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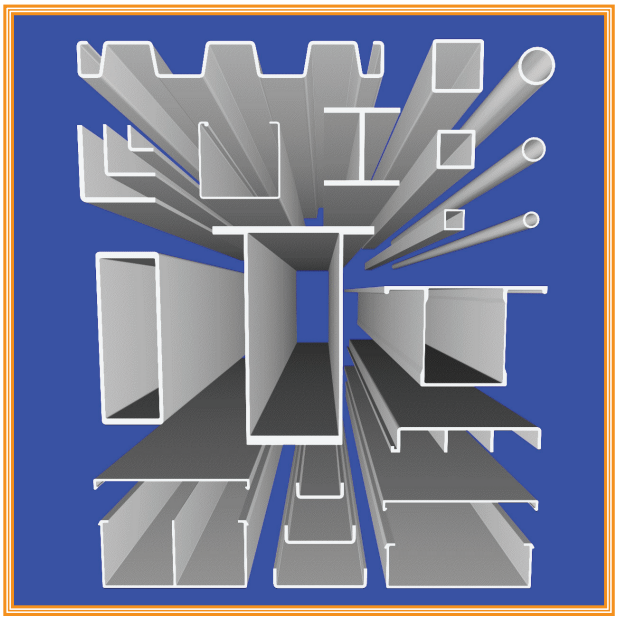
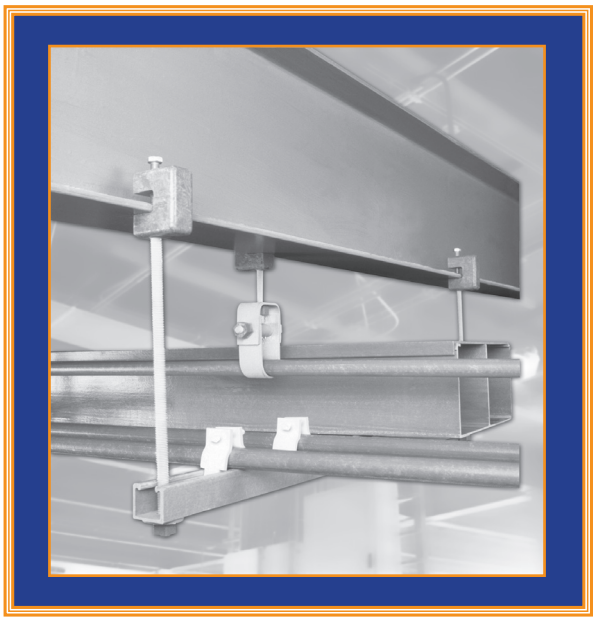
FRP Solutions for Support Systems & Strut





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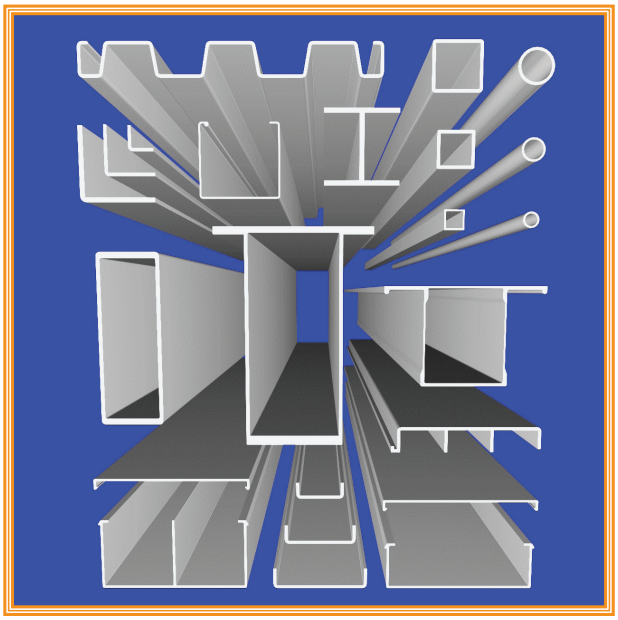

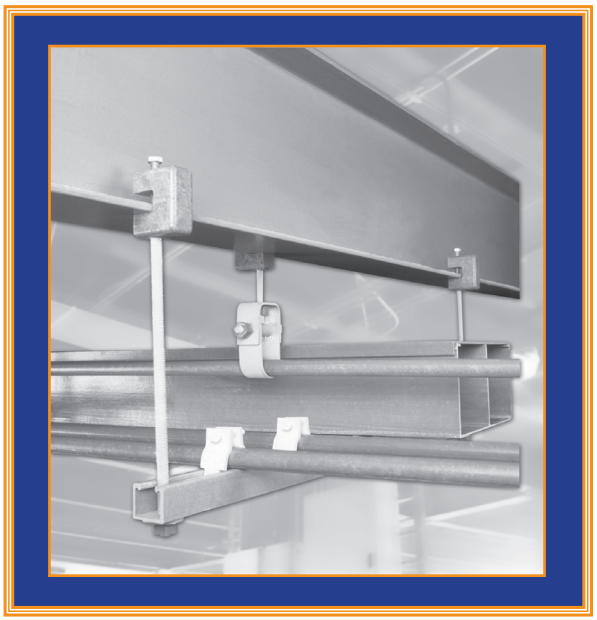

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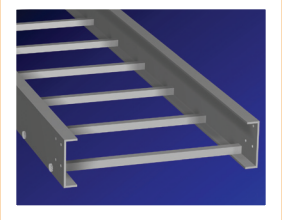
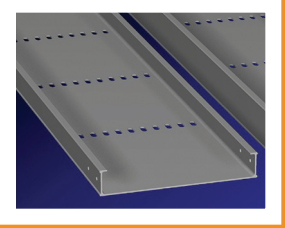
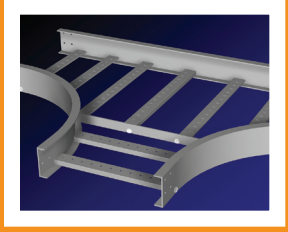
Welcome to enduro

This product catalog and guide provides the information you need to design your structural support and strut solution.

Should you need additional information feel free to contact us at **800-231-7271** or at ***elsales@endurocomposites.com***.

Please also visit our website at
www.endurocomposites.com.

Thank you for your interest and we look forward to working with you.


FRP Technical Data

Typical Properties of Structural FRP

Longitudinal Direction

Mechanical (coupon)	FR-P	FR-VE
Ultimate Tensile Strength, PSI (ASTM D638)	30,000	35,000
Ultimate Compressive Strength, PSI (ASTM D695)	30,000	35,000
Ultimate Flexural Strength, PSI (ASTM D790)	30,000	35,000
Tensile Modulus, PSI x 10^6	2.5	3.0
Compressive Modulus, PSI x 10^6	2.5	2.5
Flexural Modulus, PSI x 10^6	1.6	2.0
Ultimate Shear Strength, PSI	5,500	7,000
Ultimate Bearing Stress, PSI	30,000	35,000
Izod Impact Strength, Ft.-Lbs. per inch of notch (ASTM D256) (sample thickness ⅛" except ¼" for rod)	25	30

Transverse Direction

Mechanical (coupon)	FR-P	FR-VE
Ultimate Tensile Strength, PSI	7,000	10,000
Ultimate Compressive Strength, PSI	15,000	20,000
Ultimate Flexural Strength, PSI	10,000	14,000
Tensile Modulus, PSI x 10^6	0.8	1.0
Compressive Modulus, PSI x 10^6	1.0	1.2
Flexural Modulus, PSI x 10^6	0.8	1.0
Ultimate Shear Strength, PSI	5,500	6,000
Ultimate Bearing Stress, PSI	30,000	35,000
Izod Impact Strength, Ft.-Lbs. per inch of notch (ASTM D256)	4	5
Barcol Hardness (ASTM D2583-75	50	50

Electrical

Mechanical (coupon)	FR-P	FR-VE
Electric Strength, short term in oil, ⅛", vpm (ASTM D149)*	200	200
Electric Strength, short term in oil, KV per inch	35	35
Dielectric Constant, 60 Hz.(ASTM D150)*	5.6	5.2
Dissipation Factor, 60 Hz. (ASTM D150)*	0.03	0.03
Arc Resistance, seconds (ASTM D495)**	120	120

Full Section in Bending

Mechanical (coupon)	FR-P	FR-VE
Modulus of Elasticity, PSI x 10^6	2.5	3.0
Tensile Strength, PSI	20,000	25,000
Compressive Strength, PSI	20,000	25,000

Thermal

Mechanical (coupon)	FR-P	FR-VE
Thermal Coefficient of Expansion Inches/Inch/°F (ASTM D696)**	5 x 10^{-6}	5 x 10^{-6}
Thermal Conductivity, BTU per Sq. Ft./Ht./°F/In. (ASTM C-177-76)	4	4
Specific Heat, BTU/Lb./°F	0.28	0.28

Fire Retardant Properties

Mechanical (coupon)	FR-P	FR-VE
Flame Resistance, ign/burn, seconds (FTMS 406-2023)	75/75	75/75
Intermittent Flame Test, rating (HLT-15)	100	100
Flammability Test	average time of burning 5 seconds, average extent of burning 15mm (ASTM D635)	
Surface Burning Characteristics, maximum (ASTM E84)	15	15

Other

Mechanical (coupon)	FR-P	FR-VE
Density, Lbs./In.^{3} (ASTM D792)	0.065	0.065
Specific Gravity (ASTM D792)	1.80	1.80
Water Absorption, Max. % by weight (24 hour immersion) (ASTM D570)	.50	.50

Note: 1 PSI = 6.894 K Pa; 1 Ft.-Lb./In. = 5.443 kg-m/m; * Specimen tested perpendicular to laminate face ** Indicates reported value measured in logitudinal direction; Depending on the specific glass content and resin, the strength and stiffness properties may be significantly higher. Contact us for specific values on Halogen-Free Low Smoke Plus resin properties.

Concentric Static Load (if required)

A concentrated static load is not included in the table on page 9. Some user applications may require that a given concentrated static load be imposed over and above the working load. Such concentrated static load represents a static weight applied between the side rail at midspan. When so specified, the concentrated static load may be converted to an equivalent load (W_e) in pounds per linear foot (kg/m) using the formula to the below right and added to the static weight of cable in the tray. This combined load may be used to select a suitable load/span designation (table on page 9).

If the combined load exceeds the working load shown, please contact us. This data was obtained from the NEMA and NEC Standards Publications and other sources to assist in the proper selection of the most appropriate cable tray type offered by Enduro.

$$W_e = \frac{2 \times (\text{Concentrated Static Load})}{\text{span length (ft or m)}}$$

Thermal Contraction & Expansion

The table to the right compares the thermal contraction and expansion based on various temperature differentials for fiberglass, steel and aluminum cable trays. The values shown represent the length of cable tray that will produce a ⅝" movement between expansion connectors for the indicated temperature differential. Fiberglass has the least movement. Enduro has expansion connectors to provide for total movement of ⅝".

