Preparing Activity: NASA Superseding
UFGS-06 71 33 (May 2018)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in Agreement with UMRL dated July 2023
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08/23

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SECTION 06 71 33

FIBERGLASS REINFORCED PLASTIC (FRP) LADDERS
08/23

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NOTE: This guide specification covers fiberglass reinforced plastic (FRP) ladders, customarily manufactured to meet specific requirements in building construction and fabricated FRP items not a part of the structural FRP components or framework.

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).
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PART 1 GENERAL

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Include in drawings a complete design indicating the character of the work to be performed and giving the following:

Location and details of each fabricated FRP ladder component showing all dimensions, shapes, and sizes of members, connections, and the relation of items to other building components.

Anchorage devices embedded in other construction, including but not limited to, precast concrete wall panels, precast concrete structural members, precast

concrete roof decking, brick and block masonry, and precast stone work.

Anchorage devices to structural steel framework, including, but not limited to, steel bar grating, steel floor plates, and structural steel roof or floor decking.

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This Section includes, but is not limited to, new fiberglass reinforced plastic (FRP) ladder systems, including safety ladder cages, mounting systems and related accessories.

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.

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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 LADDER INSTITUTE (ALI)

ALI A14.3	(2008; R 2018) Ladders - Fixed - Safety Requirements

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D430	(2006; R 2012) Standard Test Methods for Rubber Deterioration - Dynamic Fatigue
ASTM D495	(1999; R 2004) Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation

ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) 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 D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1148	(2013; R 2018) Standard Test Method for Rubber Deterioration—Discoloration from Ultraviolet (UV) or UV/Visible Radiation and Heat Exposure of Light-Colored Surfaces
ASTM D2344/D2344M	(2016) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM D3039/D3039M	(2017) Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials
ASTM D4000	(2016) Standard Classification System for Specifying Plastic Materials
ASTM D7264/D7264M	(2021) Standard Test Method for Flexural Properties of Polymer Matrix Composite Materials
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2021; TIA 21-1) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.23	(Nov 2016) Ladders
29 CFR 1910.27	(Nov 2016) Scaffolds and Roope Descent Systems
29 CFR 1910.28	(Nov 2016)Duty to Have Fall Protection and Falling Object Protection
29 CFR 1926	Safety and Health Regulations for Construction

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Preinstallation Meetings

Within [30] [_____] calendar days of Contract Award, a preinstallation meeting will be scheduled by the Contracting Officer. Submit the following for review:

a. Qualification of Manufacturer

b. Qualification of Engineer of Record

c. Manufacturer's Catalog Data

Include two copies of manufacturer's specifications, load tables, dimension diagrams, and anchor details for the following items:

(1) FRP Ladders and Ladder Safety Cages

(2) Anchorage Materials

d. Fabrication and Installation Drawings and Details

Include plans, elevations, sections, and details of FRP fabrications and their connections. Show anchorage and all accessory items.

Provide templates for anchors and bolts specified for installation under other Sections.

Provide structural analysis data complying with design loads, signed and sealed by the qualified professional engineer responsible for their preparation.

e. Manufacturer's Recommendations

Provide shipping, handling, and erection procedures, along with instructions for care and maintenance after installation.

f. Manufacturer's Sample Warranty

1.3 SUBMITTALS

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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.

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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-01 Preconstruction Submittals

Qualification of Manufacturer

Qualification of Engineer of Record

SD-02 Shop Drawings

Fabrication and Installation Drawings and Details; G[, [____]]

SD-03 Product Data

Manufacturer's Catalog Data; G[, [____]]

SD-06 Test Reports

Ultraviolet Testing; G[, [____]]

Thermal Expansion; G[, [____]]

Flame Spread; G[, [____]]

SD-07 Certificates

Manufacturer's Sample Warranty

SD-08 Manufacturer's Instructions

Manufacturer's Recommendations

SD-11 Closeout Submittals

Manufacturer's Warranty

1.4 QUALITY CONTROL

In each of the NFPA standards referred to herein, the advisory provisions are mandatory, as though the word "shall" is substituted for the word "should" wherever it appears. Reference in these standards to the authority having jurisdiction is interpreted to mean the Contracting Officer.

1.4.1 Qualification of Manufacturer

Fiberglass reinforced plastic (FRP) manufacturer is required to have a minimum of [10][_____] years of experience in manufacturing FRP products.

[A record of a minimum of five separate, similar installations within the last [five] [10] [_____] years is required.

] Provide manufacturer's warranty for all FRP products against defects in material and workmanship for a minimum of [five] [_____] years.[Manufacturer to provide evidence of ISO 9001-2000 standard certification.]

