INTER PIPE FACTORY

IPF

GRE

GLASS FIBER REINFORCED EPOXY
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.
- Involve in the advancement of the community by offering quality scale salary, developing social Circle and environmental programs.
- Maintain reasonable profitability to support the mission and to expand the experience to customer around the globe.

1. INTRODUCTION

Inter Pipe GRE piping systems are manufactured from glass fibers, impregnated with an aromatic or cycle aliphatic amine cured epoxy resin. This thermosetting resin system possesses superior corrosion resistance, together with excellent mechanical, physical and thermal properties.

The glass fiber reinforced epoxy resin piping system resists the corrosive effects of mixtures of low concentration of acids, neutral or near –neutral salts, solvents and caustics, both under internal and external loads at temperatures up to 95°C .

The helically wound continuous glass fibers of the reinforced (structural) wall of the pipes and the fittings are protected on the inner side by resin-rich reinforced liner and on the outer side by the resin topcoat. Its corrosion resistant and high strength to weight ratio makes it an ideal piping material for demanding corrosive applications.

The installation cost of GRE pipe systems are typically 80% of the costs of carbon steel. The corrosion resistance and resistance to UV light reduce the maintenance costs for both above and buried pipelines. The smooth internal surface reduces the head loss resulting in lower pump energy consumption.

Inter Pipe is designed for use in bi-axially loaded applications without the use of thrust blocks. It covers diameters from 25 to 1200mm, pressures from 10 to 100brag, and is available in bonded, mechanical, laminated and flanged jointing systems

Inter Pipe Factory® manufactures glass-fiber-reinforced polymer pipes using the continuously – advancing mandrel process done by the Dis -continuous filament winding machine, guaranteeing a consistently homogeneous product meter to meter. A GRE pipe system manufactured by **Inter Pipe Factory®** is the ultimate pipe selection for demanding corrosive applications.

2. LEADING THE FIBERGLASS MARKET WITH HIGH TECHNOLOGIES

Corrosion resistant, Lightweight and manufactured under stringent quality standards, **Inter Pipe Factory®** GRE pipes are available in different pressure classes. Diameters range from 25mm up to 1200mm 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 – Epoxy reinforced plastic pipe by **Inter Pipe Factory®** operations has resulted in its widespread application for the following:

- Chemical process
- Chlorination
- Crude oil transmission lines
- Cooling water
- Condensate lines
- Ballast (water treatment)
- Potable water
- Firefighting
- Geothermal
- General industrial service for mildly corrosive liquids.
- Water Transmission and Distribution (Potable Water)
- Sea water intake and outfalls
- Chemicals & Industrial applications
- Sounding & ventilation lines.

Inter Pipe Factory® GRE pipe material delivers long, effective service life with lower operating and maintenance costs compared to other piping materials. In comparison with galvanized and rubber lined steel and CuNiFe, the installation costs of GRE systems are lower as a result of GRE's lightweight nature and ease of handling and Installation.

When com–pared to polyester and vinyl ester pipe systems GRE is significantly less hazardous. GRE pipe systems are also eco-friendly and pose no risk to the environment.

Inter Pipe Factory® Glass Fiber Reinforced Epoxy (GRE) pipes, fittings and accessories are produced by using the highest levels of technology and quality in manufacturing provided by Fiber Flow

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 GRE pipes systems and add up to provide effective design life and cost effective system.

Features	Benefits
Durable and Corrosion Resistant	◢ Extensive, effective service life ◢ No need for coatings, lining, catholic protection, wraps or other forms of corrosion protection ◢ Hydraulic characteristics effectively constant over time ◢ Low maintenance costs
Design life time is more than 50 years	◢ Maximum economical optimization ◢ Non corrosive characteristics.
Long standard Lengths (6 & 12 meters)	◢ Fewer joints reduce installation time ◢ More Pipe per Transport Vehicle results in lower delivery cost
Extremely smooth Bore	◢ Low friction loss means less pumping energy needed and lower operating cost ◢ Minimum slime build up helps in lowering cleaning costs
Flexible manufacturing process	◢ Custom diameters can be manufactured to provide maximum flow volumes with ease of installation for rehabilitation lining projects
High technology pipe design	◢ Lower Wave celerity than other piping materials which implies less cost when designing for surge and water hammer pressures ◢ Pipes are hydrostatically tested at twice the pressure class
GRE pipe manufacturing system producing pipe that strictly complies with stringent performance international standards (ASTM, AWWA, ISO, etc…	◢ High and consistent product quality worldwide which ensures reliable product performance

Table 3.1

4. APPLICABLE STANDARDS

Glass Fiber Reinforced Epoxy 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® GRE 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 & API Standards

Presently, there are several ASTM product standards in use which apply to a variety of fiberglass pipe applications.