Fiberglass vs Steel vs Aluminum

Temp. Differential	Fiberglass Ft. (m)	Steel Ft. (m)	Aluminum Ft. (m)
25°F (14°C)	417 (126)	320 (97)	162 (49)
50°F (28°C)	208 (63)	160 (48)	81 (25)
75°F (42°C)	138 (42)	106 (32)	54 (16)
100°F (56°C)	104 (32)	80 (24)	40 (12)
125°F (69°C)	83 (25)	63 (19)	32 (10)
150°F (83°C)	69 (21)	53 (16)	26 (8)
175°F (97°C)	59 (17)	45 (13)	23 (6)

Effect of Temperature - FRP

Strength properties of reinforced plastics are reduced when continuously exposed to elevated temperatures. Working loads shall be reduced when based on the table to the right. Percentages shown are approximate. If unusual temperature conditions exist, please contact us for consultation. Below freezing temperatures do not adversely affect the load rating capability of the tray. Fiberglass does not become brittle at below freezing temperatures. Careful review should be made of applications involving service temperatures over 200°F.

Temp.	Polyester Strength %	Vinyl Ester Strength %
75°F (24°C)	100%	100%
100°F (38°C)	90%	100%
125°F (52°C)	78%	100%
150°F (66°C)	68%	90%
175°F (79°C)	60%	90%
200°F (93°C)	52%	75%

The test values in the chart below were obtained from tests conducted by Enduro's vinyl ester resin supplier. The values shown, although obtained from an actual coupon test, are intended for illustrative purposes only, and not for use in design calculations. The values for polyester are slightly lower.

Test Temp. °F (°C)	-100° (-73°)	-50° (-46°)	0° (-18°)	50° (10°)	77° (25°)	100° (38°)	150° (66°)	200° (93°)	250° (121°)	300° (149°)
Flex. St., PSI, ASTM D790	101,500	86,400	79,500	72,300	68,100	66,300	58,700	27,400	13,200	9,200
Flex. Mod., PSI x 10^6, ASTM D790	3.36	3.32	3.42	3.38	3.24	3.29	3.07	1.98	0.98	0.83
Tensile St., PSI, ASTM D638	84,100	70,400	63,900	58,000	56,100	54,600	49,900	41,800	29,600	22,000

Corrosion Resistance of Resin Systems

Enduro offers a variety of resin systems which are listed in more detail on page 9. The two resin systems most often used are isophthalic polyester fire-retardant (FR-P) and vinyl ester fire-retardant (FR-VE). Polyester is more widely used and sufficient for most applications while vinyl ester is recommended where strong acids (such as hydrochloric acid), strong alkalies (such as caustic soda), organic solvents and organic conditions exist. An abbreviated guide is provided below to assist in the selection of the proper standard resin system for individual application.

Polyester and vinyl ester resin systems are available in conductive formulation. Contact us for corrosion resistance information for halogen-free and halogen-free low smoke plus resins.

All composite materials have an ultra-violet light inhibiting chemical additive and has a maximum flame spread of 25 or less, per ASTM E-84 (Class 1 flame spread). All pultruded products have complete synthetic veil coverage (outer surfacing fabric) to provide maximum chemical and UV protection.

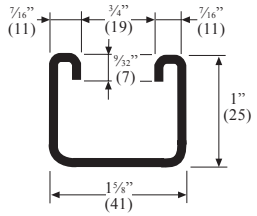
Chemicals	75°F (24°C)	160F° (71°C)	Chemicals	75°F (24°C)	160°F (71°C)
Acetic Acid 5%	FR-P	FR-P	Magnesium Chloride	FR-P	FR-P
Acetic Acid 25%	FR-P	FR-VE-210° (*)	Methyl Alcohol 10%	FR-P	FR-VE-150° (*)
Aluminum Potassium Sulfate 5%	FR-P	FR-P	Naphtha	FR-P	FR-P
Ammonium Hydroxide 10%	FR-P	FR-VE-150°	Nitric Acid 5%	FR-P	FR-P
Ammonium Nitrate	FR-P	FR-P	Nitric Acid 20%	FR-VE	FR-VE-120° (*)
Benzenesulfonic Acid 5%	FR-P	FR-P	Phosphoric Acid 10%	FR-P	FR-P
Calcium Chloride	FR-P	FR-P	Phosphoric Acid 30%	FR-P	FR-P
Carbon Tetrachloride	FR-VE	FR-VE-100° (*)	Phosphoric Acid 85%	FR-P	FR-P
Chlorine Dioxide 15%	FR-P	FR-VE-150° (*)	Sodium Bicarbonate 10%	FR-P	FR-P
Chromic Acid 5%	FR-P	FR-VE-150° (*call)	Sodium Bisulfate	FR-P	FR-P
Copper Sulfate	FR-P	FR-P	Sodium Carbonate	FR-P	FR-VE
Diesel Fuel No. 1	FR-P	FR-P	Sodium Chloride	FR-P	FR-P
Diesel Fuel No. 2	FR-P	FR-P	Sodium Hydroxide 1-50%	FR-VE	FR-VE-120° (*)
Ethylene Glycol	FR-P	FR-P	Sodium Hypochlorite 5%	FR-P	FR-VE-120° (*)
Fatty Acids 100%	FR-P	FR-P	Sodium Nitrate	FR-P	FR-P
Ferrous Sulfate	FR-P	FR-P	Sodium Silicate	FR-P	FR-VE-210° (*)
Fluosilicic Acid 0-20%	FR-VE	FR-VE (call)	Sodium Sulfate	FR-P	FR-P
Hydrochloric Acid 1%	FR-P	FR-P	Sulfuric Acid 0-30%	FR-P	FR-P
Hydrochloric Acid 15%	FR-P	FR-VE-180° (*)	Sulfuric Acid 30-50%	FR-VE	FR-VE
Hydrochloric Acid 37%	FR-P	FR-VE-150° (*)	Sulfuric Acid 50-70%	FR-VE	FR-VE-180° (*)
Hydrogen Sulfide	FR-P-140°	FR-VE-210°	Trisodium Phosphate 25%	FR-P	FR-VE-210° (*)
Kerosene	FR-P	FR-P	Trisodium Phosphate - All	FR-VE	FR-VE-210° (*)
			Water, Distilled	FR-P	FR-P

FR = Fire-Retardant; P = Polyester Resin; VE = Vinyl Ester Resin; (*) = Not recommended to exceed this temperature; call = Call for recommendations

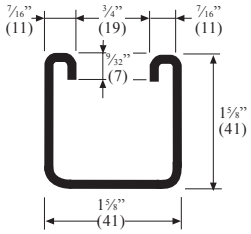
Information contained in this chart is based on data from raw material suppliers and collected from several years of actual industrial applications. Temperaturers are not the minimum nor the maximum (except where specifically stated) but represent standard test conditions. The products may be suitable at higher temperatures, but individual test data should be required to establish such suitability. The recommendations or suggestions contained in this chart are made without guarantee or representation as to results. We suggest that you evaluate these recommendations and suggestions in your own laboratory or by actual field trial prior to use.

Channel Framing (Solid & Punched)

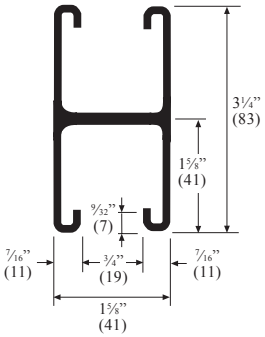
Part No.	Lbs/Ft.
Polyester: EC-10	0.47
Vinyl Ester: EC-VE-10	

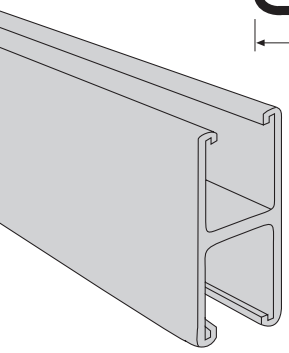


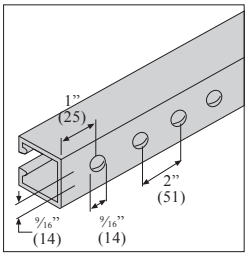
Part No.	Lbs/Ft.
Polyester: EC-158	0.68
Vinyl Ester: EC-VE-158	



Part No.	Lbs/Ft.
Polyester: EC-158D	1.36
Vinyl Ester: EC-VE-158D	







For punched channel framing add "H" to the end of the part number; example: EC-10H. Punched not available for double channel. Punched holes are 9/16" holes on 2" centers. Replaces drilled strut.

For use in tray support systems, electrical conduit and tray rungs for tying down cable. Available in 10 ft and 20 ft lengths. See below for loading, and see page 38 for specification information.

Technical Data - Support Systems & Strut

Channel Framing Loading

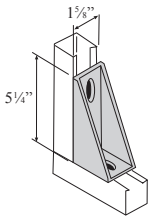
Beam and Column Data: Polyester and Vinyl Ester Resin Base

Beam Span or Column Height In.(mm)	Part No.	Maximum Allowable Uniform Beam Load Poly Lbs.(kg)	Maximum Allowable Uniform Beam Load Vinyl Lbs.(kg)	Deflection @ Maximum Allowable Uniform Beam Load Poly In.(mm)	Deflection @ Maximum Allowable Uniform Beam Load Vinyl In.(mm)	Uniform Load @ Maximum Deflection = 0.25 In. (6mm) Poly Lbs.(kg)	Uniform Load @ Maximum Deflection = 0.25 In. (6mm) Vinyl Lbs.(kg)	Uniform Load @ Maximum Deflection = 0.50 In. (13mm) Poly Lbs.(kg)	Uniform Load @ Maximum Deflection = 0.50 In. (13mm) Vinyl Lbs.(kg)	Maximum Allowable Column Load Lbs.(kg)
12" (305)	**EC-10**	790 (358)	990 (449)	0.11 (3)	0.12 (3)	-	-	-	-	2550 (1156)
	EC-158	1720 (780)	2150 (975)	0.07 (2)	0.07 (2)	-	-	-	-	3650 (1655)
	EC-158D	5080 (2301)	6350 (2880)	0.04 (1)	0.04 (1)	-	-	-	-	7300 (3111)
18" (457)	**EC-10**	530 (240)	670 (304)	0.24 (6)	0.27 (7)	-	620 (281)	-	-	2350 (1066)
	EC-158	1150 (521)	1440 (653)	0.15 (4)	0.17 (4)	-	-	-	-	3370 (1528)
	EC-158D	5080 (2301)	4240 (1923)	0.09 (2)	0.10 (2)	-	-	-	-	6740 (3058)
24" (610)	**EC-10**	400 (181)	500 (227)	0.43 (11)	0.48 (12)	240 (109)	270 (122)	-	-	2070 (939)
	EC-158	860 (390)	1080 (490)	0.27 (7)	0.30 (8)	810 (367)	910 (412)	-	-	2960 (1342)
	EC-158D	2540 (1152)	3180 (1442)	0.16 (4)	0.17 (4)	-	-	-	-	5920 (2685)
30" (762)	**EC-10**	320 (145)	400 (181)	0.67 (17)	0.75 (19)	120 (54)	140 (63)	240 (109)	270 (122)	1710 (775)
	EC-158	690 (313)	870 (394)	0.42 (11)	0.48 (12)	410 (186)	460 (209)	-	-	2450 (1111)
	EC-158D	2040 (925)	2550 (1156)	0.24 (6)	0.27 (7)	2000 (907)	2350 (1066)	-	-	4900 (2222)
36" (914)	**EC-10**	270 (122)	340 (154)	0.98 (25)	1.10 (28)	70 (31)	80 (36)	140 (63)	160 (72)	1260 (571)
	EC-158	580 (263)	730 (331)	0.61 (15)	0.69 (19)	240 (109)	270 (122)	480 (217)	540 (245)	1800 (816)
	EC-158D	1700 (771)	2130 (966)	0.35 (9)	0.39 (10)	1220 (553)	1370 (621)	-	-	3600 (1633)
42" (1067)	**EC-10**	230 (104)	290 (131)	1.32 (34)	1.49 (38)	50 (22)	55 (25)	100 (45)	115 (52)	920 (417)
	EC-158	490 (222)	620 (281)	0.82 (21)	0.92 (23)	150 (68)	170 (77)	300 (136)	340 (154)	1320 (598)
	EC-158D	1460 (662)	1830 (830)	0.48 (12)	0.62 (16)	770 (349)	870 (394)	1510 (650)	1720 (530)	2640 (1197)
48" (1219)	**EC-10**	200 (91)	250 (113)	1.72 (44)	1.92 (49)	30 (13)	25 (16)	60 (27)	70 (31)	700 (317)
	EC-158	430 (195)	540 (245)	1.07 (27)	1.20 (30)	100 (45)	115 (52)	200 (90)	230 (104)	1010 (458)
	EC-158D	1270 (576)	1590 (721)	0.62 (16)	0.69 (17)	520 (236)	590 (267)	1040 (471)	1170 (780)	2020 (916)
60" (1524)	**EC-10**	160 (72)	200 (91)	2.68 (68)	2.99 (76)	20 (9)	23 (10)	40 (18)	45 (20)	180 (81)
	EC-158	350 (158)	400 (200)	1.70 (43)	1.91 (48)	60 (27)	70 (32)	120 (54)	135 (61)	260 (118)
	EC-158D	1020 (462)	1280 (580)	0.97 (25)	1.09 (28)	270 (122)	310 (140)	540 (245)	610 (276)	520 (235)
72" (1829	**EC-10**	140 (63)	180 (81)	*	*	10 (4)	12 (5)	20 (9)	23 (10)	-
	EC-158	290 (131)	370 (168)	2.44 (62)	2.78 (71)	30 (13)	34 (15)	60 (27)	70 (32)	-
	EC-158D	850 (385)	1070 (485)	1.40 (35)	1.57 (40)	160 (72)	180 (81)	320 (145)	360 (163)	-
84" (2134)	**EC-10**	120 (54)	150 (68)	*	*	NR	-	12 (5)	15 (7)	-
	EC-158	250 (113)	320 (145)	*	*	20 (9)	23 (10)	40 (18)	45 (20)	-
	EC-158D	730 (331)	920 (417)	1.91 (48)	2.15 (55)	100 (45)	115 (52)	200 (90)	230 (104)	-
96" (2438)	**EC-10**	100 (45)	130 (59)	*	*	NR	-	-	-	-
	EC-158	220 (100)	250 (113)	*	*	13 (6)	15 (7)	26 (12)	30 (13)	-
	EC-158D	640 (290)	800 (363)	2.50 (63)	2.79 (71)	70 (32)	80 (36)	140 (63)	160 (72)	-