1.4.2 Qualification of Engineer of Record

[Ensure that the Engineer of Record is currently licensed within the jurisdiction of the project.

][Provide documentation that the Engineer of Record is approved, authorized, and currently licensed by the State of [_____], and has a minimum of five years of experience as an approved Engineer for manufacturers of similar ladder systems. Supply the names and locations of five projects of similar size and scope for which the ER has provided engineering calculations using the manufacturer's products submitted for this project within the previous 3 years. Provide ER-certified engineering calculations and sealed documents for:

a. Meeting ASCE 7-22 requirements in accordance with the International Building Code

b. Fabrication and installation drawings and details

]

1.5 DELIVERY, HANDLING, AND STORAGE

Deliver all manufactured materials in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturers, clearly marked and identified relative to the complete system. Provide all adhesives, resins, and their catalysts and hardeners in clearly marked or noted crates or boxes. Store all manufactured materials in a dry indoor facility with a constant temperature range between 21.11 and 29.44 degrees C 70 and 85 degrees F until they are required.

Submit manufacturer's recommendations for shipping and handling. Handle all materials to prevent abrasion, cracking, chipping, twisting, or other deformations and other types of damage.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Ensure that all ladder side rails, rungs, mounting brackets, cage straps, and related safety rail system are FRP structural shapes manufactured to comply with or exceed the standards identified in this Section. Provide FRP ladders and ladder safety cages and anchorage materials, including cage hoops, brackets, and all other structural shapes composed of reinforced fiberglass components and resin in qualities, quantities, properties, arrangements, and dimensions as specified in the Contract Documents. Ensure that the complete assembly meets the minimum requirements of ASCE 7-22 and 29 CFR 1910.27.

2.1.1 Design Requirements

Ensure that fiberglass reinforcement is a combination of continuous roving, continuous strand mat, bidirectional roving mat, and surfacing veil in sufficient quantities as required by the application, the physical properties, or both. Clearly identify components as specified in ASTM D4000. Submit documentation verifying structural integrity in relation to thermal expansion.

Ensure that all finished surfaces of FRP items are smooth, resin-rich, and free of voids, dry spots, cracks, crazes or unreinforced areas. Provide a system that is completely covered with resin protection against wear, weathering, and damage from ultraviolet light. Submit ultraviolet testing (UV) results and documented protection with:

a. Integral UV inhibitors in the resin

b. A synthetic, resin-rich surfacing veil, meeting or exceeding the requirements of ASTM D1148.

Provide FRP products that have a tested flame spread rating of 25 or less as specified in ASTM E84 Tunnel Test, with a ladder system meeting the minimum requirements of ASTM D430 and ASTM D495.

Provide 316 stainless steel bolts for attaching ladder cage vertical bars to hoops, ladder hoops to brackets, ladder cage brackets to the ladder, wall brackets to the ladder, and landing safety rails to the system. Mechanically attach all rungs to the ladder with 18-8 stainless-steel rivets, and chemically bond with resin.

All ladder and cage components are to be integrally pigmented yellow. All wall and vertical rail base mount brackets are to be light gray.

2.1.2 Performance Requirements

Provide structural shapes in the ladder system meeting minimum longitudinal mechanical properties as follows:

Tensile Strength	ASTM D638	2.068427e+008 pascal
Tensile Modulus	ASTM D638	1.723689e+010 pascal

Flexural Strength	ASTM D790	2.068427e+008 pascal
Flexural Modulus	ASTM D790	1.241056e+010 pascal
Flexural Modulus-Full Section		1.930532e+010 pascal
Short Beam Shear	ASTM D2344/D2344M	3.102641e+007 pascal
Shear Modulus-Transverse		3.102641e+009 pascal
Coefficient of Thermal Expansion	ASTM D696	2.032e-005 cm/cm/m
Flame Spread	ASTM E84	2.032e-005 cm/cm/m

Tensile Strength	ASTM D3039/D3039M	30,000 psi
Tensile Modulus	ASTM D3039/D3039M	2,500,000 psi
Flexural Strength	ASTM D7264/D7264M	30,000 psi
Flexural Modulus	ASTM D7264/D7264M	1,800,000 psi
Flexural Modulus-Full Section		2,800,000 psi
Short Beam Shear	ASTM D2344/D2344M	4,500 psi
Shear Modulus-Transverse		450,000 psi
Coefficient of Thermal Expansion	ASTM D696	0.000008 in/in/F
Flame Spread	ASTM E84	25 or less

2.1.2.1 Structural Performance of Ladders

Provide ladders capable of withstanding the effects of gravity loads as specified in ASCE 7-22 and the International Building Code, as well as loads and stresses within limits and under conditions specified in 29 CFR 1910.27 and ALI A14.3.