Standard	Application
ASTM D 2310	Standard Classification for Machine – Made "Fiberglass" (Glass – Fiber-Reinforced Thermosetting – Resin) Pipe
ASTM D 2996	Standard Specification for Filament – Wound "Fiberglass" (Glass – Fiber-Reinforced Thermosetting – Resin) Pipe
ASTM D 2517	Standard Specification for Reinforced Epoxy Resin Gas Pressure Pipes & Fittings
ASTM D 5685	Standard Specification for "Fiberglass" (Glass – Fiber-Reinforced Thermosetting – Resin) Pressure Pipe & Fittings
API 15 HR	Specification for High Pressure Fiberglass Line Pipe
API 15 LR	Specification for Low Pressure Fiberglass Line Pipe

Table 4.2

4.3. ISO Standards

Inter Pipe Factory® manufacture GRE pipes ensuring that the performance requirements qualification and control testing, and design to meet the following ISO Standards:

Standard	Application
ISO 14692*	Petroleum and natural gas industries Glass-Reinforced Plastics (GRP) Piping

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. Refractive index of Epoxy Resin Hardener mix – ASTMD 1045
2. Viscosity of Epoxy Resin – ISO 2555
3. Resin Gel Time, Cure Time & Peek Temperature – ASTMD 2471
4. Glass Fibers – Moisture content – ISO 3344
   – Size / Binder content. – ISO 1887
   – Tex properties – ISO 1889
5. C Glass Veil & W/R Mat: – N/mm^2
   – Moisture content – ISO 3344
   – Size / Binder content. – ISO 1887
   – Gms/Sq.Mt. – ISO 3374.

5.2. Physical Properties

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

Pipe Property	Units	Value
Thermal conductivity	W/mK	0.3
Thermal linear Expansion	10-6 mm/mm/°C	18.0
Flow coefficient	Hazen-Williams	150
Absolute roughness	10-6m	5.3
Density	g/cm^3	1.8

5.3. Mechanical Properties

Pipe Property	Units	Value
Hydrostatic design Stress	N/mm2	63
Ultimate Hoop Tensile Strength	N/mm2	310
Hoop Tensile Strength	N/mm2	300
Axial tensile strength	N/mm2	75
Hoop tensile Modulus	N/mm2	20500
Axial Tensile Modulus	N/mm2	15000
Poisson's ration hoop to axial		0.4
Poisson's ration axial to hoop		0.6

5.4. Finished Pipe

GRE pipe products produced by **Inter Pipe Factory®** are subject to the following control check:

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)

5.5. Qualification Testing

A. Hydrostatic Design Basis Hdb

6. JOINTING SYSTEMS

Key – Lock Joint:

This joint is an excellent joint for fast pipeline laying. The joint design allows Axial and Radial movement. In general, no thrust blocks are required.

Taper/Taper Joint:

This joint is an adhesive bonded joint. It can be made on the field by using a Field Shaver.

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	400
50	450
80	500
100	600
150	700
200	800
250	900
300	1000
350	1200

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

Table 7.1

7.2. Standard Lenghts

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

ND (mm)	Standard Length (meters)
25mm to 50mm	3 meters
80mm to 200mm	6 meters
ND 200mm	12 meters

Table 7.2

Pressure class:

- From 10 bar up to 100 bar.
- Higher pressure classes can be manufactured as per the customer's request. In such case, kindly consult **Inter Pipe Factory®**

Pipe Data : Inter pipe GRE pipe possess the following details:

Total Pipe wall thickness in mm (excluding 0.5mm Liner)							
ND	10 Bar	12 Bar	14 Bar	16 Bar	20 Bar	25 Bar	32 Bar
80	3.0	3.0	3.0	3.0	3.0	3.0	3.0
100	3.0	3.0	3.0	3.0	3.0	3.0	3.0
150	3.0	3.0	3.0	3.0	3.0	3.3	4.2
200	3.0	3.0	3.0	3.0	3.5	4.4	5.6
250	3.0	3.0	3.1	3.5	4.4	5.5	7.0
300	3.0	3.1	3.7	4.2	5.2	6.5	8.4
350	3.0	3.6	4.3	4.9	6.1	7.6	9.8
400	3.5	4.2	4.9	5.5	6.9	8.7	11.2
450	4.0	4.5	5.0	6.5	8.0	10.0	12.6
500	4.3	5.2	6.1	6.9	8.7	10.9	14.0
600	5.2	6.2	7.3	8.3	10.4	13.1	16.7
This design is also satisfying the New ISO 14692							

Table 7-3A

Total Pipe wall thickness in mm (excluding 0.5mm Liner)							
ND	40 Bar	50 Bar	60 Bar	65 Bar	70 Bar	75 Bar	100 Bar
80	3.5	4.0	4.8	5.5	6.0	6.5	8.5
100	3.5	4.5	5.5	6.0	6.5	7.0	9.5
150	5.5	7.0	8.5	-	-	-	-
200	7.5	9.0	11.0	-	-	-	-
250	9.0	11.5	13.5	-	-	-	-
300	11.0	13.5	-	-	-	-	-
350	12.3	16.0	-	-	-	-	-
400	14.5	18.0	-	-	-	-	-
450	16.0	-	-	-	-	-	-
500	18.0	-	-	-	-	-	-
600	-	-	-	-	-	-	-
This design is also satisfying the New ISO 14692							

Table 7-3B

Total Pipe Weight in Kg/m (excluding end joint)							
ND	10 Bar	12 Bar	14 Bar	16 Bar	20 Bar	25 Bar	32 Bar
80	1.4	1.4	1.4	1.4	1.4	1.4	1.4
100	1.7	1.7	1.7	1.7	1.7	1.7	1.7
150	2.6	2.6	2.6	2.6	2.6	2.8	3.6
200	3.4	3.4	3.4	3.4	4.0	5.0	6.4
250	4.3	4.3	4.4	5.0	6.3	7.9	10.0
300	5.1	5.3	6.3	7.2	8.9	11.1	14.4
350	6.0	7.2	8.6	9.8	12.2	15.2	19.7
400	7.9	9.5	11.1	12.5	15.7	19.9	25.7
450	10.2	11.5	12.8	16.7	20.5	25.7	32.5
500	12.2	14.8	17.3	19.6	24.8	31.1	40.1
600	17.7	21.1	24.9	28.3	35.6	44.9	53.9
This is only pipe weight , joint weight is not included							

