

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.



Table of Contents

FIBERGLASS REINFORCED PLASTIC PIPE	
PRODUCT INFORMATION	
1	DESCRIPTION 2
	A. General 2
	B. Construction 2
	C. Applicable Codes/Standards 2
2	FEATURES AND BENEFITS 3
3	USE AND APPLICATION 3
4	PRESSURE AND LOADING RESTRICTIONS 4
	A. Pressure Restrictions 4
	B. Stiffness Classes and Allowable Vacuum 4
5	JOINTS 5
	A. Double Bell Reka Couplings 5
	B. Alternative Jointing Systems 5
6	PRODUCT QUALIFICATION 5
7	QUALITY CONTROL 6
8	PHYSICAL / MECHANICAL PROPERTIES 7
	A. Spigot Outside Diameter 7
	B. Dimensions 7
	C. Specific Tangential Initial Stiffness (STIS) 8
	D. Mechanical Properties 8
	E. Approximate Pipe and Joint Weights for Handling Purposes Only-(Based on PN6) 8
9	FITTINGS 9
	A. Elbows 9
	B. Reducers 10
	C. Tees 12
	D. Gravity Wyes 18
	E. Flanges 21
	F. Custom Designed Fittings 21
10	VISUAL PROPERTIES 22
	A. EXTERIOR VISUAL PROPERTIES 22
	B. VISUAL DEFECTS LIMITS 22
11	REPAIR WORK 23
12	MARKING AND IDENTIFICATION 23

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.
AS 3571	Glass Filament Reinforced Thermosetting Plastics (GRP) pipes - Polyester based - Water Supply, Sewerage and Drainage applications.

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 / ASTM D 2563
Wall Thickness	X		FPI / AS 3571.1 / AS 3571.2
Spigot End Outside Diameter	X		FPI / AS 3571.1 / AS 3571.2
Length	X		FPI / AS 3571.1 / AS 3571.2
Squareness of Ends	X		AS 3572.4
Hydrostatic Pressure	X		FPI
Barcol Hardness	X		FPI / ASTM D 2583
Initial Specific Ring Stiffness		X	ISO 7685 / AS 3571.1 / AS 3571.2
Initial Resistance to Failure in a Deflected Condition		X	ISO 10466 / AS 3571.1 / AS 3571.2
Initial Specific Longitudinal Tensile Strength		X	ISO 8513 / AS 3571.1 / AS 3571.2
Initial Failure & Design Pressure		X	ISO 8521 / AS 3571.1 / AS 3571.2
Constituents by Weight % (LOI)		X	FPI / ASTM D 2584
Joint Performance**			ISO 8639 / AS 3571.1 / AS 3571.2
Product Marking		X	AS 3571.1 / AS 3571.2

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

** Qualification Type test

8. PHYSICAL / MECHANICAL PROPERTIES

A. SPIGOT OUTSIDE DIAMETER

Nominal Diameter: DN (mm)	DOS** MIN (mm)
300	345.00
375	426.00
450	507.00
525	587.00
600	667.00
675	747.00
750	826.00
800	820.50
900	922.50
1,000	1,024.50
1,100	1,126.50
1,200	1,228.50

* Check with your local Future Pipe Industries sales office for the applicable spigot OD values.

** For High pressure pipes i.e. PN20 and PN25, an additional 0.5 mm to be added to the tabulated values of DOSMIN, DOSNOM and DOSMAX.

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)

DN	SN	Weight	DN	SN	Weight	DN	SN	Weight
mm	Pa	Kg/m	mm	Pa	Kg/m	mm	Pa	Kg/m
300	2,500	10	300	5,000	12	300	10,000	15
375	2,500	15	375	5,000	18	375	10,000	22
450	2,500	21	450	5,000	26	450	10,000	31
525	2,500	27	525	5,000	34	525	10,000	41
600	2,500	35	600	5,000	43	600	10,000	52
675	2,500	43	675	5,000	53	675	10,000	65
750	2,500	53	750	5,000	65	750	10,000	79
800	2,500	52	800	5,000	64	800	10,000	78
900	2,500	65	900	5,000	79	900	10,000	99
1,000	2,500	79	1,000	5,000	98	1,000	10,000	121
1,100	2,500	94	1,100	5,000	117	1,100	10,000	145
1,200	2,500	113	1,200	5,000	139	1,200	10,000	171

