



STRONGWELL®

FRP Specifications

Section 06 71 00
Fiberglass Reinforced Polymer (FRP)
Structural Shapes/Plate and Fabrications

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BRISTOL FACILITY

400 Commonwealth Ave., Bristol, VA 24201 USA
(276) 645-8000

HIGHLANDS FACILITY

26770 Newbanks Road, Abingdon, VA 24210 USA
(276) 645-8000

CHATFIELD FACILITY

1610 Highway 52 South, Chatfield, MN 55923 USA
(507) 867-3479

www.strongwell.com

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SECTION 06 71 00

FIBERGLASS REINFORCED POLYMER (FRP) PRODUCTS AND FABRICATIONS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.02 SUMMARY:

- A. This section includes FRP Products & Fabrications for Structural Shapes and Plate.

1.03 SCOPE OF WORK:

- A. Furnish all labor, materials, equipment, and incidentals governed by this section necessary to install the fiberglass reinforced polymer (FRP) products as specified herein.

1.04 QUALITY ASSURANCE:

- A. The material covered by these specifications shall be furnished by an ISO 9001 certified manufacturer of proven ability who is regularly engaged in the manufacture, fabrication, and installation of FRP systems.
- B. Substitution of any component or modification of system shall be made only when approved by the Architect or Design Engineer.
- C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.
- D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.05 DESIGN CRITERIA:

- A. The design of EXTREN® structural shapes and plate, including connections, shall be in accordance with governing building codes and standards as applicable.
- B. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/180 of span for structural members unless specifically stated otherwise in drawings and/or supplementary conditions. Connections shall be designed to transfer the loads.

1.06 SUBMITTALS:

- A. Shop drawings of all structural shapes and plate shall be submitted to the Design Engineer for approval in accordance with the requirements of Section _____. Fabrication shall not start until receipt of Design Engineer's approval marked "Approved As Submitted" or "Approved As Noted".
- B. Detail shop drawings showing:
 - 1. Dimensions
 - 2. Sectional assembly
 - 3. Location and identification mark
 - 4. Size and type of supporting frames required
- C. Samples of each type of product shall be submitted for approval in accordance with the requirements of Section _____.

1.07 SHIPPING AND STORAGE INSTRUCTIONS:

- A. All systems, sub-systems, and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- B. All materials and equipment necessary for the fabrication and installation of structural shapes and plate and appurtenances shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping, or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Design Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.
- C. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

PART 2 – PRODUCTS

2.01 GENERAL:

- A. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification and certified as meeting the manufacturer's approved list of raw materials.
- B. All raw materials shall be as specified by the contract.
- C. The visual quality of the pultruded shapes shall conform to ASTM D4385.
- D. All FRP products noted in 1.02 shall be manufactured using a pultruded process utilizing _____ (select premium polyester or vinyl ester) resin (select with or without additional flame retardant additives). A synthetic surface veil fabric with embedded EXTREN® logo shall encase the glass reinforcement. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84, the flammability characteristics of UL 94 V-0 and the self-extinguishing requirements of ASTM D635. All structural shapes shall contain a UV inhibitor.
- E. If specified, after fabrication, cut ends, holes, and abrasions of FRP shapes shall be sealed with a compatible resin coating.
- F. FRP products exposed to weather shall contain an ultraviolet inhibitor.
- G. All exposed surfaces shall be smooth and true to form, consistent with ASTM D4385.
- H. Manufacturers:
 - 1. Strongwell
- I. Pultruded FRP products shall be manufactured and fabricated in the USA. Manufacturer shall provide a written Certificate of Compliance.
- J. The materials covered by these specifications shall be furnished by an ISO 9001 certified manufacturer.

2.02 FRP STRUCTURAL SHAPES AND PLATE:

A. Material

1. Structural shapes and plate shall be made from _____ (select premium polyester or vinyl ester) resin (select with or without additional flame retardant additives). A synthetic surface veil fabric with embedded EXTREN® logo shall encase the glass reinforcement. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84, the flammability characteristics of UL 94 V-0 and the self-extinguishing requirements of ASTM D635. All structural shapes shall contain a UV inhibitor.
2. Pultruded profiles shall satisfy the visual requirements of ASTM D4385.
3. Structural shapes and plate shall be EXTREN® as manufactured by Strongwell.

B. Process

1. Manufactured by the pultrusion process.

2.03 Structural FRP members' composition shall consist of a glass fiber reinforced premium polyester or vinyl ester resin matrix and glass reinforcements. A synthetic surface veil fabric with embedded EXTREN® logo shall encase the glass reinforcement. All members shall meet or exceed the minimum published mechanical, physical, electrical, flammability, and corrosive properties published in the Strongwell Design Manual.

