FUTURE PIPE INDUSTRIES S.A.L.

FIBERSTRONG®
GRP Pipe Product Information

www.futurepipe.com

FIBERSTRONG®

GRP Pipe Product Information

Polyester Pipe Systems

DISCLAIMER

All information was correct at the time of going to press. However, we reserve the right to alter, amend and update any product, information and service described in this brochure.

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.

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GLASSFIBER REINFORCED PLASTIC PIPE

PRODUCT INFORMATION

1. DESCRIPTION

A. GENERAL

FIBERSTRONG® non-restrained pipe and joint are Glass Reinforced Plastic (GRP) 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 5480 / AWWA C-950.

Large diameter pipes are available in nominal diameters ranging from 300 to 4000 mm.

Available standard pressure classes are PN1, 3, 6, 10, 12 and 16 and stiffness classes of 2500, 5000 and 10000 N/m^2.

* 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" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D-3517	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe
ASTM D-3754	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe
AWWA C-950	Fiberglass Pressure Pipe
AWWA M-45	Fiberglass Pipe Design Manual
BS 5480	British Standard Specification for Glass Reinforced Plastics (GRP) pipes, joints and fittings for use for water supply or sewerage.

2. FEATURES AND BENEFITS

Features	Benefits
Manufactured with corrosion resistant composite material. 	• 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.
Double bell coupling joints manufactured with corrosion resistant glass fiber and sealed with elastomeric gaskets.	• Ease of jointing helps reduce installation time. • Tight, efficient joints designed to eliminate infiltration and exfiltration. • Costly joint diapers are not required. • Allows for flexible alignment, accommodating changes in line direction with fewer fittings.
Light weight. 1/4 the weight of ductile iron and 1/10 of concrete pipe.	• Easy to install. No need for expensive handling equipment. • Low delivery costs.
Manufactured in long sections up to 12m.	• Fewer joints reduce installation time.
Extremely smooth bore.	• Low friction loss means less pumping energy needed. • Minimum slime build up can help lower cleaning costs.
Pipe specifications meet or exceed worldwide standards.	• Assures high quality product specifications. Easy for engineers to specify Fiberstrong pipe with confidence.
High technology pipe manufacturing system.	• Helps ensure consistent product quality worldwide.

3. USE AND APPLICATION

FIBERSTRONG® GRP 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
Maximum operating pressure (KPa)	100	300	600	1,000	1,200	1,600
Maximum surge pressure (KPa)	140	420	840	1,400	1,680	2,240
Maximum field test pressure (KPa)	150	450	900	1,500	1,800	2,400
Maximum factory test pressure (KPa)	200	600	1,200	2,000	2,400	3,200

B. STIFFNESS CLASSES AND ALLOWABLE VACUUM

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

Stiffness Class (N/M^2)	SN 2500	SN 5000	SN 10000
Minimum Specific Tangential Initial Stiffness STIS = EI/D^3 (N/m^2)	2500	5000	10000
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.

C. BURIAL DEPTH

Minimum Cover Depth** for:

- AASHTO H-20 Loading (m) 1.0
- BS 153 HA Loading (m) 1.5
- Cooper E 80 Railroad (m) 3.0

Maximum Cover Depth*** installed in:

	SN 2500	SN 5000	SN 10000
- Fully compacted gravel (m)	14	16	18
- Fully compacted sand to 90% standard proctor density	8	10	15

** Minimum cover restrictions may be reduced with special installation such as concrete encasement, concrete cover slabs, casting, or other provisions to carry the surface load.

***Maximum allowable cover depth varies with the type of installation and native soil conditions. Refer to the current Future Pipe Industries **FIBERSTRONG® Installation Guide for Underground Pipe System** for installation details.

D. MAXIMUM ALLOWABLE DEFLECTION

Regardless of pipe stiffness or pressure class, the following restrictions apply:

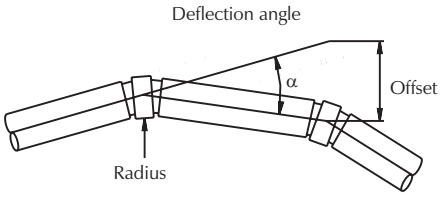
Native soil Blow Count*	>30	16 to 30	8 to 15	4 to 7	1 to 3
Maximum allowable initial vertical deflection (%)	4	3½	3	2½	2
Maximum allowable long-term vertical deflection (%)	5	5	5	5	5

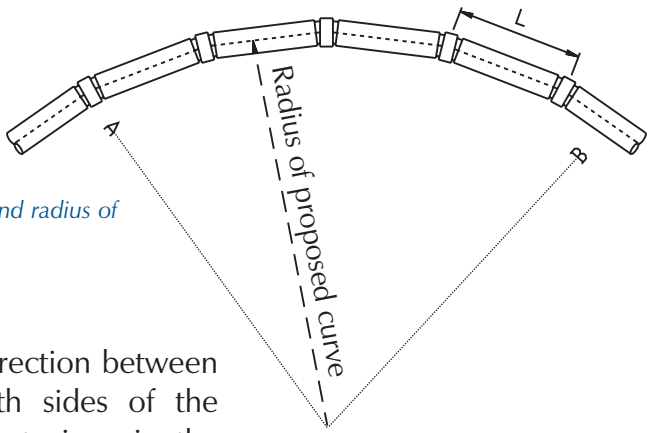
*Blow count shall be determined as per Standard Method for Penetration Test and Split-barrel Sampling of Soil (SPT), ASTM designation: D 1586.

5. JOINTS

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.

A. ALLOWABLE JOINT ANGULAR DEFLECTION





Double bell coupler joint angular deflection, offset and radius of curvature

The maximum angular change of direction between pipe axis (equally distributed at both sides of the coupling) must not exceed the amount given in the following table:

Nominal Pipe Diameter (mm)	Nominal Angular Deflection (α) (degree)	Nominal Offset (mm) Section Lengths			Nominal Radius of Curvature (m) Section Lengths		
		3m	6m	12m	3m	6m	12m
0080 to 0150	4.0	210	420	840	43	86	172
0200 to 0300	3.5	183	367	733	49	98	196
0350 to 0500	3.0	157	314	629	57	115	229
0600 to 0900	2.0	105	210	419	86	172	344
1000 to 1200	1.5	79	157	314	114	229	458
1300 to 1800	1.0	52	105	210	172	344	687
1900 to 3000	0.5	26	52	105	344	687	1375

For larger diameters consult Future Pipe Industries

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, or equivalent may be used for jointing to different pipe materials. Refer to section ***SPIGOT OUTSIDE DIAMETER*** for FIBERSTRONG® pipe O.D's.

C) GRP 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

ASTM D 2992	Standard practice for obtaining hydrostatic or pressure design basis for "Fiberglass" (Glass - Fiber - Reinforced Thermosetting - Resin) pipe and fittings. (Hydrostatic Design Basic (HDB)).
ASTM D 3681	Chemical resistance of "Fiberglass" (Glass - Fiber - Reinforced Thermosetting - Resin) pipe in deflected condition (Strain corrosion performance).
ASTM D 4161	Standard specification for "Fiberglass" (Glass - Fiber - Reinforced Thermosetting - Resin) pipe joint using flexible elastomeric seals.
ASTM D 5365	Standard test method for long term ring - bending strain of "Fiberglass" (Glass - Fiber - Reinforced Thermosetting - Resin) pipe. (Sb)
BS 5480 Appendix L	British standard specification for glass reinforced plastics (GRP) 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.

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 D 2290/D 638/BS 5480
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 C 950 section 5.1.2.1

8. PHYSICAL / MECHANICAL PROPERTIES

A. SPIGOT OUTSIDE DIAMETER

Pipe outside diameter at spigot end; for all stiffness and pressure classes

Nominal Diameter (mm)	Spigot Outside Diameter (mm) $(^{+1}_{-0})$	Nominal Diameter (mm)	Spigot Outside Diameter (mm) $(^{+1}_{-0})$
300	*	2100	2146
350	*	2200	2248
400	412 *	2300	2350
450	463 *	2400	2452
500	514 *	2500	2554
600	616 *	2600	2656
700	718	2700	2758
800	820	2800	2860
900	922	2900	2962
1000	1024	3000	3064
1100	1126	3100	3166
1200	1228	3200	3268
1300	1330	3300	3370
1400	1432	3400	3472
1500	1534	3500	3574
1600	1636	3600	3676
1700	1738	3700	3778
1800	1840	3800	3880
1900	1942	3900	3982
2000	2044	4000	4084

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

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%

*Pipe self-deflection not included

C. SPECIFIC TANGENTIAL INITIAL STIFFNESS (STIS)

Stiffness Class	Minimum STIS* (EI/D^3) Pa	Minimum Pipe Stiffness (PS**) $F/\Delta Y = EI/(0.149\ r^3)$ KPa
SN 2500	2500	124.0
SN 5000	5000	248.0
SN 10000	10000	496.0

* 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:

Property	Design Value
Linear Coefficient of thermal expansion (mm/mm/°C)	25 to 30 x 10^{-6}
Poisson's Ratio	0.25 to 0.3

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

DN	SN 2500 (Kg/m)	SN 5000 (Kg/m)	SN 10000 (Kg/m)	Couplings (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
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

For larger diameters consult Future Pipe Industries

Minimum Strength Requirements

FIBERSTRONG® Pipes are designed to exceed AWWA C950 / ASTM D 3754 minimum strength requirements.

