

FIBERSTRONG®

PRODUCT INFORMATION



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OVERVIEW

Future Pipe Industries, member of Future Pipe Group, is a leading manufacturer of high performance, anti-corrosive pipe systems for Oil & Gas, Petrochemical, Power Generation, Desalination and Civil Industries, in addition to the municipal applications. The group was founded in 1973, and since then, has evolved into the leading provider of composite thermosetting pipe systems and technologies in Europe, Africa and the Middle East.

ACCREDITATIONS

Future Pipe Group is accredited for the Quality Management System (BS EN ISO 9001:2000) and Environmental Management System (BS EN ISO 14001:1996). In addition, certificates of the suitability to transmit potable water from the Water Regulation Advisory Scheme (WRAS) Great Britain and the National Sanitation Foundation (NSF) USA.



Only products bearing
the NSF Mark are
Certified



1. DESCRIPTION

A. GENERAL

FIBERSTRONG® non-restrained pipe and joint are Fiberglass Reinforced Plastic (FRP) flexible corrosion resistant pipe system intended for underground use*. It consists of a Thermosetting Chemical resistant polyester resin, Fiberglass Reinforcements and fine Silica sand aggregates to BS EN 1796 / BS EN 14364 / AWWA C-950.

Large diameter pipes are available in nominal diameters ranging from 80 to 4000 mm.

Available standard pressure classes are PN1, 3, 6, 10, 12, 16, 20 and 25 and stiffness classes of 2,500, 5,000 and 10,000 N/m².

* With special engineering procedures the pipes can also be used for above ground installation.


B. CONSTRUCTION

The pipe consists of a resin-rich reinforced liner, structural wall and a resin-rich exterior layer. "C" glass is used at the internal and external pipe surfaces.

C. APPLICABLE CODES/STANDARDS

Standards	Main Applications
ASTM D-3262	Standard Specification for "Fiberglass" (Fiber Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D-3517	Standard Specification for "Fiberglass" (Fiber Reinforced Thermosetting-Resin) Pressure Pipe
ASTM D-3754	Standard Specification for "Fiberglass" (Fiber Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe
AWWA C-950	Fiberglass Pressure Pipe
AWWA M-45	Fiberglass Pipe Design Manual
BS EN 1796	Plastics Piping Systems for Water Supply With or Without Pressure – Fiber-Reinforced Thermosetting Plastics (FRP) Based on Unsaturated Polyester Resin (UP).
BS EN 14364	Plastics Piping Systems for Drainage and Sewerage With or Without Pressure – Fiber-Reinforced Thermosetting Plastics (FRP) Based on Unsaturated Polyester Resin (UP) – Specifications for Pipes, Fittings and Joints.

2. FEATURES AND BENEFITS

Features	Benefits
<p>Manufactured with corrosion resistant composite material.</p> 	<ul style="list-style-type: none"> • Long, effective service life. • No need for expensive cathodic protection. • No need for costly pipe coating, wrapping, lining, painting, or use of polyethylene wraps. • Low maintenance costs. • Hydraulic characteristics essentially remain unchanged over time.
<p>Double bell coupling joints manufactured with corrosion resistant glass fiber and sealed with elastomeric gaskets.</p>	<ul style="list-style-type: none"> • Ease of jointing helps reduce installation time. Tight, efficient joints designed to eliminate infiltration and ex-filtration. • Costly joint diapers are not required. • Allows for flexible alignment, accommodating changes in line direction with fewer fittings.
<p>Light weight. 1/4 the weight of ductile iron and 1/10 of concrete pipe.</p>	<ul style="list-style-type: none"> - Easy to install. - Low delivery costs. No need for expensive handling equipment.
<p>Manufactured in long sections up to 12m.</p>	<ul style="list-style-type: none"> - Fewer joints reduce installation time.
<p>Extremely smooth bore.</p>	<ul style="list-style-type: none"> - Low friction loss means less pumping energy needed. - Minimum slime build up can help lower cleaning costs.
<p>Pipe specifications meet or exceed worldwide standards.</p>	<ul style="list-style-type: none"> - Assures high quality product specifications. Easy for engineers to specify FIBERSTRONG® pipe with confidence.
<p>High technology pipe manufacturing system.</p>	<ul style="list-style-type: none"> - Helps ensure consistent product quality worldwide.

