SECTION 06 82 14 REINFORCED PLASTIC (FRP) PIPE AND TUBE RAILINGS

PART 1 - General

This Section includes new fiberglass reinforced plastic (FRP) pipe and tube railing/guards, mounting systems and 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 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

B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

ASME B18.6.2 (1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASME B18.21.1 (2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

ASME B18.21.2M (1999; R 2014) Lock Washers (Metric Series)

C. AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.3 (2013) Safety Requirements for Powder-Actuated Fastening Systems American National Standard for Construction and Demolition Operations

D. ASTM INTERNATIONAL (ASTM)

ASTM A307 (2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM C1107/C1107M (2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

ASTM D430 (2006; R 2012) Standard Test Methods for Rubber Deterioration - Dynamic Fatigue

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

ASTM E488/E488M (2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

E. INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2018) International Building Code

F. 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

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

29 CFR 1910.23 (Nov 2016) Ladders

29 CFR 1926 Safety and Health Regulations for Construction

1.2 Submittals

A. Preconstruction Submittals

1. Qualifications of Manufacturer;
2. Qualifications of Engineer of Record;

B. Shop Drawings

1. Installation Drawings;

C. Product Data

1. FRP Pipe and Tube;

2. Railings/Guards;
3. Anchorage Materials;
4. Adhesives;
5. Resins;
6. Hardeners;
7. Manufacturer's Sample Warranty

D. Test Reports

1. Ultraviolet Test Reports
2. Thermal Expansion Test Reports
3. Flame Spread Test Reports

E. Certificates

1. Manufacturer's Certification by the State of Pennsylvania Product Approval
2. Proof of Certification from a minimum of two quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR)

F. Manufacturer's Instructions

1. Manufacturer's Instructions

G. Manufacturer's Field Reports

1. Manufacturer's Certification of Installation

H. Closeout Submittals

1. Manufacturer's Warranty

1.3 Quality Control

A. Qualifications of Manufacturer

Submit Qualifications Of Manufacturer documentation certifying that the Fiberglass Reinforced Plastic (FRP) manufacturer has a minimum of 10 years of experience in manufacturing FRP products.

Provide items within this section from manufacturers having a minimum of 5 years of experience in the design and manufacture of similar products and systems.

Submit documentation proving a minimum of five separate, similar installations within the last 5 years.

Submit the Proof of Certification from a minimum of two quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR).

Submit the manufacturer's certification by the State of Pennsylvania Product Approval.

Provide the manufacturer's sample warranty for all FRP products against defects in material and workmanship for a minimum of 5 years. Provide evidence of manufacturer's ISO

9001:2000 standard certification.

B. Qualifications of Engineer of Record

Submit Qualifications of Engineer performing design of FRP system: Documentation documentation that the Engineer of Record is currently licensed within the jurisdiction of the project.

Submit documentation that the Engineer performing design of FRP system: Documentation 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 pipe and tube railing systems. Require the Engineer of Record to supply the name and location of five projects of similar size and scope for which they have provided engineering calculations using the manufacturer's products submitted for this project within the previous 3 years. Provide certified and signed calculations prepared by Engineer for:

1. The design in accordance with International Building Code and ASCE 7-16
2. Installation drawings

1.4 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 dry indoor facilities with a constant temperature range between 70 and 85 degrees F until they are required.

Handle all materials to prevent abrasion, cracking, chipping, twisting, or other deformations, and other types of damage.

PART 2 - Products

2.1 System Description

A. Installation Drawings

Submit templates and erection and installation drawings indicating thickness, type, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

Include plans, elevations, sections, details, and attachments to other work. Indicate for installed products to comply with design loads. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Product Data

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

1. FRP Pipe and Tube
2. Railings/Guards

3. Anchorage Materials
4. Adhesives
5. Resins
6. Hardeners

C. Design Requirements

Ensure that all posts and rails are FRP structural shapes manufactured by the pultrusion process. Compose structural shapes of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements, and dimensions as necessary to meet the design requirements in accordance with ASCE 7-16, 29 CFR 1910.23, NFPA 101, and dimensions specified.

Ensure that fiberglass reinforcements are a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application required, the physical properties required, or both.

Provide resins, with appropriate hardeners, of isophthalic polyester, with the chemical formulation necessary for corrosion resistance, strength, and other physical properties.

Ensure that all finished surfaces of FRP items, including FRP pipe and tube, railings/guards, anchorage materials, and fabrications, are smooth, resin-rich, and free of voids, dry spots, cracks, and unreinforced areas. Provide complete coverage of all glass fibers with resin to protect against their exposure to wear or weathering.

Protect all pultruded structural shapes from ultraviolet (UV) attack with:

1. Integral UV inhibitors within the resin
2. Synthetic surfacing veil to help produce a resin-rich surface
3. UV-resistant coating for outdoor exposures

Provide FRP products that have a flame spread rating of 25 or less as specified in ASTM E84, Tunnel Test. Submit three (3) copies of Flame Spread Test Reports to the Architect.

