

# SUPERPILE® - PIPE PILE

## Engineering Specifications



### MECHANICAL PROPERTIES

SUPERPILE® Mechanical Properties	Round FRP Pipe Pile TU440 Polyester 10"x3/8" Metric (254mm x 9.52m)		Round FRP Pipe Pile TU455 Polyurethane 12"x3/8" Metric (305mm x 9.52mm)		Round FRP Pipe Pile TU450 Polyurethane 12"x1/2" Metric (305mm x 12.7mm)		Round FRP Pipe Pile TU460 Polyurethane 16"x1/2" Metric (406mm x 12.7mm)	
Average Flexural Strength per ASTM D6109 psi (Mpa)	65,722 <sup>3</sup>	(453) <sup>3</sup>	52,000	(359)	69,658	(480)	57,270	(395)
Characteristic Flexural Strength per ASTM D6109 psi (Mpa)	*****	*****	*****	*****	56,111	(387)	49,840	(344)
Average Compression Strength per ASTM D6109 psi (Mpa)	65,722 <sup>3</sup>	(453) <sup>3</sup>	52,000	(359)	69,658	(480)	57,270	(395)
Characteristic Compression Strength per ASTM D6109 psi (Mpa)	*****	*****	*****	*****	56,111	(387)	49,840	(344)
Average In-Plane Shear Strength psi (Mpa)	10,792	(74)	15,605	(108)	16,039	(111)	17,170	(118)
Characteristic In-Plane Shear Strength psi (Mpa)	9,456	(65)	13,212	(91)	13,713	(95)	14,936	(103)
Average Shear Capacity lbs (Kg)	61,185	(27,753)	106,894	(48,486)	145,153	(65,840)	208,616	(94,626)
Characteristic Shear Capacity lbs (Kg)	53,611	(24,317)	90,502	(41,051)	124,103	(56,292)	181,472	(82,314)
Average Torque Strength lb-ft (kN•m)	49,076	(67)	103,519	(140)	138,829	(188)	269,987	(366)
Characteristic Torque Strength lb-ft (kN•m)	43,001	(58)	87,644	(119)	118,696	(161)	234,859	(318)
Average Axial Compression Strength psi (Mpa)	65,722	(453)	52,000	(359)	69,658	(480)	57,270	(395)
Characteristic Axial Compression Strength psi (Mpa)	*****	*****	*****	*****	56,111	(387)	49,840	(344)
Average Axial Compression Capacity (Short Column) lb (kg)	745,222	(338,027)	712,400	(323,139)	1,260,810	(571,894)	1,391,661	(631,247)
Characteristic Axial Compression Capacity (Short Column) lb (kg)	*****	*****	*****	*****	1,015,609	(460,673)	1,211,112	(549,351)
Average Modulus of Elasticity per ASTM D6109 psi (Gpa)	6.31E+06 <sup>4</sup>	(43.5) <sup>4</sup>	5.26E+06	(36.3)	5.91E+06	(40.7)	5.99E+06	(41.3)
Bending Stiffness (EI) per ASTM D6109 lbs•in <sup>2</sup> (kg•mm <sup>2</sup> )	8.30E+08 <sup>4</sup>	(2.43E+11) <sup>4</sup>	1.22E+09	(3.57E+11)	1.77E+09	(5.17E+11)	4.38E+09	(1.28E+12)
Average Moment Capacity per ASTM D6109 kip-ft (kN•m)	144 <sup>3</sup>	(195) <sup>3</sup>	167	(227)	289	(392)	437	(592)
Characteristic Moment Capacity per ASTM D6109 kip-ft (kN•m)	*****	*****	*****	*****	233	(316)	380	(515)
Average Energy Absorption kip-in (kN•m)	*****	*****	341	(39)	643	(73)	829	(94)
Characteristic Energy Absorption kip-in (kN•m)	*****	*****	*****	*****	405	(46)	603	(68)
Average Pin Bearing Strength Crosswise psi (Mpa)	19,155	(132)	19,823	(137)	21,676	(149)	23,666	(163)
Characteristic Pin Bearing Strength Crosswise psi (Mpa)	16,577	(114)	12,447	(86)	12,546	(87)	20,771	(143)
Average Pin Bearing Strength Lengthwise psi (Mpa)	31,824	(219)	30,793	(212)	30,149	(208)	27,788	(192)
Characteristic Pin Bearing Strength Lengthwise psi (Mpa)	27,755	(191)	18,053	(125)	25,132	(173)	19,217	(133)
Average Pile Crush Strength lb (kg) (based on a 9" wide load path) <sup>1</sup>	*****	*****	10,600	(4,808)	17,970	(8,151)	16,600	(7,530)
Characteristic Pile Crush Strength lb (kg) (based on a 9" wide load path) <sup>1</sup>	*****	*****	8,060	(3,656)	13,782	(6,251)	11,667	(5,292)

