



GRP / GRV

GLASS FIBER REINFORCED POLYESTER / VINYLESTER
PRODUCT GUIDE

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IPF

A market **leader**

VISION

Leading the pipe industry by discovering the new, reinventing the old, while preserving the culture of pipe technology and its tradition, guarantying our client around the world the ultimate experience by upholding our commitments and maintain the highest standards in design, manufacturing, quality, services and trust worthy business practices.



MISSION

- ▲ Offer the highest quality products through monitoring every stage of the process leading to complete customer satisfaction.
- ▲ Commitment to uphold the strictest quality assurance standards on all product in all aspects of production.
- ▲ Optimize the researched techniques to continually improve the efficiency of the facility and the productivity of the staff.
- ▲ Maintain reasonable profitability to support the mission and to expand the experience to customer around the globe.

1. INTRODUCTION

Although the world's infrastructure has developed a lot during the past decades, still thousands of kilometers of water and sewer pipes needing rehabilitation due to corrosion. Corrosion is mainly caused by:

- ▲ Internally unprotected concrete sewer pipes are rapidly aged by the presence of sulfuric acid in sanitary sewer systems, which are generated through the hydrogen sulfide cycle.
- ▲ Externally, soil conditions and stray electrical currents will weaken underground pipes. Metallic pipes can corrode when placed in poorly aerated, poorly drained soils of low resistivity. The presence of sulfate – reducing bacteria will accelerate this deterioration.

These problems can be radically reduced, if not eliminated, by the cautious selection of materials resistant to corrosion, or the inclusion of corrosion protection systems into pipeline designs. Unfortunately, in hopes of cost saving, agencies will often forego the necessary corrosion protection, only to learn a few years later of the consequences. Corrosion is not a reversible process.

The solution to this situation is very easy....

Inter Pipe Factory® (Glass Fiber Reinforced Polyester/Vinyl ester Pipes)

Inter Pipe Factory® is accredited with ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007, WARS (Water Regulation Advisory Scheme), Kitemark for GRP, etc ... and also approvals from ministries and municipalities all over U.A.E.

Inter Pipe Factory® manufactures glass-fiber-reinforced polymer (GRP/GRV) pipes using the continuously – advancing mandrel process done by the continuous filament winding machine, guaranteeing a consistently homogeneous product meter to meter. A GRP/GRV pipe system manufactured by **Inter Pipe Factory®** is the ultimate pipe selection for water supply systems as it has proven its resistance to galvanic and electrolytic corrosion. Moreover, GRP pipe systems are used in sewer and storm applications since it has verified its resistance to the acidic environment and other corrosive fluids. GRP/GRV pipes have been the preferred selected material for sewer, storm water, and water applications around the globe for the past 30 years.

2. LEADING THE FIBERGLASS MARKET WITH HIGH TECHNOLOGIES

Corrosion resistant, Lightweight and manufactured under stringent quality standards, **Inter Pipe Factory®** GRP/GRV pipes are available in seven pressure classes and four stiffness classes. Diameters range from 25mm up to 2800mm and can be supplied with lengths up to 12 meters. The increasing knowledge of the operational cost savings and superior corrosion resistance offered by glass – fiber reinforced plastic pipe by **Inter Pipe Factory®** operations has resulted in its widespread application for the following:

- ▲ Sanitary sewerage collection systems & treated water
- ▲ Storm water and drainage
- ▲ Water Transmission and Distribution (Potable & Raw Water)
- ▲ Hydroelectric penstock lines
- ▲ Sea water intake and outfalls
- ▲ Chemicals & Industrial applications
- ▲ Power & Desalination
- ▲ Fire Fighting
- ▲ Irrigation
- ▲ Circulating cooling water.

Inter Pipe Factory® fiberglass pipe material delivers long, effective service life with lower operating and maintenance costs compared to other piping materials

Inter Pipe Factory® Glass Fiber Reinforced Polyester (GRP) and Glass Fiber Reinforced Vinylester (GRV) pipes, fittings and accessories are produced by using the highest levels of technology and quality.



3. PRODUCT FEATURES & BENEFITS

Inter Pipe Factory® brings a product to market that can provide low cost, long – term pipe solutions to client around the globe. The multiple advantages of GRP/GRV pipes systems and add up to provide effective design life and cost effective system.

Features	Benefits
Corrosion Resistant Material	<ul style="list-style-type: none"> ▲ Extensive, effective service life ▲ No need for coatings, lining, cathodic protection, wraps or other forms of corrosion protection ▲ Hydraulic characteristics effectively constant over time ▲ Low maintenance costs ▲ Ideal pipe for the rehabilitation of corroded sewer lines
Design life time is more than 50 years	<ul style="list-style-type: none"> ▲ Maximum economical optimization
Light weight (25% weight of Ductile Iron Pipe & 10% weight of Concrete Pipe)	<ul style="list-style-type: none"> ▲ Low Transportation Cost ▲ Eliminates need for expensive pipe handling equipment ▲ Optimum pipe nesting can be applied
Long standard Lengths (6 & 12 meters)	<ul style="list-style-type: none"> ▲ Fewer joints reduce installation time ▲ More Pipe per Transport Vehicle results in lower delivery cost

Features	Benefits
Extremely smooth Bore	<ul style="list-style-type: none"> ▲ Low friction loss means less pumping energy needed and lower operating cost ▲ Minimum slime build up helps in lowering cleaning costs
Precision Double Bell Coupling with elastomeric REKA gaskets	<ul style="list-style-type: none"> ▲ Tight efficient joints designed to eliminated infiltration and exfiltration. ▲ Ease of joining, reducing installation time ▲ Accommodates small changes in the line direction without fittings or differential settlement.
Flexible manufacturing process	<ul style="list-style-type: none"> ▲ Custom diameters can be manufactured to provide maximum flow volumes with ease of installation for rehabilitation lining projects
High technology pipe design	<ul style="list-style-type: none"> ▲ Lower Wave celerity than other piping materials which implies less cost when designing for surge and water hammer pressures ▲ Multiple pressure and stiffness classes to meet the design engineer's criteria ▲ Pipes are hydrostatically tested at twice the pressure class
High Technology pipe manufacturing system producing pipe that strictly complies with stringent performance international standards (ASTM, AWWA, BS, EN, etc...)	<ul style="list-style-type: none"> ▲ High and consistent product quality worldwide which ensures reliable product performance

Table 3.1

4. APPLICABLE STANDARDS

Glass Fiber Reinforced Polyester / Vinlyester Pipes produced by **Inter Pipe Factory®** are manufactured and tested according to international American Standards (ASTM / AWWA), European Standards (EN) and British Standards (BS)

4.1. AWWA Standards

AWWA C950 is one of the most widespread product standards in existence for fiberglass pipe. This standard for pressure water applications has strict requirements for pipe and joints, concentrating on quality control and prototype qualification testing. AWWA C950 is also considered to be a product performance standard.

Inter Pipe Factory® GRP/GRV is designed to meet the performance requirements of this standard. In addition to being a pressure pipe product standard, AWWA has also published one of the most comprehensive design methods for a buried pipe. AWWA M45, Fiberglass Pipe Design, provides complete criteria for pipe design, installation including deflection, external loads, combined pressure / bending effects and bucking.

All of the installation limitations presented for **Inter Pipe Factory®** Fiberglass are based on this manual's guidelines. AWWA M45 also covers the design of an aboveground fiberglass pipe installation.

Standard	Application
AWWA C – 950	Fiberglass Pressure Pipe
AWWA M – 45	Fiberglass Pipe Design Manual

Table 4.1

4.2. ASTM Standards

Presently, there are several ASTM product standards in use which apply to a variety of fiberglass pipe applications. These product standards cover pipe with diameter ranges of 200mm to 4000mm and required the flexible joints to withstand hydrostatic testing in configuration (per ASTM D4161) that simulate exaggerated in – use conditions.

