

# FIBERSTRONG™

## Product Information

Glass Reinforced Polyester Pipe Systems





**FIBERSTRONG™**

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Product Information

## DISCLAIMER

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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



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## 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 ISO 23856-2021.

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/m<sup>2</sup>.

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

\*\*PN32 designs may also be provided based on project requirements, contact FPI for more information


### 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	Code Description
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 ISO 23856-2021	Plastics piping systems for pressure and non-pressure water supply, drainage or sewerage. Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin

## 2. FEATURES AND BENEFITS

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

## 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

Note: PN32 designs may also be provided based on project requirements, contact FPI for more information



### 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 <sup>2</sup> )	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: DN (mm)	DOS** <sub>MIN</sub> (mm)	Nominal Diameter: DN (mm)	DOS** <sub>MIN</sub> (mm)
300	313.5*	2100	2146.0
350	365.5*	2200	2248.0
400	412.0*	2300	2350.0
450	463.0*	2400	2452.0
500	514.0*	2500	2554.0
600	616.0*	2600	2656.0
700	718.0	2700	2758.0
800	820.0	2800	2860.0
900	922.0	2900	2962
1000	1024.0	3000	3064.0
1100	1126.0	3100	3166
1200	1228.0	3200	3268.0
1300	1330.0	3300	3370
1400	1432.0	3400	3472
1500	1534.0	3500	3574.0
1600	1636.0	3600	3676
1700	1738.0	3700	3778.0
1800	1840.0	3800	3880
1900	1942.0	3900	3982
2000	2044.0	4000	4084.0

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

\*\* For High pressure pipes i.e. PN20, PN25 & PN32 (as applicable), an additional 0.5 mm to be added to the tabulated values of  $DO_{SMIN}$ ,  $DOS_{NOM}$  and  $DOS_{MAX}$ .

### 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 <sup>3</sup> ) Pa	F/ AY=EI/(0.149 r <sup>3</sup> ) PSI
SN 2500	2500	18
SN 5000	5000	36
SN 10000	10000	72

\* 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<sup>-6</sup>

Poisson's Ratio 0.25 to 0.3

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

DN	SN 2500	SN 5000	SN 10000	Couplings
	(Kg/m)	(Kg/m)	(Kg/m)	(Kg)
80	2	3	6	5
100	3	4	7	6
150	4	5	8	7
200	5	7	9	8
250	6	8	10	9
300	7	9	11	10
350	10	12	15	12
400	13	16	20	13
450	16	20	25	15
500	19	24	31	18
600	27	34	44	24
700	36	46	59	30
800	47	60	76	36
900	59	75	96	42
1000	73	92	119	49
1100	87	111	142	56
1200	103	131	170	63
1300	120	153	199	70
1400	138	177	230	77
1500	159	203	265	83
1600	178	230	300	90
1700	203	260	337	97
1800	228	291	379	104

DN	SN 2500	SN 5000	SN 10000	Couplings
	(Kg/m)	(Kg/m)	(Kg/m)	(Kg)
1900	253	323	421	111
2000	280	361	466	118
2100	307	396	513	125
2200	335	435	564	132
2300	368	474	615	139
2400	398	517	669	146
2500	434	559	723	153
2600	469	604	783	162
2700	505	652	844	172
2800	541	700	904	183
2900	595	760	965	195
3000	650	830	1030	210
3100	662	858	1102	230
3200	704	913	1175	235
3300	750	970	1248	245
3400	794	1031	1326	255
3500	841	1091	1403	265
3600	890	1156	1483	275
3700	940	1218	1570	285
3800	991	1283	1657	295
3900	1041	1353	1743	305
4000	1095	1420	1832	315

## 9. FITTINGS

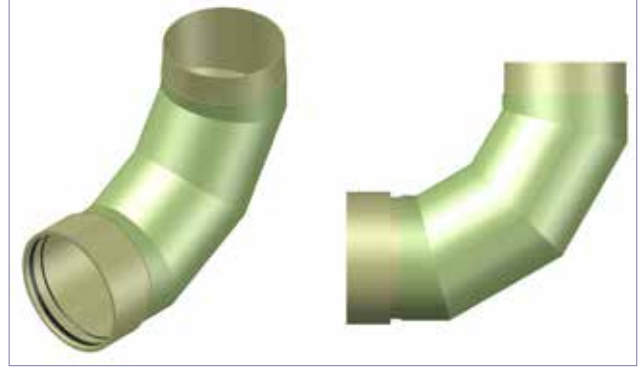
Future Pipe Industries has established a standardized line of FRP fittings. The most common fittings are (Elbows, Reducers, Tees, Wyes and Flanges) and can be supplied either as standard pieces or custom designed spools making it easier for the erection contractor to install.

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**



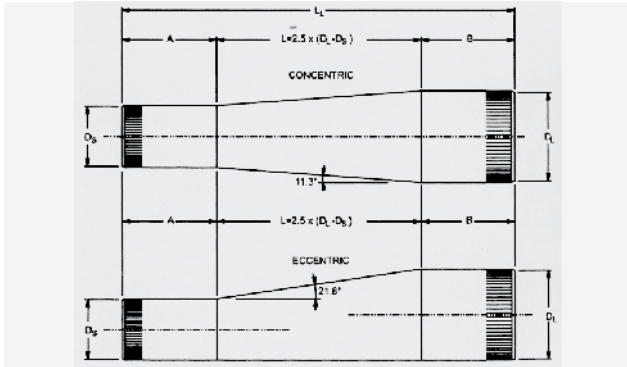
Mitered Elbows. Effective Laying Length (mm) = BL