3. USE AND APPLICATION

FIBERSTRONG® FRP pipe is Suitable for underground use in potable water, raw water, seawater and corrosive environments including sanitary sewage, and many industrial effluents with a temperature range of -40 ° C to +50 °C. All industrial pipe applications must be approved by Future Pipe Industries.



4. PRESSURE AND LOADING RESTRICTIONS

A. PRESSURE RESTRICTIONS

Pipe manufactured per this specification will have the following pressure capabilities regardless of pipe stiffness.

Pressure Class (KPa)	PN1	PN3	PN6	PN10	PN12	PN16	PN20	PN25
Maximum operating pressure (KPa)	100	300	600	1,000	1,200	1,600	2,000	2,500
Maximum surge pressure (KPa)	140	420	840	1,400	1,680	2,240	2,800	3,500
Maximum field test pressure (KPa)	150	450	900	1,500	1,800	2,400	3,000	3,750
Maximum factory test pressure (KPa)	200	600	1,200	2,000	2,400	3,200	4,000	5,000



B. STIFFNESS CLASSES AND ALLOWABLE VACUUM

FRP pipes shall have the following characteristics regardless of pressure class.

Stiffness Class	SN 2500	SN 5000	SN 10000
Minimum Specific Tangential Initial Stiffness STIS = EI/D^3 (N/m ²)	2,500	5,000	10,000
Maximum allowable vacuum level in KPa at cover with hard soil & water table at grade and pipe installed in:			
Installation Type*			
(I) Full compacted gravel @maximum cover depth	-100	-100	-100
(II) Full Sand compacted to 90%standard proctor density (@depth shown in m)	-60 (4m)	-100 (6m)	-100 (13m)

*Maximum vacuum level varies with the type of installation and burial depth. Refer to the current Future Pipe Industries **FIBERSTRONG®** Installation Guide for Underground Pipe System for the allowable vacuum levels for other installation types.

5. JOINTS

A. DOUBLE BELL REKA COUPLINGS

FIBERSTRONG® pipes and fittings are jointed using Double Bell Reka Couplings. The sealing of the joints is achieved by the compression of two rubber gaskets when the joint is assembled.



B. ALTERNATIVE JOINTING SYSTEMS

- a) In certain applications Pipe sections may be laminated* together utilizing an external (and internal) lay-up “butt-strap” consisting of layers of fiberglass mats and/or tapes impregnated with polyester resin. The strength of the lay-up exceeds the pipe wall strength.
- b) Mechanical couplings manufactured by Straub, Teekay, Dresser, VJ or equivalent may be used for jointing to different pipe materials. Refer to section SPIGOT OUTSIDE DIAMETER for **FIBERSTRONG®** pipe O.D.'s.
- c) FRP flanges drilled to any standard dimensions requested by client, such as ANSI, DIN, ISO, etc...



*Laminated pipes may have different design if lamination is intended to avoid thrust blocks.

6. PRODUCT QUALIFICATIONS

FIBERSTRONG® Pipes have been tested and qualified for the following tests:

ASTM D 3681:	Chemical resistance of “Fiberglass” (Fiber Reinforced Thermosetting - Resin) pipe in deflected condition (Strain corrosion performance).
BS 5480: 1990 (Appendix L):	British standard specification for fiberglass reinforced plastics (FRP) pipes, joints and fittings for use for water supply or sewerage - method for determination of long term specific ring stiffness and creep factor under ring deflection.
ASTM D 4161:	Standard specification for “Fiberglass” (Fiber Reinforced Thermosetting - Resin) pipe joint using flexible elastomeric seals.
ASTM D 1599	Short time Hydraulic failure pressure of pipes, fittings and prefabricated spools
BS 5480:1990 (Appendix J):	British standard specification for Fiberglass reinforced plastics (FRP) pipes, joints and fittings for use for water supply or sewerage - method for determination of Impact Resistance
ASTM D 2992:	Standard practice for obtaining hydrostatic or pressure design basis for “Fiberglass” (Fiber Reinforced Thermosetting - Resin) pipe and fittings. (Hydrostatic Design Basic (HDB)).
ASTM D 5365:	Standard Test Method for Long-Term Ring-Bending Strain of “Fiberglass” Pipe