These standards include many tough qualification and quality control tests. GRP/GRV pipes by **Inter Pipe Factory®** are designed to meet all of the following ASTM standards:

Standard	Application
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

Table 4.2

4.3. EN & British Standards

Inter Pipe Factory® manufacture GRP and GRV pipes ensuring that the performance requirements qualification and control testing, and design to meet the following European & British Standards:

Standard	Application
BS 5480*	British Standard Specification for Glass Reinforced Plastics (GRP) pipes, joints and fittings for use for water supply or sewerage.
BS EN 1796	Plastics Piping Systems For Drainage and Sewage With or Without Pressure – Glass – Reinforced Thermosetting Plastics (GRP) Based On Unsaturated Polyester Resin (UP)
BS EN 14364	Plastics Piping Systems For Water Supply With or Without Pressure – Glass – Reinforced Thermosetting Plastics (GRP) Based On Unsaturated Polyester Resin (UP) – Specifications for Pipes, Fittings and Joints

*BS 5480 is superseded and replaced by BS EN 1796 & BS EN 14364

Table 4.3

5. CONTROL TESTING

Quality Control testing includes scrupulous checks for all incoming raw materials and finished pipe products against **Inter Pipe Factory®** strict written standards.

5.1. Raw Materials

Raw materials are only delivered with vendor certification indicating their conformity with **Inter Pipe Factory®** quality requirements. Prior to their use, all raw materials are sample tested so as to guarantee that pipe materials do comply with the declared technical specifications

Raw Material Tests

1. Viscosity of Resin (ASTM D 2196) / ISO 2555
2. Resin Gel time, cure time and peak temperature (ASTM D 2471)
3. Glass Fibers: Moisture content, size/ binder content and TEX properties (Internal Method)
4. Silica Sand: Sieve Analysis, Moisture Content, LOI, Acid test (Internal Method)

5.2. Physical Properties

Hoop and axial load capacities are checked on a regular basis for GRP/GRV Pipes. Moreover, pipe composition and construction are confirmed. The following control checks are carried out:

1. Pipe stiffness
2. Deflection without structural failure or damage
3. Axial load capacity
4. Circumferential (Hoop) load capacity
5. Loss on Ignition (LOI)

Inter Pipe Factory® has demonstrated its products compliance with the performance requirements of international standards. The performance requirements are divided in to two parts:

- ▲ Short-term requirements
- ▲ Long-term requirements

Inter Pipe Factory® has been rigorously tested to verify conformance to ASTM, AWWA and EN Standards.

5.3. Finished Pipe

GRP & GRV pipe products produced by **Inter Pipe Factory®** are subject to the following control checks:

1. Wall Thickness
2. Diameter
3. Section length
4. Visual Inspection
5. Barcol Hardness
6. Hydrostatic leak tightness test (1.5 times the rated pressure class)





6. QUALIFICATION TESTING

6.1. Hydrostatic Design Basis Hdb

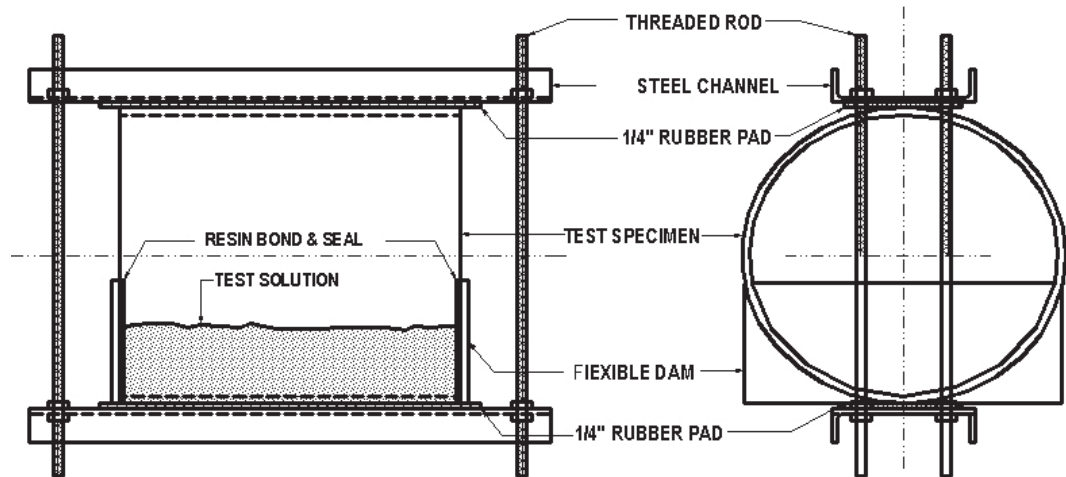
The establishment of the Hydrostatic Design Basis – HDB is an important qualification test. This test is carried out in accordance with ASTM D2992 Procedure B and requires hydrostatic pressure testing to failure of many pipe samples at a variety of very high constant pressure levels. The resulting data is evaluated on a log-log basis for pressure (or hoop tensile strain) vs. time to failure and then extrapolated to 50 years.

The extrapolated failure pressure (strain) at 50 years, referred to as the Hydrostatic Design Basis (strain) or HDB, must be at least 1.8 times the rated pressure class (strain at the rated pressure). In other words, the design criteria require that the average pipe be capable of withstanding a constant pressure of 1.8 times the maximum operating condition for 50 years. This qualification test helps assure the long-term performance of the pipe in pressure service.

6.2. Strain Corrosion Test

Another distinctive and essential performance requirement for gravity GRP pipes used in sewer applications is the chemical testing of the pipe in a deflected (strained) condition. This strain corrosion testing is carried out in accordance with ASTM D3681, and requires a minimum of 18 ring samples of the pipe to be deflected to various levels and held steady. These strained rings are then exposed at the invert of the interior surface 1.0 N concentration sulfuric acid H₂SO₄. This is anticipated to create the worst case of a buried sewer pipe.

This has been shown to be representative of the worst sewer conditions around the globe, where many fiberglass pipes have been effectively installed. The time to failure (leakage) for each test sample is recorded. The minimum extrapolated failure strain at 50 years, using a least squares regression analysis of the failure data, must equal the values shown for each stiffness class. The value achieved is then related to the pipe design to enable prediction of safe installation margins for GRP pipe used for sewerage applications. Characteristically this is 5% long – term deflection.



Strain-Corrosion Test Apparatus

Stiffness Class (N/m ²)	ESCV Strain, %
SN 2500	.49(t/d)
SN 5000	.41(t/d)
SN 10000	.34(t/d)
SN 12500	.30(t/d)*

*By Extrapolation from table 4 of ASTM D 3262
Table 6.1 – Min. Strain Corrosion Value

6.3. Initial Ring Deflection

GRP pipes should meet the initial ring deflection levels without any visual cracks or crazing (Level A) and no structural damage to the pipe wall (Level B) when vertically deflected between two parallel flat plates or rods.

Deflection Level	SN 2500 (N/m ²)	SN 5000 (N/m ²)	SN 10000 (N/m ²)	SN 12500 (N/m ²)
LEVEL A	15%	12%	9%	8%
LEVEL B	20%	20%	15%	12%

Table 6.3 – Initial Ring Deflection

6.4. Long Term Bending

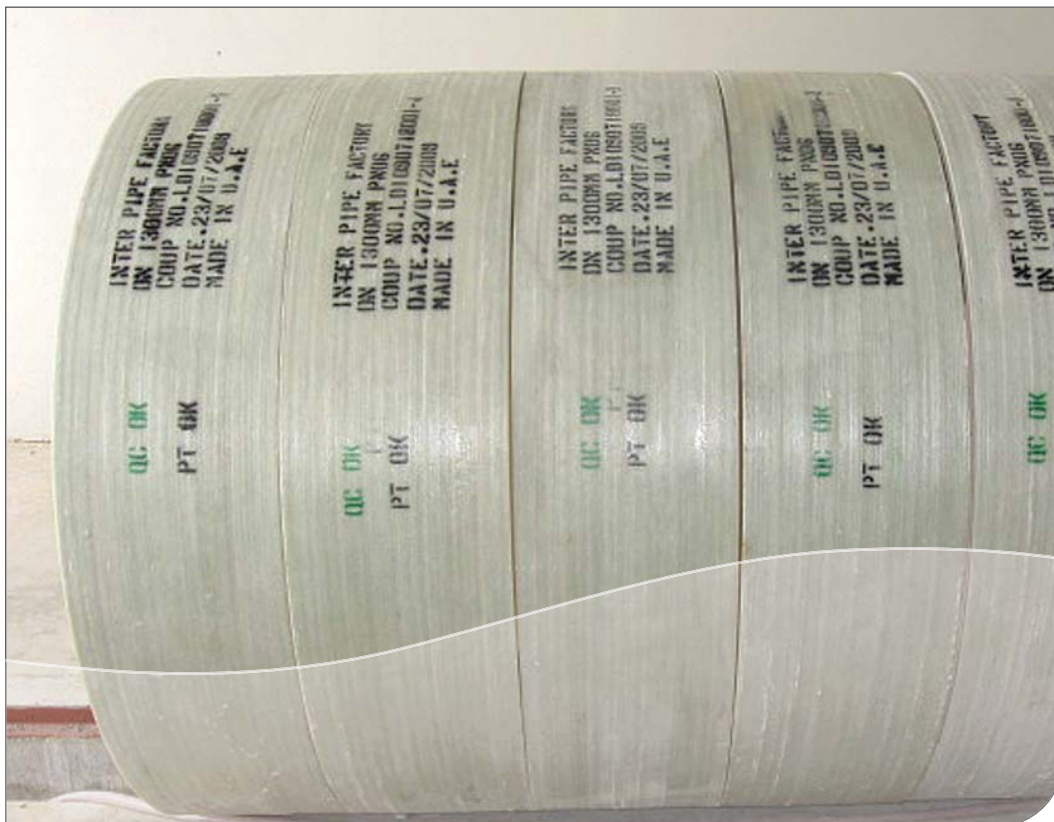
GRP pipe's long-term (50 year) ring deflection or ring bending (strain) capability, when exposed to an aqueous environment and under a constant load, must meet the Level A deflection level specified in the initial ring deflection test. AWWA C950 requires the test to be carried out, with the resulting 50-year predicted value used in the pipes design.