The below dimensions are valid for all pressure classes

Angle $\alpha$	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
80	250	250	250	300	350
100	250	250	250	300	350
150	250	250	300	300	400
200	300	300	350	400	500
250	300	300	400	450	600
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
1300	700	800	1,175	1,400	2,325
1400	750	850	1,250	1,500	2,475
1500	750	850	1,250	1,500	2,475
1600	750	850	1,250	1,500	2,625
1700	750	850	1,275	1,575	2,775
1800	750	850	1,325	1,650	2,925
1900	750	875	1,400	1,725	3,075
2000	750	900	1,450	1,825	3,225

Angle $\alpha$	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
2100	775	925	1,525	1,900	3,375
2200	800	950	1,575	1,975	3,525
2300	825	1,000	1,650	2,050	3,700
2400	850	1,025	1,700	2,125	3,850
2500	850	1,075	1,700	2,150	3,925
2600	850	1,125	1,775	2,225	4,075
2700	850	1,150	1,825	2,300	4,225
2800	900	1,175	1,900	2,400	4,400
2900	900	1,225	1,900	2,400	4,425
3000	900	1,250	1,900	2,450	4,575
3100	900	1,250	1,975	2,525	4,725
3200	900	1,250	2,025	2,600	4,850
3300	900	1,250	2,075	2,675	5,000
3400	925	1,250	2,125	2,750	5,150
3500	950	1,250	2,200	2,825	5,300
3600	975	1,250	2,250	2,900	5,450
3700	975	1,250	2,300	2,950	5,575
3800	1,000	1,275	2,375	3,025	5,725
3900	1,025	1,300	2,425	3,100	5,875
4000	1,050	1,325	2,475	3,175	6,025

**B. REDUCERS**



Concentric and Eccentric Reducers. Taper Length (L) = 2.5 x (D<sub>L</sub> - D<sub>S</sub>)

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)
150	80	200	175	200	575
150	100	200	125	200	525
200	80	300	300	200	800
200	100	300	250	200	750
200	150	300	125	200	625
250	80	300	425	200	925
250	100	300	375	200	875
250	150	300	250	200	750
250	200	300	125	300	725
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

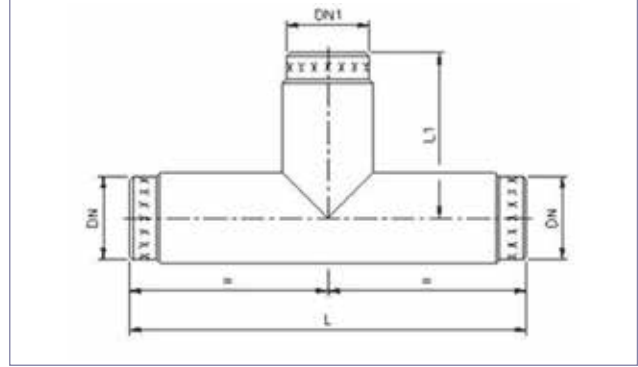
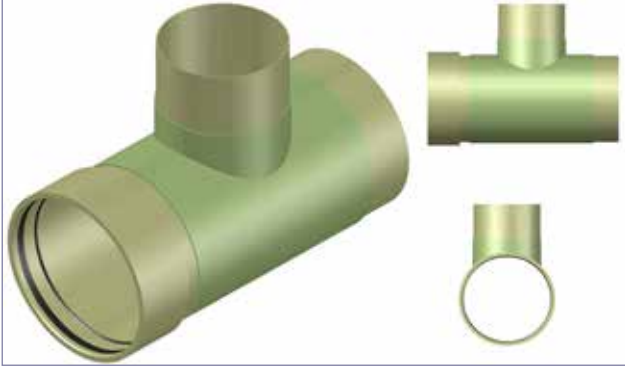


DN Large End	DN Small End	Pipe length	Taper Length	Pipe Length	Laying Length
DL(mm)	Ds(mm)	A (mm)	L(mm)	B (mm)	LL(mm)
450	250	400	500	300	1,200
450	300	400	375	300	1,075
450	350	400	250	400	1,050
450	400	400	125	400	925
500	200	400	750	300	1,450
500	250	400	625	300	1,325
500	300	400	500	300	1,200
500	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
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
1,300	1,000	650	750	600	2,000
1,300	1,100	650	500	600	1,750
1,300	1,200	650	250	650	1,550
1,400	1,100	650	750	600	2,000
1,400	1,200	650	500	650	1,800

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)
1,400	1,300	650	250	650	1,550
1,500	1,200	650	750	650	2,050
1,500	1,300	650	500	650	1,800
1,500	1,400	650	250	650	1,550
1,600	1,300	650	750	650	2,050
1,600	1,400	650	500	650	1,800
1,600	1,500	650	250	650	1,550
1,700	1,400	650	750	650	2,050
1,700	1,500	650	500	650	1,800
1,700	1,600	650	250	650	1,550
1,800	1,500	650	750	650	2,050
1,800	1,600	650	500	650	1,800
1,800	1,700	650	250	650	1,550
1,900	1,600	650	750	650	2,050
1,900	1,700	650	500	650	1,800
1,900	1,800	650	250	650	1,550
2,000	1,700	650	750	650	2,050
2,000	1,800	650	500	650	1,800
2,000	1,900	650	250	650	1,550
2,100	1,800	750	750	650	2,150
2,100	1,900	750	500	650	1,900
2,100	2,000	750	250	650	1,650
2,200	1,900	750	750	650	2,150
2,200	2,000	750	500	650	1,900
2,200	2,100	750	250	750	1,750
2,300	2,000	750	750	650	2,150
2,300	2,100	750	500	750	2,000
2,300	2,200	750	250	750	1,750
2,400	2,100	750	750	750	2,250
2,400	2,200	750	500	750	2,000
2,400	2,300	750	250	750	1,750
2,500	2,200	750	750	750	2,250
2,500	2,300	750	500	750	2,000
2,500	2,400	750	250	750	1,750
2,600	2,300	750	750	750	2,250
2,600	2,400	750	500	750	2,000
2,600	2,500	750	250	750	1,750
2,800	2,500	800	750	750	2,300