7. QUALITY CONTROL

Quality Control testing will include thorough checks for all incoming raw materials and finished products against Future Pipe Industries strict written standards. The following physical and dimensional checks will be made:

Type of Test	Each Pipe	Once per LOT*	Standard Reference
Visual Inspection	x		FPI
Wall Thickness	x		FPI
Spigot end Outside diameter	x		FPI
Length	x		FPI
Hydrostatic Pressure**	x		FPI
Barcol Hardness	x		ASTM D 2583
Stiffness		x	ASTM D 2412
Constituents by Wt % (LOI)		x	ASTM D 2584
Axial Tensile Strength		x	ASTM D 638/ BS 5480
Circumferential Tensile Strength		x	ASTM D2290/D638/ BS5480
Impact Resistance		x	BS 5480 Ap. J
Deflection to crack		x	ASTM D 2412

Records of all testing on pipe sections will be maintained by Future Pipe Industries and provided upon request.

* 1 in 100 pipes or as required by the project specifications

** As per AWWA C950 section 5.1.2.1

8. PHYSICAL / MECHANICAL PROPERTIES

A. SPIGOT OUTSIDE DIAMETER

Nominal Diameter		Spigot Outer Diameter		Nominal Diameter		Spigot Outer Diameter	
ND		DOS (min)		ND		DOS (min)	
mm	inch	mm	inch	mm	inch	mm	inch
80	3	90.5	3.56	1,800	72	1,840.5	72.46
100	4	110.5	4.35	1,900	76	1,942.5	76.48
150	6	160.5	6.32	2,000	80	2,044.5	80.49
200	8	210.5	8.29	2,100	84	2,146.5	84.51
250	10	262.0	10.31	2,200	88	2,248.5	88.52
300	12	314.0	12.36	2,300	92	2,350.5	92.54
350	14	366.0	14.41	2,400	96	2,452.5	96.56
400	16	412.5	16.24	2,500	100	2,554.5	100.57
450	18	463.5	18.25	2,600	104	2,656.5	104.59
500	20	514.5	20.26	2,700	108	2,758.5	108.60
600	24	616.5	24.27	2,800	112	2,860.5	112.62
700	28	718.5	28.29	2,900	116	2,962.5	116.63
750	30	769.5	30.30	3,000	120	3,064.5	120.65
800	32	820.5	32.30	3,100	124	3,166.5	124.67
900	36	922.5	36.32	3,200	128	3,268.5	128.68
1,000	40	1,024.5	40.33	3,300	132	3,370.5	132.70
1,100	44	1,126.5	44.35	3,400	136	3,472.5	136.71
1,200	48	1,228.5	48.37	3,500	140	3,574.5	140.73
1,300	52	1,330.5	52.38	3,600	144	3,676.5	144.74
1,400	56	1,432.5	56.40	3,700	148	3,778.5	148.76
1,500	60	1,534.5	60.41	3,800	152	3,880.5	152.78
1,600	64	1,636.5	64.43	3,900	156	3,982.5	156.79
1,700	68	1,738.5	68.44	4,000	160	4,084.5	160.81

B. DIMENSIONS

Dimensions	Specifications	Tolerances
Standard Pipe Length (L)	Standard Lengths 12m. Random Length or factory jointed lengths supplied shall not exceed 10% of the order.	±25mm
End Squareness/ End Planeness	Ends shall be square to both axis of the pipe plane.	Not to exceed 2+0.005D (mm) where D is the nominal diameter of the pipe or 10mm, whichever is smaller.
Straightness	Pipes shall be straight.	Not to exceed 0.3% of the effective length of the pipe or 15mm, whichever is smaller.
Thickness	As per FPI design values.	Single point 87.5% of minimum average.
Roundness Deviation *	Pipes shall be round.	±1%