Table 7-3C

Total Pipe wall thickness in mm (excluding 0.5mm Liner)							
ND	40 Bar	50 Bar	60 Bar	65 Bar	70 Bar	75 Bar	100 Bar
80	2.5	3.2	3.9	4.3	4.7	5.1	7.0
100	4.2	5.3	6.4	7.1	7.6	8.6	11.7
150	9.3	11.9	14.5	-	-	-	-
200	16.4	22.5	25.6	-	-	-	-
250	25.6	32.6	40.1	-	-	-	-
300	36.9	47.1	-	-	-	-	-
350	50.2	64.0	-	-	-	-	-
400	65.5	83.3	-	-	-	-	-
450	82.9	-	-	-	-	-	-
500	102.4	-	-	-	-	-	-
600	-	-	-	-	-	-	-
This design is also satisfying the New ISO 14692							

Table 7-3D

8. MANUFACTURING PROCESS

8.1. Pipes

Inter Pipe GRE pipes are manufactured by the reciprocal filament winding process. In this process, the continuous fibrous glass strand rovings are wound onto the outside of a mandrel in a predetermined pattern under controlled tension. The rovings are saturated with resin/curing agent mixture and helically wound under calculated winding angle. The inside diameter (ID) of the finished pipe is fixed by the mandrel outside diameter. The outside diameter (OD) of the finished pipe is determined by the number of helically wound layers.

8.2. Fittings

Inter Pipe GRE fittings up to 600mm diameter are filament wound on purpose built steel molds. Fittings are built –up from resin impregnated woven glass fabric, which is applied onto the outside of a mandrel in a pre-determined pattern under controlled tension.The inside diameter (ID) is fixed by the outside diameter of the mandrel. The outside diameter (OD) of the fittings is determined by the amount of material that is wound on the mandrel.

Inter Pipe GRE fittings larger than 600mm in diameter are filament wound from Inter pipe GRE pipe parts, which are first fitted together and then wrapped with resin impregnated woven glass fabrics. Pipe parts used for the production of fittings meet the pipe requirements.

8.3. Flanges

Inter Pipe GRE flange up to 600mm are filament wound either on purpose built molds or on Inter Pipe GRE pipe sections. Flanges above 600 mm are filament wound on Inter Pipe GRE pipe sections. Pipe parts used for the production of flanges meet the pipe requirements.

9. VISUAL PROPERTIES

9.1. 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 the faces that are wet out with resin
Resin Runs	Runs of resin on the surface of the pipe
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.
Air Bubbles	Air entrapment between the plies of the reinforcement.

10. 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. Pipe Serial Number
6. Manufacturing date

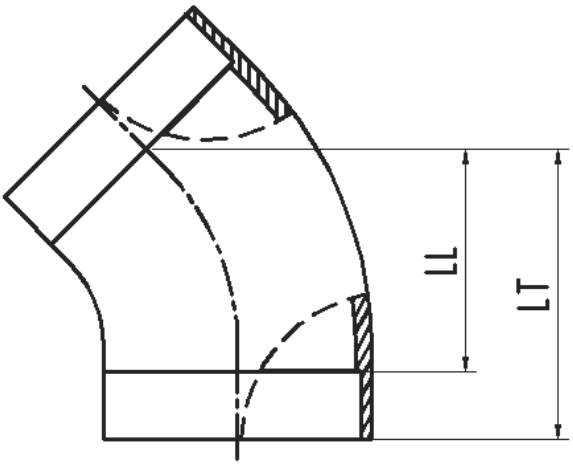
Specific marking requirement by customer could be arranged; **Inter Pipe Factory®** marks the product accordingly while maintaining traceability.

11. PIPE & FITTINGS

Inter Pipe Factory® has established a standardized line of GRE 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.

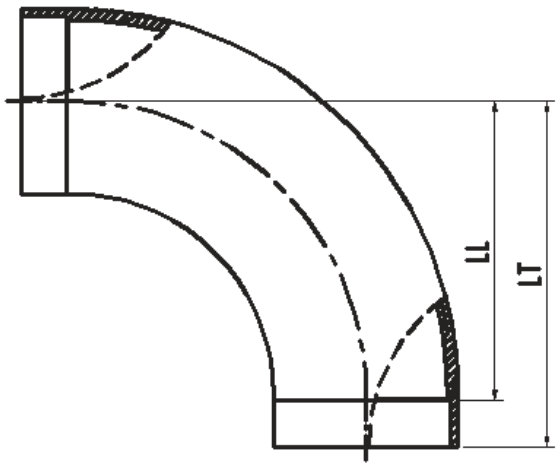
ELBOW 45 Deg – ABAB

ND (mm)	Pressure Class (PN Barg)
250 to 400	10 Barg
200 to 400	12 Barg
150 to 400	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

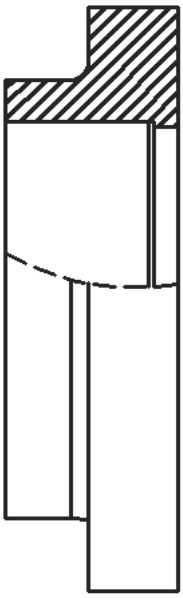


ELBOW 90 Deg – ABAB

ND (mm)	Pressure Class (PN Barg)
250 to 400	10 Barg
200 to 400	12 Barg
150 to 400	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