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)
2,800	2,600	800	500	750	2,050
2,800	2,700	800	250	750	1,800
3,000	2,700	800	750	750	2,300
3,000	2,800	800	500	800	2,100
3,000	2,900	800	250	800	1,850
3,100	2,800	800	750	800	2,350
3,100	2,900	800	500	800	2,100
3,100	3,000	800	250	800	1,850
3,200	2,900	900	750	800	2,450
3,200	3,000	900	500	800	2,200
3,200	3,100	900	250	800	1,950
3,300	3,000	900	750	800	2,450
3,300	3,100	900	500	800	2,200
3,300	3,200	900	250	900	2,050
3,400	3,100	900	750	800	2,450
3,400	3,200	900	500	900	2,300
3,400	3,300	900	250	900	2,050
3,500	3,200	900	750	900	2,550
3,500	3,300	900	500	900	2,300
3,500	3,400	900	250	900	2,050
3,600	3,300	900	750	900	2,550
3,600	3,400	900	500	900	2,300
3,600	3,500	900	250	900	2,050
3,700	3,400	900	750	900	2,550
3,700	3,500	900	500	900	2,300
3,700	3,600	900	250	900	2,050
3,800	3,500	900	750	900	2,550
3,800	3,600	900	500	900	2,300
3,800	3,700	900	250	900	2,050
3,900	3,600	900	750	900	2,550
3,900	3,700	900	500	900	2,300
3,900	3,800	900	250	900	2,050
4,000	3,700	900	750	900	2,550
4,000	3,800	900	500	900	2,300
4,000	3,900	900	250	900	2,050

**C. TEES**



DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
80	80	495	250
100	80	495	250
100	100	565	285
150	80	495	250
150	100	565	285
150	150	620	310
200	80	495	250
200	100	565	285
200	150	620	310
200	200	720	360
250	100	585	295
250	150	640	320
250	200	740	370
250	250	840	420
300	150	660	330
300	200	760	380
300	250	860	430
300	300	915	460
350	150	690	345
350	200	795	400
350	250	895	450
350	300	950	475
350	350	1,050	525

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
400	150	690	345
400	200	795	400
400	250	895	450
400	300	950	475
400	350	1,050	525
400	400	1,100	550
450	200	795	400
450	250	895	450
450	300	950	475
450	350	1,050	525
450	400	1,100	550
450	450	1,175	590
500	200	795	400
500	250	895	450
500	300	950	475
500	350	1,050	525
500	400	1,100	550
500	450	1,175	590
500	500	1,275	640
600	250	955	480
600	300	1,010	505
600	400	1,160	580
600	450	1,235	620
600	500	1,335	670
600	600	1,490	745

\*x = 5 mm for DN ≤ 400, 10 mm for 400 < DN ≤ 1200 and 20 mm for DN > 1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
700	300	1,040	520
700	400	1,220	610
700	450	1,295	650
700	500	1,405	705
700	600	1,580	790
700	700	1,765	885

800	300	1,040	520
800	400	1,220	610
800	450	1,295	650
800	500	1,405	705
800	600	1,580	790
800	700	1,765	885
800	800	1,940	970

900	300	1,040	520
900	400	1,220	610
900	450	1,295	650
900	500	1,405	705
900	600	1,580	790
900	700	1,765	885
900	800	1,940	970
900	900	2,160	1,080

1,000	400	1,220	610
1,000	450	1,295	650
1,000	500	1,405	705
1,000	600	1,580	790
1,000	700	1,765	885
1,000	800	1,940	970
1,000	900	2,160	1,080
1,000	1,000	2,345	1,175

1,100	400	1,220	610
1,100	450	1,295	650
1,100	500	1,405	705
1,100	600	1,580	790
1,100	700	1,765	885
1,100	800		
1,100	900	2,160	1,080
1,100	1,000	2,345	1,175
1,100	1,100	2,520	1,260

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
1,200	400	1,220	610
1,200	450	1,295	650
1,200	500		
1,200	600	1,580	790
1,200	700	1,765	885
1,200	800	1,940	970
1,200	900	2,160	1,080
1,200	1,000	2,345	1,175
1,200	1,100	2,520	1,260
1,200	1,200	2,705	1,355

1,300	400	1,220	610
1,300	450	1,295	650
1,300	500	1,405	705
1,300	600	1,580	790
1,300	700	1,765	885
1,300	800	1,940	970
1,300	900	2,160	1,080
1,300	1,000	2,345	1,175
1,300	1,100	2,520	1,260
1,300	1,200	2,705	1,355
1,300	1,300	2,930	1,465

1,400	400	1,220	610
1,400	450	1,295	650
1,400	500	1,405	705
1,400	600	1,580	790
1,400	700	1,765	885
1,400	800	1,940	970
1,400	900		
1,400	1,000	2,345	1,175
1,400	1,100	2,520	1,260
1,400	1,200	2,705	1,355
1,400	1,300		
1,400	1,400	3,100	1,550

1,500	400	1,220	610
1,500	450	1,295	650
1,500	500	1,405	705
1,500	600	1,580	790
1,500	700	1,765	885
1,500	800	1,940	970

\*x = 5 mm for DN ≤400, 10 mm for 400 <DN≤1200 and 20 mm for DN>1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
1,500	900	2,160	1,080
1,500	1,000	2,345	1,175
1,500	1,100	2,520	1,260
1,500	1,200	2,705	1,355
1,500	1,300	2,930	1,465
1,500	1,400	3,100	1,550
1,500	1,500	3,285	1,645