**Table 1 – Fiberglass Pultruded Material Properties
Minimum Ultimate Coupon Properties**

PROPERTIES	ASTM TEST METHOD	UNITS/VALUE	SERIES 500/525 SHAPES	SERIES 600/625 SHAPES	SERIES 500/525 PLATE ③			SERIES 600/625 PLATE ③		
					1/8"	3/16" -3/8"	1/2"-1"	1/8"	3/16"-1/4"	3/8"-1"
					3.175 mm	4.76-6.35 mm	9.5-25.4 mm	3.175 mm	4.76-6.35 mm	9.5-25.4 mm
MECHANICAL										
Tensile Stress, LW	D638	psi N/mm ²	30,000 207	30,000 207	20,000 138	20,000 138	20,000 138	20,000 138	20,000 138	20,000 138
Tensile Stress, CW	D638	psi N/mm ²	7,000 48.3	7,000 48.3	7,500 51.7	10,000 68.9	10,000 68.9	7,500 51.7	10,000 68.9	10,000 68.9
Tensile Modulus, LW	D638	10 ⁶ psi 10 ³ N/mm ²	2.5 17.2	2.6 17.9	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4
Tensile Modulus, CW	D638	10 ⁶ psi 10 ³ N/mm ²	0.8 5.52	0.8 5.52	0.7 4.83	0.9 6.21	1.0 6.89	1.0 6.89	1.0 6.89	1.0 6.89
Compressive Stress, LW	D695	psi N/mm ²	30,000 207	30,000 207	24,000 165	24,000 165	24,000 165	24,000 165	24,000 165	24,000 165
Compressive Stress, CW	D695	psi N/mm ²	15,000 103	16,000 110	15,500 107	16,500 114	20,000 138	16,500 114	17,500 121	17,500 121
Compressive Modulus, LW	D695	10 ⁶ psi 10 ³ N/mm ²	2.5 17.2	2.6 17.9	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4
Compressive Modulus, CW	D695	10 ⁶ psi N/mm ²	0.8 5.52	0.8 5.52	0.7 4.83	0.9 6.21	1.0 6.89	1.0 6.89	1.0 6.89	1.0 6.89
Flexural Stress, LW	D790	psi N/mm ²	30,000 207	30,000 207	24,000 165	24,000 165	24,000 165	24,000 165	24,000 165	24,000 165
Flexural Stress, CW	D790	psi N/mm ²	10,000 68.9	10,000 68.9	10,000 68.9	13,000 89.6	17,000 117	10,000 68.9	13,000 89.6	17,000 117
Flexural Modulus, LW	D790	10 ⁶ psi 10 ³ N/mm ²	1.6 11.0	1.6 11.0	1.1 7.58	1.1 7.58	1.4 9.65	1.1 7.58	1.1 7.58	1.4 9.65
Flexural Modulus, CW	D790	10 ⁶ psi 10 ³ N/mm ²	0.8 5.52	0.8 5.52	0.8 5.51	0.8 5.51	1.3 8.96	0.8 5.51	0.9 6.21	1.3 8.96
Modulus of Elasticity ①	full section	10 ⁶ psi	2.6	2.8	LW: 2.0 CW: 0.8	2.0 0.8	2.0 1.3	2.0 0.8	2.0 0.9	2.0 1.3
		10 ³ N/mm ²	17.9	19.3	LW: 13.7 CW: 5.51	13.7 5.51	13.7 8.96	13.7 5.51	13.7 6.21	13.7 8.95
Modulus of Elasticity >4" ① >102 mm	full section	10 ⁶ psi	2.5	2.5	-	-	-	-	-	-
		10 ³ N/mm ²	17.2	17.2	-	-	-	-	-	-
Shear Modulus, LW ②⑧	D5379	10 ⁶ psi	0.425	0.425	-	-	-	-	-	-
		10 ³ N/mm ²	2.93	2.93	-	-	-	-	-	-
Short Beam Shear, LW ⑦⑧	D2344	psi	4,500	4,500	-	-	-	-	-	-
		N/mm ²	31.0	31.0	-	-	-	-	-	-
Ultimate Bearing Stress, LW	D953	psi N/mm ²	30,000 207	30,000 207	32,000 221	32,000 221	32,000 221	32,000 221	32,000 221	32,000 221
Poisson's Ratio, LW ⑧	D3039	in/in mm/mm	0.33 0.33	0.33 0.33	0.31 0.31	0.31 0.31	0.31 0.31	0.32 0.32	0.32 0.32	0.32 0.32
Notched Izod Impact, LW	D256	ft-lbs/in J/mm	25 1.33	25 1.33	15 0.801	10 0.533	10 0.533	15 0.801	10 0.533	10 0.533
Notched Izod Impact, CW	D256	ft-lbs/in J/mm	4 0.214	4 0.214	5 0.267	5 0.267	5 0.267	5 0.267	5 0.267	5 0.267