Minimum Circumferential Tensile Capacity (N/mm)

DN	PN 1	PN 3	PN 6	PN 10	PN 12	PN 16
80	53	53	105	158	184	237
100	70	70	140	210	245	315
150	105	105	210	315	368	473
200	140	140	280	420	490	630
250	175	175	350	525	613	788
300	210	210	420	630	735	945
350	245	245	490	735	858	1103
400	280	280	560	840	980	1260
450	315	315	630	945	1103	1418
500	350	350	700	1050	1225	1575
600	420	420	840	1260	1470	1890
700	473	473	945	1418	1654	2127
800	525	525	1050	1575	1838	2363
900	630	630	1260	1890	2205	2835
1000	683	683	1365	2048	2389	3072
1100	735	735	1470	2205	2573	3308
1200	840	840	1680	2520	2940	3780
1300	893	893	1785	2678	3124	4017
1400	945	945	1890	2835	3308	4253
1500	1050	1050	2100	3150	3675	4725
1600	1100	1100	2200	3300	3855	4961
1700	1155	1155	2310	3465	4043	5198
1800	1260	1260	2520	3780	4410	5670
1900	1310	1310	2625	3938	4594	5906
2000	1365	1365	2730	4095	4778	6143
2100	1415	1415	2835	4253	4961	6379
2200	1470	1470	2940	4410	5145	6615
2300	1575	1575	3150	4725	5513	7088
2400	1680	1680	3360	5040	5880	7560
2500	1730	1730	3465	5198	6064	7796
2600	1785	1785	3570	5355	6248	8033
2700	1838	1838	3675	5513	6431	8269
2800	1890	1890	3780	5670	6615	8505
2900	1995	1995	3990	5985	6983	8978
3000	2100	2100	4200	6300	7350	9450

For larger diameters consult Future Pipe Industries

Minimum Strength Requirements (continued)

Minimum Axial Tensile Capacity (N/mm)

DN	PN 1	PN 3	PN 6	PN 10	PN 12	PN 16
80	63	63	63	63	63	63
100	63	63	63	63	63	63
150	63	63	63	63	63	66
200	102	102	102	102	102	102
250	102	102	102	102	102	115
300	102	102	102	113	118	138
350	102	102	102	132	137	160
400	102	102	102	150	157	183
450	102	102	108	160	165	192
500	102	102	118	177	183	213
600	102	102	142	213	220	256
700	102	102	156	239	247	287
800	102	102	167	250	257	296
900	122	122	200	300	308	355
1000	137	137	217	325	333	384
1100	140	140	233	350	359	413
1200	161	161	244	366	382	447
1300	171	171	259	389	406	475
1400	182	182	274	412	430	503
1500	200	200	305	457	477	559
1600	210	210	321	480	501	587
1700	220	220	336	503	525	615
1800	238	238	366	549	573	671
1900	249	249	368	551	577	678
2000	260	260	369	553	581	685
2100	270	270	383	575	603	711
2200	280	280	397	596	626	737
2300	301	301	426	638	670	790
2400	322	322	454	681	715	843
2500	331	331	468	702	737	869
2600	340	340	482	723	760	896
2700	350	350	497	745	782	922
2800	360	360	511	766	805	948
2900	382	382	539	809	849	1001
3000	400	400	567	851	894	1053

For larger diameters consult Future Pipe Industries

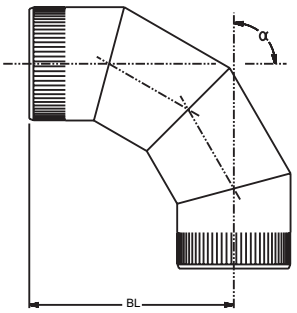
9. FITTINGS

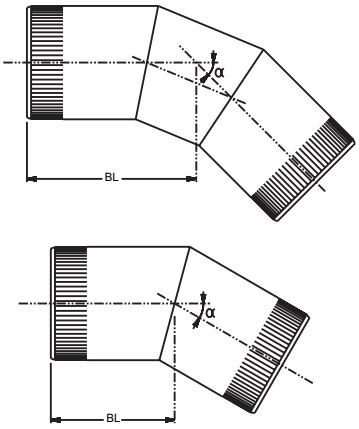
Future Pipe Industries has established a standardized line of GRP fittings. The most common fittings are (Elbows, Reducers, Tees, Wyes and Flanges) and can be supplied either as standard pieces or custom designed spools making it easier for the erection contractor to install.

Fittings are jointed to GRP 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 GRP 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

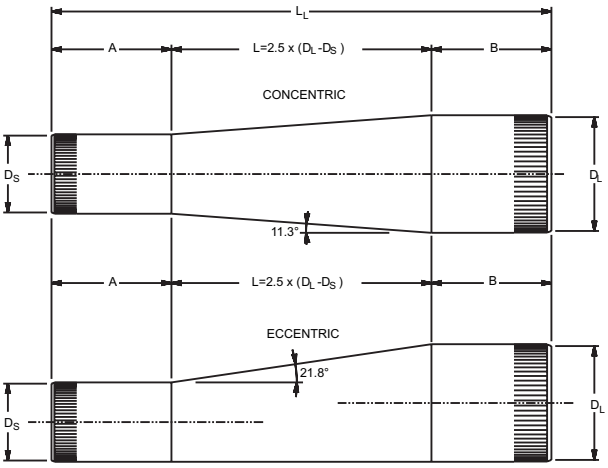




Mitred Elbows.
Effective Laying Length (mm) = BL
The below dimensions are valid for all pressure classes

	α Angle				
	1° to 15°	16° to 30°	31° to 45°	46° to 60°	61° to 90°
DN	# 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	1025
600	375	475	600	700	1075
700	375	475	625	750	1200
800	400	525	700	825	1350
900	425	550	750	900	1475
1000	450	600	800	975	1625
1100	475	625	850	1050	1750
1200	475	650	925	1125	1900
1300	500	700	975	1200	2025
1400	525	725	1025	1275	2175
1500	575	775	1100	1375	2325
1600	575	800	1150	1425	2450
1700	575	825	1175	1475	2550
1800	575	850	1225	1550	2675
1900	600	875	1275	1600	2800
2000	625	900	1325	1700	2950
2100	625	925	1375	1750	3075
2200	625	950	1425	1800	3200
2300	650	975	1475	1875	3325
2400	675	1025	1525	1950	3475
2500	700	1075	1600	2050	3625
2600	725	1125	1675	2125	3775
2700	775	1150	1725	2200	3925
2800	775	1175	1775	2275	4050
2900	800	1225	1850	2350	4200
3000	825	1250	1875	2425	4325

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

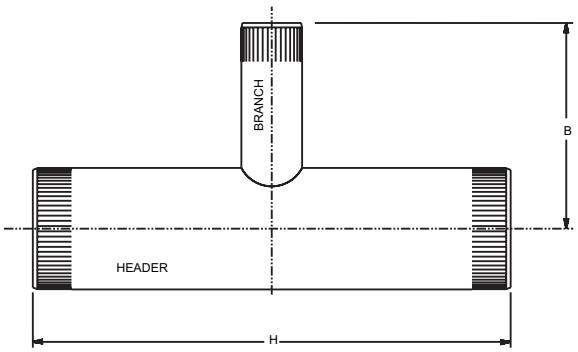
DN Large End D_L (mm)	DN Small End D_S (mm)	Taper Length L (mm)	Pipe Length A (mm)	Pipe Length B (mm)	Laying Length L_L (mm)
100	80	50	200	200	450
150	80	175	200	200	575
	100	125	200	200	525
200	100	250	250	200	700
	150	125	250	200	575
250	150	250	250	200	750
	200	125	250	250	625
300	200	250	350	350	950
	250	125	350	350	825
350	250	250	400	350	1000
	300	125	400	350	875
400	300	250	400	350	1000
	350	125	400	400	925
450	350	250	400	400	1050
	400	125	400	400	925
500	400	250	400	400	1050
	450	125	400	400	925
600	450	375	500	400	1275
	500	250	500	400	1150
700	500	500	500	400	1400
	600	250	500	500	1250
800	600	500	500	500	1500
	700	250	500	500	1250
900	700	500	500	500	1500
	800	250	500	500	1250
1000	800	500	500	500	1500
	900	250	500	500	1250
1100	900	500	500	500	1500
	1000	250	500	500	1250
1200	1000	500	500	500	1500
	1100	250	500	500	1250

REDUCERS (continued)

