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INTRODUCTION

PIPE provides services in Engineering, Manufacturing, Design, and Installation of piping products. Our piping system is capable of withstanding aggressive environments including chemical & seawater applications. Thermosetting polyester, vinylester, and epoxy resins form a durable bond to fibers that are designed to withstand the rated pressure in both pipe & fittings.

PIPE LENGTH

Manufactured length standards between 3m-12m may also be manufactured depending on the desired length according to the project needs.

NOMINAL DIAMETERS

Size range is DN 12.5 mm to DN 3,000 mm (Standard diameter is applied for both pipe and fittings).

PRESSURE CATEGORIES

PN 1 bar - PN 25 bar. May also be manufactured above 25 Bar, a special design based on the Customer's needs (Standard pressure is applied for both pipe and fittings)

STIFFNESS CATEGORIES

Manufactured in SN 1,250, SN 2,500, SN 5,000, SN 10,000. Full vacuum series are also available, may also be manufactured in the desired values of stiffness according to the project needs.

SUPERIORITIES AND ADVANTAGES OF FRP/GRP

CORROSIVE AND ABRASIVE RESISTANT

FRP/GRP has been the clear choice for corrosive and abrasive environments for the past 50 years (can withstand environments such as extreme temperature, high pressure, chemicals, etc). At a given temperature and chemical environment, we can recommend the right materials for the most critical applications. Corrosion resistance is often the primary reason for choosing corrosion composites.

LIGHTWEIGHT, HIGH STRENGTH, AND TOUGH

The pipes are lighter (strength to weight ratio) compared to iron, steel and concrete pipes and eliminates the need for expensive pipe handling equipment. In contrast to most metals, fibreglass does not change shape even when it is ruptured and can be designed to withstand impact.

HIGH MECHANICAL PROPERTIES

FRP is so strong and stiff for its weight, it can out-perform most other materials including steel and aluminium. Carbon-fibre and Kevlar can be used to make items even lighter - the strength and stiffness per weight of these exotic materials exceeds that of all known materials.

NON-CONDUCTIVE

Unlike metal products, FRP is not conductive to heat, sound, has no magnetic field and resists electrical sparks. It makes the work environment safer. Fibreglass can be made to be conductive for some applications.

DURABLE AND COST EFFECTIVE

High resistance to fatigue and requires minimal maintenance.

CUTTING AND FINISHING

Adjustment of pipes on site with easy cutting and finishing according to the desired length.

MATERIAL USE

We are using the best materials from approved manufacturers.

RESIN

Polyester (Orthophtalic, Isophthalic, Bisphenolic), Vinylester (ASHLAND,AOC,SHCP,SHOWA), and Epoxy.

GLASS

E-Glass, C-Glass, ECR-Glass, boron free-Glass (PFG, Owens Corning, Nitttobo).

HARDENER

Only approved catalysts are used in the manufacturing process (MEKP, BPO).

ADDITIVES

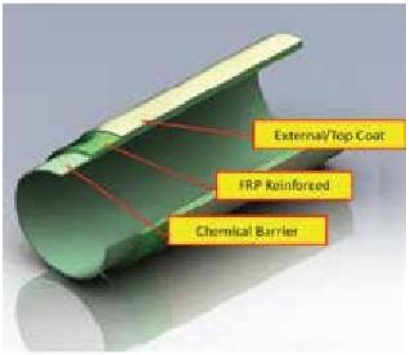
Additives are used as promoter and accelerator for the resin (DMA, Cobalt-Napthenate).

MANUFACTURING PROCESS

Pipes are produced using a colaborative process between hand lay-up and helical filament winding processes.The hand lay-up process creates a chemical layer in direct contact with fluid. The Filament winding process creates a structure layer as a buffer against stress. Production process is fully operated with computer controlled machines.
Fitting manufactured by a contact molded and hand layup process combined with chopped strand mat (CSM), woven roving (WR), unidirection woven roving stitch mat, and surfacing veil.

ORI Lathe facility is capable of making mandrel and flange up to 3,000 mm in diameter. Customized sizes are available based on customer requirements.