1,600	400	1,220	610
1,600	450	1,295	650
1,600	500	1,405	705
1,600	600	1,580	790
1,600	700	1,765	885

1,600	800	1,940	970
1,600	900	2,160	1,080
1,600	1,000	2,345	1,175
1,600	1,100	2,520	1,260
1,600	1,200	2,705	1,355
1,600	1,300	2,930	1,465
1,600	1,400	3,100	1,550
1,600	1,500	3,285	1,645
1,600	1,600	3,460	1,730

1,700	400	1,220	610
1,700	450	1,295	650
1,700	500	1,405	705
1,700	600	1,580	790
1,700	700	1,765	885
1,700	800	1,940	970
1,700	900	2,160	1,080
1,700	1,000	2,345	1,175
1,700	1,100	2,520	1,260
1,700	1,200	2,705	1,355
1,700	1,300	2,930	1,465
1,700	1,400	3,100	1,550
1,700	1,500	3,285	1,645
1,700	1,600	3,460	1,730
1,700	1,700	3,685	1,845

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
1,800	400	1,220	610
1,800	450	1,295	650
1,800	500	1,405	705
1,800	600	1,580	790
1,800	700	1,765	885
1,800	800	1,940	970
1,800	900	2,160	1,080
1,800	1,000	2,345	1,175
1,800	1,100	2,520	1,260
1,800	1,200	2,705	1,355
1,800	1,300	2,930	1,465
1,800	1,400	3,100	1,550
1,800	1,500	3,285	1,645
1,800	1,600	3,460	1,730
1,800	1,700	3,685	1,845
1,800	1,800	3,870	1,935

1,900	400	1,220	610
1,900	450	1,295	650
1,900	500	1,405	705
1,900	600	1,580	790
1,900	700	1,765	885
1,900	800	1,940	970
1,900	900	2,160	1,080
1,900	1,000	2,345	1,175
1,900	1,100	2,520	1,260
1,900	1,200	2,705	1,355
1,900	1,300	2,930	1,465
1,900	1,400	3,100	1,550
1,900	1,500	3,285	1,645
1,900	1,600	3,460	1,730
1,900	1,700	3,685	1,845
1,900	1,800	3,870	1,935
1,900	1,900	4,040	2,020

2,000	400	1,220	610
2,000	450	1,295	650
2,000	500	1,405	705
2,000	600	1,580	790
2,000	700	1,765	885

\*x = 5 mm for DN <=400, 10 mm for 400 <DN<=1200 and 20 mm for DN>1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
2,000	800	1,940	970
2,000	900	2,160	1,080
2,000	1,000	2,345	1,175
2,000	1,100	2,520	1,260
2,000	1,200	2,705	1,355
2,000	1,300	2,930	1,465
2000	1400	3,100	1,550
2,000	1,500	3,285	1,645
2,000	1,600	3,460	1,730
2,000	1,700	3,685	1,845
2,000	1,800	3,870	1,935
2,000	1,900	4,040	2,020
2,000	2,000	4,215	2,110

2,100	400	1,220	610
2,100	450	1,295	650
2,100	500	1,405	705
2,100	600	1,580	790
2,100	700	1,765	885
2,100	800	1,940	970
2,100	900	2,160	1,080
2,100	1,000	2,345	1,175
2,100	1,100	2,520	1,260
2,100	1,200	2,705	1,355
2,100	1,300	2,930	1,465
2,100	1,400	3,100	1,550
2,100	1,500	3,285	1,645

2,100	1,600	3,460	1,730
2,100	1,700	3,685	1,845
2,100	1,800	3,870	1,935
2,100	1,900	4,040	2,020
2,100	2,000	4,215	2,110
2,100	2,100	4,450	2,225

2,200	400	1,220	610
2,200	450	1,295	650
2,200	500	1,405	705
2,200	600	1,580	790
2200	700	1,765	885
2,200	800	1,940	970

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
2,200	900	2,160	1,080
2,200	1,000	2,345	1,175
2,200	1,100	2,520	1,260
2,200	1,200	2,705	1,355
2,200	1,300	2,930	1,465
2,200	1,400	3,100	1,550
2,200	1,500	3,285	1,645
2,200	1,600	3,460	1,730
2,200	1,700	3,685	1,845
2,200	1,800	3,870	1,935
2,200	1,900	4,040	2,020
2,200	2,000	4,215	2,110
2,200	2,100	4,450	2,225
2,200	2,200	4,625	2,315

2,300	400	1,220	610
2,300	450	1,295	650
2,300	500	1,405	705
2,300	600	1,580	790
2,300	700	1,765	885
2,300	800	1,940	970
2,300	900	2,160	1,080
2,300	1,000	2,345	1,175
2,300	1,100	2,520	1,260
2,300	1,200	2,705	1,355
2,300	1,300	2,930	1,465
2,300	1,400	3,100	1,550
2,300	1,500	3,285	1,645
2,300	1,600	3,460	1,730
2,300	1,700	3,685	1,845
2,300	1,800	3,870	1,935
2,300	1,900	4,040	2,020
2,300	2,000	4,215	2,110
2,300	2,100	4,450	2,225
2,300	2,200	4,625	2,315
2,300	2,300	4,800	2,400

2,400	400	1,220	610
2,400	450	1,295	650
2,400	500	1,405	705
2,400	600	1,580	790

\*x = 5 mm for DN <=400, 10 mm for 400 <DN<=1200 and 20 mm for DN>1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
2,400	700	1,765	885
2,400	800	1,940	970
2,400	900	2,160	1,080
2,400	1,000	2,345	1,175
2,400	1,100	2,520	1,260
2,400	1,200	2,705	1,355
2,400	1,300	2,930	1,465
2,400	1,400	3,100	1,550
2,400	1,500	3,285	1,645
2,400	1,600	3,460	1,730
2,400	1,700	3,685	1,845
2,400	1,800	3,870	1,935
2,400	1,900	4,040	2,020
2,400	2,000	4,215	2,110
2,400	2,100	4,450	2,225
2,400	2,200	4,625	2,315
2,400	2,300	4,800	2,400
2,400	2,400	4,980	2,490