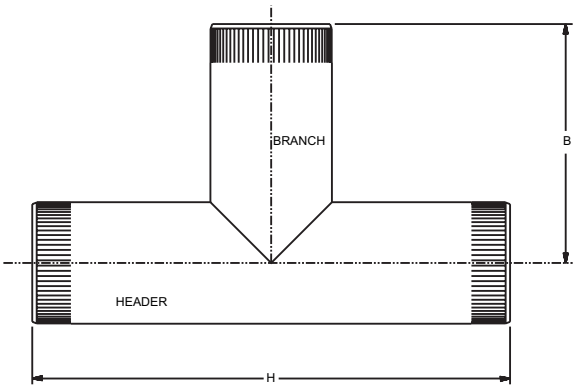
DN Large End D_L (mm)	DN Small End D_s (mm)	Taper Length L (mm)	Pipe Length A (mm)	Pipe Length B (mm)	Laying Length L_L (mm)
1300	1100	500	500	500	1500
	1200	250	500	500	1250
1400	1000	1000	500	500	2000
	1200	500	500	500	1500
	1300	250	500	500	1250
1500	1200	750	500	500	1750
	1300	500	500	500	1500
	1400	250	500	500	1250
1600	1200	1000	600	500	2100
	1400	500	600	500	1600
	1500	250	600	500	1350
1700	1400	750	600	500	1850
	1500	500	600	500	1600
	1600	250	600	600	1450
1800	1500	750	600	500	1850
	1600	500	600	600	1700
	1700	250	600	600	1450
1900	1600	750	600	600	1950
	1700	500	600	600	1700
	1800	250	600	600	1450
2000	1400	1500	600	500	2600
	1600	1000	600	600	2200
	1800	500	600	600	1700
2100	1600	1250	750	600	2600
	1800	750	750	600	2100
	2000	250	750	600	1600
2200	1600	1500	750	600	2850
	1800	1000	750	600	2350
	2000	500	750	600	1850
2300	1800	1250	750	600	2600
	2000	750	750	600	2100
	2200	250	750	750	1750
2400	1800	1500	750	600	2850
	2000	1000	750	600	2350
	2200	500	750	750	2000
2500	2000	1250	750	600	2600
	2200	750	750	750	2250
	2400	250	750	750	1750
2600	2000	1500	750	600	2850
	2200	1000	750	750	2500
	2400	500	750	750	2000
2800	2200	1500	750	750	3000
	2400	1000	750	750	2500
	2600	500	750	750	2000
3000	2400	1500	750	750	3000
	2600	1000	750	750	2500
	2800	500	750	750	2000

Consult Future Pipe Industries for Diameters not mentioned in the above tables

C. TEES



UNEQUAL TEE



EQUAL TEE

		PN 1		PN 6		PN 10		PN 16	
Header DN (mm)	Branch DN (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)
80	80	600	300	600	300	600	300	800	400
100	100	600	300	600	300	600	300	800	400
150	100	600	300	650	350	700	400	900	500
	150	600	300	800	350	800	400	1000	500
200	100	600	350	750	400	900	450	1100	600
	150	600	350	750	450	900	500	1200	600
	200	700	350	850	450	1000	500	1300	650
250	100	600	350	700	450	800	500	1100	600
	150	600	350	800	450	1000	550	1400	700
	200	700	350	900	450	1100	600	1400	750
	250	700	350	950	500	1200	600	1500	750
300	150	800	500	900	550	1050	600	1350	750
	200	850	500	1000	600	1250	700	1600	900
	250	900	500	1050	600	1300	700	1650	900
	300	1000	500	1150	600	1400	700	1750	900
350	150	800	550	950	600	1150	700	1400	850
	200	850	550	1100	650	1350	750	1800	1000
	250	900	550	1150	650	1450	800	1850	1000
	300	1000	550	1200	650	1500	800	1900	1000
	350	1050	550	1250	650	1550	800	1950	1000
400	150	800	550	950	650	1200	750	1550	900
	200	850	550	1000	650	1250	750	1600	950
	250	900	550	1200	700	1500	850	2000	1100
	300	1000	550	1250	700	1600	850	2050	1100
	350	1050	550	1300	700	1650	850	2100	1100
	400	1050	550	1350	700	1650	850	2150	1100
450	200	850	550	1050	650	1350	800	1750	1000
	250	900	550	1250	750	1650	950	2150	1200
	300	1000	550	1350	750	1700	950	2200	1200
	350	1050	550	1400	750	1750	950	2250	1200
	400	1050	550	1450	750	1800	950	2300	1200
	450	1150	600	1500	750	1850	950	2350	1200
500	200	850	600	1100	700	1400	900	1850	1100
	250	900	600	1200	750	1450	900	1900	1100

TEES (Continued)

		PN 1		PN 6		PN 10		PN 16	
Header DN (mm)	Branch DN (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)
500	300	1000	600	1400	800	1800	1000	2400	1300
	350	1050	600	1450	800	1850	1000	2450	1300
	400	1050	600	1450	800	1850	1000	2450	1300
	450	1150	600	1500	800	1900	1000	2500	1300
	500	1200	600	1550	800	1950	1000	2550	1300
600	300	950	650	1100	700	1150	700	1250	750
	400	1050	650	1250	700	1350	750	1450	850
	450	1100	650	1300	750	1400	800	1550	850
	500	1150	650	1400	750	1500	800	1600	850
	600	1300	650	1550	800	1650	850	1850	950
700	300	950	700	1100	750	1200	800	1300	850
	400	1050	700	1250	800	1400	850	1500	900
	450	1100	700	1350	800	1450	850	1600	950
	500	1200	700	1450	800	1550	850	1700	950
	600	1300	700	1550	850	1700	900	1850	1000
	700	1400	700	1700	850	1850	950	2100	1050
800	300	950	750	1100	800	1200	850	1300	900
	400	1050	750	1250	850	1350	850	1450	950
	450	1100	750	1400	850	1500	950	1650	1000
	500	1200	750	1450	850	1550	950	1700	1000
	600	1300	750	1600	900	1750	1000	1900	1050
	700	1400	750	1750	950	1900	1000	2100	1100
	800	1550	800	1850	950	2050	1050	2300	1150
900	300	950	800	1100	850	1200	900	1350	950
	400	1050	800	1250	900	1350	950	1500	1000
	450	1100	800	1350	900	1450	950	1550	1000
	500	1200	800	1450	950	1600	1000	1800	1100
	600	1300	800	1650	1000	1750	1050	1950	1150
	700	1450	850	1750	1000	1900	1100	2100	1150
	800	1550	850	1900	1000	2100	1100	2300	1200
	900	1700	850	2050	1050	2200	1100	2550	1300
1000	300	950	850	1150	950	1250	1000	1350	1050
	400	1050	850	1300	950	1400	1000	1500	1050
	450	1100	850	1350	950	1500	1000	1600	1100
	500	1200	850	1450	1000	1550	1050	1700	1100
	600	1300	850	1650	1050	1800	1100	2000	1200
	700	1450	900	1800	1050	1950	1150	2200	1250
	800	1600	900	1950	1100	2100	1200	2350	1300
	900	1700	900	2050	1100	2250	1200	2550	1350
	1000	1800	900	2200	1100	2400	1200	2750	1400
1100	300	950	900	1150	1000	1300	1050	1350	1100
	400	1050	900	1300	1000	1450	1100	1550	1150
	450	1100	900	1400	1050	1500	1100	1650	1150
	500	1200	900	1450	1050	1600	1100	1750	1200
	600	1350	950	1650	1100	1850	1200	2050	1300

TEES (Continued)

		PN 1		PN 6		PN 10		PN 16	
Header DN (mm)	Branch DN (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)
1100	700	1450	950	1850	1150	2000	1200	2200	1300
	800	1600	950	1950	1150	2150	1250	2400	1350
	900	1700	950	2100	1150	2300	1250	2550	1400
	1000	1800	950	2250	1200	2450	1300	2750	1450
	1100	1900	950	2400	1200	2600	1300	3000	1500
1200	300	950	950	1200	1050	1300	1100	1400	1150
	400	1050	950	1350	1100	1450	1150	1600	1200
	450	1100	950	1400	1100	1550	1150	1650	1200
	500	1200	950	1450	1100	1600	1150	1800	1250
	600	1300	950	1650	1150	1750	1200	1950	1300
	700	1500	1000	1850	1200	2050	1300	2250	1400
	800	1600	1000	2000	1200	2200	1300	2450	1450
	900	1700	1000	2150	1250	2350	1350	2600	1450
	1000	1800	1000	2300	1250	2500	1350	2750	1500
	1100	1950	1050	2450	1300	2650	1400	3000	1550
	1200	2050	1050	2550	1300	2800	1400	3200	1600
1300	300	950	1000	1200	1100	1300	1150	1450	1250
	400	1050	1000	1350	1150	1450	1200	1600	1250
	450	1100	1000	1400	1150	1550	1200	1700	1300
	500	1200	1000	1500	1150	1600	1250	1800	1300
	600	1300	1000	1650	1200	1800	1250	2000	1350
	700	1500	1050	1850	1250	2100	1350	2300	1450
	800	1600	1050	2050	1300	2200	1400	2450	1500
	900	1700	1050	2150	1300	2400	1400	2650	1550
	1000	1850	1100	2350	1350	2550	1450	2800	1550
	1100	1950	1100	2450	1350	2700	1450	3000	1600
	1200	2100	1100	2600	1350	2850	1500	3250	1700
	1300	2200	1100	2750	1400	3000	1500	3450	1750
1400	300	1000	1050	1200	1150	1300	1200	1450	1300
	400	1050	1050	1350	1200	1500	1250	1650	1350
	450	1150	1050	1450	1200	1550	1300	1750	1350
	500	1200	1050	1500	1200	1650	1300	1850	1400
	600	1350	1100	1650	1250	1800	1350	2000	1450
	700	1450	1100	1800	1250	2000	1350	2200	1450
	800	1600	1100	2050	1350	2300	1450	2500	1550
	900	1750	1150	2200	1350	2400	1500	2700	1600
	1000	1850	1150	2350	1400	2600	1500	2850	1650
	1100	2000	1150	2500	1400	2750	1550	3050	1700
	1200	2100	1150	2650	1450	2900	1550	3250	1750
	1300	2200	1150	2750	1450	3050	1600	3450	1800
	1400	2300	1150	2900	1450	3200	1600	3650	1850
1500	300	1000	1100	1200	1200	1350	1300	1450	1350
	400	1100	1100	1350	1250	1500	1350	1700	1400
	450	1150	1100	1450	1250	1600	1350	1750	1400