* Deflection is in excess of 3.00 In. (76mm); mid-span support is recommended. NR = Not Recommended; **Beam Loads:** Table lists the total allowable load for various simple spans based on a minimum safety factor 2:1. If load is concentrated at center of span, multiply the load from the table by 0.5 and the corresponding deflection by 0.8. **Column Loads:** Table lists the total allowable axial load for various unsupported column heights based on a minimum safety factor of 3:1. Eccentric loads should be reduced according to standard practice.
Notes: All beams should be supported in a manner to prevent rotation at supports. Long, deep beams should be tied between supports to prevent twist.

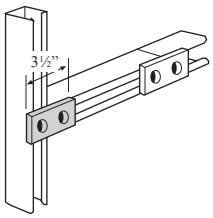
Connector Plates

Based on individual applications, changes may be required on dimension and thickness of material. Please contact us. Holes are drilled to accept ⅜" and ½" bolts.
For Vinyl Ester Connector Plates, insert the letters "VE" as indicated in this example:
Polyester = CP-100; Vinyl Ester = CP-VE-100

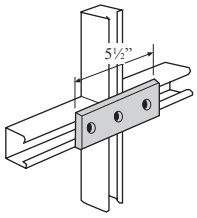


Universal Angle

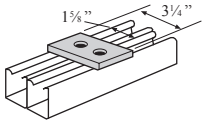
Part No.
Polyester: CP-501
Polyurethane: CP-PU-501
Nylon: CP-NY-501



Part No.
CP-100



Part No.
CP-101



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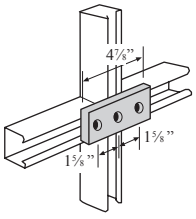
CP-102



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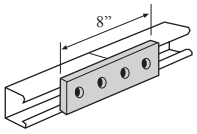

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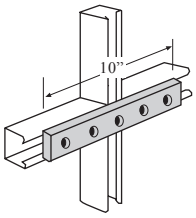

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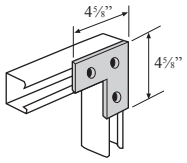

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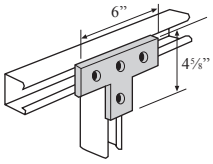

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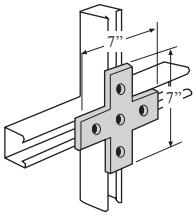

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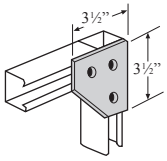
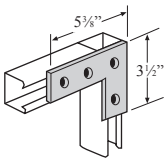
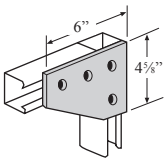
CP-111



Part No.
CP-112



Part No.
CP-113



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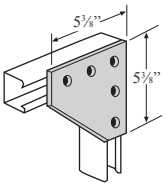

Part No.
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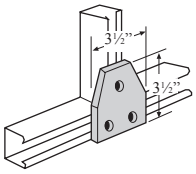

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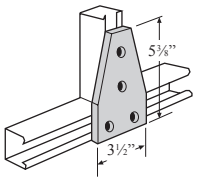
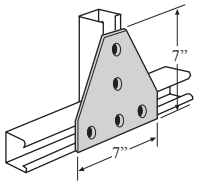


Part No.
CP-117



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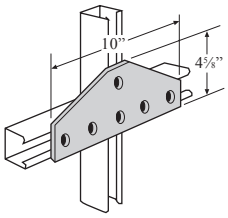
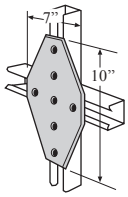
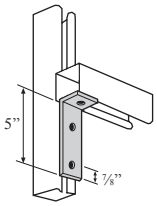
CP-118



Part No.
CP-119

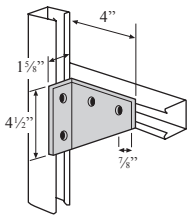


Part No.
CP-120



Note: Flat washer not required for CP-205

Part No.
CP-205



Part No.
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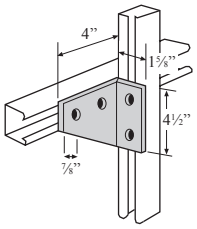
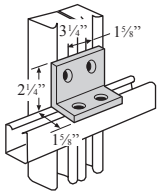
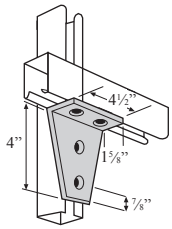


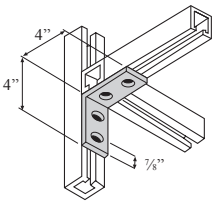
Part No.
CP-210



Part No.
CP-211



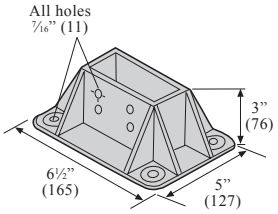
Part No.
CP-226



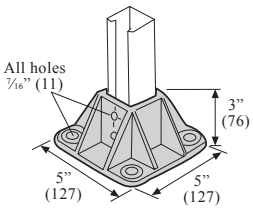
Part No.
CP-405

Post Base

Part No.
Polyester: PBD-PE
Polyurethane: PBD-PU



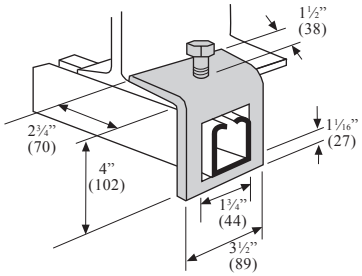
Part No.
Polyester: PBS-PE
Polyurethane: PBS-PU



Window Clamp

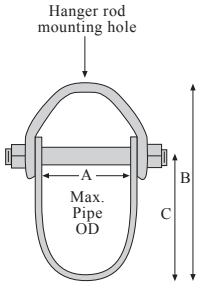
Part No.
WC-158

Stainless steel set screw included



Fiberglass Clevis Hanger

Part No.	Nominal Dia. In.	Dimension In. A	B	C	Hanger Rod In.	Allowable Load Lbs.
CH-010	1	1⅝	4¾	3	½	200
CH-015	1½	2⅛	5⅝	3⅜	½	200
CH-020	2	2½	7	4⅜	½	200
CH-025	2½	3 5/16	6 9/16	4¼	½	200
CH-030	3	3¾	7½	4¼	½	300
CH-040	4	5⅛	9¾	5⅞	½	400
CH-060	6	7 3/16	12⅜	8	½	600
CH-080	8	9⅜	15 9/16	10¼	½	600
CH-100	10	11 19/32	14⅞	12 11/16	⅝	600
CH-120	12	13⅝	22¼	14	⅝	600
CH-140	14	15¼	26 3/16	16¾	⅝	600



Vinyl Ester resin is the standard. Allowable loads have a 3:1 safety factor at 120°F. Insulation may be required at higher temperatures. Tolerance is ¾" maximum.

Non-Metallic Universal Pipe Clamp

Part No.	Pipe Size Inches	Wt./ 100 Sets* Lbs.	Conduit Outside Diameter Inches (for reference only) PVC Schedule 40 & 80	PVC Coated Steel	Rigid Steel	Fiberglass (FRP)
PC-1609N	½	9.0	0.840	0.920	0.840	-
PC-1610N	¾	10.0	1.050	1.130	1.050	0.890
PC-1611N	1	10.5	1.315	1.395	1.315	1.195
PC-1612N	1¼	11.0	1.660	1.740	1.660	1.507
PC-1613N	1½	13.0	1.900	1.980	1.900	1.757
PC-1614N	2	14.0	2.375	2.455	2.375	2.132
PC-1615N	2½	18.0	2.875	2.955	2.875	2.650
PC-1616N	3	20.0	3.500	3.580	3.500	3.132
PC-1617N	3½	23.0	4.000	4.080	4.000	3.632
PC-1618N	4	25.0	4.500	4.580	4.500	4.132

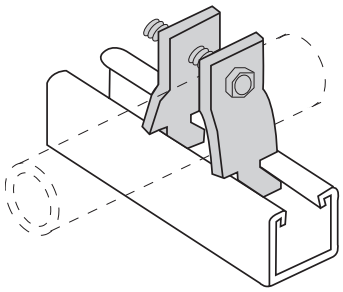
* Includes nylon bolt

For rigid, PVC coated steel, PVC Schedule 40 & 80 and fiberglass conduit.

Made from a toughened grade of glass reinforced thermoplastic polyester resin. Standard fasteners are nylon slotted hex bolt and nut. Recommended for horizontal use as shown. For vertical placement please contact us.

Packaged twenty sets per bag.