2,500	400	1,180	590
2,500	450	1,265	635
2,500	500	1,375	690
2,500	600	1,550	775
2,500	700	1,715	860
2,500	800	1,890	945
2,500	900	2,110	1,055
2,500	1,000	2,275	1,140
2,500	1,100	2,450	1,225
2,500	1,200	2,625	1,315
2,500	1,300	2,850	1,425
2,500	1,400	3,010	1,505
2,500	1,500	3,185	1,595
2,500	1,600	3,360	1,680
2,500	1,700	3,575	1,790
2,500	1,800	3,750	1,875
2,500	1,900	3,920	1,960
2,500	2,000	4,085	2,045
2,500	2,100	4,310	2,155
2,500	2,200	4,485	2,245
2,500	2,300	4,660	2,330
2,500	2,400	4,820	2,410

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
2,500	2,500	4,995	2,500

2,600	400	1,220	610
2,600	450	1,305	655
2,600	500	1,415	710
2,600	600	1,590	795
2,600	700	1,755	880
2,600	800	1,930	965
2,600	900	2,150	1,075
2,600	1,000	2,315	1,160
2,600	1,100	2,490	1,245
2,600	1,200	2,665	1,335
2,600	1,300	2,890	1,445
2,600	1,400	3,050	1,525
2,600	1,500	3,225	1,615
2,600	1,600	3,400	1,700
2,600	1,700	3,615	1,810
2,600	1,800	3,790	1,895
2,600	1,900	3,960	1,980
2,600	2,000	4,125	2,065
2,600	2,100	4,350	2,175
2,600	2,200	4,525	2,265
2,600	2,300	4,700	2,350
2,600	2,400	4,860	2,430
2,600	2,500	5,035	2,520
2,600	2,600	5,260	2,630

2,700	400	1,220	610
2,700	450	1,305	655
2,700	500	1,415	710
2,700	600	1,590	795
2,700	700	1,755	880
2,700	800	1,930	965
2,700	900	2,150	1,075
2,700	900	2,150	1,075
2,700	1,000	2,315	1,160
2,700	1,100	2,490	1,245
2,700	1,200	2,665	1,335
2,700	1,300	2,890	1,445
2,700	1,400	3,050	1,525
2,700	1,500	3,225	1,615

\*x = 5 mm for DN <=400, 10 mm for 400 <DN<=1200 and 20 mm for DN>1200.



DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
2,700	1,600	3,400	1,700
2,700	1,700	3,615	1,810
2,700	1,800	3,790	1,895
2,700	1,900	3,960	1,980
2,700	2,000	4,125	2,065
2,700	2,100	4,350	2,175
2,700	2,200	4,525	2,265
2,700	2,300	4,700	2,350
2,700	2,400	4,860	2,430
2,700	2,500	5,035	2,520
2,700	2,600	5,260	2,630
2,700	2,700	5,425	2,715
2,800	400	1,220	610
2,800	450	1,305	655
2,800	500	1,415	710
2,800	600	1,590	795
2,800	700	1,755	880
2,800	800	1,930	965
2,800	900	2,150	1,075
2,800	1,000	2,315	1,160
2,800	1,100	2,490	1,245
2,800	1,200	2,665	1,335
2,800	1,300	2,890	1,445
2,800	1,400	3,050	1,525
2,800	1,500	3,225	1,615
2,800	1,600	3,400	1,700
2,800	1,700	3,615	1,810
2,800	1,800	3,790	1,895
2,800	1,900	3,960	1,980
2,800	2,000	4,125	2,065
2,800	2,100	4,350	2,175
2,800	2,200	4,525	2,265
2,800	2,300	4,700	2,350
2,800	2,400	4,860	2,430
2,800	2,500	5,035	2,520
2,800	2,600	5,260	2,630
2,800	2,700	5,425	2,715
2,800	2,800	5,600	2,800
2,900	400	1,200	600

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
2,900	450	1,275	640
2,900	500	1,375	690
2,900	600	1,530	765
2,900	700	1,695	850
2,900	800	1,860	930
2,900	900	2,070	1,035
2,900	1,000	2,225	1,115
2,900	1,100	2,390	1,195
2,900	1,200	2,555	1,280
2,900	1,300	2,770	1,385
2,900	1,400	2,920	1,460
2,900	1,500	3,085	1,545
2,900	1,600	3,250	1,625
2,900	1,700	3,465	1,735
2,900	1,800	3,620	1,810
2,900	1,900	3,780	1,890
2,900	2,000	3,945	1,975
2,900	2,100	4,160	2,080
2,900	2,200	4,325	2,165
2,900	2,300	4,480	2,240
2,900	2,400	4,640	2,320
2,900	2,500	4,805	2,405
2,900	2,600	5,020	2,510
2,900	2,700	5,175	2,590
2,900	2,800	5,340	2,670
2,900	2,900	5,500	2,750
3,000	400	1,200	600
3,000	450	1,275	640
3,000	500	1,375	690
3,000	600	1,530	765
3,000	700	1,695	850
3,000	800	1,860	930
3,000	900	2,070	1,035
3,000	1,000	2,225	1,115
3,000	1,100	2,390	1,195
3,000	1,200	2,555	1,280
3,000	1,300	2,770	1,385
3,000	1,400	2,920	1,460
3,000	1,500	3,085	1,545
3,000	1,600	3,250	1,625