GRP pipes are tested in accordance to ASTM D5365 "Long - Term Ring Bending Strain of Fiberglass Pipe" or ISO 7685 "Determination of Initial Specific Ring Stiffness" and should meet both requirements.

6.5. Joint Testing

Joint testing is another important qualification test performed on joint models for rubber gasket sealed double bell couplings. This destructive test is performed according to ASTM D 4161 where it requires these flexible joints to withstand hydrostatic testing that simulate very severe conditions. Pressures used are twice the pipe's pressure class, or 1 bar for gravity flow pipe.

Joint configurations include straight alignment, maximum angular deflection and differential shear loading. Partial vacuum tests and cyclic tests may also be incorporated.



7. PRODUCT RANGE – TECHNICAL INFORMATION

7.1. Diameter Range

Inter Pipe Factory® are supplied in the following Nominal Diameters* ND (mm)

Nominal Diameter ND (mm)	
25	1100
50	1200
80	1300
100	1400
150	1500
200	1600
250	1700
300	1800
350	1900
400	2000
450	2100
500	2200
600	2300
700	2400
800	2500
900	2600
1000	

*for other pipe diameter range, consult Inter Pipe Factory®

Table 7.1

7.2. Standard Lengths

The standard length of GRP/GRV pipes is indicates in the below table 7.2:

ND (mm)	Standard Length (meters)
ND 25mm - 65mm	3 meters
ND 80mm - 200mm	6 meters
ND 250mm & above	12 meters

Table 7.2

7.3. Load Capacity

Axial Tensile Load Capacity

The minimum initial axial load in N/mm of circumference is as shown in Table 7.3.1:

ND (mm)	PN3 (Bar)	PN6 (Bar)	PN10 (Bar)	PN12 (Bar)	PN16 (Bar)
300	102	102	113	118	138
350	102	102	132	137	160
400	102	102	150	157	183
450	102	108	160	165	192
500	102	118	177	183	213
600	102	142	213	220	256
700	102	156	239	247	287
800	102	167	250	257	296
900	122	200	300	308	355
1000	137	217	325	333	384
1100	140	233	350	359	413
1200	161	244	366	382	447
1300	171	259	389	406	475
1400	182	274	457	477	503
1500	200	305	457	477	559
1700	220	336	503	525	615
1800	238	366	549	573	671
2000	260	369	553	581	685
2200	280	397	596	626	737
2300	301	426	638	670	790
2400	322	454	681	715	843
2600	340	482	723	760	896

Table 7.3.1

Hoop Tensile Load Capacity

The minimum initial hoop load in N/mm of length is as shown in the Table 7.3.2

ND (mm)	PN3 (Bar)	PN6 (Bar)	PN10 (Bar)	PN12 (Bar)	PN16 (Bar)
300	210	420	630	735	945
350	245	490	735	858	1103
400	280	560	840	980	1260
450	315	630	945	1103	1418
500	350	700	1050	1225	1575
600	420	840	1260	1470	1890
700	473	945	1418	1654	2127
800	525	1050	1575	1838	2363
900	630	1260	1890	2205	2835
1000	683	1365	2048	2389	3072
1100	735	1470	2205	2573	3308
1200	840	1680	2520	2940	3780
1300	893	1785	2678	3124	4017
1400	945	1890	2835	3308	4253
1500	1050	2100	3150	3675	4725
1700	1155	2310	3465	4043	5198
1800	1260	2520	3780	4410	5670
2000	1365	2730	4095	4778	6143
2200	1470	2940	4410	5145	6615
2300	1575	3150	4725	5513	7088
2400	1680	3360	5040	5880	7560
2600	1785	3570	5355	6248	8033

Table 7.3.2

Note: Please contact Inter Pipe Factory® for Tensile Load Capacities of other pressure classes not listed in the Table 7.3.1 & 7.3.2. 7.4.

7.4. Stiffness Class

Fiberglass pipes by **Inter Pipe Factory®** can be supplied according to the following specific initial stiffness $STIS = EI/D^3$

Stiffness Class	Stiss (N/m ²)	PS (Psi)
SN 1500	1500	10.8
SN 2500	2500	18
SN 5000	5000	36
SN 10000	10000	72
SN 12500	12500	90



Table 7.4.

7.5. Pressure Classes

Inter Pipe Factory® offers the pressure classes (PN) as indicated in below table 7.5. It is worth nothing that not all pressure classes are available in all stiffness classes and diameters.

Pressure Class (PN)	Pressure Rating (Bars)	Standard Factory Test Pressure 2 X Pn (Bar)	Maximum Field Test Pressure 1.5 X Pn (Bar)	Surge Pressure 1.4 X Pn (Bar)	Maximum Diameter Limit (mm)
GRAVITY	1	2	1.5	1.4	2600
PN 6	6	12	9	8.4	2600
PN 10	10	20	15	16.8	2600
PN 12	12	24	18	16.8	2600
PN 16	16	32	24	22.4	2000
PN 20	20	40	30	28	1600
PN 25	25	50	37.5	35	1400

Table 7.5.

NB: For other pressure classes, kindly consult **Inter Pipe Factory®**

7.6. Other Characteristics & Properties

Maximum Recommended Flow Velocity	3 – 4 m/s
Poisson's Ration – ν	From 0.22 to 0.29
Coefficient of Thermal Expansion	24-30 x 10 ⁻⁶ mm/mm/°C
Manning Roughness Coefficient – n	0.009
Hazen Williams Roughness Coefficient – C	150
Colebrook's Surface Roughness Factor – e	5.18 x 10 ⁻⁶

8. MANUFACTURING PROCESS

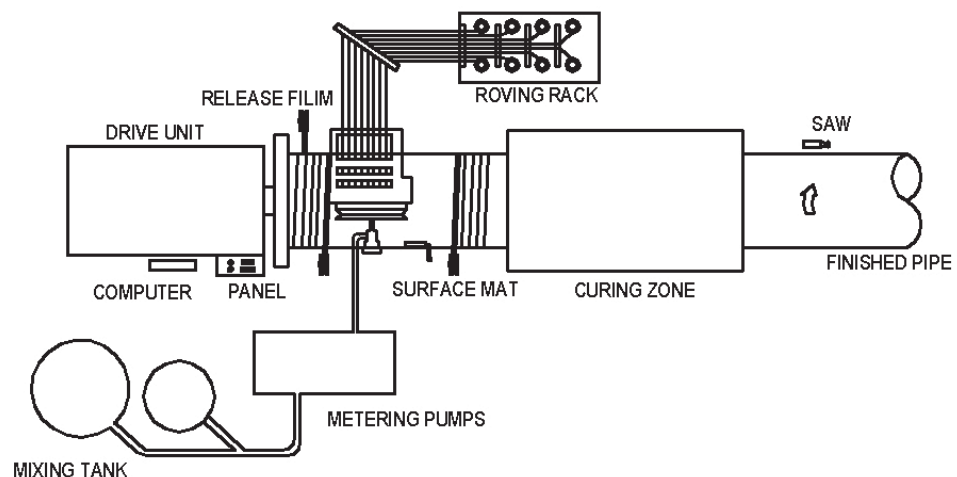
The process for manufacturing GRP pipes is the continuously – advancing mandrel process on continuous filament winding machine. The basic winder is composed of a continuous steel band supported by beams which form a cylindrically shaped mandrel. The beams rotate; friction pulls the band around and roller bearing allowing the band to move longitudinally so that the entire mandrel continuously moves in a spiral path toward the end of the machine.

