

## SECTION 067100 – STRUCTURAL FRP SHAPES AND PLATES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

#### 1.2 QUALITY ASSURANCE

- A. The material covered by these specifications shall be furnished by an ISO-9001:2000 certified manufacturer of proven ability who has regularly engaged in the manufacture and installation of fiberglass-reinforced plastic (FRP) systems.
- B. 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.
- C. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

#### 1.3 DESIGN CRITERIA

- A. The design of FRP products including connections to indicated substrates 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. Connections shall be designed to transfer the loads.

#### 1.4 SUBMITTALS

- A. Product Data: Submit fabricator's specifications, data and instructions for manufactured materials and products. Include certifications and laboratory test reports as required.
- B. Shop Drawings: Submit shop drawings of all fabricated pultruded structural shapes and plate, and appurtenances.
- C. Samples: Provide standard length sample of each structural shape and plate.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting and installation.
- B. All materials and equipment necessary for the fabrication and installation of pultruded 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 Architect, has become damaged as to be unfit for use, shall be promptly removed from the site of work.
- C. Identify and match-mark all materials, items and fabrications for installation and field assembly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers of Structural FRP Shapes and Plates: Subject to compliance with requirements, provide products by one of the following:
1. Strongwell [http://www.strongwell.com/products/pultruded\\_prod/struc\\_shapes/](http://www.strongwell.com/products/pultruded_prod/struc_shapes/)
  2. Bedford Reinforced Plastics, Inc. <http://www.bedfordplastics.com>
  3. Creative Pultrusions, Inc. <http://creativepultrusions.com/>

2.2 GENERAL

- A. Manufacture all FRP products using:
1. A pultruded process utilizing polyester resin with ultraviolet (UV) inhibitor additives.
  2. A synthetic surface veil on the outermost layer covering the exterior surface.
  3. A flame retardant additive which shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84 and meet the self-extinguishing requirements of ASTM D-635.
- B. All exposed surfaces shall be smooth and true to form.

2.3 STRUCTURAL SHAPES AND PLATES

- A. Material
1. Structural shapes and plates shall be made from isophthalic polyester resin.
  2. Design Standard: Structural shapes and plates shall be EXTREN® as manufactured by Strongwell – Bristol Division, Bristol, VA.
- B. Process
1. Manufactured by the pultrusion process.
  2. Structural FRP members' composition shall consist of a glass fiber reinforced poly-ester or vinyl ester resin matrix, approximately 50% glass by weight. A synthetic surface veil shall be the outermost layer covering the exterior surfaces. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats or stitched reinforcements shall be used internally for transverse strength.
  3. Mechanical properties shall meet or exceed the values listed in Table 1.

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

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 500/525 SHAPES	SERIES 500/525 PLATE $\phi$		
				1/8"	3/16" -1/4"	3/8"-1"
<b>MECHANICAL</b>						
Tensile Stress, LW	D638	psi	30,000	20,000	20,000	20,000
		N/mm <sup>2</sup>	207	138	138	138
Tensile Stress, CW	D638	psi	7,000	7,500	10,000	10,000
		N/mm <sup>2</sup>	48.3	51.7	68.9	68.9
Tensile Modulus, LW	D638	10 <sup>6</sup> psi	2.5	1.8	1.8	1.8
		10 <sup>3</sup> N/mm <sup>2</sup>	17.2	12.4	12.4	12.4
Tensile Modulus, CW	D638	10 <sup>6</sup> psi	.8	.7	.9	1
		10 <sup>3</sup> N/mm <sup>2</sup>	5.52	4.83	6.21	6.89
Compressive Stress, LW &	D695	psi	30,000	24,000	24,000	24,000

