.
- c. Square mesh, 1-1/2 inch maximum spacing.

2.2.3 Pultruded Type Grating

- a. Main bars joined by cross bars secured in holes drilled in main bars.
- b. Cross bars, with 6-inch maximum spacing, shall mechanically lock main bars in position such that they prevent movement.
- c. Intersections: Bond using adhesive as corrosive resistant as pultrusion resin.
- d. Main Bar Ends: Minimum bearing support width of 1-1/2 inches.
- e. Skid Resistant Surface: Grit adhesively bonded, manufacturer's standard.
- f. provide extra stiffness around openings.

2.2.4 Hold-Down Clamps

Clamps shall be same material as grating or Type 316 stainless steel.

2.2.5 Bolts and Connectors

- a. Corrosion resistant FRP or Type 316 stainless steel.
- b. Size and strength to meet ICC CBC requirements.

2.2.6 Fabrications

- a. Field measure areas to receive grating. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
- b. Section Length: Sufficient to prevent its falling through clear opening when oriented in span direction when one end is touching either concrete or vertical leg of grating support.

2.3 PLATFORMS, STAIRS, AND SUPPORT STRUCTURES

- a. Deflection and Safety Factors:
 - 1. Deflection Criteria: Not to exceed L/360.
 - 2. Safety Factors: Minimum ratios of ultimate stress to allowable

static service stress.

- a) Flexural Members: 2.5.
- b) Compression Members: 3.0.
- c) Shear: 3.0.
- d) Connections: 4.0.

3. Minimum design safety factors for dynamic or impact loads shall be twice the values for static service loads.

b. Loads:

- 1. 100 psf uniform live load over platform.
- 2. Static and dynamic loads for equipment shown.

c. Glass fiber reinforced polyester or vinyl ester resin matrix, approximately 50 percent resin to glass ratio.

d. Continuous glass strand rovings shall be used internally for longitudinal strength.

e. Continuous strand glass mats shall be used internally for transverse strength.

f. Material Properties:

Minimum Ultimate Coupon Properties (UN)

<u>Material Properties</u>	<u>Test Method</u>	<u>Units</u>
Pultruded Fiberglass Structural Shapes		
Ultimate tensile stress in longitudinal direction, psi (MPa)	ASTM D 638	30,000 (207)
Ultimate compressive stress in longitudinal direction, psi (MPa)	ASTM D 695	30,000 (207)
Ultimate flexural stress in longitudinal direction, psi (MPa)	ASTM D 790	30,000 (207)
Ultimate short beam shear in longitudinal direction, psi (MPa)	ASTM D 2344	4,500 (31)
Ultimate tensile stress in transverse direction, psi (MPa)	ASTM D 638	7,000 (48)
Ultimate compressive stress in transverse direction, psi (MPa)	ASTM D 695	15,000 (103)
Ultimate flexural stress in transverse direction, psi (MPa)	ASTM D 790	10,000 (69)
Density (lb/in. ³) (kg/mm ³)	ASTM D 792	0.060 to 0.070 (0.00166 to 00194)
Water absorption (25-hr immersion) % by weight	ASTM D 570	0.60 max,

Minimum Ultimate Coupon Properties (UN)

<u>Material Properties</u>	<u>Test Method</u>	<u>Units</u>
Barcol hardness	ASTM D 2583	45
Coefficient of thermal expansion 10 ⁻⁶ in./in./deg. C	ASTM D 696	
Expansion, LW10 ⁻⁶ in./in./deg. F		4.4
Thermal conductivity, Btu in./ft ² /hr/deg. F	ASTM C 177	

Flame-Retardant Properties

Flammability test	ASTM D 635	Self-extinguishing
Surface burning characteristics	ASTM E 84	25 maximum
Flammability class	UL 94	VO
Temperature index	UL 94	130 deg. C

2.4 **HANDRAIL**

2.4.1 Structural Criteria

- a. Deflection: No permanent set in any member or connection when tested to design load.
- b. Apply load to produce maximum stress and deflection in each of the respective components. Provide [factory test reports](#) to document physical properties of product.
- c. Top Rail and Posts of Handrails: Capable of withstanding the following load cases applied with a safety factor of 1.33:
 1. Concentrated load of 200 pounds applied at any point and in any direction in accordance with [ICC CBC](#).
 2. Uniform load on the top rail of 50 pounds per linear foot applied in any direction in accordance with [ICC CBC](#).
 3. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with [ICC CBC](#).
- d. In-Fill Area of Railing Systems:
 1. Capable of withstanding horizontal concentrated load of 200 pounds applied to 1 square foot at any point in the system including panels, intermediate rails, balusters, or other elements composing in-fill area.
 2. Horizontal concentrated load need not be assumed to act concurrently with loads on top rails of handrails.
- e. Mid-Rails with Corner Returns: Withstand 300-pound concentrated

vertical load applied at any point or direction without damage and loosening of fittings or attachment hardware.