As the mandrel moves, glass fibers, resin, fine graded filler, and surface materials are metered on, in precise amounts controlled by programmable logic controller and computer. The system provides integrated process control based on preprogrammed recipes. Another device measures the thickness of the laminate with rotation of the pipe at the cut. Minimum, maximum and average thickness are recorded and displayed on the operator's PC monitor. Raw materials are fed to the mandrel from overhead. A metering pump system, two glass fiber choppers, one sand unit feed and two polyester resin mixers with dispenser are included. A release film and surface mat and other surface liner materials are applied from rolls adjacent to the mandrel. Curing of the laminate is accomplished with a combination of induction heating through the steel band and infrared elements directly heating the laminate.

The pipe structure is composed of the following material:

- A. Internal liner, made of 'C' type glass fiber impregnated with the resin
- B. Structural layer made of 'E' / 'C' glass, resin and Silica Sand
- C. Outer Liner, made of 'C' type glass fiber impregnated with the resin

The saw and calibration unit is synchronized with the continuous longitudinal movement of the laminate, which ensures a clean perpendicular cut of the pipe. Pipes can be cut to any length as preset. After passing the cutting station, the cured pipe is supported on lifting tables that are specially designed for receiving the pipes. The pipe is then moved by conveyor to the hydrostatic pipe tester.



9. GRP PIPE & COUPLING DIMENSION



ND (mm)	W (mm)
100 to 150	150
200 to 250	176
300 to 500	270
600 to 2600	330

ND (mm)	DOS min	DOS max	CID (mm)	ND (mm)	DOS min	DOS max	CID (mm)
300	313.5	314.5	316.5	1400	1432.0	1433.0	1435.0
350	365.5	366.5	371.0	1500	1534.0	1535.0	1537.0
400	412.0	413.0	415.0	1600	1636.0	1637.0	1639.0
450	463.0	464.0	466.0	1700	1738.0	1739.0	1741.0
500	514.0	515.0	517.0	1800	1840.0	1841.0	1843.0
600	616.0	617.0	619.0	1900	1942.0	1943.0	1945.0
700	718.0	719.0	721.0	2000	2044.0	2045.0	2047.0
800	820.0	821.0	823.0	2100	2146.0	2147.0	2149.0
900	922.0	923.0	925.0	2200	2248.0	2249.0	2251.0
1000	1024.0	1025.0	1027.0	2300	2350.0	2351.0	2353.0
1100	1126.0	1127.0	1129.0	2400	2452.0	2453.0	2455.0
1200	1228.0	1229.0	1231.0	2500	2554.0	2555.0	2557.0
1300	1330.0	1331.0	1333.0	2600	2656.0	2657.0	2659.0

Note: Please contact Inter Pipe Factory® for other diameters which are not included in the above table

10. VISUAL PROPERTIES

10.1. Exterior Visual Properties

The exterior surface of GRP pipe, joints and fittings shall be commercially free of the following irregularities:

Visual Properties	Definitions
Fuzz	Glass fibers loosely adhering to the pipes that are not wet out with resin
Protruding fibers	Glass fibers sticking out from faces 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.

10.2. Visual Limits

The following visual limits apply:

Visual defect	Definition	Allowable Limits External Surface	Allowable Limits Internal Surface
De-lamination	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 or 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 de-lamination and end gouges	Tears and rips in the edges of cuts	N/A	None that will affect the integrity of the joints
Ground	Area around lay-up which has been abraded but lay-up does not cover or has not been coated	Permitted	None

11. PIPE REPAIR

- ▲ Repairs to the internal and external layers shall not exceed 5% of the total surface area.
- ▲ Structural repair work is not allowed.
- ▲ The number of repair will not exceed and average of one (1) per one (1) meter length of the 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. Manufacturer's name
2. Manufacturing standard number
3. Pipe Diameter – ND (mm)
4. Pressure Class – PN (Bars)
5. Stiffness class – SN
6. Pipe Serial Number
7. Manufacturing date

Specific marking requirement by customer could be arranged; **Inter Pipe Factory®** marks the product accordingly while maintaining traceability.

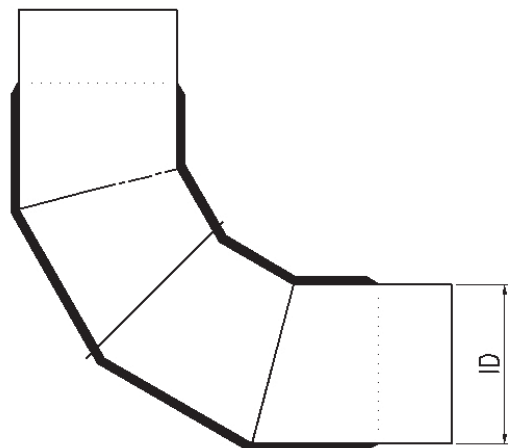
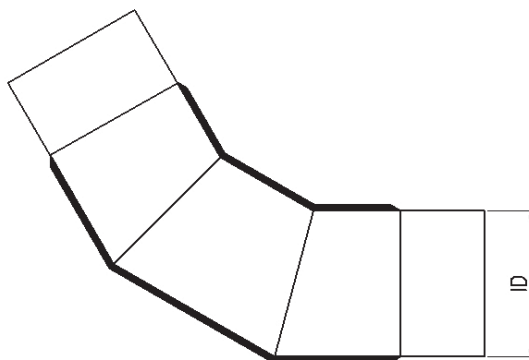
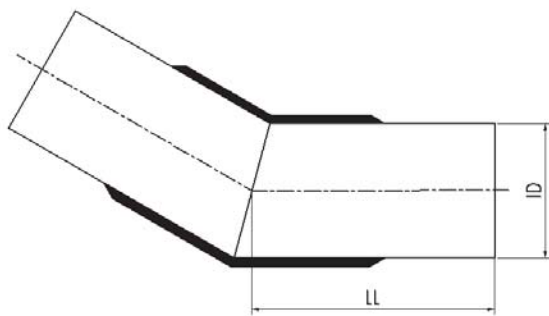
13. FITTINGS

Inter Pipe Factory® 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 **Inter Pipe Factory®** 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. Pipes sections are then joined together by lamination. The thickness and width of the lamination is designed to exceed the pipe performance.

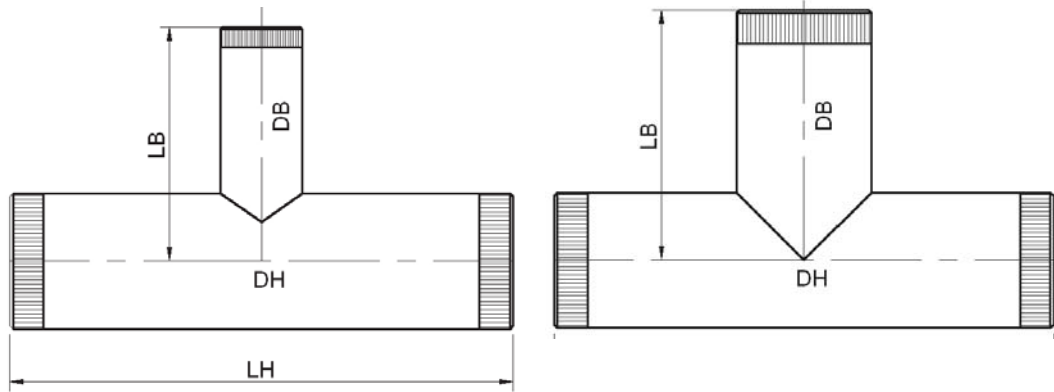
A. MITERED ELBOWS



ND (mm)	1 MITER		2 MITERS		3 MITERS	
	L (mm) A=0- 30°	L (mm) A=31- 45°	L (mm) A=46- 60°	L (mm) A=61- 90°		
300	400	500	550	750		
350	450	550	600	800		
400	450	600	650	900		
450	500	600	700	1000		
500	500	650	750	1050		
600	500	650	750	1100		
700	500	650	800	1200		
800	500	700	850	1350		
900	550	800	950	1500		
1000	550	850	1000	1650		
1100	600	900	1100	1800		
1200	600	950	1200	1950		
1300	700	1050	1300	2100		
1400	700	1100	1350	2250		
1500	750	1200	1450	2400		
1600	800	1250	1550	2550		
1700	800	1300	1600	2700		
1800	850	1350	1700	2850		
1900	850	1400	1750	2950		
2000	900	1450	1800	3100		
2100	900	1500	1850	3200		
2200	900	1550	1950	3350		
2300	950	1550	2000	3450		
2400	1000	1550	2100	3600		
2500	1000	1600	2200	3750		