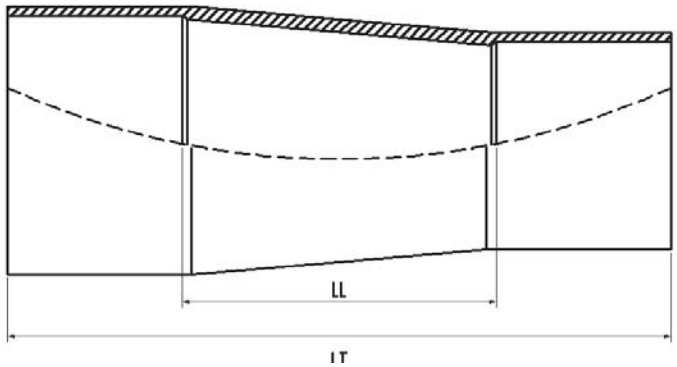


FLANGE – ABFF



ND (mm)	Pressure Class (PN Barg)
250 to 400	10 Barg
200 to 400	12 Barg
150 to 400	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

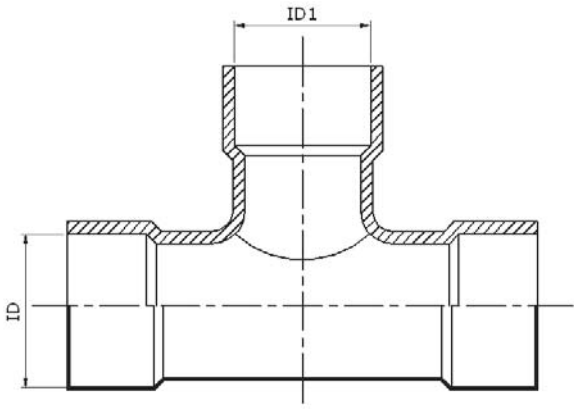
REDUCER – ABAB



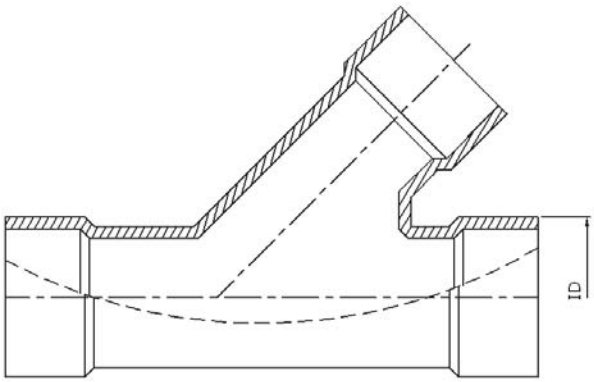
ND (mm)	Pressure Class (PN Barg)
250 to 400	10 Barg
200 to 400	12 Barg
150 to 400	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

TEE – ABAB

ND (mm)	Pressure Class (PN Barg)
250 to 400	10 Barg
200 to 400	12 Barg
150 to 400	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg



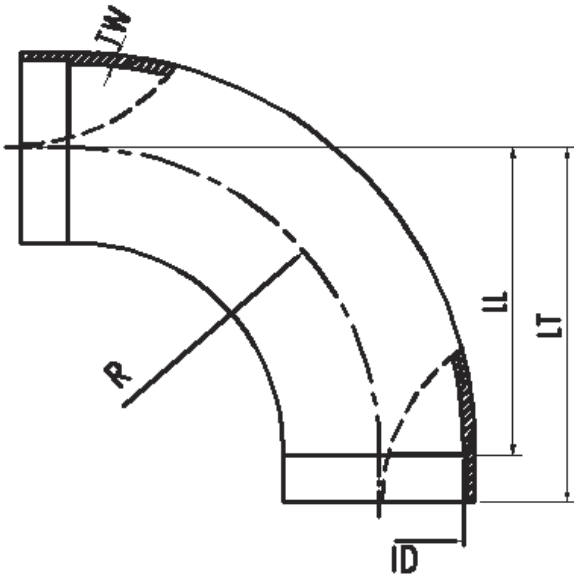
WYE – ABAB



ND (mm)	Pressure Class (PN Barg)
250 to 400	10 Barg
200 to 400	12 Barg
150 to 400	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

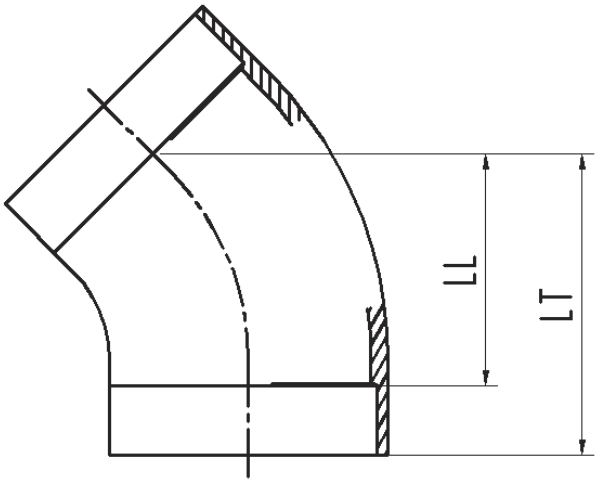
ELBOW 45 Deg – TBTB

ND (mm)	Pressure Class (PN Barg)
450 to 600	10 Barg
350 to 600	12 Barg
150 to 600	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