- f. Concrete Anchors for Handrail Wall Brackets: Not to exceed ICC Engineering Reports allowable loads for actual spacing, edge distance, and embedment, with assumed concrete strength of 4,000 psi.
- g. Concrete Anchors: In accordance with ICC Engineering Reports allowable load values for size, length, embedment, spacing, and edge distance to match required loads shown in calculations.
- h. Connections, Mounts, and Bases: Withstand all handrail loads without permanent set and with a safety factor of at least 1.65 against failure.

2.4.2 Thermal Movement

- a. Allow for maximum range of ambient temperature change (difference between high or low and installation temperature).
- b. Base design on actual surface temperatures of materials due to both solar heat gain and night time sky heat loss.
- c. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

2.4.3 Rails and Posts

- a. 2-inch nominal square or round tubing posts.
- b. 1-3/4- or 2-inch nominal round or square rails.
- c. Maximum Post Spacing: 5 feet.
- d. Clearance Between Rails: 11-1/2 inches.

2.4.4 Kickplates

Kickplates shall be corrugated, 4 inches by 1/2-inch by 0.125-inch thick or 4 inches by 9/16-inch thick at all handrail locations.

2.4.5 Kickplate Connectors and Splices

Continuous with provision for expansion and contraction without distortion or buckling.

2.4.6 Connections, Mounts, Bases

Fiberglass or Type 316 stainless steel.

2.4.7 Pultruded Parts

<u>Minimum Mechanical Properties</u>	<u>Test Method</u>	<u>Values</u>
Tensile Stress	ASTM D 638	30,000 psi
Tensile Modulus	ASTM D 638	2.5 x 10 ⁶ psi
Compressive Stress	ASTM D 695	30,000 psi

<u>Minimum Mechanical Properties</u>	<u>Test Method</u>	<u>Values</u>
Compressive Modulus	ASTM D 695	2.5 x 10 ⁶ psi
Flexural Stress	ASTM D 790	30,000 psi
Flexural Modulus	ASTM D 790	1.6 x 10 ⁶ psi
Shear Stress	ASTM D 2344	4,500 psi
Density	ASTM D 792	0.060 0.070 lbs/in. ³
24-Hour Water Absorption	ASTM D 570	0.6% max.
Coefficient of Thermal Expansion	ASTM D 696	4.4 x 10 ⁻⁶ in./in./degree F
Flexural Stress	Full Section	36,000 psi
Flexural Modulus	Full Section	3.7 x 10 ⁶ psi

2.5 LADDERS

2.5.1 Design Performance

Fabricate ladders with rails, rungs, landings, and cages to meet applicable requirements of OSHA, Section 7 of 29, CFR 1910.27, and ANSI A14.3.

- a. Concentrated load of 250 pounds plus 30 percent impact on rungs.
- b. Maximum rung deflection of 1/360.
- c. Concentrated load of 250 pounds.

PART 3 EXECUTION

3.1 GENERAL

Install in accordance with manufacturer's written instructions.

Install plumb or level, rigid and neat, as applicable.

Furnish fasteners and anchorages for complete installation.

Seal field cut holes, edges, and abrasions with catalyzed resin compatible with original resin.

3.2 GRATING

Anchor grating securely to supports to prevent displacement.

Install each grating section such that it is easily removable.

Clearance (Grating to Vertical Surfaces): 1/4-inch (plus or minus 1/8-inch

tolerance).

3.3 HANDRAIL

Provide and install expansion and contraction connections as shown on approved Shop Drawings.

3.4 STRUCTURAL SHAPES

Connect parts with approved connectors meeting manufacturer's design requirements and with corrosion resistance equal to structural shapes.

Provide supports and bracings required to comply with applicable codes and design requirements.

3.5 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to masonry or concrete with not less than two 1/2-inch diameter post-installed anchors. Install intermediate clip angles not over 48 inches on center, unless noted otherwise. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. In no case shall ends of ladders rest upon finished roof.

-- End of Section --