PIPE COMPOSITION



Chemical Barrier

Having good chemical resistance properties, special anti chemical resistance C-Veil glass & the resin matrix forms the inner liner. Liner thickness of 1.3 mm is used as standard, but thicker liners are available on request.

Reinforced layer

The continuous glass rovings are impregnated in the resin bath to give excellent wet out, and these continuous rovings after their impregnation travel on to a mandrel which is rotating at controlled speeds. The continuous rovings move at fixed angles over the mandrel, and these angles are specifically chosen to ensure high mechanical strength characteristics. The thicknesses of the pipes are controlled by the continuous glass rovings winding sequence.

Top Coat

External resin-rich surface of 0.3 mm, provides excellent Ultraviolet protection. The pipes are left resin-rich on the outside surface to enhance these specific properties.

PRODUCT TEST

Quality of our pipes is ensured by checking & testing to the following standards:

TEST	BASE STANDARD
Longitudinal Tensile Strength	ASTM D 2105
Hoop Tensile Strength	ASTM D 2290
Pipe Stiffness or Load Deflection	ASTM D 2412
Flexural Strength	ASTM D 790
Short Term Hydraulic Failure Pressure	ASTM D 1599
Degree of Cure	API 15 LR I-2001, APPENDIX B

Load deflection test

Tensile strength test

Hydro test of spool

Hydro test of pipe

ENGINEERING DESIGN STANDARD

ASTM STANDARD

D 2996	Standard Specification for Filament Wound Reinforced Thermosetting Pipes
D 2992	Obtaining Hydrostatic Design Basis for Reinforced Thermosetting Resin Pipe and Fittings
D 638	Test for Tensile Properties of Plastics
D 2583	Standard Test Method for Indentation Hardness of Rigid Plastics by Means of A Barcol Impressor

AWWA STANDARD

AWWA C950-95	Standard for Fiberglass Pressure Pipe
AWWA M-45	Standard for Fiberglass Pipe Design

BRITISH STANDARD

BS 6464	Reinforced Plastics Pipes, Fittings and Joints for Process Plants
BS 5480	Glass Reinforced Plastics (GRP) Pipes,Fittings and Joints for use for water supply or sewerage

ISO STANDARD

ISO 14692 Petroleum and Natural Gas Industries Glass Reinforced Plastics (GRP) Piping :

- Part 1 : Application and Materials
- Part 2 : Qualification and Manufacture
- Part 3 : System Design
- Part 4 : Fabrication, Installation and Operation

AREA OF USE

FRP provides fantastic chemical resistance in highly corrosive industrial environments. Some of the most common areas where these pipes are used is shown below:

- Discharge lines of the sea (sea water pipe)
- Pipelines to carry liquid chemical waste
- Pipelines to remove industrial waste
- Pressure Pipelines for hydroelectric power stations
- Cooling water pipes for supply and discharge
- Sewerage projects force mains
- Storm water drainage
- Drinking water networks and water distribution pipelines
- Irrigation networks and drainage application



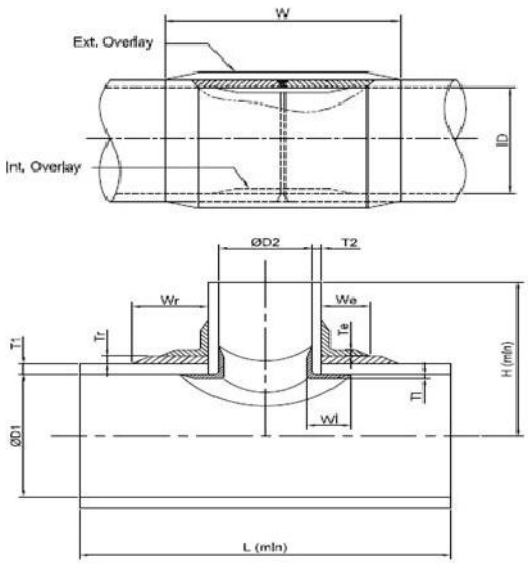



PRODUCT RANGE

Standard products are as follows (for customized products please contact us) :

1. FRP Pipe and Fitting.
2. PVC FRP Pipe and Fitting.
3. RPM.
   Affordable substitution for concrete, commonly used for underground purposes.
4. Epoxy Pipe.
   Pipes able to withstand hot temperatures. (Standard is up to 600 mm in diameter).