Note: Please contact Inter Pipe Factory® for other Diameters which are not included in the above Table

B. MITERED TEES (90 DEG)



DH (mm)	DB (mm)	PN 1 (Bar)		PN 10 (Bar)		PN 16 (Bar)	
		Header	Branch	Header	Branch	Header	Branch
		LH (mm)	LB (mm)	LH (mm)	LB (mm)	LH (mm)	LB (mm)
300	300	900	450	1400	1700	1800	900
350	300	900	450	1500	800	2000	1000
350	350	900	450	1800	800	2000	1000
400	300	900	500	1600	850	2100	1100
400	350	1000	500	1700	850	2200	1100
400	400	1000	500	1700	850	2300	1150
500	300	900	550	1800	1000	2500	1350
500	350	1000	550	1500	1000	2600	1350
500	400	1000	550	1900	1000	2700	1350
500	500	1200	600	2000	1000	2700	1350
600	300	900	600	1100	700	1400	800
600	400	1100	600	1400	750	1700	900
600	500	1200	600	1500	750	1800	900
600	600	1300	650	1700	850	1900	950
700	300	900	650	1200	750	1500	900
700	400	1100	650	1500	850	1800	1000
700	500	1200	700	1600	850	1900	1000
700	600	1300	700	1700	900	2000	1050
700	700	1400	700	1900	900	2100	1050
800	300	900	700	1300	850	1600	1000
800	400	1100	700	1400	850	1700	1000

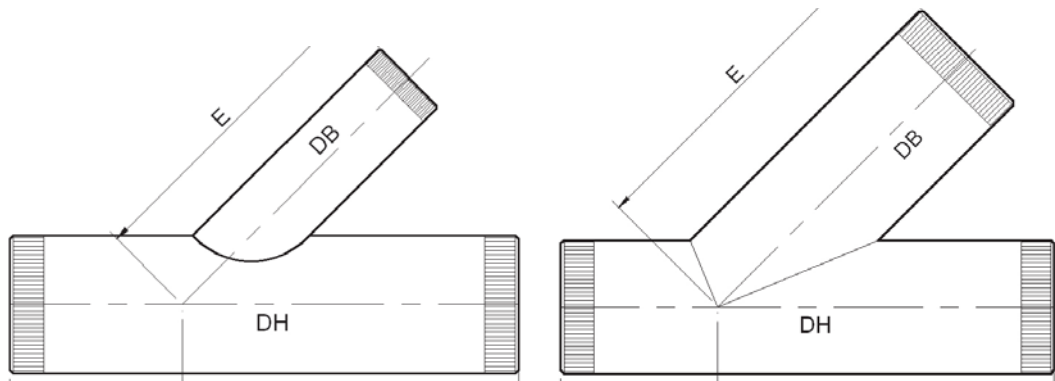
DH (mm)	DB (mm)	PN 1 (Bar)		PN 10 (Bar)		PN 16 (Bar)	
		Header	Branch	Header	Branch	Header	Branch
		LH (mm)	LB (mm)	LH (mm)	LB (mm)	LH (mm)	LB (mm)
800	500	1200	750	1700	950	2000	1150
800	600	1400	750	1800	1000	1200	1150
800	700	1500	800	1900	1000	2200	1150
800	800	1600	800	2100	1050	2300	1160
900	300	900	750	1400	950	1600	1100
900	400	1100	750	1500	950	1800	1100
900	500	1200	800	1700	1000	2100	1250
900	600	1400	850	1900	1050	2200	1300
900	700	1500	850	2000	1050	2400	1300
900	800	1600	850	2100	1100	2500	1300
900	900	1700	850	2300	1150	2600	1300
1000	300	900	800	1400	1000	1700	1200
1000	400	1100	800	1500	1000	1800	1200
1000	500	1200	850	1600	1000	2000	1200
1000	600	1400	900	1900	1150	2400	1400
1000	700	1500	900	2000	1150	2500	1400
1000	800	1600	900	2200	1200	2600	1400
1000	900	1800	950	2300	1200	2800	1400
1000	1000	1900	950	2500	1250	2900	1400
1200	300	1000	900	1500	1200	1800	1350
1200	400	1100	950	1600	1200	2000	1350
1200	500	1200	950	1700	1200	2100	1350
1200	600	1400	1000	1800	1200	2200	1400
1200	700	1600	1000	2200	1350	2700	1500
1200	800	1700	1050	2300	1350	2800	1600
1200	900	1800	1050	2400	1350	2900	1600
1200	1000	1900	1100	2500	1350	3000	1600
1200	1200	2200	1100	2800	1400	3200	1600
1400	300	1000	1000	1600	1350	-	-
1400	400	1100	1050	1700	1350	-	-

DH (mm)	DB (mm)	PN 1 (Bar)		PN 10 (Bar)		PN 16 (Bar)	
		Header	Branch	Header	Branch	Header	Branch
		LH (mm)	LB (mm)	LH (mm)	LB (mm)	LH (mm)	LB (mm)
1400	500	1300	1050	1800	1350	-	-
1400	600	1400	1100	2000	1400	-	-
1400	700	1500	1100	2100	1400	-	-
1400	800	1700	1150	2400	1500	-	-
1400	900	1900	1150	2500	1500	-	-
1400	1000	2000	1200	2600	1500	-	-
1400	1200	2200	1200	2900	1550	-	-
1400	1400	2500	1250	3200	1600	-	-
1600	300	1000	1150	1700	1500	-	-
1600	400	1200	1150	1800	1500	-	-
1600	500	1300	1200	2000	1500	-	-
1600	600	1400	1200	2100	1550	-	-
1600	700	1600	1250	2200	1550	-	-
1600	800	1700	1250	2300	1550	-	-
1600	900	1800	1300	2700	1700	-	-
1600	1000	2000	1300	2800	1700	-	-
1600	1200	2300	1350	3100	1750	-	-
1600	1400	2500	1350	3400	1800	-	-
1600	1600	2800	1400	3600	1800	-	-
1800	300	1000	1250	-	-	-	-
1800	400	1200	1250	-	-	-	-
1800	500	1300	1300	-	-	-	-
1800	600	1400	1300	-	-	-	-
1800	700	1600	1350	-	-	-	-
1800	800	1700	1350	-	-	-	-
1800	900	1800	1350	-	-	-	-
1800	1000	2100	1450	-	-	-	-
1800	1200	2300	1450	-	-	-	-
1800	1400	2600	1500	-	-	-	-
1800	1600	2800	1500	-	-	-	-

DH (mm)	DB (mm)	PN 1 (Bar)		PN 10 (Bar)		PN 16 (Bar)	
		Header	Branch	Header	Branch	Header	Branch
		LH (mm)	LB (mm)	LH (mm)	LB (mm)	LH (mm)	LB (mm)
1800	1800	3100	1550	-	-	-	-
2000	300	1000	1350	-	-	-	-
2000	400	1200	1400	-	-	-	-
2000	500	1300	1400	-	-	-	-
2000	600	1500	1450	-	-	-	-
2000	700	1600	1450	-	-	-	-
2000	800	1700	1450	-	-	-	-
2000	900	1900	1500	-	-	-	-
2000	1000	2000	1500	-	-	-	-
2000	1200	2400	1550	-	-	-	-
2000	1400	2600	1600	-	-	-	-
2000	1600	2900	1650	-	-	-	-
2000	1800	3100	1650	-	-	-	-
2000	2000	3400	1700	-	-	-	-
2400	300	1100	1600	-	-	-	-
2400	400	1200	1600	-	-	-	-
2400	500	1200	1600	-	-	-	-
2400	600	1500	1650	-	-	-	-
2400	700	1700	1650	-	-	-	-
2400	800	1800	1700	-	-	-	-
2400	900	1900	1700	-	-	-	-
2400	1000	2100	1750	-	-	-	-
2400	1200	2300	1750	-	-	-	-
2400	1400	2700	1850	-	-	-	-
2400	1600	2900	1850	-	-	-	-
2400	1800	3200	1900	-	-	-	-
2400	2000	3300	1900	-	-	-	-
2400	2400	3900	1950	-	-	-	-