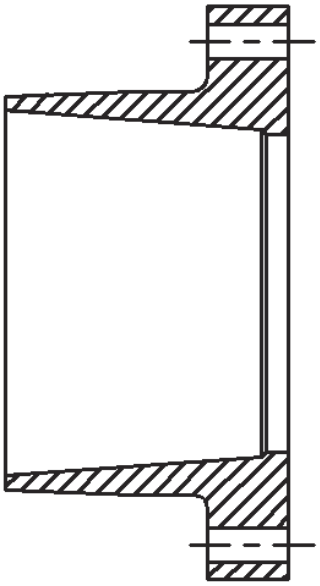


ELBOW 90 Deg – TBTB

ND (mm)	Pressure Class (PN Barg)
450 to 600	10 Barg
350 to 600	12 Barg
150 to 600	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

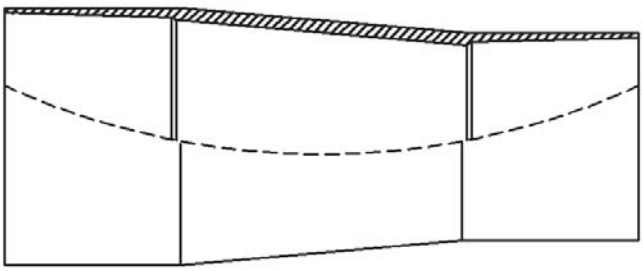


FLANGE – ABFF



ND (mm)	Pressure Class (PN Barg)
450 to 600	10 Barg
350 to 600	12 Barg
150 to 600	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

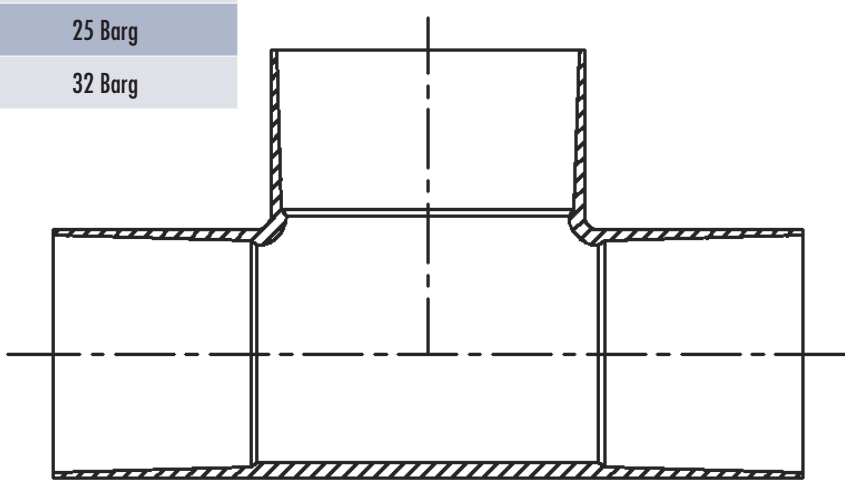
REDUCER – ABAB



ND (mm)	Pressure Class (PN Barg)
250 to 400	10 Barg
200 to 400	12 Barg
150 to 400	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

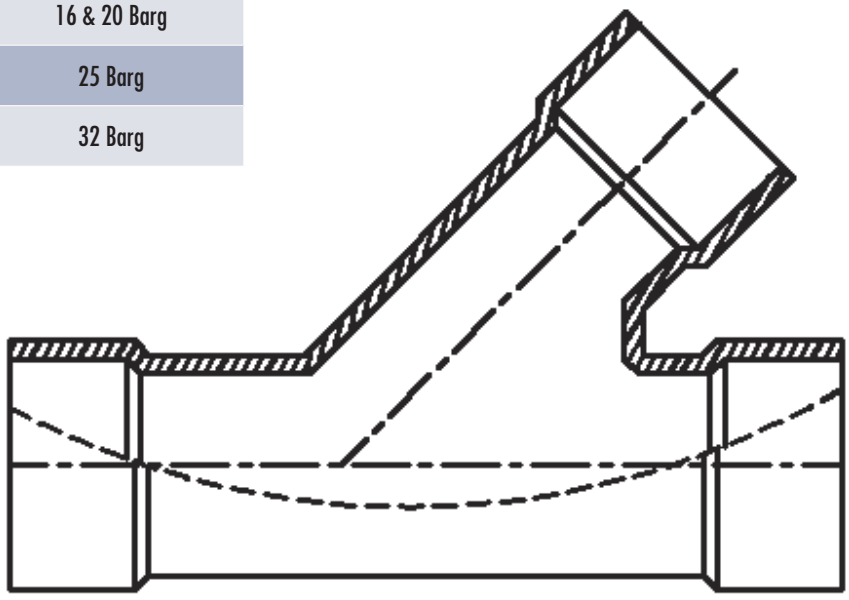
TEE – TBTB

ND (mm)	Pressure Class (PN Barg)
450 to 600	10 Barg
350 to 600	12 Barg
150 to 600	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

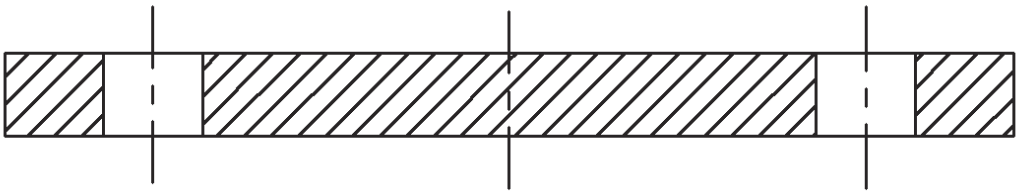


WYE – TBTB

ND (mm)	Pressure Class (PN Barg)
450 to 600	10 Barg
350 to 600	12 Barg
150 to 600	16 & 20 Barg
100 to 400	25 Barg
100 to 300	32 Barg