LAMINATION (BUTT AND WRAP)



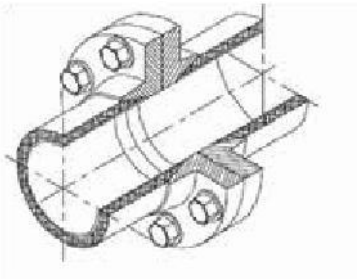
Butt and Wrap laminated joints are made by joining two pieces of pipe and then interlaying Chopped Strand Mat and Woven Roving in pre-defined sequence. The width and thickness of the Butt and Wrap joint are calculated based on pressure class to suit the customer's requirement.
Butt and Wrap Joints are available from 12.5 mm to DN 3,000 mm and are designed up to 25 bar. We can also make custom lamination joints to suit your project requirements.



FEATURES

- Preparation of lamination surface
- Lower / High Pressure Performance compared to other joint types
- Versatile
- Flexibility to accommodate minor misalignments

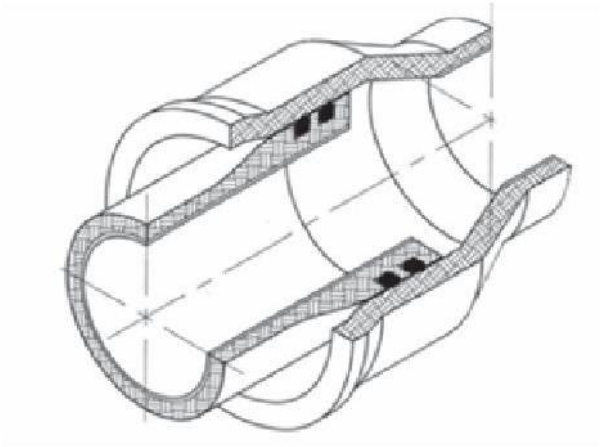
FLANGES



Flanges are made on a standard pipe, by hand lay-up process. The flange laminate is built up using C-Veil, Chopped Strand Mat and Woven Roving combination. Drilling patterns are available on request. Full-faced elastomeric gaskets may be used, suitable for the service pressure, service temperature and fluid.



SOCKET JOINTS



A tensile resistant type of joint, this type can be used in unrestrained environments such as above ground.

FEATURES

- Reliable and reusable
- Simple and faster joint method
- O-Ring seal
- Mechanical o-ring joint with restraint
- Also termed as o-ring seal lock joint

PIPE use the best raw materials from approved manufacturers. We always ensure the quality of our products in every single delivery, starting with the incoming inspection of raw materials to the completed installation. Below is the list of standard tests that are performed.

Tests	Standard	Frequency
Inspection of Resin	In-House Standard	Every Batch
Inspection of Hardener	In-House Standard	Every Batch
Inspection of Continuous Roving	In-House Standard	Every Batch
Tool Calibration	In-House Standard	Calibration every 3 to 6 months
Glass Content	ASTM D 2564	As per customer's requirement
Pressure Test (1.5 x_Design Pressure)	ISO 14692	As per customer's requirement
Visual Control	ASTM D 2563	100%
Dimensional Control	ASTM D 3567	100%
Barcol Hardness	ASTM D 2583	100%
Pipe Stiffness	ASTM D 2412	As per customer's requirement
Axial Tensile	ASTM D 638	As per customer's requirement
Short-term Hydraulic Failure Pressure	ASTM D 1599	As per customer's requirement
Hoop Tensile Strength Test	ASTM D 2290	As per customer's requirement
Long-Term HDB	ASTM D 2992	As per customer's requirement