C. SPECIFIC TANGENTIAL INITIAL STIFFNESS (STIS)

Stiffness Class	Minimum STIS*	Minimum Pipe Stiffness (PS**)
	(EI/D ³) Pa	F/ AY=EI/(0.149 r ³) KPa
SN 2500	2500	124
SN 5000	5000	248
SN 10000	10000	496

* Specific Tangential Initial Stiffness determined as per ASTM D-2412 or BS 5480

** As per ASTM D-2412

D. MECHANICAL PROPERTIES

All Pipes will exhibit the following properties

Linear Coefficient of thermal expansion (mm/mm/°C) 25 to 30 x 10⁻⁶

Poisson's Ratio 0.25 to 0.3

E. Approximate Pipe and Joint Weights for Handling Purposes Only-(Based on PN6)

Nominal Diameter		Weight							
		W							
ND		SN2500		SN5000		SN1000		Coupling	
mm	inch	Kg/m	lb/ft	Kg/m	lb/ft	Kg/m	lb/ft	Kg	lb
80	3	2.70	2.02	2.70	2.02	2.70	0.02	5.00	11.02
100	4	3.40	2.02	3.40	2.02	3.40	2.02	6.00	13.23
150	6	4.90	3.36	4.90	3.36	4.90	3.36	7.00	15.43
200	8	6.50	4.70	6.50	4.70	6.50	4.70	8.00	17.64
250	10	9.20	6.05	9.20	6.05	9.20	6.05	9.00	19.84
300	12	7.29	4.70	9.16	6.05	11.63	8.06	33.88	74.96
350	14	9.91	6.72	12.56	8.74	15.92	10.75	39.17	85.98
400	16	12.65	8.74	16.13	10.75	20.21	13.44	43.89	97.00
450	18	16.10	10.75	20.44	13.44	25.54	17.47	49.08	108.03
500	20	20.07	13.44	25.12	16.80	30.90	20.83	54.25	119.05
600	24	28.92	19.49	35.94	24.19	44.24	29.57	76.89	169.76
700	28	38.94	26.21	48.01	32.25	59.97	40.32	89.88	198.42
750	30	44.32	29.57	55.05	36.96	68.52	46.37	96.79	213.85
800	32	50.62	34.27	62.59	42.33	76.73	51.74	103.79	229.28
900	36	63.38	42.33	78.20	52.41	96.61	65.18	118.06	260.15
1,000	40	77.82	52.41	95.80	64.51	118.77	79.96	132.70	293.21
1,100	44	92.92	62.49	116.47	77.95	143.44	96.09	148.08	326.28
1,200	48	110.79	74.59	136.29	91.39	170.73	114.91	163.51	361.56
1,300	52	129.01	86.68	159.47	106.84	197.67	133.05	179.30	394.63
1,400	56	148.26	99.45	186.48	124.99	229.12	153.88	196.05	432.11
1,500	60	169.20	113.56	211.30	141.79	262.95	176.73	212.66	469.58