If stainless steel fasteners are preferred, indicate by adding the letter "S" after the catalog number (Example: PC-1609S).



FRP Channel Nut

Part No.	Size	Weight	t
CN-038	⅜"-16	5.46 Lbs/C	1 1/16" (27)
CN-050	½"-13	5.00 Lbs/C	1 1/16" (27)

Vinyl Ester resin is the standard. Channel nuts are self locking and designed for use with EC-158 and EC-158D strut only.
Resistance to slip = 450 Lbs. per bolt
Pull out strength = 700 Lbs. per bolt
Recommended safety factor = 3

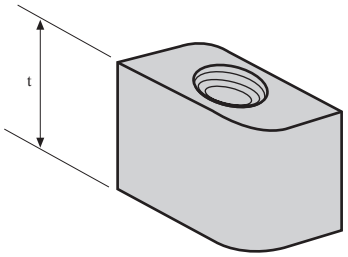
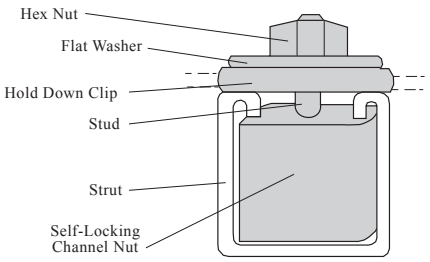
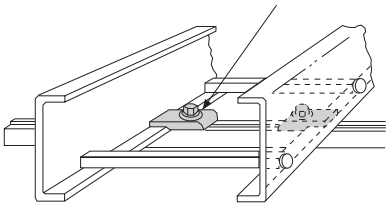


Diagram: FRP Channel Nut with Hold Down Clip



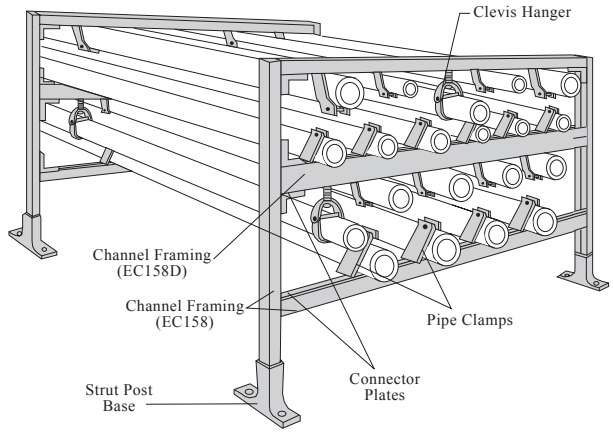


Typical Installations - Support Systems & Strut

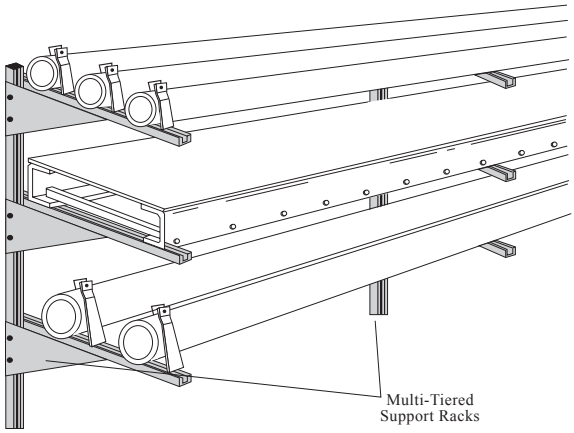
Enduro's DuroStrut combined with our cable tray accessories are functional in many non-cable tray applications. DuroStrut includes all the items necessary to field fabricate to your specifications whether wall, floor, or ceiling mounted. Enduro can also assist in engineering to your requirements.

If you need a special shape or assembly, call Enduro for information on custom pultrusions and fabrications.

Pipe Support Racks Sample Installation



Wall Stanchion Sample Installation



Specification - DuroStrut

1.0 Scope
1.1 This specification covers the requirements for Enduro non-metallic Channel Framing Systems & Accessories

2.0 Standards
2.1 All channel shall have a flame spread rating of 25 or less, and the Smoke Developed Index shall have a density of 450 or less when tested in accordance with the provisions of ASTM E-84; therefore qualifying as a class 1 material in the Uniform Building Code
2.2 All channel shall have a surfacing veil over the entire surface in addition to a UV inhibitor in the resin system to protect against degradation from ultra-violet light.

3.0 Materials
3.1 All channel shall be manufactured by the pultrusion process, and contain a minimum of 50% glass by weight.
3.2 All channel shall conform, as a minimum requirement, to loads and deflections shown on the tables in the latest version of the Enduro technical catalog.

4.0 Non-Metallic Pipe Clamps
4.1 All pipe clamps shall be manufactured by the injection molding process with an impact modified, 30% glass filled thermoplastic polyester resin.
4.2 All pipe clamps interlock with the channel framing described above.
4.3 All pipe clamps shall be designed for rigid PVC coated steel, Schedule 40 and 80 PVC, and filament wound fiberglass pipe or conduit. Clamps shall be adjustable to accommodate a ¾" minimum deviation in O.D. size.

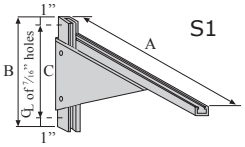
5.0 Fasteners
5.1 All fasteners shall be injected molded glass reinforced nylon, 316 stainless steel, or pultruded vinyl ester rod with ground threads and compression molded vinyl ester nuts.

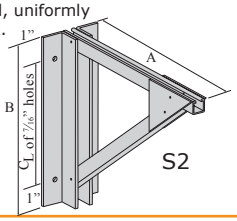
6.0 Acceptable Manufacturer
6.1 DuroStrut is manufactured and fabricated exclusively by Enduro - Houston, TX.

Cable Tray Support Racks

Part No. Key*	Dimension In. A	B	C	Allowable Load Lbs.
SR1-6(Δ)	10"	12"	10"	1,600
SR1-9(Δ)	13"	12"	10"	1,100
SR1-12(Δ)	16"	12"	10"	850
SR1-18(Δ)	22"	12"	10"	725
SR1-24(Δ)	28"	12"	10"	480
SR2-24(Δ)	26"	21"	15"	750
SR2-30(Δ)	32"	21"	15"	750
SR2-36(Δ)	38"	21"	15"	750

Allowable load is based on a total load, uniformly distributed over the length of the rack.
Safety factor = 2.0



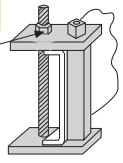


Vertical Tray Hanger Support

Part No. Key*
VH-(H)(Δ)

Not available for EMZ6.

½" hanger rod and nuts separate order items



SemKit Adhesive

Part No.
SEMKIT

Fiberglass to fiberglass adhesive for custom fabrication or repair. Meets NTSA and UPS requirements for sea and ground transportation.

Field Cutting Sealant

Part No.
Quart Can: ES-Q
Gallon Can: ES-G

Seals exposed fibers after any field cuts. Restores gloss and luster to weathered fiberglass.

Seals exposed FRP threads after installation of fiberglass threaded rod and hex nuts. For polyester and vinyl ester resin products. Clear color.

Meets NSTA and UPS requirements for sea and ground transportation.

Enduro fastener and hanging systems are exceptionally strong non-metallic mechanical systems with outstanding shear and tensile strengths. This makes the Enduro fastener system an excellent choice for all structural, mechanical, and electrical applications where fasteners must be corrosion-resistant and/or non-conductive. Refer to the fastener and hanging system installation guide on page 40 and threaded rod properties in the table below. It is not recommended that FRP threaded rod be used in conjunction with steel or PVC coated steel beam clamps or nuts. Thread shear could occur due to insufficient thread engagement.

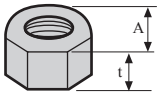
FRP Threaded Rod

Part No.	Size	Weight
TR-FRP-038	⅜"-16	0.07 Lbs/Ft
TR-FRP-050	½"-13	0.12 Lbs/Ft
TR-FRP-0625	⅝"-11	0.18 Lbs/Ft
TR-FRP-075	¾"-10	0.28 Lbs/Ft
TR-FRP-100	1"-8	0.50 Lbs/Ft

Vinyl Ester resin is the standard. Available in 8 ft. lengths.

FRP Hex Nut

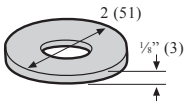
Part No.	Size	Weight	t	A
FN-FRP-038	⅜"-16	2.43 Lbs/C	⅝" (16)	⅞" (22)
FN-FRP-050	½"-13	2.17 Lbs/C	⅝" (16)	⅞" (22)
FN-FRP-0625	⅝"-11	6.05 Lbs/C	⅞" (22)	1¼" (32)
FN-FRP-075	¾"-10	5.42 Lbs/C	⅞" (22)	1¼" (32)
FN-FRP-1000	1"-8	20.49 Lbs/C	1¼" (32)	2" (51)



Vinyl Ester resin is the standard.

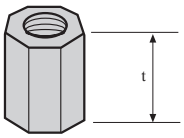
FRP Flat Washer

Part No.	Size	Weight
FW-FRP-038	⅜"-16	1.3 Lbs/C
FW-FRP-050	½"-13	1.3 Lbs/C
FW-FRP-0625	⅝"-11	1.3 Lbs/C
FW-FRP-075	¾"-10	1.3 Lbs/C
FW-FRP-1000	1"-8	1.3 Lbs/C



FRP Rod Coupler

Part No.	Size	Weight	t
RC-FRP-038	⅜"-16	7.80 Lbs/C	2" (51)
RC-FRP-050	½"-13	7.00 Lbs/C	2" (51)
RC-FRP-0625	⅝"-11	13.73 Lbs/C	2" (51)
RC-FRP-075	¾"-10	12.66 Lbs/C	2" (51)
RC-FRP-1000	1"-8	44.03 Lbs/C	2¾" (70)



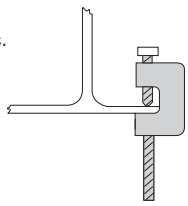
Vinyl Ester resin is the standard.
IMPORTANT: Minimum thread engagement must be ¾" per side.

Beam Clamps

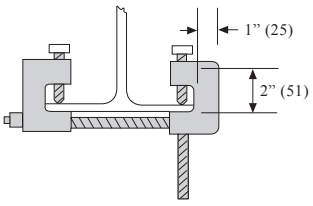
Part No.	Description
BCS-3/8	Single for ⅜" FRP Threaded Rod
BCS-1/2	Single for ½" FRP Threaded Rod
BCD-3/8	Double for ⅜" FRP Threaded Rod
BCD-1/2	Double for ½" FRP Threaded Rod

Ultimate load = 300 Lbs
Recommended safety factor = 3
SS set screws included with clamps.