Note: Please contact Inter Pipe Factory® for other Diameters which are not included in the above Table

C. MITERED WYES (45 DEG)



Header Dia (mm)	Branch Dia (mm)	B (mm)	F (mm)	E (mm)
300	300	1100	700	710
350	300	1100	725	710
350	350	1200	775	780
400	300	1100	750	780
400	350	1200	800	850
400	400	1300	850	850
450	300	1100	750	780
450	350	1200	825	875
450	400	1300	875	900
450	450	1400	950	975
500	300	1100	800	850
500	350	1200	850	920
500	400	1300	900	920
500	450	1400	950	950
500	500	1500	1000	1000
600	300	1100	850	915
600	400	1300	950	990
600	450	1400	1000	1030
600	500	1500	1050	1070
600	600	1600	1100	1100
700	300	1100	900	990
700	400	1300	1000	1060
700	450	1400	1050	1100
700	500	1500	1100	1140

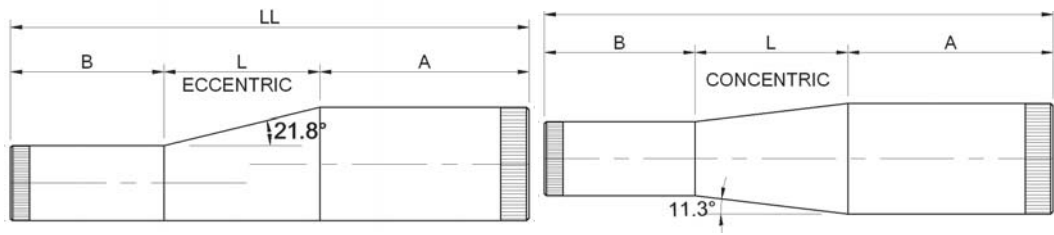
Header Dia (mm)	Branch Dia (mm)	B (mm)	F (mm)	E (mm)
700	600	1700	1200	1200
700	700	1900	1300	1270
800	300	1100	950	1050
800	400	1300	1050	1130
800	450	1400	1100	1170
800	500	1500	1150	1210
800	600	1600	1200	1240
800	700	1800	1300	1320
800	800	2100	1450	1450
900	300	1100	1000	1130
900	400	1300	1100	1200
900	500	1500	1200	1280
900	600	1700	1300	1360
900	700	1900	1400	1490
900	800	2100	1500	1560
900	900	2300	1600	1630
1000	300	1100	1050	1200
1000	400	1300	1150	1270
1000	500	1500	1250	1350
1000	600	1800	1400	1480
1000	700	1900	1450	1510
1000	800	2100	1550	1600
1000	900	2200	1600	1620
1000	1000	2500	1750	1750
1200	300	1200	1200	1380
1200	400	1400	1300	1470
1200	500	1600	1400	1545
1200	600	1700	1450	1574
1200	700	2000	1600	1620
1200	800	2200	1700	1780
1200	900	2400	1800	1850
1200	1000	2500	1850	1900
1200	1100	2700	1950	1970
1200	1200	2900	2050	2050

Header Dia (mm)	Branch Dia (mm)	B (mm)	F (mm)	E (mm)
1300	300	1300	1300	1510
1300	400	1400	1350	1530
1300	500	1600	1450	1615
1300	600	1700	1500	1645
1300	700	1900	1600	1725
1300	800	2000	1650	1755
1300	900	2200	1750	1830
1300	1000	2500	1900	1960
1300	1100	2600	1950	1990
1300	1200	2900	2100	2120
1300	1300	3200	2250	2250
1400	300	1400	1400	1628
1400	400	1500	1450	1657
1400	500	1600	1500	1680
1400	600	1800	1600	1770
1400	700	2000	1700	1840
1400	800	2200	1800	1925
1400	900	2400	1900	2000
1400	1000	2600	2000	2080
1400	1100	2800	2100	2160
1400	1200	2900	2150	2200
1400	1300	3000	2200	2320
1400	1400	3300	2350	2350
1500	300	1300	1400	1750
1500	400	1600	1550	1780
1500	500	1800	1650	1855
1500	600	2000	1750	1940
1500	700	2200	1850	2016
1500	800	2400	1950	2095
1500	900	2600	2050	2125
1500	1000	2800	2150	2205
1500	1200	3000	2250	2312
1500	1400	3200	2350	2371
1500	1500	3500	2500	2500

Header Dia (mm)	Branch Dia (mm)	B (mm)	F (mm)	E (mm)
1600	300	1300	1450	1719
1600	400	1700	1650	1898
1600	500	1800	1700	1928
1600	600	2000	1800	2007
1600	700	2200	1900	2086
1600	800	2400	2000	2166
1600	900	2500	2050	2195
1600	1000	2600	2100	2224
1600	1200	3000	2300	2383
1600	1400	3400	2500	2541
1600	1600	3700	2650	2650
1800	300	1300	1550	1861
1800	400	1500	1650	1940
1800	500	1700	1750	2019
1800	600	2000	1900	2148
1800	700	2200	2000	2228
1800	800	2400	2100	2307
1800	900	2500	2150	2336
1800	1000	2700	2250	2416
1800	1200	3000	2400	2524
1800	1400	3400	2600	2683
1800	1600	3800	2800	2841
1800	1800	4200	3000	3000
2000	400	1600	1800	2131
2000	600	2000	2000	2290
2000	800	2400	2200	2448
2000	1000	3000	2500	2707
2000	1200	3200	2600	2766
2000	1400	3500	2750	2874
2000	1600	3800	2900	2983
2000	1800	4400	3200	3241
2000	2000	4800	3400	3400

Note: Please contact Inter Pipe Factory® for other Diameters which are not included in the above Table

D. REDUCERS



ND Large end DL (mm)	ND Small end DS (mm)	Taper Length L (mm)	Pipe Length A (mm)	Pipe Length B (mm)	Laying Length LL (mm)
350	300	125	400	400	925
400	300	250	400	400	1050
400	350	125	400	400	925
450	300	375	400	400	1175
450	350	250	400	400	1050
450	400	125	400	400	925
500	300	500	400	400	1300
500	350	375	400	400	1175
500	400	250	400	400	1050
500	450	125	400	400	925
600	300	750	400	400	1550
600	400	500	400	400	1300
600	450	375	400	400	1175
600	500	250	400	400	1050
700	300	1000	400	400	1800
700	400	750	400	400	1550
700	450	625	400	400	1425
700	500	500	400	400	1300
700	600	250	400	400	1050
800	300	1250	400	400	2050
800	400	1000	400	400	1800
800	450	875	400	400	1675
800	500	750	400	400	1550

ND Large end DL (mm)	ND Small end DS (mm)	Taper Length L (mm)	Pipe Length A (mm)	Pipe Length B (mm)	Laying Length LL (mm)
800	600	500	400	400	1300
800	700	250	400	400	1050
900	300	1500	400	400	2300
900	400	1250	400	400	2050
900	450	1125	400	400	1925
900	500	1000	400	400	1800
900	600	750	400	400	1550
900	700	500	400	400	1300
900	800	250	400	400	1050
1000	300	1750	500	500	2750
1000	400	1500	500	500	2500
1000	450	1375	500	500	2375
1000	500	1250	500	500	2250
1000	600	1000	500	500	2000
1000	700	750	500	500	1750
1000	800	500	500	500	1500
1000	900	250	500	500	1250
1100	300	2000	500	500	3000
1100	400	1750	500	500	2750
1100	450	1625	500	500	2625
1100	500	1500	500	500	2500
1100	600	1250	500	500	2250
1100	700	1000	500	500	2000
1100	800	750	500	500	1750
1100	900	500	500	500	1500
1100	1000	250	500	500	1250
1200	400	2000	500	500	3000
1200	450	1875	500	500	2875
1200	500	1750	500	500	2750
1200	600	1500	500	500	2500