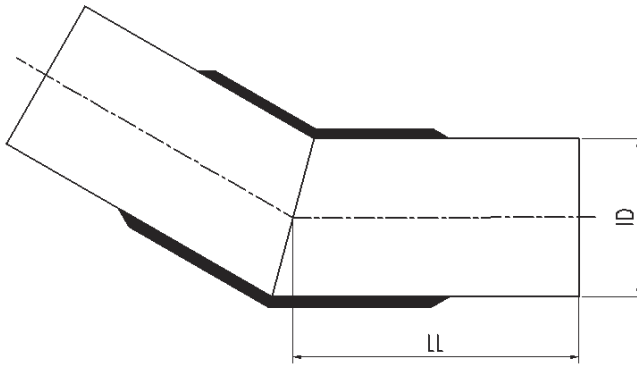


BLIND FLANGE – FFFF



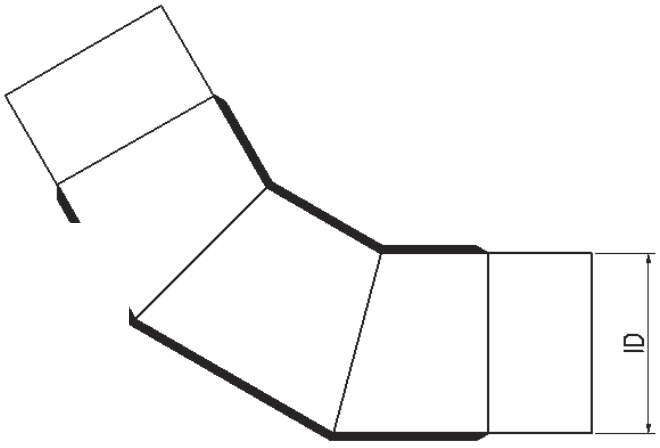
ND (mm)	Pressure Class (PN Barg)
250 to 1200	10 Barg
200 to 1000	12 Barg
150 to 800	16 Barg
100 to 400	25 Barg
100 to 300	32 Barg