TEES (Continued)

		PN 1		PN 6		PN 10		PN 16	
Header DN (mm)	Branch DN (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)
1500	500	1200	1100	1550	1300	1700	1350	1850	1450
	600	1350	1150	1700	1300	1850	1400	2050	1500
	700	1450	1150	1850	1350	2000	1450	2200	1550
	800	1600	1150	2100	1400	2300	1550	2550	1650
	900	1750	1200	2200	1450	2450	1550	2750	1700
	1000	1850	1200	2350	1450	2600	1550	2900	1700
	1100	2000	1200	2500	1500	2800	1600	3100	1750
	1200	2100	1200	2650	1500	2950	1650	3250	1800
	1300	2200	1200	2800	1500	3100	1650	3450	1850
	1400	2350	1250	2950	1550	3250	1700	3650	1900
	1500	2450	1250	3050	1550	3400	1700	3900	1950
1600	300	1000	1150	1250	1300	1350	1350	1500	1400
	400	1100	1150	1400	1300	1500	1400	1700	1450
	450	1150	1150	1500	1350	1600	1400	1800	1500
	500	1200	1150	1550	1350	1700	1400	1900	1500
	600	1350	1200	1700	1350	1900	1450	2100	1550
	700	1500	1200	1850	1400	2050	1500	2250	1600
	800	1600	1200	2000	1400	2200	1500	2450	1650
	900	1750	1250	2250	1500	2500	1650	2800	1750
	1000	1900	1250	2400	1500	2650	1650	2950	1800
	1100	2000	1250	2550	1550	2800	1650	3150	1850
	1200	2100	1250	2700	1550	3000	1700	3300	1850
	1300	2200	1250	2800	1600	3100	1700	3450	1900
	1400	2350	1300	2950	1600	3300	1750	3700	1950
	1500	2450	1300	3100	1650	3400	1750	3900	2000
	1600	2600	1300	3250	1650	3600	1800	4100	2050
1700	300	1000	1200	1250	1350	1350	1400	1550	1500
	400	1100	1200	1400	1350	1550	1450	1700	1550
	450	1150	1200	1500	1400	1650	1450	1850	1550
	500	1250	1250	1550	1400	1700	1500	1900	1550
	600	1350	1250	1750	1450	1900	1500	2100	1650
	700	1500	1250	1850	1450	2050	1550	2300	1650
	800	1600	1300	2050	1500	2200	1600	2450	1700
	900	1800	1300	2300	1550	2550	1700	2850	1850
	1000	1900	1300	2400	1600	2700	1700	3000	1850
	1100	2000	1300	2600	1600	2850	1750	3200	1900
	1200	2100	1300	2700	1650	3000	1750	3350	1950
	1300	2250	1350	2850	1650	3200	1800	3550	2000
	1400	2350	1350	3000	1650	3300	1800	3700	2000
	1500	2500	1350	3150	1700	3500	1850	3900	2100
	1600	2600	1350	3300	1700	3600	1850	4100	2100
	1700	2700	1350	3400	1700	3800	1900	4350	2200
1800	300	1000	1250	1250	1400	1400	1400	1550	1550
	400	1100	1250	1450	1450	1550	1550	1750	1600

TEES (Continued)

		PN 1		PN 6		PN 10		PN 16	
Header DN (mm)	Branch DN (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)
1800	450	1150	1250	1500	1450	1650	1550	1850	1600
	500	1250	1300	1600	1450	1750	1550	1950	1650
	600	1350	1300	1750	1500	1900	1600	2150	1700
	700	1500	1300	1900	1500	2100	1600	2300	1750
	800	1600	1350	2050	1550	2250	1650	2500	1800
	900	1700	1350	2200	1550	2400	1700	2650	1800
	1000	1900	1400	2450	1650	2750	1800	3050	1950
	1100	2000	1400	2600	1650	2900	1800	3250	2000
	1200	2150	1400	2750	1700	3050	1850	3400	2000
	1300	2250	1400	2900	1700	3200	1850	3550	2050
	1400	2400	1400	3000	1750	3350	1900	3750	2100
	1500	2500	1400	3200	1750	3500	1900	3900	2150
	1600	2600	1400	3300	1800	3650	1950	4150	2200
	1700	2700	1400	3450	1800	3800	1950	4350	2250
	1800	2850	1450	3600	1800	3950	2000	4600	2300
1900	300	1000	1300	1300	1450	1400	1500	1550	1600
	400	1100	1300	1450	1500	1600	1550	1800	1650
	450	1200	1350	1500	1500	1650	1600	1850	1700
	500	1250	1350	1600	1500	1750	1600	2000	1700
	600	1350	1350	1750	1550	1950	1650	2150	1750
	700	1500	1350	1900	1550	2100	1700	2350	1800
	800	1600	1400	2050	1600	2300	1700	2550	1850
	900	1750	1400	2200	1600	2450	1750	2700	1850
	1000	1900	1450	2500	1700	2750	1850	3100	2000
	1100	2000	1450	2600	1750	2950	1900	3250	2050
	1200	2150	1450	2800	1750	3050	1900	3450	2100
	1300	2300	1450	2900	1800	3250	1950	3600	2150
	1400	2400	1450	3050	1800	3400	1950	3800	2150
	1500	2500	1450	3200	1850	3550	2000	3950	2200
	1600	2600	1450	3350	1850	3700	2000	4150	2250
	1700	2750	1500	3500	1850	3850	2050	4350	2300
	1800	2850	1500	3600	1850	4000	2050	4600	2350
	1900	3000	1500	3750	1900	4150	2100	4800	2400
2000	300	1000	1350	1300	1500	1450	1600	1600	1650
	400	1100	1350	1450	1550	1600	1600	1800	1700
	450	1200	1400	1550	1550	1700	1650	1900	1750
	500	1250	1400	1600	1600	1800	1650	2000	1750
	600	1350	1400	1750	1600	1950	1700	2200	1850
	700	1500	1450	1900	1650	2150	1750	2350	1850
	800	1600	1450	2100	1650	2300	1800	2550	1900
	900	1750	1450	2200	1700	2450	1800	2750	1950
	1000	1850	1450	2350	1700	2600	1850	2900	1950
	1100	2050	1500	2650	1800	2950	1950	3300	2150
	1200	2150	1500	2800	1850	3100	1950	3500	2150

TEES (Continued)

		PN 1		PN 6		PN 10		PN 16	
Header DN (mm)	Branch DN (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)
2000	1300	2300	1500	2950	1850	3250	2000	3650	2200
	1400	2400	1550	3100	1850	3450	2050	3850	2250
	1500	2500	1550	3250	1900	3600	2050	4000	2300
	1600	2650	1550	3400	1900	3750	2100	4200	2300
	1700	2750	1550	3500	1950	3900	2100	4400	2350
	1800	2900	1550	3650	1950	4050	2150	4600	2400
	1900	3000	1550	3800	1950	4200	2150	4800	2450
	2000	3100	1550	3900	1950	4350	2200	5050	2550
2200	300	1000	1500	1300	1600	1450	1700	1650	1800
	400	1150	1500	1450	1650	1650	1750	1850	1850
	450	1200	1500	1550	1650	1750	1750	1900	1850
	500	1250	1500	1600	1700	1800	1800	2050	1900
	600	1350	1500	1800	1700	2000	1850	2250	1950
	700	1500	1550	1950	1750	2200	1850	2450	2000
	800	1650	1550	2100	1800	2350	1900	2650	2050
	900	1750	1550	2250	1800	2500	1950	2800	2100
	1000	1900	1550	2400	1850	2700	1950	3000	2100
	1100	2000	1600	2550	1850	2850	2000	3150	2150
	1200	2200	1600	2850	1950	3200	2100	3600	2300
	1300	2300	1650	3000	2000	3350	2150	3750	2350
	1400	2400	1650	3150	2000	3500	2150	3900	2400
	1500	2550	1650	3300	2000	3650	2200	4100	2450
	1600	2650	1650	3450	2050	3850	2250	4300	2450
	1700	2800	1650	3600	2050	3950	2250	4450	2500
	1800	2900	1650	3700	2100	4150	2300	4600	2500
	1900	3000	1700	3850	2100	4300	2300	4800	2550
	2000	3100	1700	4000	2100	4450	2350	5050	2650
	2100	3250	1700	4150	2150	4550	2350	5250	2700
	2200	3350	1700	4300	2150	4750	2400	5500	2750
2400	300	1000	1600	1350	1750	1450	1800	1650	1900
	400	1150	1600	1500	1750	1700	1850	1850	1950
	450	1200	1600	1550	1800	1750	1900	2000	2000
	500	1250	1600	1650	1800	1850	1900	2100	2050
	600	1400	1650	1800	1850	2050	1950	2300	2100
	700	1550	1650	2000	1850	2200	2000	2500	2150
	800	1650	1650	2150	1900	2400	2050	2700	2200
	900	1800	1650	2300	1900	2600	2050	2850	2200
	1000	1900	1700	2450	1950	2750	2100	3050	2250
	1100	2000	1700	2600	1950	2900	2100	3250	2300
	1200	2150	1700	2750	2000	3050	2150	3400	2300
	1300	2300	1750	3050	2100	3450	2300	3850	2500
	1400	2450	1750	3200	2150	3600	2300	4000	2550
	1500	2600	1750	3350	2150	3750	2350	4200	2600
	1600	2700	1750	3500	2200	3900	2350	4400	2600