\*x = 5 mm for DN <=400, 10 mm for 400 <DN<=1200 and 20 mm for DN>1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
3,000	1,700	3,465	1,735
3,000	1,800	3,620	1,810
3,000	1,900	3,780	1,890
3,000	2,000	3,945	1,975
3,000	2,100	4,160	2,080
3,000	2,200	4,325	2,165
3,000	2,300	4,480	2,240
3,000	2,300	4,480	2,240
3,000	2,400	4,640	2,320
3,000	2,500	4,805	2,405
3,000	2,600	5,020	2,510
3,000	2,700	5,175	2,590
3,000	2,800	5,340	2,670
3,000	2,900	5,500	2,750
3,000	3,000	5,715	2,860

3,100	400	1,200	600
3,100	450	1,275	640
3,100	500	1,375	690
3,100	600	1,530	765
3,100	700	1,695	850
3,100	800	1,860	930
3,100	900	2,070	1,035
3,100	1,000	2,225	1,115
3,100	1,100	2,390	1,195
3,100	1,200	2,555	1,280
3,100	1,300	2,770	1,385
3,100	1,400	2,920	1,460
3,100	1,500	3,085	1,545
3,100	1,600	3,250	1,625
3,100	1,700	3,465	1,735
3,100	1,800	3,620	1,810
3,100	1,900	3,780	1,890
3,100	2,000	3,945	1,975
3,100	2,100	4,160	2,080
3,100	2,200	4,325	2,165
3,100	2,300	4,480	2,240
3,100	2,400	4,640	2,320
3,100	2,500	4,805	2,405
3,100	2,600	5,020	2,510
3,100	2,700	5,175	2,590

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
3,100	2,800	5,340	2,670
3,100	2,900	5,500	2,750
3,100	3,000	5,715	2,860
3,100	3,100	5,870	2,935

3,200	400	1,200	600
3,200	450	1,275	640
3,200	500	1,375	690
3,200	600	1,530	765
3,200	700	1,695	850
3,200	800	1,860	930
3,200	900	2,070	1,035
3,200	1,000	2,225	1,115
3,200	1,100	2,390	1,195
3,200	1,200	2,555	1,280
3,200	1,300	2,770	1,385
3,200	1,400	2,920	1,460
3,200	1,500	3,085	1,545
3,200	1,600	3,250	1,625
3,200	1,700	3,465	1,735
3,200	1,800	3,620	1,810
3,200	1,900	3,780	1,890
3,200	2,000	3,945	1,975
3,200	2,100	4,160	2,080
3,200	2,200	4,325	2,165
3,200	2,300	4,480	2,240
3,200	2,400	4,640	2,320
3,200	2,500	4,805	2,405
3,200	2,600	5,020	2,510
3,200	2,700	5,175	2,590
3,200	2,800	5,340	2,670
3,200	2,900	5,500	2,750
3,200	3,000	5,715	2,860
3,200	3,100	5,870	2,935
3,200	3,200	6,035	3,020

3,300	400	1,200	600
3,300	450	1,275	640
3,300	500	1,375	690
3,300	600	1,530	765
3,300	700	1,695	850

\*x = 5 mm for DN <=400, 10 mm for 400 <DN<=1200 and 20 mm for DN>1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
3,300	800	1,860	930
3,300	900	2,070	1,035
3,300	1,000	2,225	1,115
3,300	1,100	2,390	1,195
3,300	1,200	2,555	1,280
3,300	1,300	2,770	1,385
3,300	1,400	2,920	1,460
3,300	1,500	3,085	1,545
3,300	1,600	3,250	1,625
3,300	1,700	3,465	1,735
3,300	1,800	3,620	1,810
3,300	1,900	3,780	1,890
3,300	2,000	3,945	1,975
3,300	2,100	4,160	2,080
3,300	2,200	4,325	2,165
3,300	2,300	4,480	2,240
3,300	2,400	4,640	2,320
3,300	2,500	4,805	2,405
3,300	2,600	5,020	2,510
3,300	2,700	5,175	2,590
3,300	2,800	5,340	2,670
3,300	2,900	5,500	2,750
3,300	3,000	5,715	2,860
3,300	3,100	5,870	2,935
3,300	3,200	6,035	3,020
3,300	3,300	6,200	3,100

3,400	400	1,200	600
3,400	450	1,275	640
3,400	500	1,375	690
3,400	600	1,530	765
3,400	700	1,695	850
3,400	800	1,860	930
3,400	900	2,070	1,035
3,400	1,000	2,225	1,115
3,400	1,100	2,390	1,195
3,400	1,200	2,555	1,280
3,400	1,300	2,770	1,385
3,400	1,400	2,920	1,460
3,400	1,500	3,085	1,545
3,400	1,600	3,250	1,625

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
3,400	1,700	3,465	1,735
3,400	1,800	3,620	1,810
3,400	1,900	3,780	1,890
3,400	2,000	3,945	1,975
3,400	2,100	4,160	2,080
3,400	2,200	4,325	2,165
3,400	2,300	4,480	2,240
3,400	2,400	4,640	2,320
3,400	2,500	4,805	2,405
3,400	2,600	5,020	2,510
3,400	2,700	5,175	2,590
3,400	2,800	5,340	2,670
3,400	2,900	5,500	2,750
3,400	3,000	5,715	2,860
3,400	3,100	5,870	2,935
3,400	3,200	6,035	3,020
3,400	3,300	6,200	3,100
3,400	3,400	6,410	3,205

