SECTION 06 71 33 FIBERGLASS REINFORCED PLASTIC (FRP) LADDERS

PART 1 - General

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

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.

A. AMERICAN LADDER INSTITUTE (ALI)

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

B. 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

C. 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 D4000 (2016) Standard Classification System for Specifying Plastic Materials

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

D. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2018; ERTA 18-1; ERTA 18-2; ERTA 18-3; ERTA 18-4; TIA 18-1; TIA 18-2; TIA 18-3; TIA 18-4) Life Safety Code

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

29 CFR 1910.27 (N0v 2016) Scaffolds and Roope Descent Systems

29 CFR 1926 Safety and Health Regulations for Construction

1.2 Administrative Requirements

A. Preinstallation Meetings

Within 30 calendar days of Contract Award, submit the following for review:

1. Qualification of Manufacturer
2. Qualification of Engineer of Record
3. Manufacturer's Catalog Data

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

a. FRP Ladders and Ladder Safety Cages
b. Anchorage Materials

B. 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.

C. Manufacturer's Recommendations

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

D. Manufacturer's Sample Warranty

1.3 Submittals

A. Preconstruction Submittals

1. Qualification of Manufacturer
2. Qualification of Engineer of Record

B. Shop Drawings

1. Fabrication and Installation Drawings and Details;

C. Product Data

1. Manufacturer's Catalog Data; G, AE

D. Test Reports

1. Ultraviolet Testing;
2. Thermal Expansion;
3. Flame Spread;

E. Certificates

1. Manufacturer's Sample Warranty

F. Manufacturer's Instructions

1. Manufacturer's Recommendations

G. Closeout Submittals

1. Manufacturer's Warranty

1.4 Quality Control

A. 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 5 years is required.

Provide manufacturer's warranty for all FRP products against defects in material and workmanship for a minimum of 5 years Qualification of Engineer of Record

Ensure that the Engineer designing FRP Ladder and associated components) is currently licensed within the jurisdiction of the project.

Provide documentation that the Engineer designing FRP Ladder and associated components (ER) is approved, authorized, and currently licensed by the State of Pennsylvania, and has a minimum of 5 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 Engineer has provided engineering calculations using the manufacturer's products submitted for this project within the previous 3 years. Provide Engineer-certified engineering calculations and sealed documents for:

1. Meeting ASCE 7-16 requirements in accordance with the International Building Code
2. 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 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 7-16 and 29 CFR 1910.27.

A. 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:

1. Integral UV inhibitors in the resin
2. 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.

B. Performance Requirements

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

Tensile Strength	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2,500,000 psi
Flexural Strength	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	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

1. Structural Performance of Ladders

   Provide ladders capable of withstanding the effects of gravity loads as specified in ASCE 7-16 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 1200 pounds applied at mid-span of the rung.

2. Thermal Movements

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

3. Safety Performance of Ladders

   Provide a ladder system that fully complies with NFPA 101, OSHA 29 CFR 1910.27, and ALI A14.3 for distance between rungs, cleats, and steps and for minimum clearances for cages and climbing space.

2.2 Components

A. Ladders

Fabricate ladder side rails of a continuous pultruded, 1 3/4 inch square tube with a minimum wall thickness of 1/4 inch or greater. Fabricate ladder rungs to be 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, 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.

B. Ladder Safety Cages

Provide primary hoops at the top and bottom of the safety cage, with spacing no more than 20 feet on center. Provide secondary intermediate hoops with spacing no more than 48 inches on center between primary hoops.

Ensure that safety cage vertical bars are 1 1/2 inches wide by 5/8 inch pultruded I-beam shapes and offer protection to workers from exposed hardware. Ensure that safety cage hoops and brackets are manufactured by the open-mold hand-lay-up process. Ensure that all cage hoops are a minimum 3 inches wide by 1/4 inch thick.

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.

A. 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.

B. 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

A. Manufacturer's Warranty

Submit three (3) copies of manufacturer's warranty 30 calendar days before final inspection.

END OF SECTION