ITEM	PIPE-FRP	PIPE-RPM	PCCP	PCP	SP	NCIP
Water Conveying Capacity (M^3/s)	6.8	6.8	6.8	6.8	6.8	6.8
Roughness coefficient	0.0084	0.0084	0.0013	0.0013	0.0011	0.0013
Diameter (mm)	2,000	2,000	2,400	2,400	2,200	2,400
Length/Piece (meter)	5.85 & 11.85 (max)	11.85 (max)	6	4	6	4
Lifetime (year)	50 ~ 70	50 ~ 70	< 50	30	10 ~ 20	30
Corrosion Resistance	Excellent	Excellent	Need treatment Cathode protection	Need treatment Cathode protection	Poor	Poor
Safety	Not to pollute water	Not to pollute water	Not to pollute water	Not to pollute water	Stain, to pollute water	Stain, to pollute water
Reference	ASME B.31.3, ASTM D2992, AWWA C-950	AWWA C-950	AWWA C-304	AWWA C-304	GBJ69-84	GB5696-4

PCCP : Pre-tensioned Concrete Casing Pipe

PCP : Pre-tensioned Concrete Pipe

SP : Steel Pipe

NCIP : Nodular Cast Iron Pipe

ITEM	PIPE-FRP	PIPE-RPM	PCCP	PCP	SP	NCIP
Type of Joint	Butt & wrap joint - Socket joint- Bolted	Butt & wrap joint - bell & spigot- Bolted	Slide single seal ring and single spigot	Flexible seal ring	Welding	Socket & spigot
Installation speed	Fast	Medium fast	Medium	Slow	Medium	Slow
Explosion phenomenon	No	No	Yes	Yes	Yes	Yes
Convenience degree of repair/Maintenance	Easy	Easy	Difficult	Difficult	Difficult	Difficult
Joint whether can be deflected	3 degree is acceptable	3 degree is acceptable	3 degree is acceptable	-	-	-
Leak proofness	Good	Very good	Good in Cylinder	Good	Good	Good
Support distance (m)	Depends on size and fluid type	Depends on size and fluid type	3	3	3	3
Price/m	LD Pipe equal than Galvanized pipe	LD Pipe lower than Galvanized pipe	Expensive	Expensive	Very expensive	Very expensive

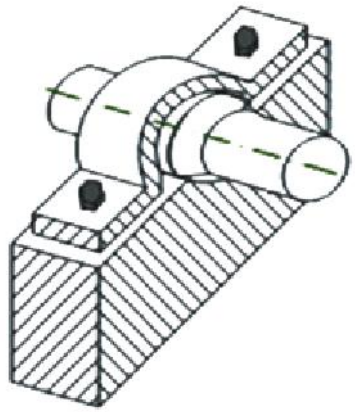
PCCP : Pre-tensioned Concrete Casing Pipe

PCP : Pre-tensioned Concrete Pipe

SP : Steel Pipe

NCIP : Nodular Cast Iron Pipe

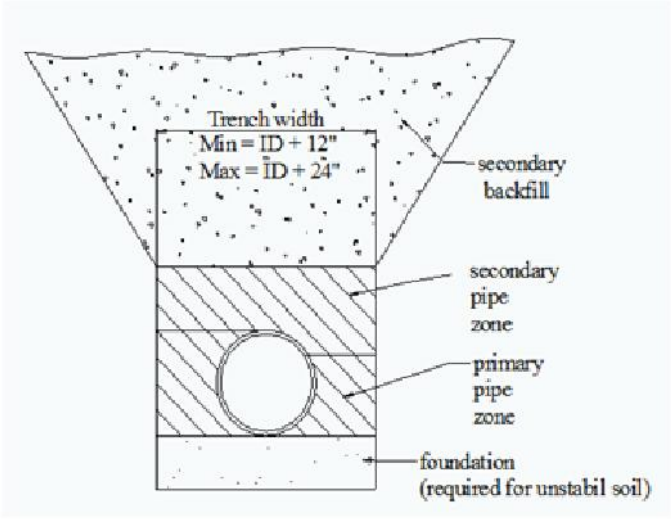
ABOVEGROUND PIPE-SUPPORT SYSTEM



When designing an aboveground pipe installation it is important to be aware of the forces that act on the pipe system, particularly for high pressure systems.