Provide ladders that to support a concentrated vertical load of 34.02 kg [1200] [____] pounds applied at mid-span of the rung.

2.1.2.2 Thermal Movements

Provide exterior metal fabrications that withstand thermal movements resulting from maximum change (range) between 49 degrees C 120 degrees F, ambient, and 83 degrees C 180 degrees F, material surface. Specifically, prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

2.1.2.3 Safety Performance of Ladders

Provide a ladder system that fully complies with NFPA 101, OSHA 29 CFR 1910.23, 29 CFR 1910.27, 29 CFR 1910.28, and ALI A14.3 for

distance between rungs, cleats, and steps and for minimum clearances for cages and climbing space.

2.2 COMPONENTS

2.2.1 Ladders

Fabricate ladder side rails of a continuous pultruded, 4.5 cm 1 3/4 inch square tube with a minimum wall thickness of 0.635 cm 1/4 inch or greater. Fabricate ladder rungs to be 3.175 cm 1 1/4 inch diameter pultruded structural shapes, continuously fluted to provide a nonslip surface. Rungs that are gritted as a secondary operation are not permitted. Fit the rungs in the centerline of the side rails.

Fabricate ladder walls and floor mounts from pultruded angles,0.953 3/8 inch minimum thickness. Mechanically attach all ladder rungs to ladder side rails by use of stainless-steel rivets and a chemical bond of epoxy.

Protect all pultruded ladder components from ultraviolet (UV) attack by providing integral UV inhibitors in the resin and a synthetic surfacing veil to help produce a resin-rich surface.

2.2.2 Personal Fall Arrest System (PFAS) or Ladder Safety System (LSS) Requirements

2.2.2.1 New Ladders

Ladders installed on or after November 19, 2018 require a PFAS or LSS where an accident would result in a fall 24 foot or greater. Accidents resulting in a fall less than 24 foot should be considered on a case by case basis for additional protection by the Safety Officer, as specified in 29 CFR 1910.28.

2.2.2.2 Existing Ladders

When a fixed ladder, cage, or well, or any portion of a section, is replaced, install a PFAS or LSS in at least that section of the fixed ladder, cage or well where the replacement is located.

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NOTE: Coordinate with the Contracting Officer's appointed Safety Officer to determine the requirement for a personal fall arrest or LSS on fixed ladders less than 24 foot in height as well as repair requirements for existing fixed ladders.

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[2.2.3 Ladder Safety Cages

Ladder safety cages are not permitted as fall protection on newly installed or replaced fixed ladders installed after November 19, 2018. Phasing out of all ladder safety cages is in place until November 18, 2036. Following the phase out period, all fixed ladders must be equipped with a personal fall arrest system or a ladder safety system.

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NOTE: Include the following for projects requiring ladder safety cages.

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]PART 3 EXECUTION

3.1 INSTALLATION

Install fabricated FRP work in accordance with the approved detail drawings and descriptive data for each item of fabricated FRP, in conformance with 29 CFR 1926, and as specified.

Assemble and install ladder systems and all components in strict accordance with the manufacturer's assembly documentation. Seal cut or drilled surfaces in accordance with the manufacturer's instructions. Provide adequate ventilation during all drilling, cutting, and resin application procedures.

3.1.1 Fabrication

Ensure that the design and layout of ladders and safety cages complies with ALI A14.3 and OSHA 29 CFR 1910.27. Ensure that all ladder rungs penetrate the tube side wall of the ladder rails. Provide ladder rung connections that are both chemically locking epoxy and mechanically locking rivets.

Fully shop-assemble ladders. Test-assemble safety cages; drill and fit to ensure proper field assembly. Leave safety cage brackets attached with bolts to the ladder for shipping, but disassemble ladder cage components. Package and ship each set of cage components with each respective ladder.

Field-attach hoops to the brackets. Seal all cut, machined edges, holes, and notches to provide maximum corrosion resistance. Coat all field-fabricated cuts in accordance with the manufacturer's instructions.

3.1.2 Fastening to Construction-In-Place

Provide anchorage devices and fasteners where necessary for fastening fabricated FRP items to construction-in-place. Provide threaded fasteners for concrete inserts embedded in cast-in-place concrete; masonry anchorage devices and threaded fasteners for solid masonry and concrete-in-place; toggle bolts for hollow masonry and stud partitions; through-bolting for masonry and wood construction; lag bolts and wood screws for wood construction; and connections for structural steel.

3.2 CLOSEOUT ACTIVITIES

3.2.1 Manufacturer's Warranty

Submit [_____] copies of manufacturer's warranty [30][_____] calendar days before final inspection.

-- End of Section --