		N/mm <sup>2</sup>	207	165	165	165
Compressive Stress, CW	D695	psi	15,000	15,500	16,500	20,000
		N/mm <sup>2</sup>	103	107	114	138
Compressive Modulus, LW	D695	10 <sup>6</sup> psi	2.5	1.8	1.8	1.8
		10 <sup>3</sup> N/mm <sup>2</sup>	17.2	12.4	12.4	12.4
Compressive Modulus, CW	D695	10 <sup>6</sup> psi	0.8	0.8	0.8	0.8
		10 <sup>3</sup> N/mm <sup>2</sup>	5.52	5.52	5.52	5.52
Flexural Stress, LW	D790	psi	30,000	24,000	24,000	24,000
		N/mm <sup>2</sup>	207	165	165	165
Flexural Stress, CW	D790	psi	10,000	10,000	13,000	17,000
		N/mm <sup>2</sup>	68.9	68.9	89.6	117
Flexural Modulus, LW	D790	10 <sup>6</sup> psi	1.6	1.8	2	2
		10 <sup>3</sup> N/mm <sup>2</sup>	11.0	12.4	13.8	13.8
Flexural Modulus, CW	D790	10 <sup>6</sup> psi	0.8	0.9	1.1	1.4
		10 <sup>3</sup> N/mm <sup>2</sup>	5.52	6.21	7.58	9.65
Modulus of Elasticity	full	10 <sup>6</sup> psi	2.6			
	section	10 <sup>3</sup> N/mm <sup>2</sup>	17.9			
Modulus of Elasticity >4" >102 mm	full	10 <sup>6</sup> psi	2.5			
	section	10 <sup>3</sup> N/mm <sup>2</sup>	17.2			
Shear Modulus, LW	—	10 <sup>6</sup> psi	.425			
		10 <sup>3</sup> N/mm <sup>2</sup>	2.93			
Short Beam Shear, LW	D2344	psi	4,500			
		N/mm <sup>2</sup>	31.0			
Ultimate Bearing Stress, LW	D953	psi	30,000	32,000	32,000	32,000
		N/mm <sup>2</sup>	207	220.6	221	221
Poisson's Ratio, LW	D3039	in/in	.33	.31	.31	.31
		mm/mm	.330	.310	.310	.310
Notched Izod Impact, LW	D256	ft-lbs/in	25	15	10	10
		J/mm	1.33	.988	1.07	1.07
Notched Izod Impact, CW	D256	ft-lbs/in	4	5	5	5
		J/mm	.214	.267	.267	.267

**Table 1 – Fiberglass Pultruded Material Properties  
Minimum Ultimate Coupon Properties – (continued)**

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 500/525 SHAPES	SERIES 500/525 PLATE <sup>Ⓟ</sup>		
				1/8" 3.175 mm	3/16 -1/4" 4.76–6.35 mm	3/8"-1" 9.5-25.4 mm
<b>PHYSICAL</b>						
Barcol Hardness <sup>⊗</sup>	D2583	—	45 <sup>Ⓟ</sup>	40	40	40
24 HR Water Absorption <sup>⊕</sup>	D570	% Max by wt	.6	.6	.6	.6
Density	D792	lbs/in <sup>3</sup> 10 <sup>-3</sup> g/mm <sup>3</sup>	.062-.070 1.72-1.94	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88
Coefficient of Thermal Expansion, LW <sup>∩</sup>	D696	10 <sup>-6</sup> in/in/°F 10 <sup>-5</sup> in/in/°C	7.0 1.2	8.0 1.45	8.0 1.45	8.0 1.45
Thermal Conductivity <sup>∩</sup>	C177	BTU-in/ ft <sup>2</sup> /hr/°F W (m * °K)	4 .58			
<b>ELECTRICAL</b>						
Arc Resistance, LW <sup>∩</sup>	D495	seconds	120			
Dielectric Strength, LW <sup>∩</sup>	D149	KV/in	35	35	35	35
		KV/mm	1.38	1.38	1.38	1.38
Dielectric Strength, PF <sup>∪</sup>	D149	volts/mil	200	200	N.T.	N.T.
<b>FLAMMABILITY</b> <sup>⊗</sup>						
Tunnel Test	E-84	25 Max				
NBS Smoke Chamber	E-662	650-700 (typical)				
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.

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

∩ The shear stress test results will change radically if the notched orientation is altered. The value in this chart represents the test configuration where the notches are machined parallel to the reinforcing mat. For notches machined perpendicular to the reinforcing mat, this value would be two to three times larger.

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

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

⊗ Values apply to Series 525.

⊕ Measured as a percentage maximum by weight.

∩ 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.

∩ Typical values because these are shape and composite dependent tests.

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

LW = Lengthwise

PF = Perpendicular to laminate face

CW = Crosswise

N.T. = Not Tested

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

#### 3.2 INSTALLATION, GENERAL

- A. 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 Architect.
- B. 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.
- D. Seal all field cut and drilled edges, holes and abrasions with a catalyzed resin compatible with the original resin as recommended by the manufacturer.
- E. Install items as indicated and in accordance with manufacturer's instructions.

END OF SECTION 067100