TEES (Continued)

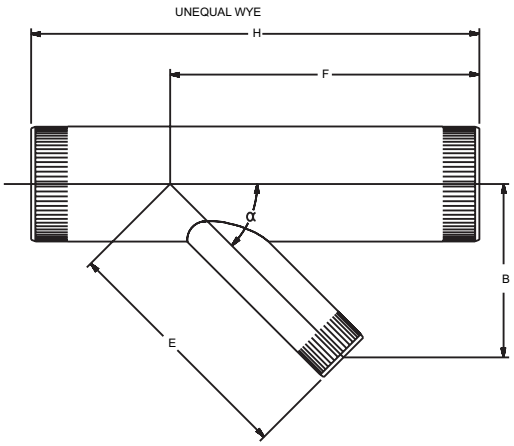
		PN 1		PN 6		PN 10		PN 16	
Header DN (mm)	Branch DN (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)
2400	1700	2800	1800	3650	2200	4050	2400	4550	2650
	1800	2900	1800	3800	2200	4200	2400	4700	2650
	1900	3050	1800	3900	2250	4350	2450	4900	2700
	2000	3150	1800	4100	2250	4550	2500	5050	2750
	2100	3300	1800	4200	2250	4650	2500	5250	2800
	2200	3400	1800	4350	2300	4850	2550	5500	2850
	2300	3500	1850	4500	2300	4950	2550	5750	2950
	2400	3650	1850	4600	2300	5150	2600	5950	3000
2600	300	1000	1700	1350	1850	1500	1900		
	400	1150	1700	1500	1900	1700	2000		
	450	1200	1700	1600	1900	1800	2000		
	500	1250	1700	1700	1900	1900	2050		
	600	1400	1750	1850	1950	2100	2050		
	700	1550	1750	2000	2000	2300	2100		
	800	1650	1750	2200	2000	2450	2150		
	900	1800	1750	2350	2050	2600	2200		
	1000	1900	1800	2500	2050	2750	2200		
	1100	2050	1800	2650	2100	2950	2250		
	1200	2150	1800	2800	2100	3100	2300		
	1300	2300	1800	2900	2150	3250	2300		
	1400	2500	1850	3250	2250	3650	2450		
	1500	2600	1850	3400	2300	3850	2500		
	1600	2700	1900	3550	2300	3950	2500		
	1700	2800	1900	3700	2350	4150	2550		
	1800	2950	1900	3850	2350	4300	2550		
	1900	3050	1900	4000	2350	4450	2600		
	2000	3200	1900	4150	2400	4600	2600		
	2100	3300	1900	4300	2400	4750	2650		
	2200	3400	1950	4400	2400	4900	2650		
	2300	3500	1950	4550	2450	5050	2700		
	2400	3650	1950	4700	2450	5200	2700		
	2500	3750	1950	4850	2500	5350	2750		
	2600	3900	1950	5000	2500	5500	2750		
2800	300	1050	1800	1350	1950	1550	2050		
	400	1150	1800	1550	2000	1750	2100		
	450	1200	1800	1650	2000	1850	2100		
	500	1300	1850	1700	2050	1950	2150		
	600	1450	1850	1900	2100	2100	2200		
	700	1550	1850	2050	2100	2300	2250		
	800	1650	1850	2200	2150	2450	2250		
	900	1800	1900	2400	2150	2650	2300		
	1000	1950	1900	2500	2200	2850	2350		
	1100	2050	1900	2700	2200	3000	2400		
	1200	2200	1900	2800	2250	3150	2400		

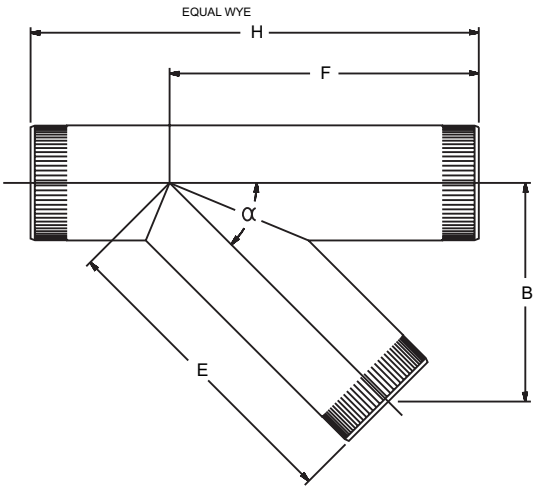
TEES (Continued)

Header DN (mm)	Branch DN (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)	[H] Header Length (mm)	[B] Branch Length (mm)
2800	1300	2300	1900	3000	2250	3300	2450		
	1400	2400	1950	3100	2300	3450	2450		
	1500	2600	2000	3500	2400	3900	2600		
	1600	2700	2000	3600	2450	4050	2650		
	1700	2850	2000	3750	2450	4200	2650		
	1800	3000	2000	3900	2500	4350	2700		
	1900	3100	2000	4050	2500	4500	2750		
	2000	3200	2050	4200	2550	4700	2750		
	2100	3300	2050	4350	2550	4800	2800		
	2200	3450	2050	4500	2550	5000	2800		
	2300	3550	2050	4600	2550	5150	2850		
	2400	3700	2050	4750	2600	5300	2850		
	2500	3800	2050	4900	2600	5450	2900		
	2600	3950	2100	5050	2650	5600	2900		
	2700	3950	2100	5100	2650	5650	2950		
	2800	4150	2100	5300	2650	5900	2950		
3000	300	1050	1900	1400	2100	1550	2150		
	400	1150	1900	1550	2100	1750	2200		
	450	1250	1950	1650	2150	1850	2250		
	500	1300	1950	1750	2150	2000	2250		
	600	1450	1950	1900	2200	2150	2300		
	700	1550	1950	2100	2250	2350	2350		
	800	1700	2000	2250	2250	2550	2400		
	900	1800	2000	2400	2300	2700	2450		
	1000	1950	2000	2550	2300	2850	2450		
	1100	2100	2000	2700	2350	3050	2500		
	1200	2200	2000	2900	2350	3200	2550		
	1300	2300	2050	3000	2400	3350	2550		
	1400	2400	2050	3200	2400	3550	2600		
	1500	2550	2050	3300	2450	3700	2650		
	1600	2750	2100	3650	2550	4100	2800		
	1700	2900	2100	3800	2600	4300	2800		
	1800	3000	2100	3950	2600	4400	2850		
	1900	3100	2150	4100	2650	4600	2850		
	2000	3200	2150	4250	2650	4750	2900		
	2100	3350	2150	4400	2700	4900	2950		
	2200	3500	2150	4550	2700	5050	2950		
	2300	3600	2150	4700	2700	5200	3000		
	2400	3700	2200	4800	2700	5400	3000		
	2500	3800	2200	5000	2750	5500	3050		
	2600	3950	2200	5100	2750	5700	3050		
	2700	3950	2200	5250	2800	5800	3100		
	2800	4200	2200	5350	2800	5900	3100		
	2900	4300	2200	5450	2800	6000	3100		
	3000	4400	2200	5550	2800	6150	3100		

Consult Future Pipe Industries for Diameters not mentioned in the above tables

D. WYES (PN1)





Standard Dimensions for 45° Wyes

Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
80	80	800	424	300	424
100	80	800	438	325	434
	100	800	448	325	448
150	80	800	473	350	459
	100	800	483	350	473
	150	900	508	375	508
200	100	800	522	375	500
	150	900	547	400	536
	200	950	575	425	575
250	100	800	561	400	528
	150	900	586	425	563
	200	950	613	450	602
	250	1050	641	475	641
300	150	900	625	450	589
	200	950	650	475	625
	250	1000	676	500	662
	300	1100	710	525	710
350	150	900	661	475	615
	200	950	687	500	651

Standard Dimensions for 60° Wyes

[H] Header Length	[E] Branch Length	B (mm)	F (mm)
750	445	400	393
750	456	400	399
800	474	425	410
750	485	425	413
800	503	450	425
850	546	475	454
800	534	475	441
850	578	525	469
900	625	550	501
800	566	500	456
850	609	550	485
900	657	575	517
950	705	625	549
850	639	575	500
900	683	600	529
950	728	650	559
1050	787	700	598
850	669	600	515
900	713	625	544

WYES (Continued)