9. FITTINGS

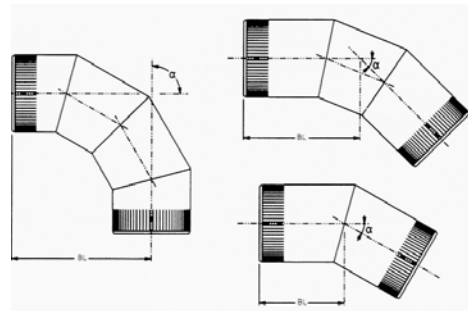
Future Pipe Industries has established a standardized line of FRP fittings. The most common fittings are (Elbows, Reducers, Tees, Wyes and Flanges) and can be supplied either as standard pieces or custom designed spools making it easier for the erection contractor to install.

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.



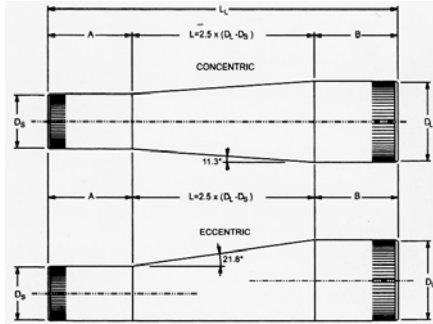
A. ELBOWS



Mitered Elbows. Effective Laying Length (mm) = BL
The below dimensions are valid for all pressure classes

Angle α	1° to 15°	16° to 30°	31° to 45°	46° to 60°	61° to 90°
DN	# of Mitres	# of Mitres	# of Mitres	# of Mitres	# of Mitres
(mm)	1	1	2	2	3
300	375	425	500	550	725
350	400	450	525	600	825
400	425	475	575	625	900
450	450	525	600	700	975
500	450	525	625	700	1,025
600	450	525	650	750	1,175
700	475	525	725	850	1,350
800	500	575	800	950	1,500
900	550	625	875	1,025	1,675
1000	600	650	950	1,125	1,825
1100	625	700	1,025	1,225	2,000
1200	675	750	1,100	1,300	2,175

B. REDUCERS

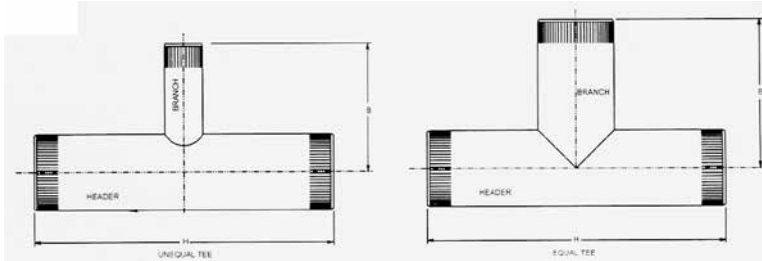


Concentric and Eccentric Reducers. Taper Length (L) = 2.5 x (D_L - D_S)
The below dimensions are valid for all pressure classes

DN Large End	DN Small End	Pipe length	Taper Length	Pipe Length	Laying Length
DL(mm)	Ds(mm)	A (mm)	L(mm)	B (mm)	LL(mm)
300	100	300	500	200	1,000
300	150	300	375	200	875
300	200	300	250	300	850
300	250	300	125	300	725
350	100	400	625	200	1,225
350	150	400	500	200	1,100
350	200	400	375	300	1,075
350	250	400	250	300	950
350	300	400	125	300	825
400	100	400	750	200	1,350
400	150	400	625	200	1,225
400	200	400	500	300	1,200
400	250	400	375	300	1,075
400	300	400	250	300	950
400	350	400	125	400	925
450	150	400	750	200	1,350
450	200	400	625	300	1,325
450	250	400	500	300	1,200
450	300	400	375	300	1,075
450	350	400	250	400	1,050
450	400	400	125	400	925
500	200	400	750	300	1,450
500	250	400	625	300	1,325
500	300	400	500	300	1,200
500	350	400	375	400	1,175
500	400	400	250	400	1,050
500	450	400	125	400	925
600	300	500	750	300	1,550