Ensure that rails, posts, and kick plates are integrally pigmented yellow. Submit three (3) copies of Ultraviolet Test Reports for FRP material, similar to the requirements of ASTM D1148 for rubber deterioration, and ASTM D430, to the Architect. Submit testing data relating to Thermal Expansion Test Reports.

Provide structural shapes in the guardrail system to meet 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	.000008 in/in/F
Flame Spread	ASTM E84	25 or less

D. Performance Requirements

1. Structural Performance of Pipe and Tube Railings

Provide a pipe and tube railing system capable of withstanding the effects of gravity loads in accordance with ASCE 7-16 and International Building Code, ICC IBC the State of Pennsylvania Building Code, with the following loads and stresses within limits and under the conditions indicated:

a. Handrails:

- Uniform load of 50 lbf/foot applied in any direction.
- (Concentrated load of 200 lbf applied in any direction.
- Uniform and concentrated loads need not be assumed to act concurrently.

b. Top Rails of Guards:

- Uniform load of 50 lbf/foot applied in any direction.
- Concentrated load of 200 lbf applied in any direction.
- Uniform and concentrated loads need not be assumed to act concurrently.

c. Infill of Guards:

- Concentrated load of 50 lbf applied horizontally on an area of 1 square foot.
- Uniform load of 25 lbf/square foot applied horizontally.
- Infill load and other loads need not be assumed to act concurrently.

2.2 Fabrication

Perform fabrication of the handrail post/rail connection such that the rails are unbroken and continuous through the post without the use of packs or splices. Install the bottom rail through the post at a prepared hole made to fit the outside dimensions of the rail, and the top rail fit into a machined, u-shaped pocket formed into the top of the post such that the rail is located at the center of the post. Radius all exposed corners to eliminate sharp edges. Join the rails to the post through a combination of bonding and riveting. Ensure that no sharp, protruding edges remain after assembly of the handrail. Space the posts no more than 72 inches apart. Attach post bases according to the construction contract drawings. Reinforce post bases to a height of 8 1/2 inches. Coat all field-fabricated and shop-fabricated cuts with a vinyl ester resin to provide maximum corrosion resistance.

2.3 Materials

A. Fasteners

Provide Type 316 stainless-steel concealed fasteners, unless unavoidable or standard for railings indicated.

B. Anchors

Provide cast-in-place epoxy mechanical anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the design load imposed when installed in unit masonry and equal to four times the design load imposed when installed in concrete, as determined by testing as specified in ASTM E488/E488M.

C. Grout and Anchoring Cement

Provide factory-packaged, nonshrink, nonmetallic grout complying with ASTM C1107/C1107M; or water-resistant, nonshrink anchoring cement; recommended by the manufacturer for exterior use. Ensure that all other adhesives conform to the manufacturer's recommendations and instructions.

D. Component Connections

1. Lag Screws and Bolts

Provide lag screws and bolts conforming to ASME B18.2.1, of the type and grade best suited for the purpose.

2. Toggle Bolts

Provide toggle bolts conforming to ASME B18.2.1.

3. Bolts, Nuts, Studs, and Rivets

Provide bolts, nuts, studs, and rivets conforming to ASME B18.2.2 and ASTM A307.

4. Powder-Driven Fasteners

Follow safety provisions of ASSP A10.3 .

5. Screws

Provide screws conforming to ASME B18.2.1, ASME B18.6.2, and ASME B18.6.3.

6. Washers

Provide plain washers conforming to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers conforming to ASME B18.21.2M and ASME B18.21.1.

PART 3 - Execution

3.1 Installation

Install items in accordance with 29 CFR 1910.23 and 29 CFR 1926 at locations indicated, according to the manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Include all materials and parts necessary to complete each item, even

though such work is not definitely shown or specified. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation. Submit three (3) signed copies of Manufacturer's Certification of Installation.

- Set posts plumb within a tolerance of 1/16 inch in 3 feet.
- Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

A. Anchorage, Fastenings, and Connections

Provide anchorage where necessary for fastening miscellaneous FRP items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through-bolts for masonry; machine and carriage bolts for steel; through-bolts and screws. Conceal fastenings where practicable.

B. Workmanship

Ensure that FRP work is well formed to shape and size, with sharp lines and angles and true curves. Ensure that drilling and punching produces clean true lines and surfaces. Ensure that exposed surfaces of work-in-place to have smooth finishes. Mill joints where tight fits are required. Ensure that corner joints are coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fasten in place. Ensure that the installation is in accordance with the manufacturer's installation instructions and the approved drawings, cuts, and details.

3.2 Closeout Activities

A. Warranty

Submit three (3) signed copies of the Manufacturer's Warranty 30 calendar days before final inspection.

B. Manufacturer's Instructions

Submit the manufacturer's instructions for shipping and handling, and procedures for erection, care, and maintenance upon completion of installation.

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