3,500	400	1,200	600
3,500	450	1,275	640
3,500	500	1,375	690
3,500	600	1,530	765
3,500	700	1,695	850
3,500	800	1,860	930
3,500	900	2,070	1,035
3,500	1,000	2,225	1,115
3,500	1,100	2,390	1,195
3,500	1,200	2,555	1,280
3,500	1,300	2,770	1,385
3,500	1,400	2,920	1,460
3,500	1,500	3,085	1,545
3,500	1,600	3,250	1,625
3,500	1,700	3,465	1,735
3,500	1,800	3,620	1,810
3,500	1,900	3,780	1,890
3,500	2,000	3,945	1,975
3,500	2,100	4,160	2,080
3,500	2,200	4,325	2,165
3,500	2,300	4,480	2,240
3,500	2,400	4,640	2,320

\*x = 5 mm for DN <=400, 10 mm for 400 <DN<=1200 and 20 mm for DN>1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
3,500	2,500	4,805	2,405
3,500	2,600	5,020	2,510
3,500	2,700	5,175	2,590
3,500	2,800	5,340	2,670
3,500	2,900	5,500	2,750
3,500	3,000	5,715	2,860
3,500	3,100	5,870	2,935
3,500	3,200	6,035	3,020
3,500	3,300	6,200	3,100
3,500	3,400	6,410	3,205
3,500	3,500	6,565	3,285

3,600	400	1,200	600
3,600	450	1,275	640
3,600	500	1,375	690
3,600	600	1,530	765
3,600	700	1,695	850
3,600	800	1,860	930
3,600	900	2,070	1,035
3,600	1,000	2,225	1,115
3,600	1,100	2,390	1,195
3,600	1,200	2,555	1,280
3,600	1,300	2,770	1,385
3,600	1,400	2,920	1,460
3,600	1,500	3,085	1,545
3,600	1,600	3,250	1,625
3,600	1,700	3,465	1,735
3,600	1,800	3,620	1,810
3,600	1,900	3,780	1,890
3,600	2,000	3,945	1,975
3,600	2,100	4,160	2,080
3,600	2,200	4,325	2,165
3,600	2,300	4,480	2,240
3,600	2,400	4,640	2,320
3,600	2,500	4,805	2,405
3,600	2,600	5,020	2,510
3,600	2,700	5,175	2,590
3,600	2,800	5,340	2,670
3,600	2,900	5,500	2,750
3,600	3,000	5,715	2,860
3,600	3,100	5,870	2,935

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
3,600	3,200	6,035	3,020
3,600	3,300	6,200	3,100
3,600	3,400	6,410	3,205
3,600	3,500	6,565	3,285
3,600	3,600	6,730	3,365

3,700	400	1,200	600
3,700	450	1,275	640
3,700	500	1,375	690
3,700	600	1,530	765
3,700	700	1,695	850
3,700	800	1,860	930
3,700	900	2,070	1,035
3,700	1,000	2,225	1,115
3,700	1,100	2,390	1,195
3,700	1,200	2,555	1,280
3,700	1,300	2,770	1,385
3,700	1,400	2,920	1,460
3,700	1,500	3,085	1,545
3,700	1,600	3,250	1,625
3,700	1,700	3,465	1,735
3,700	1,800	3,620	1,810
3,700	1,900	3,780	1,890
3,700	2,000	3,945	1,975
3,700	2,100	4,160	2,080
3,700	2,200	4,325	2,165
3,700	2,300	4,325	2,165
3,700	2,400	4,325	2,165
3,700	2,500	4,325	2,165
3,700	2,600	4,325	2,165
3,700	2,700	4,325	2,165
3,700	2,800	4,325	2,165
3,700	2,900	4,325	2,165
3,700	3,000	4,325	2,165
3,700	3,100	4,325	2,165
3,700	3,200	4,325	2,165
3,700	3,300	4,325	2,165
3,700	3,400	4,325	2,165
3,700	3,500	4,325	2,165
3,700	3,600	4,325	2,165
3,700	3,700	4,325	2,165

\*x = 5 mm for DN <=400, 10 mm for 400 <DN<=1200 and 20 mm for DN>1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
3,800	400	1,200	600
3,800	450	1,275	640
3,800	500	1,375	690
3,800	600	1,530	765
3,800	700	1,695	850
3,800	800	1,860	930
3,800	900	2,070	1,035
3,800	1,000	2,225	1,115
3,800	1,100	2,390	1,195
3,800	1,200	2,555	1,280
3,800	1,300	2,770	1,385
3,800	1,400	2,920	1,460
3,800	1,500	3,085	1,545
3,800	1,600	3,250	1,625
3,800	1,700	3,465	1,735
3,800	1,800	3,620	1,810
3,800	1,900	3,780	1,890
3,800	2,000	3,945	1,975
3,800	2,100	4,160	2,080
3,800	2,200	4,325	2,165
3,800	2,300	4,480	2,240
3,800	2,400	4,640	2,320
3,800	2,500	4,805	2,405
3,800	2,600	5,020	2,510
3,800	2,700	5,175	2,590
3,800	2,800	5,340	2,670
3,800	2,900	5,500	2,750
3,800	3,000	5,715	2,860
3,800	3,100	5,870	2,935
3,800	3,200	6,035	3,020
3,800	3,300	6,200	3,100
3,800	3,400	6,410	3,205
3,800	3,500	6,565	3,285
3,800	3,600	6,730	3,365
3,800	3,700	6,895	3,450
3,800	3,800	7,110	3,555
3,900	400	1,200	600
3,900	450	1,275	640
3,900	500	1,375	690
3,900	600	1,530	765