DN Large End	DN Small End	Pipe length	Taper Length	Pipe Length	Laying Length
DL(mm)	Ds(mm)	A (mm)	L(mm)	B (mm)	LL(mm)
600	400	500	500	400	1,400
600	450	500	375	400	1,275
600	500	500	250	400	1,150
700	300	500	1,000	300	1,800
700	400	500	750	400	1,650
700	450	500	625	400	1,525
700	500	500	500	400	1,400
700	600	500	250	500	1,250
800	500	500	750	400	1,650
800	600	500	500	500	1,500
800	700	500	250	500	1,250
900	600	600	750	500	1,850
900	700	600	500	500	1,600
900	800	600	250	500	1,350
1,000	700	600	750	500	1,850
1,000	800	600	500	500	1,600
1,000	900	600	250	600	1,450
1,100	800	600	750	500	1,850
1,100	900	600	500	600	1,700
1,100	1,000	600	250	600	1,450
1,200	900	650	750	600	2,000
1,200	1,000	650	500	600	1,750
1,200	1,100	650	250	600	1,500

C. TEES



TEE		PN 3		PN 6		PN 10		PN 12	
Header	Branch	H	B	H	B	H	B	H	B
DN mm	DN mm	mm	mm	mm	mm	mm	mm	mm	mm
300	150	580	370	580	370	580	370	580	370
300	200	640	370	640	370	660	380	660	390
300	250	680	370	700	380	740	400	760	410
300	300	740	370	780	390	820	410	840	420
350	150	720	400	720	400	720	400	720	400
350	200	780	400	780	400	800	410	800	410
350	250	820	400	840	400	880	420	900	430
350	300	880	400	900	410	960	440	980	450
350	350	940	470	980	490	1,040	520	1,060	530
400	150	720	420	720	420	720	420	720	420
400	200	780	420	780	420	800	430	800	440
400	250	820	420	840	430	880	450	900	460
400	300	880	420	900	440	960	460	980	470
400	350	940	490	980	510	1,040	540	1,060	550
400	400	1,000	500	1,040	520	1,100	550	1,140	570
450	200	780	450	780	450	800	460	800	460
450	250	820	450	840	450	880	470	900	480
450	300	880	450	900	460	960	490	980	500
450	350	940	520	980	540	1,040	570	1,060	580
450	400	1,000	530	1,040	550	1,100	580	1,140	600
450	450	1,080	540	1,140	570	1,200	600	1,240	620
500	200	780	470	780	470	800	480	800	490
500	250	820	470	840	480	880	500	900	510
500	300	880	470	900	490	960	510	980	520
500	350	940	550	980	570	1,040	600	1,060	610
500	400	1,000	560	1,040	580	1,100	610	1,140	620
500	450	1,080	570	1,140	590	1,200	620	1,240	640
500	500	1,140	570	1,200	600	1,280	640	1,320	660
600	250	880	530	900	530	940	550	960	560
600	300	940	530	960	540	1,020	570	1,040	580

