



STRONGWELL®

FRP Specifications

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

REVISED 11.2016

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Table of Contents

PART 1: GENERAL

1.01	Related Documents	3
1.02	Summary.....	3
1.03	Scope of Work	3
1.04	Quality Assurance.....	3
1.05	Design Criteria	3
1.06	Submittals	4
1.07	Shipping and Storage Instructions	4

PART 2: PRODUCTS

2.01	General	5
2.02	FRP Structural Shapes and Plate	6-8

PART 3: EXECUTION

3.01	Preparation	9
3.02	Inspection and Testing.....	9
3.03	Installation, General	9
3.04	All FRP Installation.....	9

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 polyester or vinyl ester) resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic surface veil fabric 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 V0 and the self-extinguishing requirements of ASTM D635. (Polyester resin is available without flame retardant and UV inhibitor additives.)
- E. If required, after fabrication, all 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. Should additional ultraviolet protection be required, a one mil minimum UV coating can be applied.
- 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 with fire retardant additives to meet a flame spread rating of less than 25 per ASTM E-84, the flammability characteristics of UL 94 V0 and meet the self-extinguishing requirements of ASTM D-635. 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 polyester or vinyl ester resin matrix and glass reinforcements. A synthetic surface veil fabric shall encase the glass reinforcement. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats or stitched reinforcements shall be used internally for transverse strength.

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

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 500/525 SHAPES	SERIES 625 SHAPES	SERIES 500/525 PLATE ^④			SERIES 625 PLATE ^④		
					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
MECHANICAL										
Tensile Stress, LW	D638	psi	30,000	30,000	20,000	20,000	20,000	20,000	20,000	20,000
		N/mm ²	207	207	138	138	138	138	138	138
Tensile Stress, CW	D638	psi	7,000	7,000	7,500	10,000	10,000	7,500	10,000	10,000
		N/mm ²	48.3	48.3	51.7	68.9	68.9	51.7	68.9	68.9
Tensile Modulus, LW	D638	10 ⁶ psi	2.5	2.6	1.8	1.8	1.8	1.8	1.8	1.8
		10 ³ N/mm ²	17.2	17.9	12.4	12.4	12.4	12.4	12.4	12.4
Tensile Modulus, CW	D638	10 ⁶ psi	.8	.8	.7	.9	1	1	1	1
		10 ³ N/mm ²	5.52	5.52	4.83	6.21	6.89	6.89	6.89	6.89
Compressive Stress, LW	D695	psi	30,000	30,000	24,000	24,000	24,000	24,000	24,000	24,000
		N/mm ²	207	207	165	165	165	165	165	165
Compressive Stress, CW	D695	psi	15,000	16,000	15,500	16,500	20,000	16,500	17,500	17,500
		N/mm ²	103	110	107	114	138	114	121	121
Compressive Modulus, LW ^③	D695	10 ⁶ psi	2.5	2.6	1.8	1.8	1.8	1.8	1.8	1.8
		10 ³ N/mm ²	17.2	17.9	12.4	12.4	12.4	12.4	12.4	12.4
Compressive Modulus, CW	D695	10 ⁶ psi	0.8	0.8	0.7	0.9	1.0	1.0	1.0	1.0
		10 ³ N/mm ²	5.52	5.52	4.83	6.21	6.89	6.89	6.89	6.89
Flexural Stress, LW	D790	psi	30,000	30,000	24,000	24,000	24,000	24,000	24,000	24,000
		N/mm ²	207	207	241	241	207	241	241	207
Flexural Stress, CW	D790	psi	10,000	10,000	10,000	13,000	17,000	10,000	13,000	17,000
		N/mm ²	68.9	68.9	89.6	103	124	89.6	103	124
Flexural Modulus, LW ^③	D790	10 ⁶ psi	1.6	1.6	1.1	1.1	1.4	1.1	1.1	1.4
		10 ³ N/mm ²	11.0	11.0	7.58	7.58	9.65	7.58	7.58	9.65
Flexural Modulus, CW	D790	10 ⁶ psi	0.8	0.8	0.8	0.8	1.3	0.8	0.9	1.3
		10 ³ N/mm ²	5.52	5.52	5.51	5.51	8.96	5.51	6.21	8.96
Modulus of Elasticity ^①	full section	10 ⁶ psi	2.6	2.8						
		10 ³ N/mm ²	17.9	19.3						
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 ^{②⑦}	—	10 ⁶ psi	.425	.425						
		10 ³ N/mm ²	2.93	2.93						
Short Beam Shear, LW ^{⑥⑦}	D2344	psi	4,500	4,500						
		N/mm ²	31.0	31.0						
Ultimate Bearing Stress, LW	D953	psi	30,000	30,000	32,000	32,000	32,000	32,000	32,000	32,000
		N/mm ²	207	207	220.6	221	221	221	221	221
Poisson's Ratio, LW ^⑦	D3039	in/in	.33	.33	.31	.31	.31	.32	.32	.32
		mm/mm	.33	.33	.31	.31	.31	.32	.32	.32
Notched Izod Impact, LW	D256	ft-lbs/in	25	25	15	10	10	15	10	10
		J/mm	1.33	1.33	.801	.533	.533	.801	.533	.533
Notched Izod Impact, CW	D256	ft-lbs/in	4	4	5	5	5	5	5	5
		J/mm	.214	.214	.267	.267	.267	.267	.267	.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 ^④			SERIES 625 PLATE ^④		
					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 ^④	D2583	—	45	45	40	40	40	40	40	40
24 HR Water Absorption ^⑤	D570	% Max by wt	.6	.6	.6	.6	.6	.6	.6	.6
Density	D792	lbs/in ³ 10 ⁻³ g/mm ³	.062-.070 1.72-1.94	.062-.070 1.72-1.94	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88
Coefficient of Thermal Expansion, LW ^⑦	D696	10 ⁻⁶ in/in/°F 10 ⁻⁵ mm/mm/°C	7.0 1.2	7.0 1.2	8.0 1.45	8.0 1.45	8.0 1.45	8.0 1.45	8.0 1.45	8.0 1.45
Thermal Conductivity ^⑦	C177	BTU-in/ ft ² /hr/°F W (m * °K)	4 .58	4 .58						
ELECTRICAL										
Arc Resistance, LW ^⑦	D495	seconds	120	120						
Dielectric Strength, LW ^⑦	D149	KV/in KV/mm	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38
Dielectric Strength, PF ^⑧	D149	volts/mil	200	200	200	N.T.	N.T.	250	N.T.	N.T.
FLAMMABILITY ^④										
Tunnel Test 1/8" thickness	E-84	25 Max								
NBS Smoke Chamber 1/8" thickness	E-662	650-700 (typical)								
Flammability 1/8" thickness	UL 94	V0								
Flammability	D635	Self Extinguishing								
UL Thermal Index	Generic	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 Measured as a percentage maximum by weight.
- ⑥ 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.
- ⑦ Typical values
- ⑧ This is a typical value which varies with composite thickness.

LW = Lengthwise
CW = Crosswise

PF = Perpendicular to laminate face
N.T. = Not Tested

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 required, all 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 06600