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
3,900	700	1,695	850
3,900	800	1,860	930
3,900	900	2,070	1,035
3,900	1,000	2,225	1,115
3,900	1,100	2,390	1,195
3,900	1,200	2,555	1,280
3,900	1,300	2,770	1,385
3,900	1,400	2,920	1,460
3,900	1,500	3,085	1,545
3,900	1,600	3,250	1,625
3,900	1,700	3,465	1,735
3,900	1,800	3,620	1,810
3,900	1,900	3,780	1,890
3,900	2,000	3,945	1,975
3,900	2,100	4,160	2,080
3,900	2,200	4,325	2,165
3,900	2,300	4,480	2,240
3,900	2,400	4,640	2,320
3,900	2,500	4,805	2,405
3,900	2,600	5,020	2,510
3,900	2,700	5,175	2,590
3,900	2,800	5,340	2,670
3,900	2,900	5,500	2,750
3,900	3,000	5,715	2,860
3,900	3,100	5,870	2,935
3,900	3,200	6,035	3,020
3,900	3,300	6,200	3,100
3,900	3,400	6,410	3,205
3,900	3,500	6,565	3,285
3,900	3,600	6,730	3,365
3,900	3,700	6,895	3,450
3,900	3,800	7,110	3,555
3,900	3,900	7,260	3,630
4,000	400	1,200	600
4,000	450	1,275	640
4,000	500	1,375	690
4,000	600	1,530	765
4,000	700	1,695	850
4,000	800	1,860	930
4,000	900	2,070	1,035

\*x = 5 mm for DN <=400, 10 mm for 400 <DN<=1200 and 20 mm for DN>1200.

DN	DN1	L	L1
mm	mm	mm -5 / +x*	mm -5 / +x*
4,000	1,000	2,225	1,115
4,000	1,100	2,390	1,195
4,000	1,200	2,555	1,280
4,000	1,300	2,770	1,385
4,000	1,400	2,920	1,460
4,000	1,500	3,085	1,545
4,000	1,600	3,250	1,625
4,000	1,700	3,465	1,735
4,000	1,800	3,620	1,810
4,000	1,900	3,780	1,890
4,000	2,000	3,945	1,975
4,000	2,100	4,160	2,080
4,000	2,200	4,325	2,165
4,000	2,300	4,480	2,240
4,000	2,400	4,640	2,320
4,000	2,500	4,805	2,405
4,000	2,600	5,020	2,510
4,000	2,700	5,175	2,590
4,000	2,800	5,340	2,670
4,000	2,900	5,500	2,750
4,000	3,000	5,715	2,860
4,000	3,100	5,870	2,935
4,000	3,200	6,035	3,020
4,000	3,300	6,200	3,100
4,000	3,400	6,410	3,205
4,000	3,500	6,565	3,285
4,000	3,600	6,730	3,365
4,000	3,700	6,895	3,450
4,000	3,800	7,110	3,555
4,000	3,900	7,260	3,630
4,000	4,000	7,425	3,715

\*x = 5 mm for DN ≤400, 10 mm for 400 <DN≤1200 and 20 mm for DN>1200.

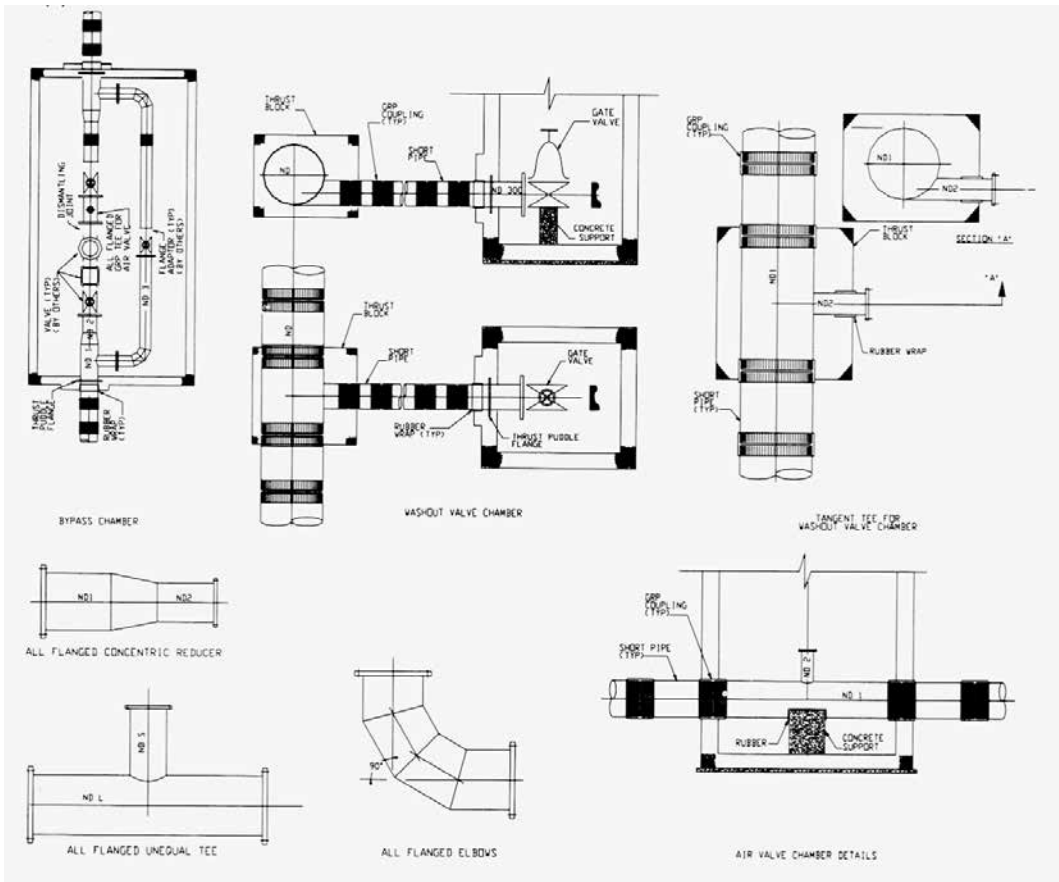
### D. FLANGES

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.



### E. 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.