TEE		PN 3		PN 6		PN 10		PN 12	
Header	Branch	H	B	H	B	H	B	H	B
DN mm	DN mm	mm	mm	mm	mm	mm	mm	mm	mm
600	350	1,000	600	1,040	620	1,100	650	1,120	660
600	400	1,060	610	1,100	630	1,160	660	1,200	670
600	450	1,140	620	1,200	640	1,260	670	1,300	690
600	500	1,200	620	1,260	650	1,340	690	1,380	710
600	600	1,340	670	1,400	700	1,500	750	1,540	770
700	300	940	580	960	590	1,020	620	1,040	630
700	350	1,000	650	1,040	670	1,100	700	1,120	710
700	400	1,060	660	1,100	680	1,160	710	1,200	730
700	450	1,140	670	1,200	700	1,260	730	1,300	750
700	500	1,200	680	1,260	710	1,340	740	1,380	760
700	600	1,340	720	1,400	760	1,500	800	1,540	820
700	700	1,480	740	1,560	780	1,660	830	1,720	860
800	300	940	630	960	650	1,020	670	1,040	680
800	350	1,000	700	1,040	720	1,100	750	1,120	760
800	400	1,060	710	1,100	730	1,160	760	1,200	780
800	450	1,140	720	1,200	750	1,260	780	1,300	800
800	500	1,200	730	1,260	760	1,340	790	1,380	810
800	600	1,340	770	1,400	810	1,500	850	1,540	870
800	700	1,480	790	1,560	830	1,660	880	1,720	910
800	800	1,600	800	1,700	850	1,820	910	1,880	940
900	300	940	680	960	700	1,020	720	1,040	730
900	350	1,000	750	1,040	770	1,100	800	1,120	810
900	400	1,060	760	1,100	780	1,160	810	1,200	830
900	450	1,140	770	1,200	800	1,260	830	1,300	850
900	500	1,200	780	1,260	810	1,340	840	1,380	860
900	600	1,340	820	1,400	860	1,500	900	1,540	920
900	700	1,480	840	1,560	880	1,660	930	1,720	960
900	800	1,600	850	1,700	900	1,820	960	1,880	990
900	900	1,740	870	1,840	920	1,980	990	2,040	1,020
1000	300	1,040	730	1,060	750	1,120	770	1,140	780
1000	350	1,100	810	1,140	830	1,200	860	1,220	870
1000	400	1,160	820	1,200	840	1,260	870	1,300	880
1000	450	1,240	830	1,300	850	1,360	880	1,400	900
1000	500	1,300	830	1,360	860	1,440	900	1,480	920
1000	600	1,440	880	1,500	910	1,600	960	1,640	980
1000	700	1,580	890	1,660	930	1,760	990	1,820	1,010
1000	800	1,700	910	1,800	950	1,920	1,010	1,980	1,040
1000	900	1,840	930	1,940	980	2,080	1,040	2,140	1,080

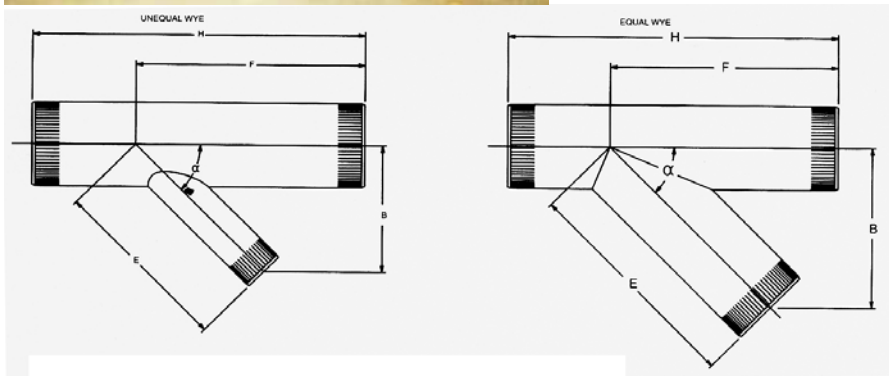
TEE		PN 3		PN 6		PN 10		PN 12	
Header	Branch	H	B	H	B	H	B	H	B
DN mm	DN mm	mm	mm	mm	mm	mm	mm	mm	mm
1000	1000	1,980	990	2,100	1,050	2,240	1,120	2,320	1,160
1100	300	1,040	790	1,060	800	1,120	830	1,140	840
1100	350	1,100	860	1,140	880	1,200	910	1,220	920
1100	400	1,160	870	1,200	890	1,260	920	1,300	930
1100	450	1,240	880	1,300	900	1,360	930	1,400	950
1100	500	1,300	880	1,360	910	1,440	950	1,480	970
1100	600	1,440	930	1,500	960	1,600	1,010	1,640	1,030
1100	700	1,580	940	1,660	980	1,760	1,040	1,820	1,060
1100	800	1,700	960	1,800	1,000	1,920	1,060	1,980	1,090
1100	900	1,840	980	1,940	1,030	2,080	1,090	2,140	1,130
1100	1000	1,980	1,040	2,100	1,100	2,240	1,170	2,320	1,210
1100	1100	2,120	1,060	2,240	1,120	2,400	1,200	2,480	1,240
1200	300	1,040	840	1,060	850	1,120	880	1,140	890
1200	350	1,100	910	1,140	930	1,200	960	1,220	970
1200	400	1,160	920	1,200	940	1,260	970	1,300	990
1200	450	1,240	930	1,300	960	1,360	990	1,400	1,010
1200	500	1,300	940	1,360	970	1,440	1,000	1,480	1,020
1200	600	1,440	980	1,500	1,020	1,600	1,060	1,640	1,080
1200	700	1,580	1,000	1,660	1,040	1,760	1,090	1,820	1,120
1200	800	1,700	1,010	1,800	1,060	1,920	1,120	1,980	1,150
1200	900	1,840	1,030	1,940	1,080	2,080	1,150	2,140	1,180
1200	1000	1,980	1,100	2,100	1,150	2,240	1,230	2,320	1,260
1200	1100	2,120	1,110	2,240	1,170	2,400	1,260	2,480	1,300
1200	1200	2,260	1,130	2,380	1,190	2,560	1,280	2,660	1,330