**Table 1 – Fiberglass Pultruded Material Properties
Minimum Ultimate Coupon Properties – cont'd**

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 500/525 SHAPES	SERIES 625 SHAPES	SERIES 500/525 PLATE ③			SERIES 625 PLATE ③		
					1/8" 3.175 mm	3/16" -3/8" 4.76-6.35 mm	1/2"-1" 9.5-25.4 mm	1/8" 3.175 mm	3/16"-1/4" 4.76-6.35 mm	3/8"-1" 9.5-25.4 mm
PHYSICAL										
Barcol Hardness ⑤	D2583	—	45	45	40	40	40	40	40	40
24 HR Water Absorption ⑥	D570	% Max by wt	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Density	D792	lbs/in ³	0.062-0.070	0.062-0.070	0.060-0.068	0.060-0.068	0.060-0.068	0.060-0.068	0.060-0.068	0.060-0.068
		10 ⁻³ g/mm ³	1.72-1.94	1.72-1.94	1.66-1.88	1.66-1.88	1.66-1.88	1.66-1.88	1.66-1.88	1.66-1.88
Coefficient of Thermal Expansion, LW ⑧	D696	10 ⁻⁶ in/in/°F	7	7	8	8	8	8	8	8
		10 ⁻⁶ mm/mm/°C	12	12	14.5	14.5	14.5	14.5	14.5	14.5
Coefficient of Thermal Expansion, CW ⑧	D696	10 ⁻⁶ in/in/°F	16	16	-	-	-	-	-	-
		10 ⁻⁶ mm/mm/°C	28.8	28.8	-	-	-	-	-	-
Thermal Conductivity ⑧	C177	BTU-in/ft ² /hr/°F	4	4	-	-	-	-	-	-
		w(m * °K)	0.58	0.58	-	-	-	-	-	-
ELECTRICAL										
Arc Resistance, LW ⑧	D495	seconds	120	120						
Dielectric Strength, LW ⑧	D149	KV/in	35	35	35	35	35	35	35	35
		KV/mm	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
Dielectric Strength, PF ⑨	D149	volts/mil	200	200	200	-	-	250	-	-
FLAMMABILITY ④ (≥1/8" thickness)										
Tunnel Test	E84	25 Max								
NBS Smoke Chamber	E662	650-700 (typical)								
Flammability	UL 94	V-0								
Flammability	D635	Self Extinguishing								
UL Thermal Index	Generic	266°F 130°C								
British Fire Test	BS 476-7	Class 1								

All values are minimum ultimate properties from coupon tests except as noted.

① This value is determined from full section simple beam bending of EXTREN® structural shapes.

② The Shear Modulus value has been determined from tests with full sections of EXTREN® structural shapes.

(See the Strongwell *Design Manual* for further information.)

③ Plate compressive stress/modulus measured edgewise and flexural stress/modulus measured flatwise.

④ Values apply to Series 525 and 625.

⑤ Strongwell incorporates a synthetic surfacing veil routinely on the surface of all EXTREN® structural shapes. This has the effect of lowering the measured Barcol Hardness and does not reflect an absence of cure. Other additives incorporated into the composite for corrosion protection and surface improvements may also reduce Barcol Hardness to a typical value of 45. A surface unprotected by a surfacing veil without additives would have a minimum value of 50.

⑥ Measured as a percentage maximum by weight.

⑦ Span to depth ratio of 3:1; EXTREN® angles will have a minimum value of 4,000 psi and the I/W shapes are tested in the web.

⑧ Typical values

⑨ This is a typical value which varies with composite thickness.

LW = Lengthwise

CW = Crosswise

PF = Perpendicular to laminate face

PART 3 – EXECUTION

3.01 PREPARATION:

- A. Coordinate and furnish setting drawings, diagrams, and templates for all FRP material. Provide instructions for installation of concrete inserts, sleeves, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.
- B. Coordinate delivery of such items to project site.

3.02 INSPECTION AND TESTING:

- A. The Design Engineer shall have the right to inspect all materials to be furnished under these specifications prior to their shipment from the point of manufacture.
- B. All labor, power, materials, equipment, and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

3.03 INSTALLATION, GENERAL:

- A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, and other connectors as determined by the Design Engineer of Record.
- B. Cutting, fitting, and placement: Perform cutting, drilling, and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; measured from established lines and levels.
- C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

3.04 ALL FRP INSTALLATION:

- A. If specified, field cut and drilled edges, holes, and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer.
- B. Install items specified as indicated and in accordance with manufacturer's instructions.

End of Section