Nominal Diameter		Weight							
		W							
ND		SN2500		SN5000		SN1000		Coupling	
mm	inch	Kg/m	lb/ft	Kg/m	lb/ft	Kg/m	lb/ft	Kg	lb
1,600	64	194.48	130.36	241.08	161.94	298.67	200.92	229.63	507.06
1,700	68	216.71	145.82	270.82	182.10	335.55	225.78	248.31	546.75
1,800	72	244.43	163.96	303.14	203.61	378.75	254.68	266.17	586.43
1,900	76	271.04	182.10	337.28	226.45	418.77	281.56	284.45	626.11
2,000	80	295.92	198.90	375.61	252.66	467.27	313.81	303.10	668.00
2,100	84	328.55	221.08	412.98	277.52	514.65	346.06	322.14	709.89
2,200	88	361.30	242.58	450.59	303.06	562.52	378.32	341.56	753.98
2,300	92	395.70	266.10	493.59	331.95	614.31	412.59	365.74	806.89
2,400	96	428.31	287.60	533.46	358.16	669.45	449.55	397.23	875.24
2,500	100	465.05	312.47	578.35	388.40	719.92	483.82	429.89	947.99
2,600	104	504.16	338.67	624.00	419.31	779.45	523.46	631.53	1,393.32
2,700	108	543.22	364.88	672.43	451.56	841.45	565.13	660.58	1,457.26
2,800	112	581.85	391.09	727.49	488.52	904.40	607.46	693.23	1,527.80
2,900	116	624.70	419.98	781.15	524.81	966.37	649.12	723.23	1,593.94
3,000	120	664.75	446.86	836.80	562.44	1,042.25	700.19	753.64	1,662.29
3,100	124	714.02	479.79	881.17	592.00	1,105.04	742.53	784.45	1,728.42
3,200	128	756.62	508.68	940.06	631.65	1,176.95	790.91	815.65	1,798.97
3,300	132	801.47	538.25	1,000.95	672.64	1,249.00	839.29	847.22	1,867.32
3,400	136	858.78	577.22	1,063.83	714.97	1,334.21	896.41	879.18	1,937.86
3,500	140	902.11	606.12	1,126.83	757.31	1,413.31	949.49	911.52	2,010.62
3,600	144	958.69	644.42	1,197.61	805.02	1,497.13	1,005.94	944.25	2,081.16
3,700	148	1,008.86	678.02	1,264.56	850.04	1,580.92	1,062.38	977.36	2,153.92
3,800	152	1,072.38	720.35	1,319.81	887.00	1,655.96	1,112.78	1,010.85	2,228.87
3,900	156	1,114.17	748.57	1,394.51	937.40	1,746.66	1,173.93	1,044.73	2,303.83
4,000	160	1,167.45	784.19	1,463.90	983.76	1,836.84	1,234.41	1,086.28	2,394.22

9. FITTINGS

Future Pipe Industries has established a standardized line of FRP fittings. The most common fittings are (Elbows, Reducers, Tees, Wyes and Flanges) and can be supplied either as standard pieces or custom designed spools making it easier for the erection contractor to install.

Fittings are jointed to FRP pipes with standard double bell couplings and require thrust blocks for pressure systems. Please refer to “**FIBERSTRONG®** Installation Guide for Underground Pipe System” for further details on proper construction of thrust blocks.

The method of fabrication of all FRP fittings is essentially the same. Pipes, after plant hydro-testing, are cut to the required dimensions. Pipe sections are then jointed together by lamination. The thickness and width of the lamination is designed to exceed the pipe performance.