TEE		PN 16		PN 20		PN 25	
Header	Branch	H	B	H	B	H	B
DN mm	DN mm	mm	mm	mm	mm	mm	mm
300	150	600	380	640	400	660	410
300	200	700	400	720	420	760	440
300	250	780	420	820	440	880	470
300	300	880	440	940	470	1,000	500
350	150	740	410	760	420	800	440
350	200	840	430	860	440	900	460
350	250	920	450	960	470	1,020	490
350	300	1,020	470	1,060	490	1,120	520
350	350	1,100	550	1,160	580	1,220	610
400	150	740	430	760	450	800	460
400	200	840	450	860	470	900	490
400	250	920	470	960	490	1,020	520
400	300	1,020	490	1,060	520	1,120	550
400	350	1,100	580	1,160	610	1,220	640
400	400	1,200	600	1,260	630	1,340	670
450	200	840	480	860	490	900	510
450	250	920	500	960	520	1,020	540
450	300	1,020	520	1,060	540	1,120	570
450	350	1,100	610	1,160	640	1,220	670
450	400	1,200	630	1,260	660	1,340	700
450	450	1,300	650	1,360	680	1,460	730
500	200	840	500	860	520	900	540
500	250	920	520	960	540	1,020	570
500	300	1,020	540	1,060	570	1,120	600
500	350	1,100	630	1,160	660	1,220	690
500	400	1,200	650	1,260	680	1,340	720
500	450	1,300	670	1,360	710	1,460	750
500	500	1,380	690	1,460	730	1,560	780
600	250	980	580	1,020	600	1,080	620
600	300	1,080	600	1,120	620	1,180	650
600	350	1,160	680	1,220	710	1,280	740
600	400	1,260	700	1,320	730	1,400	770
600	450	1,360	720	1,420	760	1,520	800

TEE		PN 16		PN 20		PN 25	
Header	Branch	H	B	H	B	H	B
DN mm	DN mm	mm	mm	mm	mm	mm	mm
600	500	1,440	740	1,520	780	1,620	830
600	600	1,620	810	1,720	860	1,840	920
700	300	1,080	650	1,120	670	1,180	700
700	350	1,160	740	1,220	770	1,280	800
700	400	1,260	760	1,320	790	1,400	830
700	450	1,360	780	1,420	810	1,520	860
700	500	1,440	800	1,520	840	1,620	880
700	600	1,620	870	1,720	910	1,840	970
700	700	1,820	910	1,920	960	2,060	1,030
800	300	1,080	700	1,120	730	1,180	760
800	350	1,160	790	1,220	820	1,280	850
800	400	1,260	810	1,320	840	1,400	880
800	450	1,360	830	1,420	860	1,520	910
800	500	1,440	850	1,520	890	1,620	930
800	600	1,620	920	1,720	960	1,840	1,020
800	700	1,820	960	1,920	1,010	2,060	1,080
800	800	2,000	1,000	2,120	1,060	2,260	1,130
900	300	1,080	750	1,120	780	1,180	810
900	350	1,160	840	1,220	870	1,280	900
900	400	1,260	860	1,320	890	1,400	930
900	450	1,360	880	1,420	910	1,520	960
900	500	1,440	900	1,520	940	1,620	980
900	600	1,620	970	1,720	1,010	1,840	1,070
900	700	1,820	1,010	1,920	1,060	2,060	1,130
900	800	2,000	1,050	2,120	1,110	2,260	1,180
900	900	2,180	1,090	2,320	1,160	2,480	1,240
1000	300	1,180	800	1,220	830	1,280	860
1000	350	1,260	890	1,320	920	1,380	950
1000	400	1,360	910	1,420	940	1,500	980
1000	450	1,460	930	1,520	970	1,620	1,010
1000	500	1,540	950	1,620	990	1,720	1,040
1000	600	1,720	1,020	1,820	1,070	1,940	1,130
1000	700	1,920	1,060	2,020	1,120	2,160	1,180
1000	800	2,100	1,100	2,220	1,160	2,360	1,240
1000	900	2,280	1,140	2,420	1,210	2,580	1,300