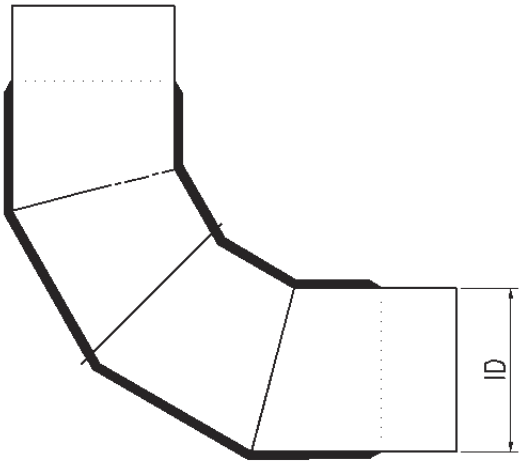
GRE MITTERED FITTINGS – PEPE



← GRE ELBOW 1 to 29DEG MITTER

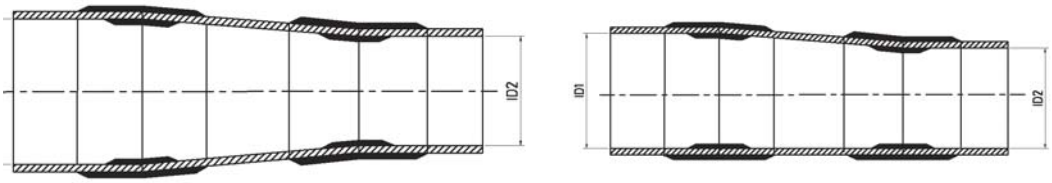
GRE ELBOW 30 – 59DEG MITTER →



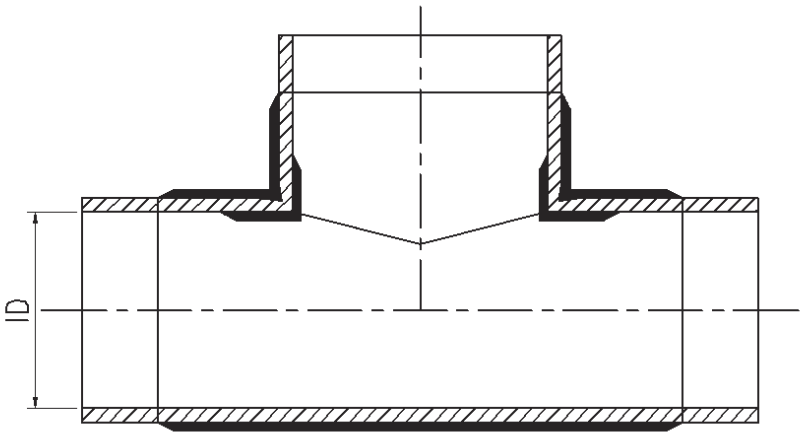


← GRE 60 – 90 DEG MITTER ELBOW

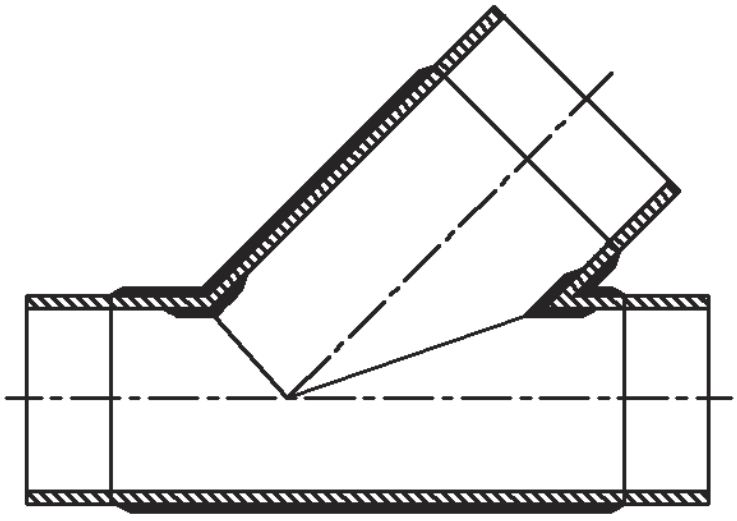
GRE CONCENTRIC REDUCER



GRE TEE

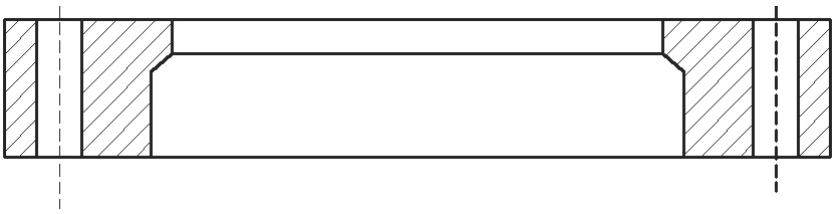


GRE WYE

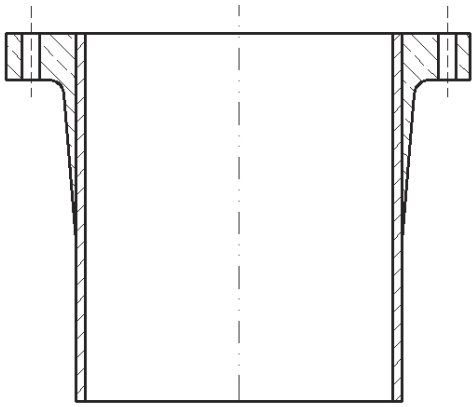


Mitered fittings can be manufactured as per the customer's request. In such case, kindly consult Inter Pipe Factory®