ND Large end DL (mm)	ND Small end DS (mm)	Taper Length L (mm)	Pipe Length A (mm)	Pipe Length B (mm)	Laying Length LL (mm)
1200	700	1250	500	500	2250
1200	800	1000	500	500	2000
1200	900	750	500	500	1750
1200	1000	500	500	500	1500
1200	1100	250	500	500	1250
1300	500	2000	500	500	3000
1300	600	1750	500	500	2750
1300	700	1500	500	500	2500
1300	800	1250	500	500	2250
1300	900	1000	500	500	2000
1300	1000	750	500	500	1750
1300	1100	500	500	500	1500
1300	1200	250	500	500	1250
1400	600	2000	500	500	3000
1400	700	1750	500	500	2750
1400	800	1500	500	500	2500
1400	900	1250	500	500	2250
1400	1000	1000	500	500	2000
1400	1100	750	500	500	1750
1400	1200	500	500	500	1500
1400	1300	250	500	500	1250
1500	700	2000	600	600	3200
1500	800	1750	600	600	2950
1500	900	1500	600	600	2700
1500	1000	1250	600	600	2450
1500	1100	1000	600	600	2200
1500	1200	750	600	600	1950
1500	1300	500	600	600	1700
1500	1400	250	600	600	1450
1600	800	2000	600	600	3200

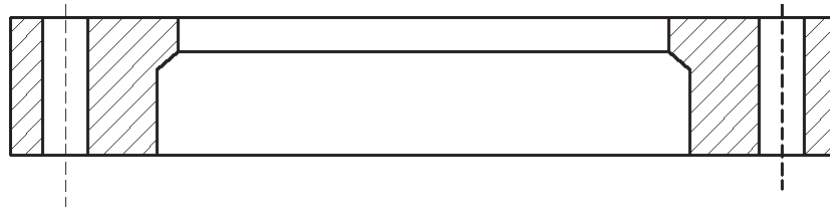
ND Large end DL (mm)	ND Small end DS (mm)	Taper Length L (mm)	Pipe Length A (mm)	Pipe Length B (mm)	Laying Length LL (mm)
1600	900	1750	600	600	2950
1600	1000	1500	600	600	2700
1600	1100	1250	600	600	2450
1600	1200	1000	600	600	2200
1600	1300	750	600	600	1950
1600	1400	500	600	600	1700
1600	1500	250	600	600	1450
1700	900	2000	600	600	3200
1700	1000	1750	600	600	2950
1700	1100	1500	600	600	2700
1700	1200	1250	600	600	2450
1700	1300	1000	600	600	2200
1700	1400	750	600	600	1950
1700	1500	500	600	600	1700
1700	1600	250	600	600	1450
1800	900	2250	600	600	3450
1800	1000	2000	600	600	3200
1800	1100	1750	600	600	2950
1800	1200	1500	600	600	2700
1800	1300	1250	600	600	2450
1800	1400	1000	600	600	2200
1800	1500	750	600	600	1950
1800	1600	500	600	600	1700
1800	1700	250	600	600	1450
1900	1100	2000	600	600	3200
1900	1200	1750	600	600	2950
1900	1300	1500	600	600	2700
1900	1400	1250	600	600	2450
1900	1500	1000	600	600	2200
1900	1600	750	600	600	1950

ND Large end DL (mm)	ND Small end DS (mm)	Taper Length L (mm)	Pipe Length A (mm)	Pipe Length B (mm)	Laying Length LL (mm)
1900	1700	500	600	600	1700
1900	1800	250	600	600	1450
2000	1000	2500	600	600	3700
2000	1100	2250	600	600	3450
2000	1200	2000	600	600	3200
2000	1300	1750	600	600	1950
2000	1400	1500	600	600	2700
2000	1500	1250	600	600	2450
2000	1600	1000	600	600	2200
2000	1700	750	600	600	1950
2000	1800	500	600	600	1700
2000	1900	250	600	600	1450
2100	1300	2000	600	600	3200
2100	1400	1750	600	600	2950
2100	1500	1500	600	600	2700
2100	1600	1250	600	600	2450
2100	1700	1000	600	600	2200
2100	1800	750	600	600	1950
2100	1900	500	600	600	1700
2100	2000	250	600	600	1450
2200	1400	2000	600	600	3200
2200	1500	1750	600	600	2950
2200	1600	1500	600	600	2700
2200	1700	1250	600	600	2450
2200	1800	1000	600	600	2200
2200	1900	750	600	600	1950
2200	2000	500	600	600	1700
2200	2100	250	600	600	1450
2300	1500	2000	600	600	3200
2300	1600	1750	600	600	2950

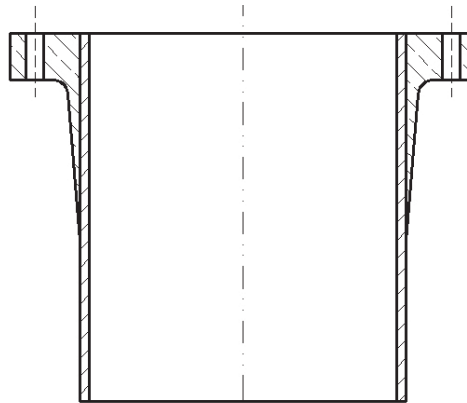
ND Large end DL (mm)	ND Small end DS (mm)	Taper Length L (mm)	Pipe Length A (mm)	Pipe Length B (mm)	Laying Length LL (mm)
2300	1700	1500	600	600	2700
2300	1800	1250	600	600	2450
2300	1900	1000	600	600	2200
2300	2000	750	600	600	1950
2300	2100	500	600	600	1700
2300	2200	250	600	600	1450
2400	1600	2000	600	600	3200
2400	1700	1750	600	600	2950
2400	1800	1500	600	600	2700
2400	1900	1250	600	600	2450
2400	2000	1000	600	600	2200
2400	2100	750	600	600	1950
2400	2200	500	600	600	1700
2400	2300	250	600	600	1450
2500	1700	2000	600	600	3200
2500	1800	1750	600	600	2950
2500	1900	1500	600	600	2700
2500	2000	1250	600	600	2450
2500	2100	1000	600	600	2200
2500	2200	750	600	600	1950
2500	2300	500	600	600	1700
2500	2400	250	600	600	1450
2600	1800	2000	600	600	3200
2600	1900	1750	600	600	2950
2600	2000	1500	600	600	2700
2600	2100	1250	600	600	2450
2600	2200	1000	600	600	2200
2600	2300	750	600	600	1950
2600	2400	500	600	600	1700
2600	2500	250	600	600	1450

Note: Please contact Inter Pipe Factory® for other Diameters which are not included in the above Table