TEE		PN 16		PN 20		PN 25	
Header	Branch	H	B	H	B	H	B
DN mm	DN mm	mm	mm	mm	mm	mm	mm
1000	1000	2,460	1,230	2,620	1,310	2,800	1,400
1100	300	1,180	860	1,220	880	1,280	910
1100	350	1,260	940	1,320	970	1,380	1,000
1100	400	1,360	960	1,420	990	1,500	1,030
1100	450	1,460	980	1,520	1,020	1,620	1,060
1100	500	1,540	1,000	1,620	1,040	1,720	1,090
1100	600	1,720	1,070	1,820	1,120	1,940	1,180
1100	700	1,920	1,110	2,020	1,170	2,160	1,230
1100	800	2,100	1,150	2,220	1,210	2,360	1,290
1100	900	2,280	1,190	2,420	1,260	2,580	1,350
1100	1000	2,460	1,280	2,620	1,360	2,800	1,450
1100	1100	2,640	1,320	2,820	1,410	3,020	1,510
1200	300	1,180	910	1,220	930	1,280	960
1200	350	1,260	1,000	1,320	1,030	1,380	1,060
1200	400	1,360	1,020	1,420	1,050	1,500	1,090
1200	450	1,460	1,040	1,520	1,070	1,620	1,120
1200	500	1,540	1,060	1,620	1,100	1,720	1,140
1200	600	1,720	1,130	1,820	1,170	1,940	1,230
1200	700	1,920	1,170	2,020	1,220	2,160	1,290
1200	800	2,100	1,210	2,220	1,270	2,360	1,340
1200	900	2,280	1,250	2,420	1,320	2,580	1,400
1200	1000	2,460	1,340	2,620	1,410	2,800	1,510
1200	1100	2,640	1,380	2,820	1,460	3,020	1,570
1200	1200	2,840	1,420	3,020	1,510	3,240	1,620

D. GRAVITY WYES



WYE		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header	Branch	H	E	B	F	H	E	B	F
DN mm	DN mm	mm	mm	mm	mm	mm	mm	mm	mm
300	100	570	440	325	490	550	370	325	430
300	150	650	480	350	510	610	400	350	440
300	200	730	520	375	540	680	430	375	460
300	250	790	550	400	570	740	460	400	470
300	300	870	590	425	590	800	490	425	490
350	100	710	540	400	520	690	450	400	460
350	150	780	570	425	550	750	480	425	470
350	200	860	610	450	580	810	510	450	490
350	250	930	650	475	600	870	540	475	500
350	300	1000	680	500	630	930	570	500	520
350	350	1100	730	525	730	1010	610	550	610
400	100	710	560	400	560	680	460	400	490
400	150	780	600	425	590	740	490	425	500
400	200	860	640	475	610	800	520	475	520
400	250	930	670	475	640	860	550	500	530
400	300	1000	710	525	670	920	580	525	550
400	350	1100	760	550	770	1000	620	550	640
400	400	1190	800	575	800	1080	660	575	660