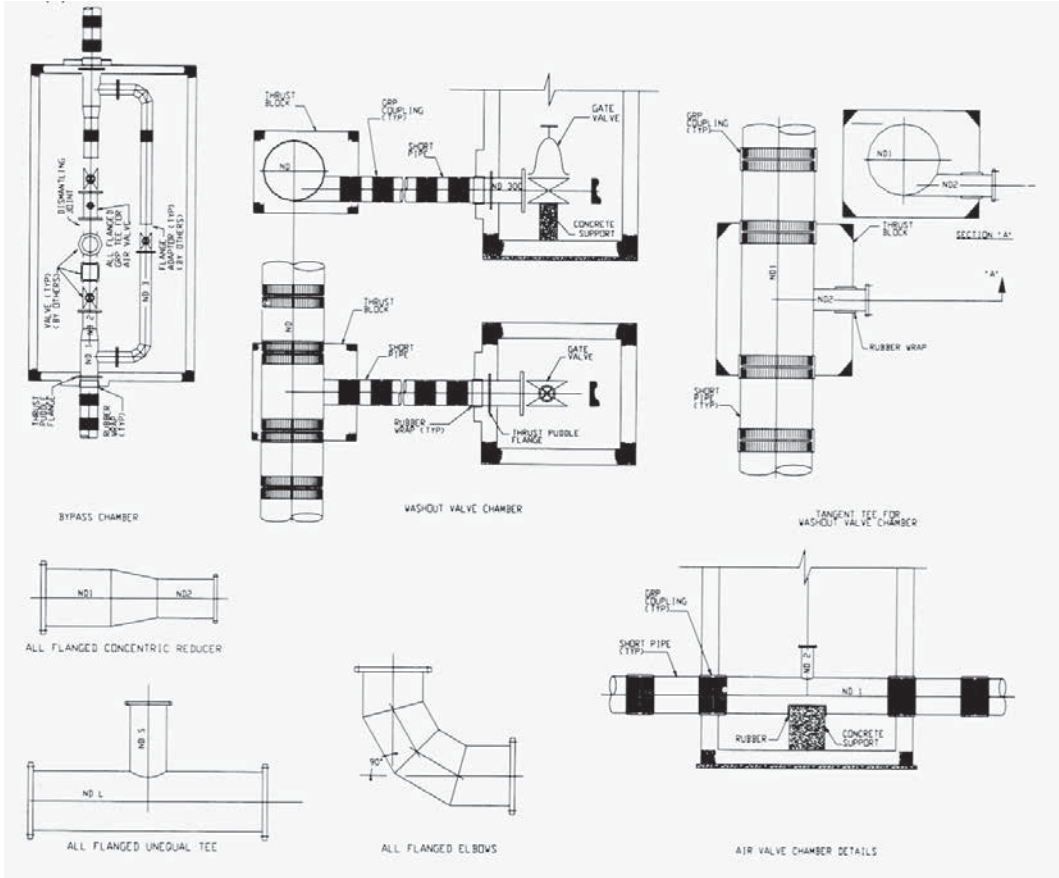
FLANGES

Flanges and blinds could be provided for the complete range of diameters with drilling pattern to match any international standard required such as DIN, ISO, ANSI, AWWA, JIS etc... or to client requirements.



CUSTOM DESIGNED FITTINGS

Future Pipe Industries can provide custom designed fittings for Air Valve Chambers, Wash-Out Chambers, By-Pass Chambers, in addition to all flanged fittings for specific applications.



10. VISUAL PROPERTIES

A. EXTERIOR VISUAL PROPERTIES

The exterior surface of **FIBERSTRONG®** pipe, joints and fittings shall be commercially free of the following visual irregularities:

Fuzz	Glass fibers loosely adhering to the pipe that are not wet out with resin.
Protruding fibers	Glass fibers sticking out from face that are wet out with resin.
Resin runs	Runs of resin and sand on surface of pipe.
Dry area	Area in laminate with glass not wet out with resin.
Hand lay-up ragged edges	Ragged edges, areas at the edge of hand lay-up that are not rolled down properly or that are rough.

B. VISUAL DEFECTS LIMITS

The following visual limits apply:

Visual defect	Definition	Allowable Limits	
		External Surface	Internal Surface
Delamination	Separation in the laminate.	None	None
Blisters	Light straw colored areas resulting from too hot a cure.	None to exceed 13mm in Dia.	None to exceed 4mm in Dia.
Crazes	Cracks on inner surface usually star shaped; caused by sharp impact.	N/A	None
Surface pits and voids	Small air pockets on the surface or directly beneath are solid. Surface mat can be broken by finger nail.	N/A	None greater than 2mm deep and 20mm Dia. Or greater than 4mm deep of any Dia.
Wrinkles, grooves and band depressions	Smooth Irregularities on liner surface.	N/A	None greater than 3mm deep
Haystacks	Accumulations of glass, resin and sand on exterior surface.	None greater than 30mm Dia.	N/A
Torn edges, end delamination and end gouges	Tears and rips in the edges of cuts.	N/A	None that will effect the integrity of the joints.
Ground area	Area around lay-up which has been abraded but lay-up does not cover or has not been coated.	Permitted	None

11. REPAIR WORK

Repairs to the internal and external layers shall not exceed 5% of the total surface area. No Structural repair work is allowed.

The number of repairs will not exceed an average of one (1) per one (1) meter length of pipe in each surface.

Pipe sections may contain factory lay-up joints which shall not be considered as repairs.

12. MARKING AND IDENTIFICATION

Each pipe section and coupling shall be marked with the following information:

- 1) Company name
- 2) Manufacturing standard
- 3) Pipe diameter
- 4) Pressure class
- 5) Stiffness class
- 6) Pipe serial number
- 7) Manufacturing date

Specific marking requirement by customers could be arranged; Future Pipe Industries marks the product accordingly while maintaining traceability.

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