E. FLANGES

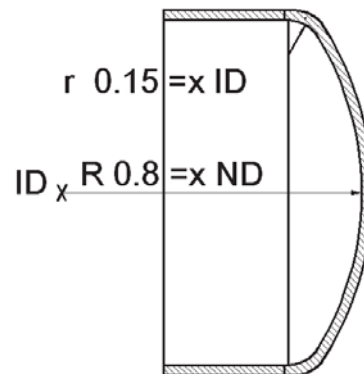


For ND < 300

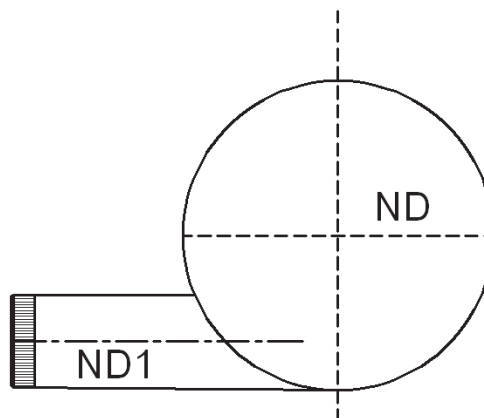


For ND ≥ 300

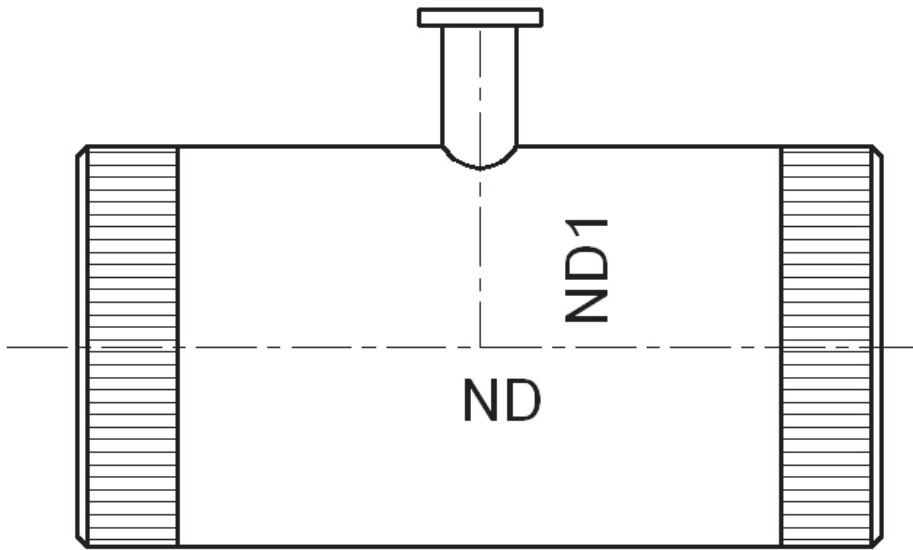
F. OTHERS FITTINGS



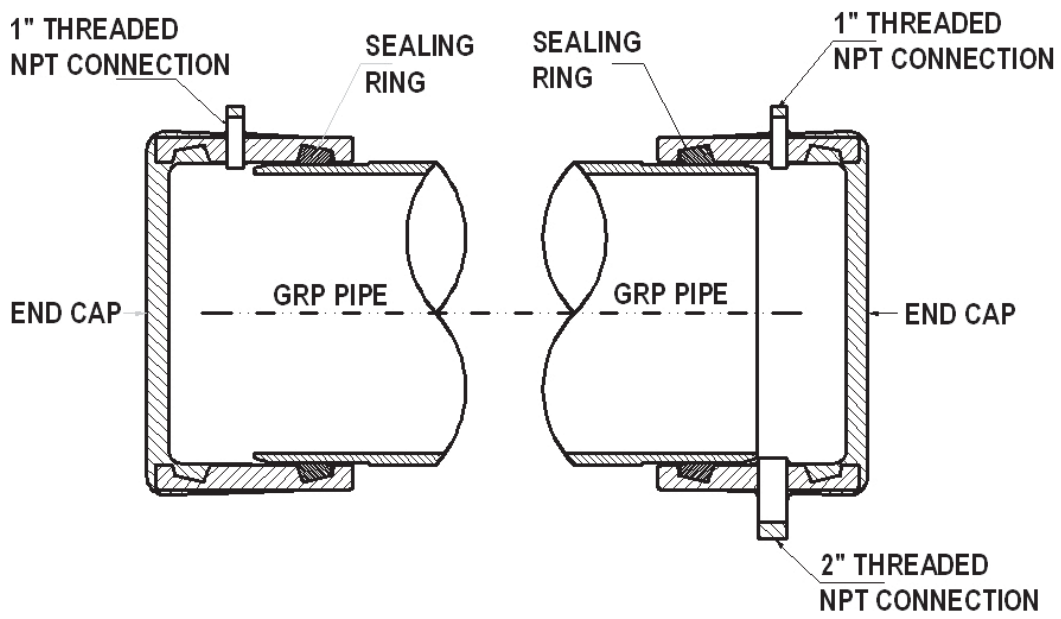
End Cap



Eccentric Tees



Flanged Nozzles



Hydrotest Spools

14. PACKING, HANDLING AND STORAGE

- ▲ Pipe and fittings shall be suitably cradled, wedged or braced to prevent damage during shipment.
- ▲ 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.
- ▲ 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.
- ▲ 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.
- ▲ Store rubber ring gaskets and lubricants in their original containers in a cool, dry area shaded from direct sunlight.
- ▲ Do not drop or impact the pipe especially at pipe ends
- ▲ Workers should wear gloves when handling pipe to protect hands from the rough pipe surface ends.
- ▲ Additional handling instructions shall be according to **Inter Pipe Factory®**.

15. INSTALLATION

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

Always use a vegetable based joint lubricant when joining REKA Coupling into pipes. As with all piping systems, unbalanced thrust forces will be present at changes of direction or cross-sections such as in elbow, reducers, tees, wyes or bulk heads. These forces must be restrained for system stabilization. Adequate restraint can be achieved through concrete thrust blocks.

DISCLAIMER :

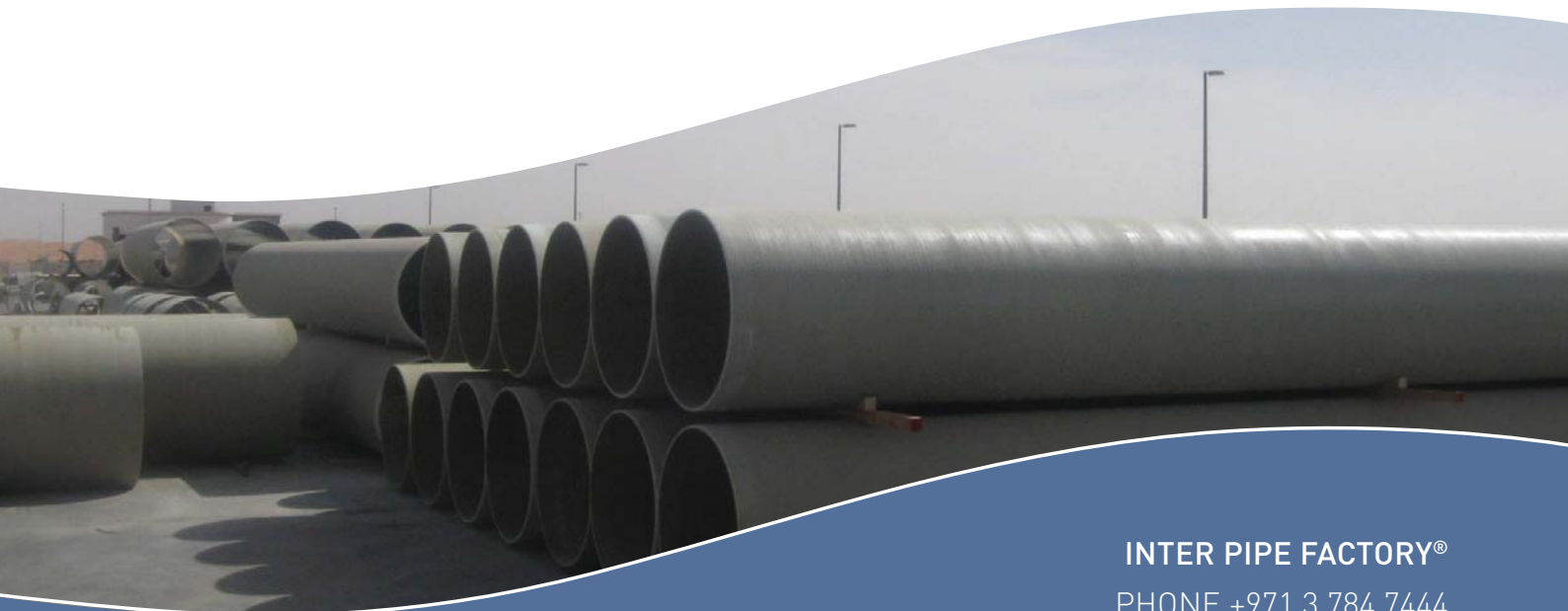
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OUTLINE :

Inter Pipe Factory® , branch of Nael & Bin Harmal Hydro Export Est. Inter Pipe Factory® was established in 2009 and look forward to be a leading supplier of composite thermosetting pipe systems and technologies in GCC, Middle East, Africa, Asia and Europe.

ACCREDITATIONS :

Inter Pipe Factory® is accredited for the Quality Management Systems ISO 9001:2008, Environmental Management Systems ISO 14001:2004 & OHSAS 18001:2007. In addition, certificates of the suitability to convey potable water from the Water Regulation Advisory Scheme (WARS) from UK, Kitemark from UK and the National Sanitation Foundation (NSF International) from USA.



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