WYE		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header	Branch	H	E	B	F	H	E	B	F
DN mm	DN mm	mm	mm	mm	mm	mm	mm	mm	mm
450	100	710	590	425	600	690	480	425	520
450	150	790	630	450	620	750	510	450	530
450	200	860	660	475	650	810	540	475	550
450	250	930	700	500	680	870	570	500	560
450	300	1010	740	525	700	930	600	525	580
450	350	1100	780	575	800	1010	640	575	670
450	400	1190	830	600	840	1090	680	600	690
450	450	1270	870	625	870	1150	710	625	710
500	100	720	620	450	630	680	490	425	550
500	150	780	650	475	660	740	520	475	560
500	200	860	690	500	690	800	550	500	580
500	250	940	730	525	710	860	580	525	590
500	300	1000	760	550	740	920	610	550	610
500	350	1100	810	575	840	1000	650	575	700
500	400	1200	860	625	880	1080	690	600	720
500	450	1280	900	650	910	1160	730	650	740
500	500	1360	940	675	940	1240	770	675	770
600	300	1060	840	600	810	980	670	600	670
600	400	1250	940	675	950	1140	750	650	780
600	450	1340	980	700	980	1220	790	700	800
600	500	1430	1030	750	1,020	1300	830	725	830
600	600	1610	1120	800	1,120	1440	900	800	900
700	300	1070	900	650	890	980	700	625	730
700	400	1250	990	725	1,020	1140	780	700	840
700	450	1330	1030	750	1,060	1220	820	725	860
700	500	1430	1080	775	1,090	1300	860	750	890
700	600	1610	1170	850	1,190	1440	930	825	960
700	700	1790	1260	900	1,260	1600	1010	875	1,010
800	300	1070	950	675	960	980	730	650	790
800	400	1250	1040	750	1,100	1140	810	725	900
800	450	1330	1080	775	1,130	1220	850	750	920
800	500	1430	1130	800	1,170	1300	890	775	950
800	600	1610	1220	875	1,260	1440	960	850	1,020
800	700	1790	1310	950	1,330	1600	1040	925	1,070
800	800	1970	1400	1000	1,400	1760	1120	975	1,120
900	300	1060	1000	725	1,030	980	760	675	850
900	400	1250	1090	775	1,170	1140	840	750	960
900	450	1340	1140	825	1,200	1220	880	775	980

WYE		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header	Branch	H	E	B	F	H	E	B	F
DN mm	DN mm	mm	mm	mm	mm	mm	mm	mm	mm
900	500	1430	1180	850	1,240	1300	920	800	1,010
900	600	1610	1270	900	1,340	1440	990	875	1,080
900	700	1790	1360	975	1,410	1600	1070	950	1,130
900	800	1970	1450	1050	1,470	1760	1150	1000	1,180
900	900	2150	1540	1100	1,540	1900	1220	1075	1,220
1,000	300	1160	1100	800	1,110	1080	840	750	910
1,000	400	1360	1200	850	1,250	1240	920	800	1,020
1,000	450	1440	1240	900	1,280	1320	960	850	1,040
1,000	500	1520	1280	925	1,310	1400	1000	875	1,070
1,000	600	1700	1370	975	1,410	1540	1070	950	1,140
1,000	700	1900	1470	1050	1,480	1700	1150	1000	1,190
1,000	800	2080	1560	1125	1,550	1860	1230	1075	1,240
1,000	900	2240	1640	1175	1,620	2000	1300	1150	1,280
1,000	1,000	2440	1740	1250	1,740	2160	1380	1200	1,380
1,100	300	1160	1150	825	1,180	1080	870	775	970
1,100	400	1350	1250	900	1,320	1240	950	825	1,080
1,100	450	1440	1290	925	1,350	1320	990	875	1,100
1,100	500	1530	1340	950	1,390	1400	1030	900	1,130
1,100	600	1710	1430	1025	1,480	1540	1100	975	1,200
1,100	700	1890	1520	1075	1,550	1700	1180	1025	1,250
1,100	800	2070	1610	1150	1,620	1860	1260	1100	1,300
1,100	900	2250	1700	1225	1,690	2000	1330	1175	1,340
1,100	1,000	2440	1790	1275	1,810	2160	1410	1225	1,440
1,100	1,100	2610	1880	1350	1,880	2320	1490	1300	1,490
1,200	300	1170	1210	875	1,250	1080	900	800	1,030
1,200	400	1350	1300	925	1,390	1240	980	850	1,140
1,200	450	1430	1340	950	1,420	1320	1020	900	1,160
1,200	500	1530	1390	1000	1,460	1400	1060	925	1,190
1,200	600	1710	1480	1050	1,560	1540	1130	1000	1,260
1,200	700	1890	1570	1125	1,630	1700	1210	1050	1,310
1,200	800	2070	1660	1175	1,700	1860	1290	1125	1,360
1,200	900	2250	1750	1250	1,760	2000	1360	1200	1,400
1,200	1,000	2430	1840	1325	1,880	2160	1440	1250	1,500
1,200	1,100	2610	1930	1375	1,950	2320	1520	1325	1,550
1,200	1,200	2790	2020	1450	2,020	2460	1590	1400	1,590

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.