Single



Double



Typical Properties - FRP Threaded Rod

Properties	⅜-16 UNC	½-13 UNC	⅝-11 UNC	¾-10 UNC	1-8 UNC
Thread shear strength using FRP hex nut in tensile - Lbs.	1,250	2,200	3,100	4,500	6,500
Transverse shear on threaded rod - double shear (load Lb.) (ASTM-B565)	3,000	5,000	7,500	12,000	22,000
Transverse shear on threaded rod - single shear (load Lb.)	1,600	2,600	3,800	6,200	15,000
Compressive strength longitudinal, PSI (ASTM-D695)	54,000	54,000	54,000	54,000	65,000
Flexural strength, PSI (ASTM-D790)	55,000	55,000	55,000	55,000	60,000
Flexural modulus, PSI x 10^6 (ASTM-D790)	2.0	2.0	2.0	2.50	2.75
Torque strength using fiberglass nut lubricated with SAE 10W30 motor oil, Ft.-Lbs.	8	18	35	50	110
Dielectric strength, KV/In. (ASTM-D149)	35	35	35	35	35
Water absorption 24 hour immersion - threaded, % (ASTM-D570)	1	1	1	1	1
Coefficient of thermal expansion - longitudinal In./In./°F	5 x 10^{-6}	5 x 10^{-6}	5 x 10^{-6}	5 x 10^{-6}	5 x 10^{-6}
Max recommended operation temp - based on 50% retention of ultimate thread shear strength °F (°C)	200°(93°)	200°(93°)	200°(93°)	200°(93°)	200°(93°)
Stud weight, Lb./Ft.	0.07	0.12	0.18	0.28	0.50
Flammability	Self-extinguishing on all				

Note: 1 Ft.-Lb. = .138 kg-M; 1 Lb = .4536 kg; 1 PSI = 6.984 K Pa; Test results are for studs with single FRP hex nuts only, stainless steel nuts will result in reduced values. Proper safety factors should be applied to testing. All values are based on laboratory test results.

Fastener & Hanging Systems - Installation Guide

The Enduro fastener system is a vinyl ester resin and fiberglass composite with unique characteristics which make it ideal for many applications where high strength, non-metallic fasters are required.

Size	Thread Shear (single nut)	Maximum Installation Torque	Socket Size
3/8" - 16 UNC	1,250 Lbs.	4 Ft.-Lbs.	15/16"
1/2" - 13 UNC	2,200 Lbs.	8 Ft.-Lbs.	15/16"
5/8" - 11 UNC	3,100 Lbs.	16 Ft.-Lbs.	15/16"
3/4" - 10 UNC	4,500 Lbs.	24 Ft.-Lbs.	15/16"
1" - 10 UNC	6,500 Lbs.	50 Ft.-Lbs.	2"

For Access After Installation

If the assembly will require occasional removal of the nuts, the rod should be lightly coated with a dry lubricant, silicon spray, or a light oil prior to assembly.

For Permanent Installation

If the assembly is designed to be a permanent installation, the nuts and studs should be bonded with an epoxy adhesive.

Apply a light coating of adhesive to the stud and nut threads, then quickly secure the assembly before adhesive has time to set, otherwise the mil thickness of the adhesive will make it impossible to thread. Next, apply a thick coat of adhesive to the exposed stud and nut surfaces. This provides a locking mechanism which eliminates the need for extra torque and lock washers.

For Hanging System Installation

The optimum method of installation for a hanger system is to finger tighten the assembly and then only tighten the nuts one-half turn to secure any jam nut assemblies. Follow the permanent installation procedure whenever possible. This results in minimum torque and allows maximum thread shear.

To insure maximum resistance to chemical attack once the assembly is completed, the exposed stud thread and nut surfaces should be coated with Enduro's Field Cutting Sealant (Part No. ES-Q or ES-G; see pg. 25).

Metal & FRP Installation

When utilizing metal fasteners, connectors, or nuts, consideration must be given to reduced strengths. Enduro rod and nuts are designed with maximum thread engagement and extra nut thickness. Metal products have less thread engagement. When installation requires metal components, special tests may be necessary to define ultimate strengths of the fastener systems.

For Beam Clamp Installation

Maximum installation torque of 10 foot-pounds is recommended to secure set screw.

Site Conditions

Vibration and dynamic loading conditions on the Enduro fastener assembly should be eliminated or minimized. If this is not possible, additional safety factors should be used in designed the fastener system.

Tools Required

The oversize hex nut design of the Enduro nut requires a larger than normal socket wrench, but either a six point or twelve point socket will work.
Important - do not exceed the torque values listed in the table above.

Caution

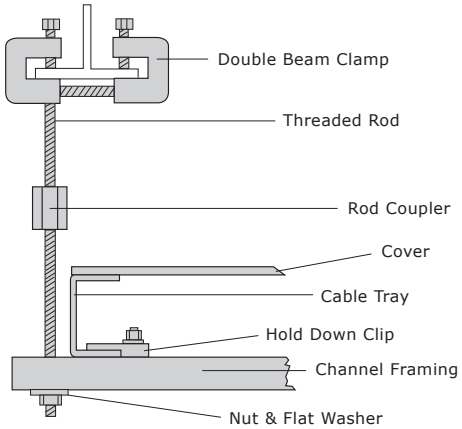
Do not over torque the Enduro nut and rod. The thread shear and torque values are NOT mutually exclusive, they are additive

Example

1/2" - 13 has a thread shear of 2,200 Lbs. and an ultimate torque strength of 18 ft-lbs. If you use the maximum installation torque of 8 ft-lbs, the amount of thread shear remaining is reduced to 1,225 lbs.

Specifying engineers should apply this information at the design stage, applying the proper safety factors to ensure a secure installation.

Typical Hanging Support System



Instrument & Pushbutton Stands

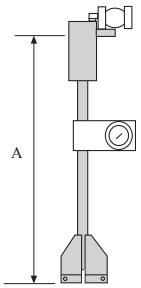
Enduro's universal instrument support system offers many of the same features and benefits as our cable tray, strut and wireway systems. Enduro instrument and pushbutton stands are built to any configuration required, including, single or double post, large mounting panel (switch rack/station) type designs, and any mounting requirements needed. For all configurations, please specify dimensions in inches.

Enduro Instrument & Pushbutton Stand Benefits:

- Costs less than stainless steel systems & competitive with most metallic systems
- Faster assembly time than metallic systems due to easy cut, fit, and adhesive design
- Lighter weight with corrosion resistance comparable to stainless steel and galvanized stand designs
- Compatible with metallic post bases and metallic support structures
- Easily built on site allowing for design freedom and increasing response time
- Constructed from 2" Schedule 80 gray vinyl ester base for superior corrosion resistance
- 2" SteelFree™ U-Bolt (shown below) may be used to attach instruments and/or gauges to the supports

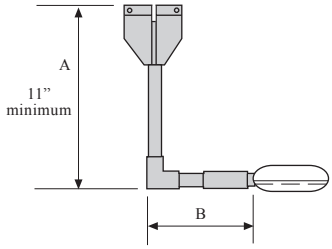
Floor Mount Single

Part No. Key*
DISR170B1 x (A)



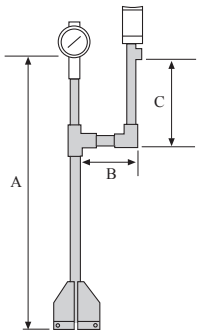
Column or Wall Mount

Part No. Key*
DISR175B48 x (A) x (B)



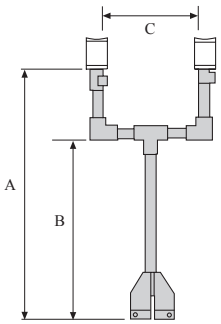
Floor Mount, Multiple Instrument

Part No. Key*
DISR172B x (A) x (B) x (C)



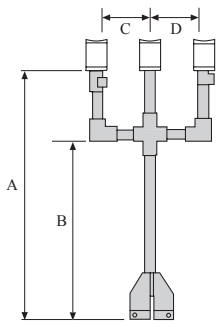
Floor Mount Double

Part No. Key*
DISR171B x (A) x (B) x (C)



Floor Mount Triple

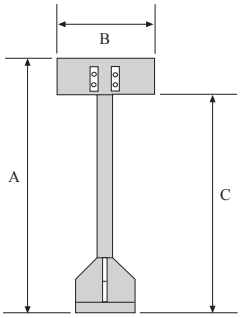
Part No. Key*
Available in 2011, Contact Us



Pushbutton Station

Part No. Key*
DPS x (A) x (B) x (C)

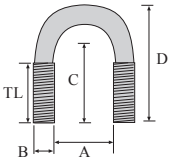
Made of pultruded fiberglass reinforced vinyl ester 2" square tube with an 8" square vinyl ester base at 6 1/2" high. Please specify dimensions in inches.



U-Bolts

Part No.	Pipe Nom. Dia.	A	B	C	D	TL	Max Rec. Loading Lbs.	Max Rec. Torque In.-Lbs.
EU050	½"	0.93	0.375	1.56	2.41	1.25	75	20
EU070	¾"	1.12	0.375	1.66	2.60	1.25	75	20
EU100	1"	1.37	0.375	1.78	2.85	1.25	75	20
EU125	1¼"	1.68	0.375	1.94	3.16	1.25	75	20
EU150	1½"	2.00	0.375	2.10	3.47	1.25	75	20
EU200	2"	2.43	0.500	2.46	4.18	1.50	150	40
EU250	2½"	2.93	0.500	2.71	4.68	1.50	150	40
EU300	3"	3.56	0.500	3.03	5.31	1.50	150	40
EU350	3½"	4.06	0.500	3.28	5.81	1.50	150	40
EU400	4	4.56	0.500	3.53	6.31	1.50	150	40

Made from glass reinforced polyurethane resin, u-bolts are the ideal choice for mounting enclosures, instrumentation, conduit, and piping on your Enduro instrument and pushbutton support systems.
Excellent as an alternative when replacing corroded steel u-bolts.
Recommended for operating temperatures up to 150 °F.
Four nuts included with each u-bolt.



* In Part No. Key, parentheses ( ) = insert corresponding dimension

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Tuff Span
FRP Structural Shapes

Corrosion Resistance

For Demanding Environments

Beams • Channels • Angles • Tube • Rod • Flat Sheet

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Tuff Span FRP Structural Shapes

Corrosion Resistant • Long Span • Non-Conductive

Structural shapes for demanding structural and environmental conditions.

Tuff Span Flanged Tube Beams are developed specifically for applications that require long span and high load capability plus corrosion resistance. This includes building structures, baffle wall columns, and support of tank cover decking. These sections utilize a custom design that optimizes structural properties and cost through innovative use of shape, glass fiber reinforcing, and manufacturing process.

Tubular shapes are utilized to enhance lateral stability and to eliminate cross bracing. The sections include extended flanges for easy installation and connections. The materials are manufactured by pultrusion process that produces consistent, reliable quality and maximizes glass fiber reinforcements. To optimize load transfer and capacity, its reinforcements are aligned in multiple directions and strategically placed within the material. This design produces higher structural properties per weight as compared to unidirectional reinforced FRP Wide Flange and I-Beam sections.

The material's isophthalic polyester or vinyl resin system provides outstanding corrosion protection and fire retardant sections with flame spread rating of 25 or less. The combination of corrosion resistance, and long span capability delivers significant end user benefits and life cost savings.

Tuff Span Standard Shapes include fiberglass reinforced plastic channel, angle, tube, wide flange, and flat sheet sections. Enduro furnishes these materials as individual structural components and in assembled products. Uses for Tuff Span FRP structural shapes include:

- Long span roof and wall beams
- Baffle Wall columns
- Long span tank cover beams
- Primary building structures
- Cooling towers
- Cable tray
- Strut
- Threaded rod
- Instrument stands
- Ladder and handrail
- Grating support
- OEM applications

Tuff Span 8F6 beams and roofing panels at galvanizing plant. Tuff Span building products provide outstanding corrosion protection and substantial, life-cycle cost savings.

Tuff Span 8F6 and 18F17 beams at EMI Test Facility under construction. Tuff Span FRP building products are non-conductive and RF transparent.

