



Standard Specification for Fiberglass (GRP) Pultruded Open-Weather Storm and Guard, Square Railing Systems¹

This standard is issued under the fixed designation F1092; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification provides the material requirements, construction, installation, and testing requirements for open-weather deck, storm-and-guard, fiberglass square railing systems. Components are to be manufactured by the pultrusion process.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 9, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D570 Test Method for Water Absorption of Plastics

D638 Test Method for Tensile Properties of Plastics

D695 Test Method for Compressive Properties of Rigid Plastics

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D3846 Test Method for In-Plane Shear Strength of Reinforced Plastics (Withdrawn 2024)³

D3917 Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Pultruded Shapes

E84 Test Method for Surface Burning Characteristics of Building Materials

3. Terminology

3.1 *Definitions:*

3.1.1 *pultrusion, n*—process of pulling fiberglass rovings (strands), mats, and other forms of reinforcements such as woven fiberglass through baths of thermosetting liquid resin, and then through a heated forming die (made of steel) to form a completed composite fiberglass structural shape.

3.1.1.1 *Discussion*—The heated die causes a chemical reaction to be initiated in the resin. The liquid resin molecules will cross-link and develop into a hardened plastic that is reinforced with the fiberglass.

4. Classification

4.1 Handrails and stanchions shall be fiberglass pultruded square tube available in the following two types:

4.1.1 *Type 1F*—Three-course railing systems, for use along the exposed peripheries of freeboards, weather decks, and superstructure decks.

4.1.2 *Type 2F*—Two-course railing systems, for use on bridges, platforms, walkways, and elsewhere as needed.

5. Ordering Information

5.1 Orders for materials under this specification shall include the following information:

5.1.1 Quantity (lineal feet (metres) of railing system).

5.1.2 Name of material (fiberglass pultruded square railing system).

¹ This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.03 on Outfitting and Deck Machinery.

Current edition approved Sept. 1, 2024. Published September 2024. Originally approved in 1987. Last previous edition approved in 2019 as F1092 – 19. DOI: 10.1520/F1092-19R24.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

5.1.3 Type (see 4.1).

5.1.4 Fiberglass coaming, if specified (lineal feet (metres)).
(See 6.2.5.)

5.1.5 Attachment method for stanchions (see 6.2.6).

5.1.6 ASTM designation and year of issue.

6. Materials and Manufacture

6.1 Materials:

6.1.1 The fiberglass (GRP) pultruded square tube shall be 2 in. × 2 in. × ¼ in. (50 mm × 50 mm × 6.4 mm) with the outside corner radius 5/32 in. (4 mm). A synthetic surface veil shall be the outermost layer of reinforcement covering the entire exterior surface. The resin used throughout the part shall be either a flame retarded isophthalic polyester or a flame retarded vinyl ester resin, meeting the requirements of 6.1.1.1, and containing an ultra-violet radiation (UV) inhibitor. The exterior of the pultruded square tubing shall have a 1 mil (0.025 mm) minimum polyurethane protective coating for added ultraviolet protection. The fiberglass pultruded square tubing shall meet the properties specified in Table 1 and dimensional tolerances shall be in accordance with Specification D3917.

6.1.1.1 The material used for the fiberglass pultruded square tube shall achieve a flame spread index not exceeding 25 and a smoke developed index not exceeding 450 when tested in accordance with Test Method E84. The test specimen (consisting of one or multiple sections) shall have a width of 20 in. to 24 in. (508 mm to 610 mm), a length of 24 ft +12 in. –6 in., and

a maximum thickness of 4 in. (101 mm), to cover the full width of the test apparatus, as required by section 6.3 of Test Method E84.

6.1.2 Fiberglass sheet or solid fiberglass bar shall be used to fabricate the internal connectors for the square tube. The internal connectors will be 1½ in. × 1½ in. (38.1 mm × 38.1 mm) with length and angularity variable to meet the requirements of each connection. Angular connections shall be fabricated from fiberglass sheet bonded together using a bisphenol A/epichlorohydrin epoxy resin with an amine curing agent to give a minimum thickness of 1½ in. (38.1 mm). The angular connections will be fabricated to the proper dimension from the fiberglass sheets that have been bonded together. Fiberglass sheet used for angular connections shall meet the properties specified in Table 1. Fiberglass solid bar, 1½ in. × 1½ in. (38.1 mm × 38.1 mm), shall be used for the straight connections and shall meet the properties specified in Table 1.

6.1.3 Rivets shall be nickel copper or nonmetallic.

6.1.4 Bolts shall be ½ in. (12.7 mm) diameter, 316 stainless steel.

6.1.5 Adhesive used to bond internal connectors to fiberglass pultruded square tube shall be a bisphenol A/epichlorohydrin epoxy resin with an amine curing agent.

6.2 Manufacture:

6.2.1 There shall be a minimum clearance of 4 in. (101 mm) between rail or stanchion centerline and other structure except where a direct tie-in is desired.

TABLE 1 Fiberglass Pultruded Material Properties

	Test Method	psi (MPa)
<i>Specifications for 2 × ¼ (51 × 6.4) Pultruded Fiberglass Square Tube and Coaming:</i>		
Ultimate tensile strength in longitudinal direction	D638	30 000 (207), min
Ultimate compressive strength in longitudinal direction	D695	30 000 (207), min
Ultimate flexural strength in longitudinal direction	D790	30 000 (207), min
Ultimate shear strength in longitudinal direction	D3846	5 500 (38), min
Ultimate tensile strength in transverse direction	D638	7 000 (48), min
Ultimate compressive strength in transverse direction	D695	15 000 (103), min
Ultimate flexural strength in transverse direction	D790	10 000 (69), min
Ultimate shear strength in transverse direction	D3846	5 500 (38), min
Density (lb/in. ³ (kg/mm ³))	D792	0.065 (0.00180), min
Water absorption (24-h immersion)	D570	0.60 max, % by weight
<i>Specification for Pultruded Fiberglass Sheet:</i>		
Ultimate tensile strength in longitudinal direction	D638	20 000 (138), min
Ultimate compressive strength in longitudinal direction	D695	25 000 (172), min
Ultimate flexural strength in longitudinal direction	D790	30 000 (207), min
Ultimate shear strength in longitudinal direction	D3846	5 500 (38), min
Ultimate tensile strength in transverse direction	D638	10 000 (69), min
Ultimate compressive strength in transverse direction	D695	15 000 (103), min
Ultimate flexural strength in transverse direction	D790	13 000 (90), min
Ultimate shear strength in transverse direction	D3846	5 500 (38), min
Density (lb/in. ³ (kg/mm ³))	D792	0.064 (0.00177), min
Water absorption (24-h immersion)	D570	0.50 max, % by weight
<i>Specifications for Pultruded 1½ × 1½ in. (38.1 × 38.1 mm) Solid Fiberglass Bar:</i>		
Ultimate tensile strength in longitudinal direction	D638	100 000 (689), min
Ultimate compressive strength in longitudinal direction	D695	60 000 (414), min
Ultimate flexural strength in longitudinal direction	D790	100 000 (689), min
Density (lb/in. ³ (kg/mm ³))	D792	0.074 (0.00205), min
Water absorption (24-h immersion)	D570	0.25 max, % by weight