E. FLANGES

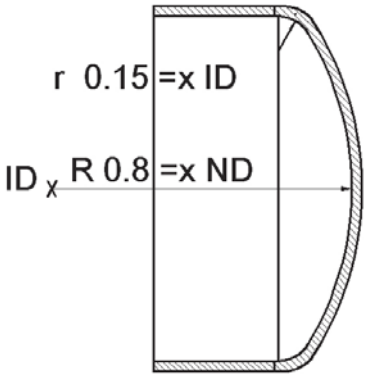


For ND < 300

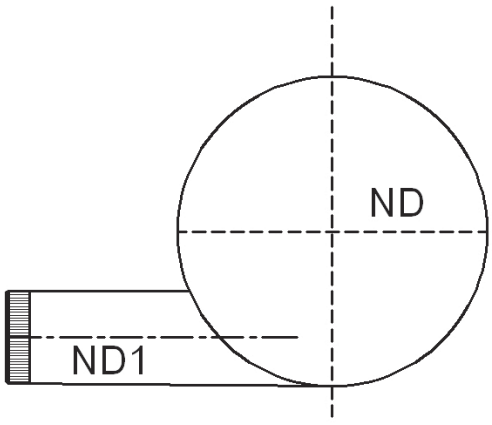


For ND ≥ 300

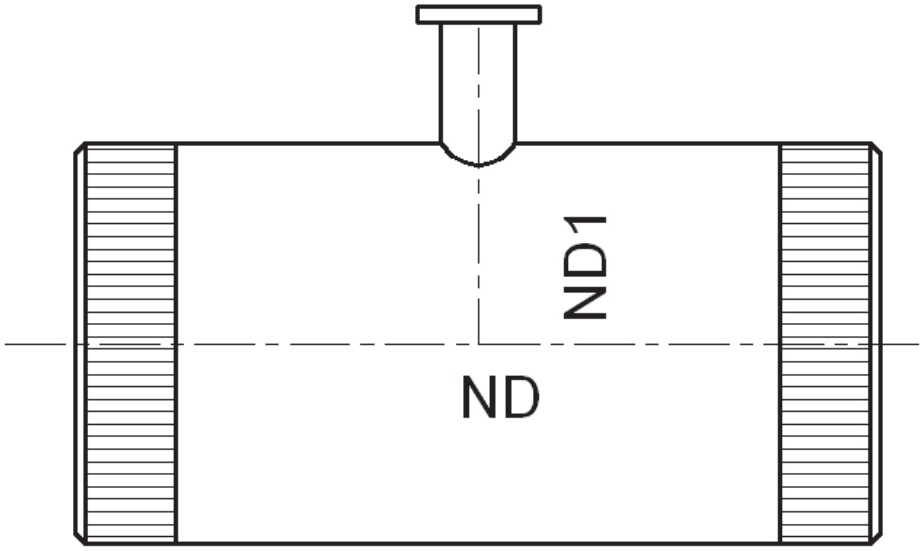
F. OTHERS FITTINGS



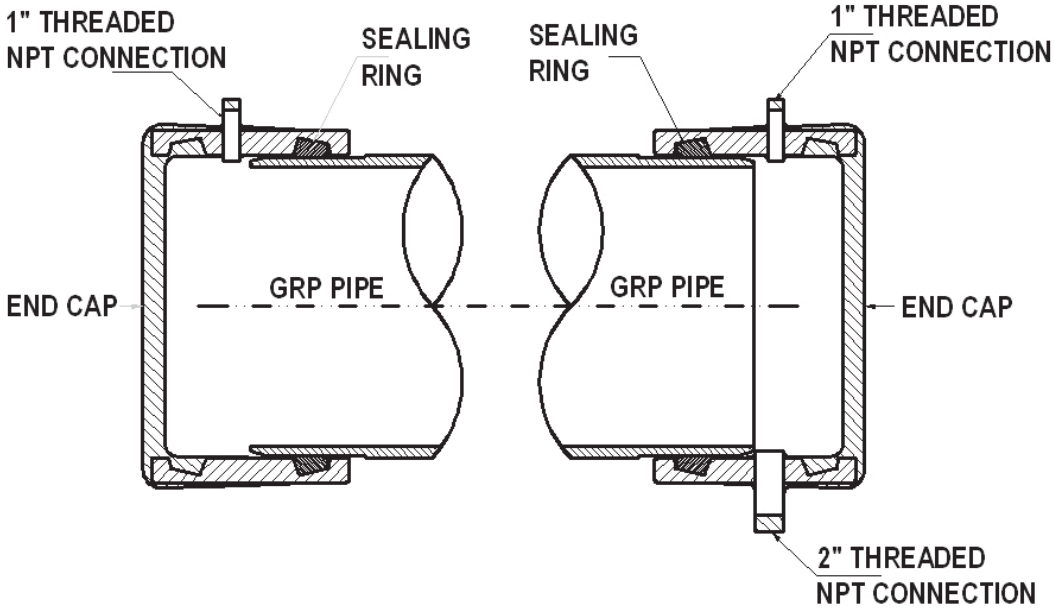
End Cap



Eccentric Tees



Flanged Nozzles



Hydrotest Spools

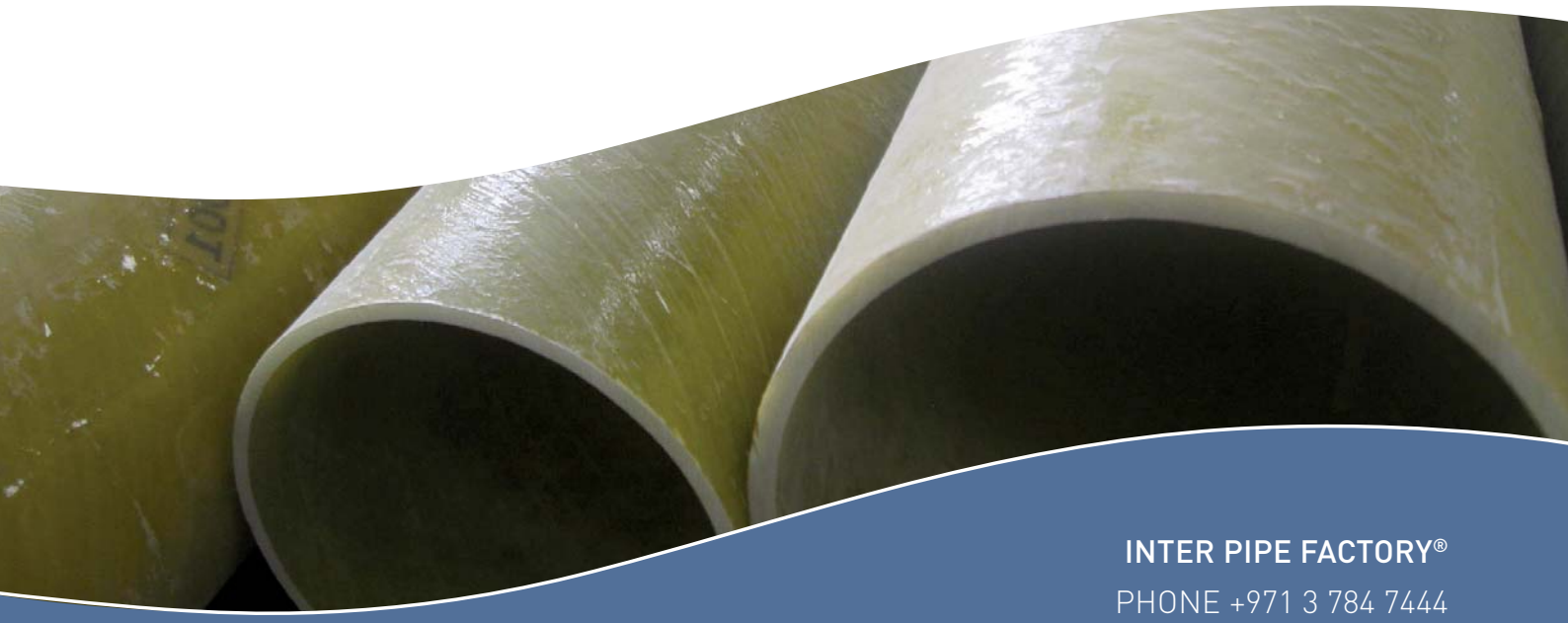
12. PACKING, HANDLING AND STORAGE

- 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.
- 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.
- When lifting fittings, care shall be taken to account for equal weight distribution.
- When storing fittings, care shall be taken that no excessive loads are exerted on Nozzles, Branches & Elbows. A particular attention has to be given to ensure that, the flange face is protected from scratches and damages.
- 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®**.

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.

NOTES



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