Table of Contents

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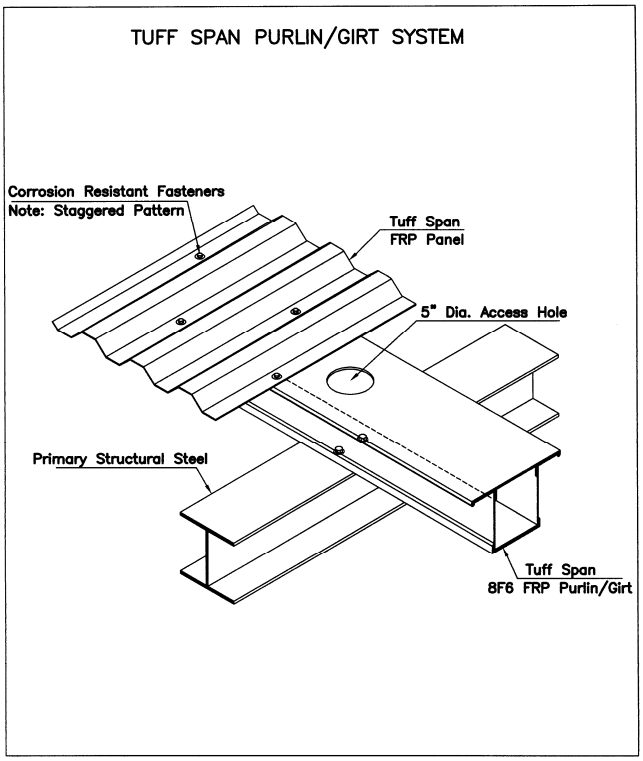
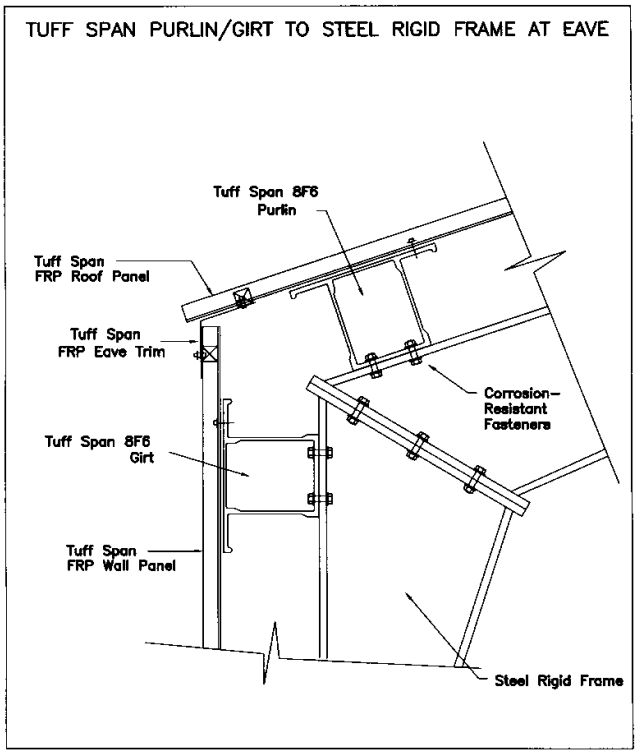
Details: Tuff Span 8F6 FRP Purlin/Girt System





Specifications: Fiberglass Reinforced Plastic Structurals

Part 1 - General

1.01 Description of Work

The scope of this specification is intended to cover fiberglass reinforced plastic beams as shown on the drawings.

1.02 Performance Testing

A. Materials shall comply with Federal and Local laws or ordinances, applicable codes, standards, and regulatory agency requirements including:
   1. ASTM D638, Standard Test Method for Tensile Properties of Plastics
   2. ASTM D790, Standard Test Method for Flexural Properties of Plastics
   3. ASTM D695, Standard Test Method for Compressive Strength of Plastics
   4. ASTM E84, Standard Test Method for Surface Burning Characteristics of Plastics

A. Structural framing shall meet performance and design criteria listed herein and indicated on the drawings.

B. Beams shall demonstrate compliance with design criteria by full-scale, 3 Point Load Bend Test.

1.03 Design Criteria

A. Uniform Design Loads
   Wind _____psf Snow _____psf
   Live _____psf Dead _____psf

B. Deflection Limits and Factors of Safety
   Roof Purlins: L/D = 120; FOS = 2.5
   Wall Girts: L/D = 120; FOS = 1.88
   Primary Beams: L/D = 180; FOS = 2.5

Part 2 – Products

2.01 Materials

Structural shapes shall be Tuff Span as manufactured by Enduro, Houston, Texas or approved equal.

A. Purlin and Girts shall be Tuff Span 8F6 Flanged Tube Beam.

B. Primary structurals shall be Tuff Span 12F12 or 18F17 Flanged Tube Beam.

C. Resin type shall be:
   _____ Isophthalic Polyester, gray color
   _____ Vinyl Ester, beige color

D. Glass fiber reinforcements shall be continuous and in multi-directional alignment with minimum glass content of 60% of the beam weight.

E. Materials shall be fire retardant with Class I Flame Spread Rating, 25 or less per ASTM E-84.

Part 3 - Execution

3.01 Installation 8F6 Purlin / Girt

A. Verify alignment of primary support beams.

B. Position 8F6 beam on primary beams with flanges upward.

C. Fasten 8F6 beam with two, 5/8" x 2" bolt and nut assemblies at each support. Access for fastening 8F6 beams is through (optional) factory-cut access holes.

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FRP Structural Shapes: Span Tables

Design parameters used for the tables on the following pages are based on material testing and theoretical analysis. Allowable uniform loads, shown in lbs/ft, are limited by bending moment with applied factor of safety (FOS) and deflection (L/D) expressed as the ratio between span length and the allowable limit. This information should be used as a guide only with usage verified by a registered Professional Engineer.

Nomenclature

W = Weight per lineal foot, lb/ft
A = Cross-sectional area, in^2
E = Apparent flexural modulus, psi
G = Apparent modulus of rigidity, psi
M = Bending moment capacity, lb.-in.
Ixx = Moment of Inertia,centroidal x-x axis, in^4
Iyy = Moment of Inertia, centroidal y-y axis, in^4
Bf/Bt = Flange width/Flange thickness ratio
K = Effective column length factor
Fb = Flexural Stress (psi)
R = Radius of Gyration (in)
Aw = Area of web (in^2)
Sxx = Section Modulus, X-Axes (in^3)

FRP Shapes	Load Table Pg. #	Stock Item (2)	Non-Stock Item (3)
Flanged Beams			
8F6 Purlin/Girt	4		*
12F12 Flanged Tube	4		*
18F17 Flanged Tube	4		*
6 x 6 x 3/8 Wide Flange	5	*	
12S12 Flanged Tube	5		*
Rectangular Tube			
14B10 Tube	5		*
3 x 4 x 1/4	Note 1		*
Square Tube			
4 x 4 x 1/4	6		*
3 x 3 x 1/4	6		*
2 x 2 x 1/4	6	*	
1 5/8 x 1 5/8 x 1/8	6		*
Channel			
C10 x 2 3/4 x 3/8	7	*	
C8 x 1 3/4 x 5/16	7	*	
C6 7/8 x 5 3/8 x 1/4	Note 1	*	
C6 x 1 5/8 x 5/16	7		*
C6 x 1 5/8 x 1/4	7	*	
C6 x 2 x 3/16	Note 1	*	
C6 x 1 5/8 x 3/16	Note 1	*	
C4 3/4 x 3 1/4 x 1/4	Note 1	*	
C4 x 1 1/8 x 1/4	8	*	
C3 x 1 x 3/16	8	*	
C2 x 1 x 3/16	Note 1	*	

FRP Shapes	Load Table Pg. #	Stock Item (2)	Non-Stock Item (3)
Angle			
6 x 6 x 3/8 Angle	8	*	
4 x 4 x 3/8 Angle	8	*	
3 x 3 x 3/8 Angle	8	*	
3 x 3 x 1/4 Angle	Note 1	*	
2 x 2 x 1/4 Angle	Note 1	*	
Solid Rod			
1 x 1/8 Square	Note 1	*	
1 x 1/8 Round	Note 1	*	
Round Tube			
2 3/8 x 1/4	Note 1		*
Flat Sheet			
3' x 10' x 1/8" Thick	Note 1	*	
3' x 10' x 3/16" Thick	Note 1		*
3' x 10' x 1/4" Thick	Note 1	*	
3' x 10' x 3/8" Thick	Note 1	*	
3' x 10' x 1/2" Thick	Note 1	*	
Flat Strip, 4 5/8 x 1/4	Note 1	*	

Notes

1) Contact Enduro for technical data.
2) Stock Lengths: 20 ft. and 10 ft.
3) Non-Stock Item: Contact Enduro for minimum order requirement.
4) Standard Color: Polyester-Gray; Vinyl Ester-Beige
6) Contact Enduro for shapes, resin system, or colors not listed.

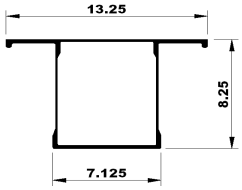
FRP Shapes: Properties

Mechanical	Longitudinal	FR - P	FR - V	Transverse	FR - P	FR - V
Tensile Strength, PSI (ASTM D638)		30,000	35,000		7,000	10,000
Compressive Strength, PSI (ASTM D695)		30,000	35,000		15,000	20,000
Flexural Strength, PSI (ASTM D790)		30,000	35,000		10,000	14,000
Tensile Modulus, PSI x 10^6 (ASTM D638)		2.5	3.0		0.8	1.0
Compressive Modulus, PSI x 10^6 (ASTM D695)		2.5	2.5		1.0	1.2
Flexural Modulus, PSI x 10^6 (ASTM D790)		1.6	2.0		0.8	1.0
Shear Strength, PSI		5,500	7,000		5,500	6,000
Bearing Stress, PSI		30,000	35,000		30,000	35,000
Barcol Hardness (ASTM D2583)		50	50		50	50
Izod Impact Strength, Ft.-Lbs./notch in. (ASTM D256)		25	30		4	5
Modulus of Elasticity, PSI x 10^6		2.5	3.0		Full Section in Bending	
Tensile Strength, PSI		20,000	25,000		Full Section in Bending	
Compressive Strength, PSI		20,000	25,000		Full Section in Bending	

Thermal		Electrical	
Coefficient of Expansion, In./In./°F (ASTM D696)	5 x 10^{-6}	Strength, short term in oil, 1/8", vpm (ASTM D149)	200
Conductivity, BTU per SF/Hr./°F/In. (ASTM C1776)	4	Electric Strength, short term in oil, KV/In.	35
Specific Heat, BTU/Lb./°F	0.28	Dielectric Constant, 60 Hz. (ASTM D150)	5.6, 5.2
		Dissipation Factor, 60 Hz. (ASTM D150)	0.03
Fire Retardant		Arc Resistance, seconds (ASTM D495)	120
Flame Spread Rating (ASTM E84)	15	**Other**	
Flame Resistance, ign/burn seconds (FTMS 406-2023)	75/75	Density, Lbs./In.^{3} (ASTM D792)	0.065
Intermittent Flame Rating (HLT-15 Test)	100	Specific Gravity (ASTM D792)	1.8
Flammability (ASTM D635): Burn Time = 5 seconds; Extent = 15mm		Water Absorption, % (ASTM D570)	0.5