		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
350	250	1000	713	525	688	950	758	675	574
	300	1100	747	550	736	1050	817	725	613
	350	1250	793	575	793	1100	862	750	643
400	150	900	685	500	632	850	689	600	525
	200	950	711	525	668	900	733	650	554
	250	1000	737	525	705	950	778	675	584
	300	1150	791	575	773	1050	837	725	623
	350	1250	817	600	810	1100	882	775	653
	400	1300	854	625	854	1150	931	825	693
450	200	950	747	550	694	900	762	675	569
	250	1050	793	575	750	950	807	700	598
	300	1150	827	600	798	1050	866	775	638
	350	1250	853	625	835	1150	931	825	688
	400	1300	890	650	879	1150	961	850	707
	450	1400	915	650	915	1250	1005	875	737
500	200	950	784	575	720	900	792	700	584
	250	1000	809	575	756	950	837	750	614
	300	1150	863	625	824	1050	896	800	653
	350	1250	909	650	881	1150	961	850	703
	400	1300	926	675	905	1150	991	875	722
	450	1450	972	700	961	1250	1055	925	772
	500	1500	998	725	998	1350	1100	975	802
600	300	1100	896	650	835	1000	935	825	662
	400	1250	955	675	912	1150	1026	900	728
	450	1350	996	725	964	1200	1070	950	757
	500	1400	1022	725	1001	1250	1115	975	787
	600	1600	1096	800	1096	1400	1226	1075	869
700	300	1100	968	700	886	1000	994	875	692
	400	1300	1043	750	979	1150	1084	950	757
	450	1350	1068	775	1015	1200	1129	1000	787
	500	1450	1110	800	1068	1300	1190	1050	833
	600	1600	1168	850	1147	1400	1285	1125	899
	700	1800	1235	875	1235	1550	1389	1225	974
800	300	1100	1056	750	953	1000	1053	925	721
	400	1250	1099	800	1014	1150	1143	1000	787
	450	1400	1156	825	1082	1250	1203	1050	832
	500	1450	1182	850	1119	1300	1249	1100	862
	600	1650	1256	900	1214	1450	1360	1200	944
	700	1800	1323	950	1302	1550	1448	1275	1003
	800	1950	1374	975	1374	1700	1553	1350	1078
900	300	1100	1128	800	1004	1000	1112	975	751
	400	1300	1187	850	1081	1150	1202	1050	816
	450	1350	1212	875	1117	1200	1246	1100	846
	500	1500	1270	900	1186	1300	1307	1150	892
	600	1650	1328	950	1265	1450	1419	1250	974

WYES (Continued)

		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
900	700	1800	1395	1000	1353	1600	1523	1325	1048
	800	2000	1462	1050	1441	1700	1611	1400	1107
	900	2150	1513	1075	1513	1850	1716	1500	1182
1000	300	1100	1200	850	1055	1000	1171	1025	780
	400	1300	1259	900	1132	1150	1261	1100	846
	450	1400	1301	925	1184	1200	1305	1150	875
	500	1450	1327	950	1221	1300	1366	1200	921
	600	1650	1417	1025	1332	1450	1478	1300	1003
	700	1850	1484	1050	1420	1600	1582	1375	1078
	800	2000	1535	1100	1492	1750	1686	1475	1153
	900	2150	1602	1150	1580	1850	1775	1550	1212
	1000	2350	1669	1200	1669	2000	1879	1650	1287
1100	300	1150	1288	925	1122	1050	1246	1100	825
	400	1300	1331	950	1183	1150	1320	1150	875
	450	1400	1373	975	1235	1250	1380	1200	921
	500	1450	1399	1000	1272	1300	1425	1250	951
	600	1650	1489	1075	1383	1450	1553	1350	1048
	700	1850	1556	1125	1471	1600	1657	1450	1123
	800	2000	1623	1150	1559	1750	1745	1525	1182
	900	2200	1690	1200	1647	1900	1850	1625	1257
	1000	2350	1741	1250	1720	2000	1938	1700	1316
	1100	2500	1808	1300	1808	2150	2042	1775	1391
1200	300	1150	1360	975	1173	1050	1304	1150	855
	400	1300	1419	1025	1250	1150	1395	1225	921
	450	1400	1445	1025	1286	1250	1439	1250	950
	500	1500	1487	1075	1339	1300	1484	1300	980
	600	1650	1545	1100	1418	1450	1595	1400	1062
	700	1850	1644	1175	1538	1600	1716	1500	1153
	800	2000	1695	1200	1610	1750	1820	1600	1228
	900	2200	1762	1250	1698	1900	1908	1675	1287
	1000	2350	1829	1300	1787	2050	2013	1750	1362
	1100	2500	1880	1350	1859	2150	2101	1825	1420
	1200	2700	1947	1400	1947	2300	2205	1925	1495
1300	300	1150	1433	1025	1224	1050	1363	1200	884
	400	1300	1492	1075	1301	1150	1454	1275	950
	450	1400	1533	1100	1353	1250	1498	1300	979
	500	1500	1559	1125	1390	1300	1559	1375	1025
	600	1650	1633	1175	1485	1450	1654	1450	1091
	700	1850	1716	1225	1589	1600	1775	1550	1182
	800	2050	1783	1275	1677	1750	1879	1650	1257
	900	2200	1850	1325	1765	1900	1983	1725	1332
	1000	2350	1901	1350	1838	2050	2072	1800	1391
	1100	2550	1968	1400	1926	2200	2176	1900	1466
	1200	2700	2035	1450	2014	2300	2264	1975	1525
	1300	2850	2086	1500	2086	2450	2369	2075	1600

WYES (Continued)

		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
1400	300	1150	1505	1075	1275	1050	1422	1250	914
	400	1300	1564	1125	1352	1150	1513	1325	979
	450	1400	1605	1150	1404	1250	1573	1375	1025
	500	1500	1631	1175	1441	1300	1618	1425	1055
	600	1650	1705	1225	1536	1450	1729	1500	1137
	700	1850	1772	1275	1624	1600	1818	1575	1196
	800	2050	1855	1325	1728	1750	1938	1700	1287
	900	2200	1922	1375	1816	1900	2042	1775	1361
	1000	2400	1989	1425	1905	2050	2147	1875	1436
	1100	2600	2056	1475	1993	2200	2235	1950	1495
	1200	2700	2107	1500	2065	2350	2339	2050	1570
	1300	2900	2174	1550	2153	2450	2428	2125	1629
	1400	3050	2225	1575	2225	2600	2532	2200	1704
1500	300	1200	1593	1150	1342	1050	1481	1300	943
	400	1350	1652	1175	1419	1150	1572	1375	1009
	450	1400	1677	1200	1455	1250	1632	1425	1054
	500	1500	1719	1225	1508	1300	1677	1475	1084
	600	1650	1777	1275	1587	1450	1788	1550	1166
	700	1850	1844	1325	1675	1600	1892	1650	1241
	800	2100	1943	1375	1795	1800	2013	1750	1332
	900	2250	2010	1425	1883	1900	2101	1825	1391
	1000	2400	2061	1475	1956	2050	2205	1925	1466
	1100	2600	2128	1525	2044	2200	2310	2025	1541
	1200	2750	2195	1575	2132	2350	2398	2100	1600
	1300	2900	2246	1600	2204	2500	2502	2175	1675
	1400	3050	2313	1650	2292	2600	2591	2250	1733
	1500	3250	2380	1700	2380	2750	2695	2350	1808
1600	300	1200	1665	1200	1393	1050	1556	1350	989
	400	1350	1724	1225	1470	1200	1646	1450	1054
	450	1400	1749	1250	1506	1250	1691	1475	1084
	500	1500	1791	1275	1559	1300	1736	1525	1114
	600	1700	1865	1325	1654	1450	1847	1600	1196
	700	1850	1932	1375	1742	1600	1951	1700	1271
	800	2000	1983	1425	1814	1750	2056	1800	1345
	900	2250	2082	1475	1934	1950	2176	1900	1436
	1000	2450	2149	1525	2023	2050	2264	1975	1495
	1100	2600	2216	1575	2111	2200	2369	2075	1570
	1200	2750	2267	1625	2183	2350	2473	2150	1645
	1300	2950	2334	1675	2271	2500	2561	2225	1704
	1400	3100	2401	1700	2359	2650	2666	2325	1779
	1500	3250	2452	1750	2431	2750	2754	2400	1838
	1600	3450	2519	1800	2519	2900	2858	2500	1913
1700	300	1200	1737	1250	1444	1050	1615	1400	1018
	400	1350	1796	1275	1521	1200	1705	1500	1084
	450	1450	1838	1300	1573	1250	1750	1525	1113

WYES (Continued)