When a component in a pressurized pipeline has a change in cross-sectional area or direction, a resultant force is induced. All such components, (e.g. bends, reducers, tees, wyes or valves) must be anchored to withstand loads. (Please contact us for further information concerning support system)

UNDERGROUND PIPE-SUPPORT SYSTEM



Underground pipe is expected to support not only the earth load but the traffic load above as well, all while limiting deflections or obstruction that can cause joint leaks. (Please contact us for further information concerning support system)

HANDLING

- FRP pipes and fittings shall be handled with care and protected from impact. Throwing, dropping, bumping or hitting the FRP pipes and the fittings is prohibited. FRP pipes shall not be dragged or pushed over sharp objects that may scratch or damage the pipes.
- The use of forklift truck can be permitted as long as the forks are padded with adequate cushion material such as rubber sheet, canvas etc. in order to prevent damage to the pipes.
- During Transportation, do not let the FRP pipes rest on floor of the container where nails, studs or other sharp objects might damage it.
- The FRP pipes shall be securely fastened directly over the timbers with tie-downs such as steel slings with PE protective hose cover (as applicable)
- No foreign materials shall be loaded in the FRP pipes or on the top of pipes that will damage the pipes.
- Do not drop the FRP product, walk or stand on it.
- When stacking 12 m length, a minimum of 4 wooden supports must be used to separate each length.
- Do not allow the FRP pipe to extend more than 2 meters beyond the truck or trailer bed to prevent excessive bowing.

STORAGE

- During storage, supports shall be spaced at 3 meters intervals and approximate not more than 1.5 meters from each end. The supports should have a minimum 100 mm wide bearing surface.
- The supports (timbers) used in the container can be used for this purpose at the storage area.
- The pipe stack should not exceed 3m height and should have side supports or blocks to prevent rolling or slipping of stack.
- It is not recommended to stack pipes directly on the ground

MECHANICAL PROPERTIES

			Temperature (°C)		
#	Property	Unit	21	40	66
1.1	E Modulus. (Axial)	MPa	14,000	11,636	8,400
1.2	E Modulus. (Hoop)	MPa	25,600	22,357	17,920
1.3	Poisson's ratio. (Axial/Hoop)	-	0.60	0.70	0.84
1.4	Poisson's ratio. (Hoop/Axial)	-	0.33	0.37	0.43
1.5	Shear modulus	MPa	5,000	4,367	3,500
1.6	Shear modulus/ E modulus. (Axial)	-	0.357	0.375	0.417
1.7	Apparent beam modulus	MPa	10,700	8,893	6,420
1.8	Density	kg/m³	1,918	1,918	1,918
1.9	Coefficient of thermal expansion	mm/mm/°C	2.50E-05	2.5E-05	2.5E-05

PRODUCT DIMENSION

PIPE Standard Lengths:

DIAMETER (Ø)			PIPE STANDARD LENGTH
15	Up to	40	3.0 M
50	Up to	125	5.85 M
150		2,450	11.89 M
2,500		3,000	5.85 M

CODE & STANDARD:

- ASTM STANDART
- D 2996
- D 2992
- D 638
- D 2583

BRITISH STANDARD

- BS 6464
- BS 5480

AWWA STANDARD

- AWWA C950-95
- AWWA M-45

ISO STANDARD

- ISO 14692

ADVANTAGES:

- Lightweight, High Strength and High Stiffness
- Excellent Corrosion-Resistant Properties
- Good Hydraulic Properties
- High Mechanical Properties
- Shock Resistant
- Abrasive Resistant
- Low Temperature Resistant Properties
- Compliance Toward the Environment

***FRP Pipe and Fitting data table is available upon request**

Description	PIPE - FRP
Construction	All Composites FRP (for Corrosion Barrier, Structure and Outer Layer)
Stiffness Class	2,500-5,000 N/m² (Ref. AWWA c-950-88)
General Instalation	Aboveground & Underground ≤ 2 meter (Ref.Experience)
Lifetime	50 years with SF = 1.8
Connection : Pipe to pipe or pipe to fittings	Butt & wrap joint, socket joint, Bolted
Diameter Nominal	15 mm - 3,600 mm
Standard Length	5,85 & 11,89 m
Fabrication System	Pipe = Filament Wound, Fittings = HLU
Performance	Rigid, has excellent strength