Tuff Span FRP Structurals

8F6 Purlin / Girt



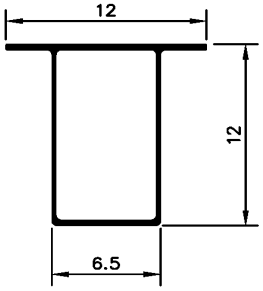
W =	6.1	lb/ft
A =	8	in^2
Ixx =	93	in^4
Iyy =	98	in^4
E =	3,841,000	psi
G =	450,000	psi
M =	456,000	lb-in

Allowable Uniform Load - Unbraced

Span (Ft.)	Purlin L/D = 120 FOS = 2.5			Purlin L/D = 180 FOS = 2.5			Girt L/D = 120 FOS = 1.88			Girt L/D = 180 FOS = 1.88		
	1	2	3	1	2	3	1	2	3	1	2	3
16	388	290	330	258	290	330	388	632	731	258	622	488
17	323	273	310	215	273	310	323	560	610	215	519	407
18	272	258	293	181	258	293	272	499	514	181	437	342
19	231	244	278	154	244	278	231	448	437	154	372	291
20	198	232	264	132	232	250	198	404	374	132	319	250
21	171	221	251	114	221	216	171	367	324	114	275	216
22	149	211	240	99	211	188	149	334	281	99	239	188
23	130	202	229	87	202	164	130	306	246	87	210	164
24	115	193	217	77	184	144	115	277	217	77	184	144
25	102	186	192	68	163	128	102	245	192	68	163	128
26	90	178	170	60	145	114	90	218	170	60	145	114
27	81	167	152	54	130	101	81	194	152	54	130	101
28	72	155	136	48	116	91	72	174	136	48	116	91
29	65	145	123	43	105	82	65	157	123	43	105	82
30	59	135	111	39	94	74	59	142	111	39	94	74

Shaded areas: 8F6 Beam has web stiffeners. Contact Enduro for purlin spans wo/stiffeners.

12F12 Flanged Tube



W =	12	lb/ft
A =	12.64	in^2
Ixx =	284.26	in^4
Iyy =	118.31	in^4
E =	4,180,000	psi
G =	425,000	psi
M =	1,225,000	lb-in
r=	3.0572	in
Bf/Bt=	32	
K=	1	

Allowable Uniform Load - Unbraced

Span (Ft.)	L/D = 120		L/D = 180		L/D = 240	
	1	2	1	2	1	2
21	570	741	380	741	285	687
22	496	675	331	675	248	597
23	434	618	289	618	217	523
24	382	567	255	567	191	460
25	338	523	225	523	169	407
26	300	483	200	483	150	362
27	268	448	179	431	134	323
28	241	417	160	386	120	290
29	217	388	144	348	108	261
30	196	363	130	314	98	236
31	177	340	118	285	89	214
32	161	319	107	259	81	194
33	147	300	98	236	73	177
34	134	283	90	216	67	162
35	123	267	82	198	62	148

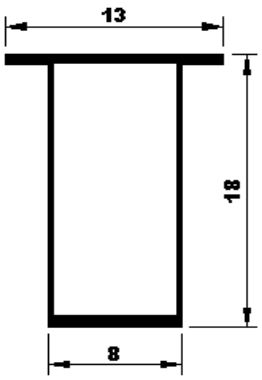
Beam FOS = 2.5

Column Load

Lth (Ft.)	Axial (Lbs.)
6	55349
7	50850
8	47249
9	44285
10	41792
11	39658
12	37804
13	36176
14	34731
15	33438
16	32272
17	31214
18	30248
19	29361
20	28545

Col. FOS = 3

18F17 Flanged Tube



W =	16.75	lb/ft
A =	22.47	in^2
Ixx =	1197.3	in^4
Iyy =	279.7	in^4
E =	3,967,000	psi
G =	425,000	psi
M =	2,000,000	lb-in
r=	3.53	in
Bf/Bt=	20.8	
K=	1	

Allowable Uniform Load - Unbraced

Span (Ft.)	L/D = 120		L/D = 180		L/D = 240	
	1	2	1	2	1	2
31	555	555	472	555	354	555
32	521	521	429	521	322	521
33	490	490	392	490	294	490
34	461	461	358	461	269	461
35	435	435	328	435	246	435
36	412	412	302	412	226	412
37	390	390	278	390	208	390
38	369	369	256	369	192	369
39	351	351	237	351	178	351
40	330	333	220	333	165	333
41	306	317	204	317	153	317
42	285	302	190	302	142	302
43	266	288	177	288	133	288
44	248	275	165	275	124	275
45	232	263	154	263	116	263

Beam FOS = 2.5

Column Load

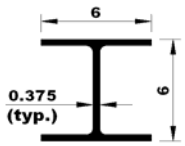
Lth (Ft.)	Axial (Lbs.)
11	72396
12	69013
13	66041
14	63403
15	61042
16	58914
17	56982
18	55218
19	53600
20	52109
21	50730
22	49448
23	48254
24	47137
25	46091

Col. FOS = 3

Tuff Span FRP Structurals

6 x 6 x 3/8 Wide Flange

W =	5.3	lb/ft
A =	6.48	in^2
Ixx =	40.129	in^4
Iyy =	13.52	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb=	8,125	psi
r=	1.45	in
Aw	1.97	in^2
Sxx	13.37	
Bf/Bt=	16	
K=	1	



Allowable Uniform Load - Braced							
Span	Stress	L/D = 120		L/D = 180		L/D = 240	
(Ft.)	Fb_Fv	1	2	1	2	1	2
4	1478	2955	3878	1970	2585	1477	1939
5	1182	1923	2758	1282	1838	962	1379
6	985	1305	2024	870	1349	653	1012
7	844	918	1520	612	1013	459	760
8	739	665	1164	443	776	333	582
9	657	495	906	330	604	247	453
10	591	377	716	251	478	188	358
11	537	293	574	195	383	146	287
12	493	231	466	154	310	116	233
13	429	186	382	124	255	93	191
14	369	151	317	101	211	76	158
15	322	125	265	83	177	62	133
16	283	104	224	69	149	52	112

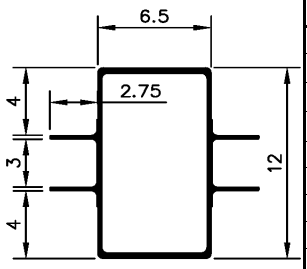
Bending FOS = 2.5 Shear FOS = 3.0

Column Load	
Lth	Axial
(Ft.)	(Lbs.)
1	43875
2	43875
3	43875
4	43875
5	43875
6	36015
7	27712
8	22085
9	18077
10	15113
11	12852
12	11085
13	9675

Col. FOS = 3

12S12 Flanged Tube

W =	12	lb/ft
A =	12.6429	in^2
Ixx =	231.2	in^4
Iyy =	140.9	in^4
E =	4,180,000	psi
G =	425,000	psi
M =	908,000	lb-in
r=	4.53	in
Bf/Bt=	17.33	
K=	1	



Allowable Uniform Load - Unbraced						
Span	L/D = 120		L/D = 180		L/D = 240	
(Ft.)	1	2	1	2	1	2
6	6726	6726	6726	6726	6726	6726
7	4941	4941	4941	4941	4941	4941
8	3783	3783	3783	3783	3783	3783
9	2989	2989	2989	2989	2946	2989
10	2421	2421	2421	2421	2148	2421
11	2001	2001	2001	2001	1614	2001
12	1681	1681	1657	1681	1243	1681
13	1433	1433	1303	1433	978	1433
14	1235	1235	1044	1235	783	1235
15	1076	1076	848	1076	636	1076
16	946	946	699	946	524	946
17	838	838	583	838	437	838
18	736	747	491	747	368	747
19	626	671	417	671	313	671
20	537	605	358	605	268	605

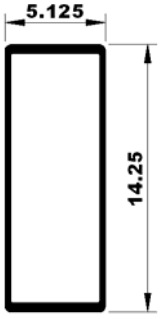
Beam FOS = 2.5

Column Load	
Lth	Axial
(Ft.)	(Lbs.)
6	68712
7	63127
8	58657
9	54977
10	51882
11	49233
12	46932
13	44911
14	43117
15	41511
16	40064
17	38750
18	37551
19	36451
20	35437

Col. FOS = 3

14B10 Rectangular Tube

W =	10	lb/ft
A =	12.96	in^2
Ixx =	354.8	in^4
Iyy =	57.5	in^4
E =	4,340,000	psi
G =	425,000	psi
M =	1,350,000	lb-in
r =	2.09	in
Bf/Bt =	10.25	
K =	1	



Allowable Uniform Load - Unbraced						
Span	L/D= 120		L/D= 180		L/D= 240	
(Ft.)	1	2	1	2	1	2
21	739	816	493	816	369	816
22	643	744	428	744	321	744
23	562	681	375	681	281	677
24	495	625	330	625	248	596
25	438	576	292	576	219	528
26	389	533	260	533	195	469
27	348	494	232	494	174	419
28	312	459	208	459	156	375
29	281	428	187	428	140	338
30	253	400	169	400	127	305
31	230	375	153	369	115	277
32	209	352	139	335	104	252
33	190	331	127	306	95	229
34	174	311	116	280	87	210
35	160	294	106	256	80	192

Beam FOS = 2.5

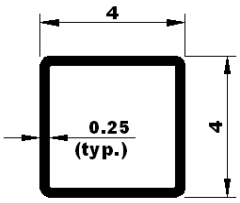
Column Load	
Lth	Axial
(Ft.)	(Lbs.)
6	47790
7	43905
8	40796
9	38237
10	36084
11	34241
12	32641
13	31235
14	29988
15	28871
16	27864
17	26951
18	26117
19	25351
20	24646

Col. FOS = 3

Tuff Span FRP Structurals

4 x 4 x 1/4 Square Tube

W =	3.25	lb/ft
A =	3.74	in^2
Ixx =	8.82	in^4
Iyy =	8.82	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	6,158	psi
r =	1.53	in
Aw =	1.75	in^2
Sxx =	4.41	in^3
Bf/Bt =	16	
K =	1	

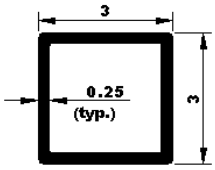


Allowable Uniform Load								Column Load	
Span	Stress	L/D= 120		L/D= 180		L/D= 240		Lth	Axial
(Ft.)	Fb_Fv	1	2	1	2	1	2	(Ft.)	(Lbs.)
6	503	407	503	272	503	204	411	6	19191
7	369	266	369	178	369	133	279	7	19191
8	283	183	283	122	263	91	197	8	19191
9	223	131	223	87	192	65	144	9	16646
10	181	97	181	64	144	48	108	10	14515
11	150	73	150	49	110	37	83	11	12824
12	126	57	126	38	86	28	65	12	11452
13	107	45	103	30	69	22	52	13	10321
14	92	36	84	24	56	18	42	14	9373

Shear FOS = 3 Bending FOS = 2.5 Col. FOS = 3

3 x 3 x 1/4 Square Tube

W =	2.2	lb/ft
A =	2.74	in^2
Ixx =	3.5	in^4
Iyy =	3.5	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	7,863	psi
r =	1.13	in
Aw =	1.25	in^2
Sxx =	2.33	in^3
Bf/Bt =	12	
K =	1	