		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
1700	500	1500	1864	1325	1610	1350	1811	1575	1159
	600	1700	1938	1375	1705	1450	1906	1675	1225
	700	1850	2005	1425	1793	1600	2010	1750	1300
	800	2050	2072	1475	1881	1750	2115	1850	1375
	900	2300	2171	1550	2001	1950	2235	1950	1466
	1000	2450	2222	1575	2074	2100	2339	2050	1541
	1100	2600	2289	1625	2162	2250	2444	2125	1616
	1200	2800	2356	1675	2250	2350	2532	2200	1675
	1300	2950	2423	1725	2338	2500	2636	2300	1749
	1400	3100	2474	1750	2410	2650	2725	2375	1808
	1500	3300	2541	1800	2498	2800	2829	2450	1883
	1600	3450	2608	1850	2586	2900	2917	2550	1942
	1700	3600	2659	1900	2659	3050	3022	2625	2017
1800	300	1200	1809	1300	1495	1050	1674	1450	1048
	400	1350	1868	1325	1572	1200	1764	1550	1113
	450	1450	1910	1375	1624	1300	1824	1600	1159
	500	1500	1936	1375	1661	1350	1869	1625	1189
	600	1700	2010	1425	1756	1500	1981	1725	1271
	700	1850	2077	1475	1844	1600	2069	1800	1329
	800	2050	2144	1525	1932	1750	2173	1900	1404
	900	2200	2211	1575	2020	1900	2278	1975	1479
	1000	2450	2310	1650	2141	2100	2398	2100	1570
	1100	2650	2377	1700	2229	2250	2502	2175	1645
	1200	2800	2428	1725	2301	2400	2607	2275	1720
	1300	2950	2495	1775	2389	2500	2695	2350	1779
	1400	3150	2562	1825	2477	2650	2799	2425	1854
	1500	3300	2613	1850	2549	2800	2888	2525	1913
	1600	3450	2680	1900	2637	2950	2992	2600	1988
	1700	3650	2747	1950	2726	3050	3080	2675	2046
	1800	3800	2798	2000	2798	3200	3185	2775	2121
1900	300	1200	1881	1350	1546	1050	1733	1525	1077
	400	1350	1956	1400	1639	1200	1823	1600	1143
	450	1450	1982	1425	1675	1300	1883	1650	1188
	500	1550	2024	1450	1728	1350	1928	1675	1218
	600	1750	2098	1500	1823	1500	2040	1775	1300
	700	1900	2165	1550	1911	1650	2144	1875	1375
	800	2050	2216	1575	1983	1750	2232	1950	1434
	900	2200	2283	1625	2071	1900	2337	2025	1509
	1000	2450	2382	1700	2192	2150	2473	2150	1616
	1100	2650	2449	1750	2280	2250	2561	2225	1675
	1200	2800	2516	1800	2368	2400	2666	2325	1749
	1300	3000	2583	1850	2456	2550	2770	2400	1824
	1400	3150	2634	1875	2528	2650	2858	2500	1883
	1500	3300	2701	1925	2616	2800	2963	2575	1958
	1600	3500	2768	1975	2704	2950	3051	2650	2017

WYES (Continued)

		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
1900	1700	3650	2819	2000	2777	3100	3155	2750	2092
	1800	3800	2886	2050	2865	3200	3244	2825	2151
	1900	4000	2953	2100	2953	3350	3348	2900	2226
2000	300	1200	1970	1400	1613	1050	1792	1575	1106
	400	1350	2029	1450	1690	1200	1882	1650	1172
	450	1450	2054	1475	1726	1300	1942	1700	1218
	500	1550	2096	1500	1779	1350	1987	1725	1248
	600	1750	2170	1550	1874	1500	2099	1825	1329
	700	1900	2237	1600	1962	1650	2203	1925	1404
	800	2100	2304	1650	2050	1800	2307	2000	1479
	900	2250	2371	1700	2138	1900	2396	2075	1538
	1000	2400	2422	1725	2211	2050	2500	2175	1613
	1100	2650	2521	1800	2331	2300	2636	2300	1720
	1200	2800	2588	1850	2419	2400	2725	2375	2375
	1300	3000	2655	1900	2507	2550	2829	2450	2450
	1400	3150	2722	1925	2595	2700	2933	2550	2550
	1500	3350	2789	1975	2683	2800	3022	2625	2625
	1600	3500	2840	2025	2755	2950	3126	2725	2725
	1700	3650	2907	2075	2844	3100	3214	2800	2800
	1800	3850	2974	2125	2932	3250	3319	2875	2875
	1900	4000	3025	2150	3004	3400	3423	2975	2975
	2000	4150	3092	2200	3092	3500	3511	3050	3050
2200	300	1200	2114	1500	1715	1100	1925	1675	1675
	400	1350	2173	1550	1792	1250	2016	1750	1247
	450	1500	2214	1575	1844	1300	2060	1800	1276
	500	1600	2256	1600	1897	1400	2121	1850	1322
	600	1750	2330	1650	1992	1550	2232	1950	1404
	700	1950	2397	1700	2080	1700	2337	2025	1479
	800	2100	2448	1750	2152	1800	2425	2125	1538
	900	2250	2515	1800	2240	1950	2529	2200	1613
	1000	2450	2582	1850	2329	2100	2634	2300	1688
	1100	2600	2649	1875	2417	2200	2722	2375	1747
	1200	2850	2748	1950	2537	2450	2858	2500	1854
	1300	3050	2815	2000	2625	2600	2963	2575	1929
	1400	3200	2882	2050	2713	2750	3067	2675	2004
	1500	3400	2949	2100	2801	2850	3155	2750	2062
	1600	3500	3000	2125	2873	3000	3260	2825	2137
	1700	3700	3067	2175	2962	3100	3348	2900	2196
	1800	3850	3134	2225	3050	3250	3452	3000	2271
	1900	4000	3185	2275	3122	3400	3541	3075	2330
	2000	4200	3252	2300	3210	3550	3645	3175	2405
	2100	4350	3319	2350	3298	3700	3749	3250	2480
	2200	4500	3370	2400	3370	3800	3838	3325	2539
2400	300	1200	2258	1600	1817	1100	2043	1775	1240
	400	1400	2333	1650	1910	1250	2134	1850	1306

WYES (Continued)

		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
2400	450	1500	2359	1675	1946	1300	2194	1900	1351
	500	1600	2401	1700	1999	1400	2239	1950	1381
	600	1750	2475	1750	2094	1550	2350	2050	1463
	700	1950	2542	1800	2182	1700	2455	2150	1538
	800	2100	2609	1850	2270	1850	2559	2225	1613
	900	2300	2676	1900	2358	2000	2663	2325	1688
	1000	2450	2743	1950	2447	2100	2752	2400	1747
	1100	2650	2810	2000	2535	2250	2856	2475	1822
	1200	2800	2861	2025	2607	2400	2960	2575	1897
	1300	3050	2976	2125	2743	2600	3097	2700	2004
	1400	3250	3043	2175	2831	2750	3185	2775	2062
	1500	3400	3110	2200	2919	2900	3289	2850	2137
	1600	3550	3161	2250	2991	3050	3394	2950	2212
	1700	3750	3228	2300	3080	3150	3482	3025	1410
	1800	3900	3295	2350	3168	3300	3586	3125	1456
	1900	4050	3346	2375	3240	3400	3675	3200	1538
	2000	4250	3413	2425	3328	3550	3779	3275	1597
	2100	4400	3480	2475	3416	3700	3883	3375	1672
	2200	4550	3531	2500	3488	3850	3972	3450	1747
	2300	4700	3598	2550	3576	4000	4076	3550	1822
	2400	4900	3665	2600	3665	4100	4164	3625	1897
2600	300	1250	2418	1725	1935	1100	2161	1875	1956
	400	1400	2477	1775	2012	1250	2267	1975	2030
	450	1500	2519	1800	2064	1300	2312	2025	2137
	500	1600	2545	1800	2101	1400	2373	2075	2212
	600	1800	2635	1875	2212	1550	2484	2175	2271
	700	1950	2702	1925	2300	1700	2572	2250	2346
	800	2150	2769	1975	2388	1850	2677	2325	2421
	900	2300	2836	2025	2476	2000	2781	2425	2480
	1000	2450	2887	2050	2549	2150	2885	2500	2555
	1100	2650	2954	2100	2637	2300	2990	2600	2614
	1200	2800	3021	2150	2725	2400	3078	2675	2688
	1300	3000	3088	2200	2813	2550	3182	2775	2763
	1400	3250	3203	2275	2949	2750	3319	2875	2822
	1500	3400	3254	2325	3021	2900	3423	2975	2897
	1600	3600	3321	2350	3109	3050	3511	3050	2956
	1700	3750	3388	2400	3198	3200	3616	3150	1374
	1800	3950	3455	2450	3286	3350	3720	3225	1440
	1900	4100	3506	2500	3358	3450	3808	3300	1469
	2000	4250	3573	2550	3446	3600	3913	3400	1515
	2100	4450	3640	2575	3534	3700	4001	3475	1597
	2200	4600	3707	2625	3622	3850	4105	3575	1672
	2300	4750	3758	2675	3694	4000	4210	3650	1747
	2400	4950	3825	2725	3783	4150	4298	3725	1822
	2500	5100	3876	2750	3855	4300	4402	3825	1881

WYES (Continued)