## MECHANICAL AND PHYSICAL PROPERTIES

SUPERPILE® Mechanical Properties	Round FRP Pipe Pile TU440 Polyester 10"x3/8" Metric (254mm x 9.52mm)		Round FRP Pipe Pile TU455 Polyurethane 12"x3/8" Metric (305mm x 9.52mm)		Round FRP Pipe Pile TU450 Polyurethane 12"x1/2" Metric (305mm x 12.7mm)		Round FRP Pipe Pile TU460 Polyurethane 16"x1/2" Metric (406mm x 12.7mm)	
	Average Crush Strength, with FRP Insert, lb (kg) (based on a 9" wide load path) <sup>1</sup>	****	****	****	****	73,780	(33,466)	44,213
Characteristic Crush Strength, with FRP Insert, lb (kg) (based on a 9" wide load path) <sup>1,2</sup>	****	****	****	****	51,370	(23,301)	****	****
Average Washer Pull Through Strength lb (kg) using a 6"x1/2" square/radius washer	****	****	26,084	(11,832)	30,686	(13,919)	27,582	(12,511)
Characteristic Washer Pull Through Strength lb (kg) using a 6"x1/2" square/radius washer	****	****	22,107	(10,028)	26,815	(12,163)	25,103	(11,387)
Average Washer Pull Through Strength lb (kg) using a 6"x3/8" square/radius washer	17,377	(7,882)	18,893	(8,570)	25,205	(11,433)	18,878	(8,563)
Characteristic Washer Pull Through Strength lb (kg) using a 6"x3/8" square/radius washer	14,812	(6,719)	13,977	(6,340)	22,420	(10,170)	13,521	(6,133)
Allowable torque permitted on a bolted connection with a 6" radius washer lb-ft (N•m)	50	(68)	50	(68)	50	(68)	50	(68)

### Notes:

1. The crush strength value is based on full section testing. The strength value was recorded at the first audible sound and change in the load deflection curve. The ultimate capacity is approximately 60% higher and is defined as the highest recorded load documented during the crush strength test.
2. Characteristic data is unavailable due to the number of tests required. A minimum of 10 tests are required to generate the ASTM D7290 Characteristic values.
3. Full section strength for the TU440 obtained from testing in accordance with ASTM D1036.
4. Modulus of elasticity value obtained from ASTM D638 protocol.
5. Capacity based on testing conducted with 3/4" hardware for the TU440 and 1" hardware for all others.

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	Diameter in (cm)	10	(25.4)	12	(30.48)	12	(30.48)	16
Wall thickness in (mm)	0.375	(9.5)	0.375	(9.5)	0.5	(12.7)	0.5	(12.7)
Moment of Inertia in <sup>4</sup> (cm <sup>4</sup> )	131.51	(5,474)	232	(9,657)	299	(12,445)	732	(30,468)
Section Modulus in <sup>3</sup> (cm <sup>3</sup> )	26.3	(431)	38.6	(633)	49.8	(816)	91.5	(1,499)
Radius of Gyration in (mm)	3.41	(87)	4.11	(104)	4.07	(103)	5.48	(139)
Weight lb/ft (Kg/m)	10.3	(15.3)	12.6	(18.7)	16.9	(25.1)	22.6	(33.6)
Coefficient of Thermal Expansion (CTE) Lengthwise in/in/°F (mm/mm/°C)	5.00E-06	(9.00E-06)	5.00E-06	(9.00E-06)	5.00E-06	(9.00E-06)	5.00E-06	(9.00E-06)
Water Absorption ASTM D570	1.0% (24hrs)	1.0% (24hrs)	0.15% (24hrs)	0.15% (24hrs)	0.15% (24hrs)	0.15% (24hrs)	0.15% (24hrs)	0.15% (24hrs)
Fiber Volume Fraction %	≥50%	≥50%	≥50%	≥50%	≥50%	≥50%	≥50%	≥50%
Cross Sectional Area in <sup>2</sup> (cm <sup>2</sup> )	11.3	(72.9)	13.7	(88.4)	18.1	(116.8)	24.3	(156.8)
Surface Area ft <sup>2</sup> /ft (m <sup>2</sup> /m)	2.62	(0.80)	3.14	(0.96)	3.14	(0.96)	4.19	(1.28)