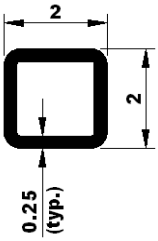


Allowable Uniform Load								Column Load	
Span	Stress	L/D= 120		L/D= 180		L/D= 240		Lth	Axial
(Ft.)	Fb_Fv	1	2	1	2	1	2	(Ft.)	(Lbs.)
1	3750	3750	3750	3750	3750	3750	3750	1	17955
2	1875	1875	1875	1875	1875	1406	1875	2	17955
3	1250	1107	1250	738	1250	553	973	3	17955
4	763	527	763	352	686	264	514	4	17955
5	489	287	489	192	398	144	298	5	17658
6	339	172	339	115	248	86	186	6	13932
7	249	111	246	74	164	55	123	7	11402
8	191	75	170	50	113	38	85	8	9585
9	151	53	122	36	81	27	61	9	8224

Shear FOS = 3 Bending FOS = 2.5 Col. FOS = 3

2 x 2 x 1/4 Square Tube

W =	1.4	lb/ft
A =	1.74	in^2
Ixx =	0.91	in^4
Iyy =	0.91	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	11,099	psi
r =	0.73	in
Aw =	0.75	in^2
Sxx =	0.91	in^3
Bf/Bt =	8	
K =	1	

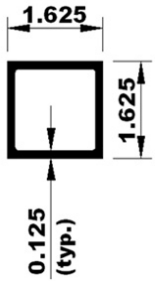


Allowable Uniform Load								Column Load	
Span	Stress	L/D= 120		L/D= 180		L/D= 240		Lth	Axial
(Ft.)	Fb_Fv	1	2	1	2	1	2	(Ft.)	(Lbs.)
1	2250	2250	2250	2250	2250	2205	2250	1	16094
2	1125	977	1125	652	1125	489	863	2	16094
3	748	338	685	225	457	169	342	3	12344
4	421	151	328	101	218	76	164	4	8493
5	269	80	179	53	119	40	89	5	6354
6	187	47	107	31	72	23	54	6	5013
7	137	30	69	20	46	15	35	7	4103
8	105	20	47	13	31	10	24	8	3449
9	83	14	33	9	22	7	17	9	2959

Shear FOS = 3 Bending FOS = 2.5 Col. FOS = 3

1 5/8 x 1 5/8 x 1/8 Square Tube

W =	0.56	lb/ft
A =	0.74	in^2
Ixx =	0.28	in^4
Iyy =	0.28	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	7,346	psi
r =	0.61	in
Aw =	0.34	in^2
Sxx =	0.339	in^3
Bf/Bt =	13	
K =	1	



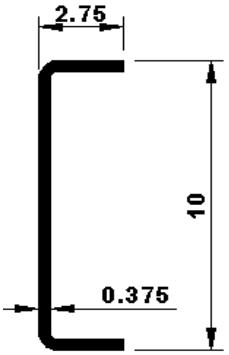
Allowable Uniform Load								Column Load	
Span	Stress	L/D= 120		L/D= 180		L/D= 240		Lth	Axial
(Ft.)	Fb_Fv	1	2	1	2	1	2	(Ft.)	(Lbs.)
1	1020	1020	1020	1020	1020	834	1020	1	4530
2	415	328	415	219	415	164	311	2	4530
3	184	109	184	72	154	54	115	3	4157
4	104	48	104	32	71	24	53	4	2860
5	66	25	57	17	38	12	29	5	2140
6	46	15	34	10	23	7	17	6	1688
7	34	9	22	6	14	5	11	7	1382
8	26	6	15	4	10	3	7	8	1161
9	20	4	10	3	7	2	5	9	997

Shear FOS = 3 Bending FOS = 2.5 Col. FOS = 3

Tuff Span FRP Structurals

C10 x 2 3/4 x 3/8 Channel

W =	4.27	lb/ft
Ixx =	69.09	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	5,805	psi
Aw =	3.47	in^2
Sxx =	13.82	in^3
Bf/Bt =	7.33	

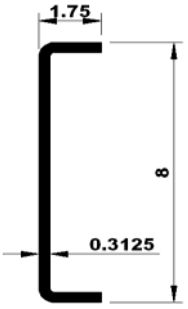


Allowable Uniform Load - Braced							
Span	Stress	L/D= 120		L/D= 180		L/D= 240	
(Ft.)	Fb_Fv	1	2	1	2	1	2
12	371	371	371	266	371	200	371
13	316	316	316	214	316	160	316
14	273	261	273	174	273	131	273
15	238	215	238	143	238	108	229
16	209	179	209	120	209	90	194
17	185	151	185	101	185	75	165
18	165	128	165	85	165	64	141
19	148	110	148	73	148	55	122
20	134	95	134	63	134	47	106

Shear FOS = 3 Bending FOS = 2.5

C8 x 1 3/4 x 5/16 Channel

W =	2.5	lb/ft
Ixx =	25.38	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	7,484	psi
Aw =	2.3	in^2
Sxx =	6.35	in^3
Bf/Bt =	5.61	

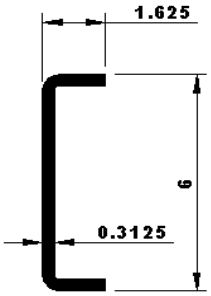


Allowable Uniform Load - Braced							
Span	Stress	L/D= 120		L/D= 180		L/D= 240	
(Ft.)	Fb_Fv	1	2	1	2	1	2
8	495	479	495	319	495	240	468
9	391	349	391	232	391	174	353
10	317	261	317	174	317	130	271
11	262	200	262	133	262	100	212
12	220	156	220	104	220	78	169
13	187	124	187	83	182	62	136
14	162	101	162	67	149	50	112
15	141	82	141	55	123	41	92
16	124	68	124	46	103	34	77

Shear FOS = 3 Bending FOS = 2.5

C6 x 1 5/8 x 5/16 Channel

W =	2.1	lb/ft
Ixx =	11.2	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	8,029	psi
Aw =	1.68	in^2
Sxx =	3.73	in^3
Bf/Bt =	5.21	

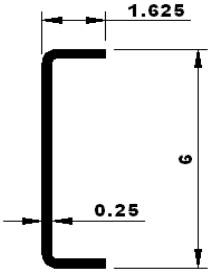


Allowable Uniform Load - Braced							
Span	Stress	L/D= 120		L/D= 180		L/D= 240	
(Ft.)	Fb_Fv	1	2	1	2	1	2
6	555	495	555	330	555	248	478
7	407	327	407	218	407	164	331
8	312	226	312	151	312	113	237
9	246	163	246	108	233	81	174
10	200	120	200	80	176	60	132
11	165	92	165	61	136	46	102
12	139	71	139	47	107	36	80
13	118	56	118	38	85	28	64
14	102	45	102	30	69	23	52

Shear FOS = 3 Bending FOS = 2.5

C6 x 1 5/8 x 1/4 Channel

W =	1.7	lb/ft
Ixx =	10.35	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	6,507	psi
Aw =	1.38	in^2
Sxx =	3.45	in^3
Bf/Bt =	6.5	



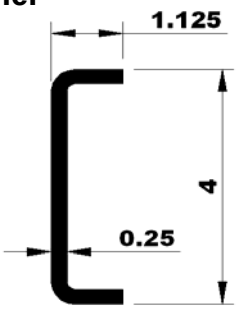
Allowable Uniform Load - Braced							
Span	Stress	L/D= 120		L/D= 180		L/D= 240	
(Ft.)	Fb_Fv	1	2	1	2	1	2
4	935	935	935	812	935	609	935
5	599	599	599	476	599	357	599
6	416	416	416	299	416	224	416
7	305	297	305	198	305	149	296
8	234	206	234	138	234	103	213
9	185	149	185	99	185	74	158
10	150	110	150	74	150	55	120
11	124	84	124	56	123	42	93
12	104	65	104	44	97	33	73

Shear FOS = 3 Bending FOS = 2.5

Tuff Span FRP Structurals

C4 x 1 1/8 x 1/4 Channel

W =	1.13	lb/ft
Ixx =	2.66	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	9,228	psi
Aw =	0.88	in^2
Sxx =	1.32	in^3
Bf/Bt =	4.5	

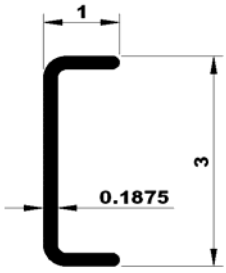


Allowable Uniform Load - Braced							
Span	Stress	L/D= 120		L/D= 180		L/D= 240	
(Ft.)	Fb_Fv	1	2	1	2	1	2
3	880	824	880	549	880	412	713
4	508	396	508	264	508	198	381
5	325	216	325	144	297	108	222
6	226	130	226	87	186	65	139
7	166	84	166	56	123	42	92
8	127	57	127	38	85	29	64
9	100	41	92	27	61	20	46

Shear FOS = 3 Bending FOS = 2.5

C3 x 1 x 3/16 Channel

W =	0.68	lb/ft
Ixx =	0.948	in^4
E =	2,600,000	psi
G =	425,000	psi
Fb =	7,857	psi
Aw =	0.49	in^2
Sxx =	0.632	in^3
Bf/Bt =	5.33	

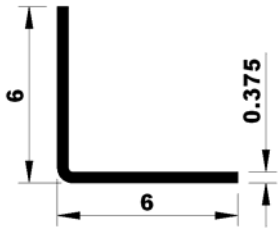


Allowable Uniform Load - Braced							
Span	Stress	L/D= 120		L/D= 180		L/D= 240	
(Ft.)	Fb_Fv	1	2	1	2	1	2
1	1470	1470	1470	1470	1470	1470	1470
2	735	735	735	589	735	442	708
3	368	326	368	217	368	163	307
4	207	151	207	100	206	75	155
5	132	81	132	54	116	40	87
6	92	48	92	32	71	24	53
7	68	31	68	20	46	15	35

Shear FOS = 3 Bending FOS = 2.5

6 x 6 x 3/8 Angle

W =	2.2	lb/ft
A =	2.74	in^2
Imin =	3.5	in^4
E =	2,600,000	psi
r =	1.13	in
Bf/Bt =	12	
K =	1	

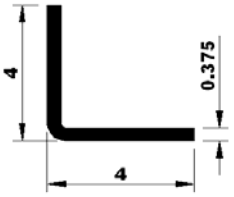


Column Load	
Length (Ft.)	Axial (Lbs.)
3	17955
4	17955
5	17658
6	13932
7	11402
8	9585
9	8224
10	7172

Column FOS = 3

4 x 4 x 3/8 Angle

W =	2.22	lb/ft
A =	2.81	in^2
E =	2,600,000	psi
r =	0.77	in
Bf/Bt =	10.67	
K =	1	

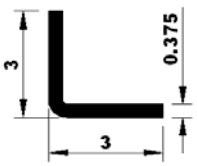


Column Load	
Length (Ft.)	Axial (Lbs.)
3	5248
4	4480
5	3962
6	3584
7	3293
8	3060
9	2868
10	2706

Column FOS = 3

3 x 3 x 3/8 Angle

W =	1.63	lb/ft
A =	2.06	in^2
E =	2,600,000	psi
r =	0.57	in
Bf/Bt =	12	
K =	1	



Column Load	
Length (Ft.)	Axial (Lbs.)
3	3261
4	2783
5	2462
6	2227
7	2046
8	1901
9	1782
10	1682

Column FOS = 3

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