		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
2600	2600	5250	3943	2800	3943	4400	4491	3900	1956
2800	300	1250	2563	1825	2037	1150	2295	2000	2030
	400	1450	2638	1875	2130	1250	2385	2075	2089
	450	1500	2663	1900	2166	1300	2429	2125	2164
	500	1600	2705	1925	2219	1400	2490	2175	2287
	600	1800	2779	1975	2314	1550	2602	2275	2346
	700	1950	2846	2025	2402	1700	2706	2350	2421
	800	2150	2913	2075	2490	1850	2810	2450	2496
	900	2300	2980	2125	2578	2000	2915	2525	2555
	1000	2500	3047	2175	2667	2150	3003	2625	2630
	1100	2650	3114	2225	2755	2300	3107	2700	2688
	1200	2850	3181	2250	2843	2450	3212	2800	2763
	1300	3050	3248	2300	2931	2550	3300	2875	2838
	1400	3150	3299	2350	3003	2700	3404	2950	2897
	1500	3450	3414	2425	3139	2950	3557	3100	2972
	1600	3600	3481	2475	3227	3050	3645	3175	3031
	1700	3800	3548	2525	3316	3200	3749	3250	3047
	1800	3950	3615	2575	3404	3350	3854	3350	3165
	1900	4100	3666	2600	3476	3500	3942	3425	2271
	2000	4300	3733	2650	3564	3650	4046	3525	2346
	2100	4450	3800	2700	3652	3750	4135	3600	2405
	2200	4650	3867	2750	3740	3900	4239	3675	2480
	2300	4800	3918	2775	3812	4050	4343	3775	2555
	2400	4950	3985	2825	3901	4150	4432	3850	2614
	2500	5150	4052	2875	3989	4300	4536	3950	2688
	2600	5300	4103	2925	4061	4450	4624	4025	2747
	2700	5300	4119	2925	4077	4450	4640	4025	1299
	2800	5600	4221	3000	4221	4700	4817	4175	1381
3000	300	1250	2707	1925	2139	1150	2413	2100	1433
	400	1450	2782	1975	2232	1250	2503	2175	1499
	450	1550	2823	2000	2284	1350	2563	2225	1544
	500	1600	2849	2025	2321	1400	2608	2275	1574
	600	1800	2939	2100	2432	1550	2720	2375	1656
	700	2000	3006	2150	2520	1700	2824	2450	1731
	800	2200	3073	2175	2608	1850	2928	2550	1806
	900	2350	3140	2225	2696	2000	3033	2650	1881
	1000	2550	3207	2275	2785	2150	3137	2725	1956
	1100	2700	3274	2325	2873	2300	3241	2825	2030
	1200	2850	3325	2375	2945	2450	3330	2900	2089
	1300	3050	3392	2400	3033	2600	3434	2975	2164
	1400	3200	3459	2450	3121	2750	3538	3075	2239
	1500	3400	3526	2500	3209	2850	3627	3150	2298
	1600	3650	3641	2575	3345	3100	3779	3275	2421
	1700	3850	3708	2625	3434	3250	3883	3375	2496
	1800	4000	3775	2675	3522	3350	3972	3450	2555

WYES (Continued)

		Standard Dimensions for 45° Wyes				Standard Dimensions for 60° Wyes			
Header DN (mm)	Branch DN (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)	[H] Header Length	[E] Branch Length	B (mm)	F (mm)
3000	1900	4150	3826	2725	3594	3500	4076	3550	2630
	2000	4300	3893	2775	3682	3650	4180	3625	2704
	2100	4500	3960	2825	3770	3800	4269	3700	2763
	2200	4700	4027	2850	3858	3950	4373	3800	2838
	2300	4800	4078	2900	3930	4050	4461	3875	2897
	2400	5000	4145	2950	4019	4200	4566	3975	2972
	2500	5150	4212	3000	4107	4350	4670	4050	3047
	2600	5300	4263	3025	4179	4450	4758	4125	3106
	2700	5500	4330	3075	4267	4600	4863	4225	3181
	2800	5650	4397	3125	4355	4750	4951	4300	3240
	2900	5800	4448	3150	4427	4900	5055	4400	3315
	3000	6000	4515	3200	4515	5000	5144	4475	3373

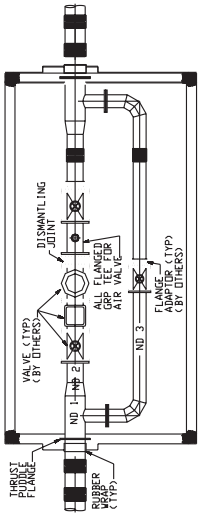
Consult Future Pipe Industries for Diameters and pressures not mentioned in the above tables.

E. FLANGES

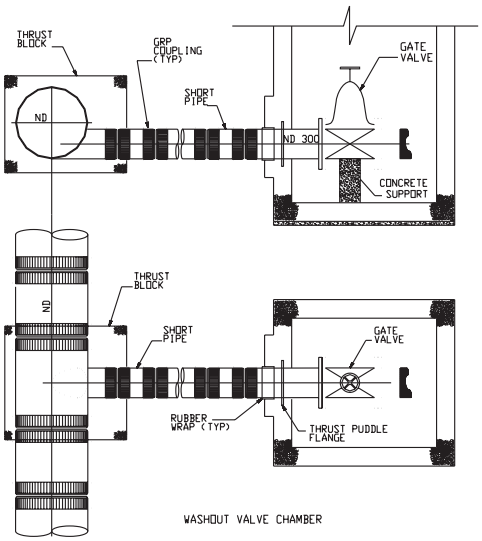
Flanges and blinds could be provided for the complete range of diameters with drilling pattern to match any international standard required such as DIN, ISO, ANSI, AWWA, JIS etc... or to client requirements.

F. CUSTOM DESIGNED FITTINGS

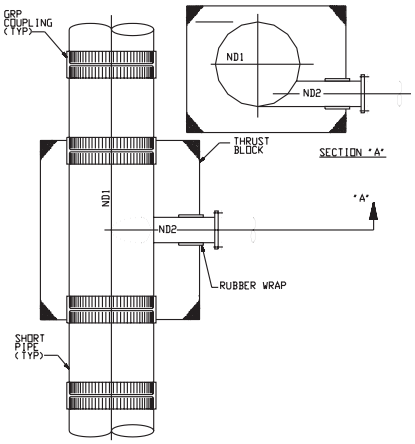
Future Pipe Industries can provide custom designed fittings for Air Valve Chambres, Wash-Out Chambers, By-Pass Chambers, in addition to all flanged fittings for specific applications.



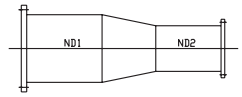
BYPASS CHAMBER



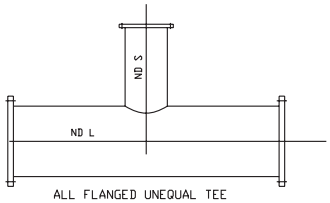
WASHOUT VALVE CHAMBER



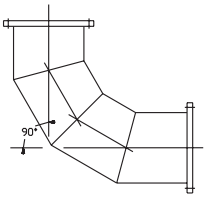
TANGENT TEE FOR WASHOUT VALVE CHAMBER



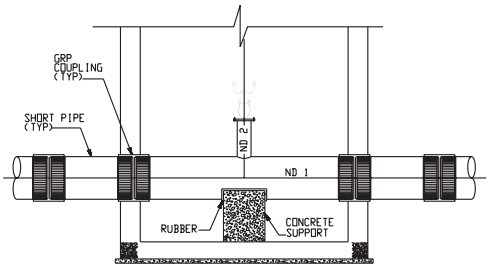
ALL FLANGED CONCENTRIC REDUCER



ALL FLANGED UNEQUAL TEE



ALL FLANGED ELBOWS



AIR VALVE CHAMBER DETAILS

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:

Visual Properties	Definitions
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.

13. PACKAGING

Pipe and fittings shall be suitably cradled, wedged or braced to prevent damage during shipment.

14. HANDLING AND STORAGE REQUIREMENTS

a) When storing the pipe directly on the ground be sure that the ground is flat and free of potentially damaging debris. GRP Reka couplings must be stored flat.

b) Pipe sections 12m or less in length may be lifted using one support point and a guide rope. Any pipe section may be lifted using two support points separated by third of the section length and located equidistant from the pipe section center.

c) Pipe support for lifting must be pliable straps or rope and shall not be steel cables or chains unless sufficient padding is used to protect the pipe surface.

d) Store rubber ring gaskets and lubricants in their original containers in a cool, dry area shaded from direct sunlight.

e) **DO NOT DROP OR IMPACT THE PIPE, PARTICULARLY AT PIPE ENDS.**

f) CAUTION: Workers should wear gloves when handling pipe to protect hands from the rough pipe surface ends.

g) Additional handling instructions shall be according to Future Pipe Industries **FIBERSTRONG® Installation Guide for Underground Pipe System**.

15. CUSTOMER INSPECTION

a) The customer is responsible for inspection of the pipe for shipping damage at the time of delivery and must note any damage, shortage or discrepancy on the delivery note at that time.

b) The customer is responsible for visually inspecting the pipe upon delivery for adherence to the product standard set forth therein.

16. INSTALLATION

Installation specifications have been developed to insure that pipe will perform as designed, and therefore, must be adhered to during installation. The contractor shall ensure that the pipes are being installed according to **FIBERSTRONG® Installation Guide for Underground Pipe System.**

Always use a vegetable based joint lubricant.

As with all piping systems, unbalanced thrust forces will be present at changes of direction or cross-sections such as in elbows, reducers, tees, wyes or bulk heads.

These forces must be restrained for system stabilization. Adequate restraint can be achieved through concrete thrust blocks.

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