

مصنع أبوظب الأنابيب (خ.م.م.) أنابيب مقواة بالأليان الزمامي Abu Dhabi Pipe Factory (L.L.C.) Filament Wound Reinforced Thermosetting Resin Pipes

40+ Years of experience in Innovation, Engineering & Development of RTRP / FRP Piping industry

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The largest manufacturer of GRP / GRE / GRV Pipes, Fittings, Flanges in Middle East. Diameter range: 25 mm to 4000 mm

















ISO 14001: 2015 (Cert. No.: 1321)



ISO 9001: 2015 (Cert. No.: 2239)



15HR-0010, 15LR-0015





## COMPANY PROFILE

Abu Dhabi Pipe Factory was established in 1981, in technical collaboration with Cord International, a French company. We are one of the leading manufacturers of Glass Reinforced Plastic Pipes and Fittings in the Gulf. We are the only factory in United Arab Emirates with more than 43 years of experience in manufacturing Glass Reinforced Plastic Pipes and Fittings. The methods employed for the manufacturing of GRP pipes are Dual helical angle filament winding and Continuous filament winding (Drostholm process).

Since 1981, thousands of kilometers of ADPF pipes have been installed in a variety of applications like petrochemical plants, sewerage lines, drainage lines, desalination plants, potable water supply, cooling water lines, firefighting system and many more.

Abu Dhabi Pipe factory has been certified to ISO 9001. ISO 9001 is a model for quality assurance in Design, Development, Production, Installation and Servicing. In addition to ISO 9001, our pipes are approved by many other International Organizations like Factory Mutual Research (FM) for usage in the fire-fighting systems, American Petroleum Institute (API-15 LR &15 HR) for usage in oil and gas industry and Thames Water Services for the usage in potable water system.

The factory has a total area of 150,000  $m^2$  of which the production area is 20,000  $m^2$ . Our production capacity is 50,000 tons of Pipes and Fittings per annum. We have 6 production lines for Dual helical winding process and 5 for Continuous winding process. Abu Dhabi Pipe Factory is equipped with a full fledged Quality Control laboratory.

**A**NTRODUCTION TO RTRP/FRP PIPES

RTRP stands for Reinforced Thermosetting Resin Pipe. RTRP is a composite material consisting of a thermosetting polymer, often a type of polyester, reinforced with glass or other fibers. Glass fibers provide strength and stiffness to a composite material. The different types of resins used for the manufacturing of GRP, GRV and GRE pipes are Isophthalic resin, Vinylester resin and Epoxy resin respectively, which are selected according to the required properties like chemical resistance, temperature resistance and mechanical properties. The properties of GRP pipes can be varied by changing the ratio of the raw materials and also by changing the winding angle.

### PIPE COMPOSITION

GRP pipe wall consists of three layers perfectly adherent to each other and having different characteristics and properties in relation to their function.

	Material	<b>GRP/GRV</b>	GRE
	Veil (Glass)	10 %	10 %
Inner	Resin	90 %	90 %
Liner	CSM (Glass)	CSM (Glass) 30 %	
	Resin	70 %	-
Charles to a to a to	Roving (Glass)	70 %	70 %
Structure	Resin	30 %	30 %
External	Veil (Glass)	10 %	10 %
Liner	Resin	90 %	90 %

#### **INNER LINER**

Liner or chemically resistant layer is the internal layer of the pipe. It is in direct contact with the conveyed fluid. This layer has the function to guarantee the resistance to the chemical corrosion and the impermeability to the pipe. Liner has the internal surface, namely the one in contact with the conveyed fluid, particularly smooth. This characteristic of smoothness reduces the fluid head losses to the minimum and opposes the growth of mineral deposits and algae. The liner is made of two monolithic sub layers. The inner one, in direct contact with the fluid, is reinforced with glass veil, with a resin content of 90% and the outer one is reinforced with CSM glass, with a resin content of 70% by weight. The standard liner thickness, is about 0.5 to 1.5 mm, higher thickness can be produced on request.

#### STRUCTURAL WALL

Glass reinforced layers guarantee the mechanical resistance of the whole pipe against stresses due to internal and external pressure, external loads and thermal loads. For GRP/GRV pipes, this layer is obtained by applying on the previous partly cured liner, continuous roving of glass wetted with resin, under controlled tension. For GRE pipes, the structural wall is wound directly on a wet liner. This layer can contain aggregates like silica sand, if allowed by specifications. Thickness of the mechanical layer depends on the design condition.

#### EXTERNAL LINER

Top coat or external liner is the outer layer of the pipe which consists of pure resin. If required, UV protectors shall be added to protect the pipe from the exposure of sun. In case of severe exposure condition like aggressive soils or very corrosive environment, the external liner can be reinforced with a surfacing veil or added with fillers or pigments.

### **RAW MATERIALS**

Fiber glass composites consists of glass fiber reinforcements, thermosetting resins and additives, designed and processed to meet the specific functional performance criteria;

**Fiber glass reinforcements:** The amount, type and orientation of the glass fibers in the pipe provides the required mechanical strength. C-Glass, E-Glass and ECR/Advantex Glass are used commonly, depending on the application of the pipe. The various forms of glass reinforcements are surface veil, chopped strand mat (CSM), chopped roving, filament roving, and woven roving (WR).

**Resins:** Isophthalic, Vinylester and Epoxy are the common type of resins used. This will provide the thermal and chemical properties such as glass transition temperature, resistance to heat, chemical resistance etc. required for the finished product.

Auxiliary raw materials: Raw materials like catalyst, accelerators, inhibitors, aggregates and pigments are used together with resin and glass reinforcements to achieve the desired properties of the fiber glass product. Catalyst is an organic compound which when added to resin in presence of an accelerator determines the polymerization reaction at ambient temperature. Accelerator is a chemical compound used together with a catalyst to shorten the polymerization time. Inhibitor is added to the resin to reduce its reactivity at ambient temperature.

# **WS**ANUFACTURING PROCESSES

## **DUAL HELICAL FILAMENT WINDING PROCESS**

Dual helical filament winding is the process of impregnating pre-stressed continuous glass fiber roving with a matrix resin, then applying the wetted roving to a steel mandrel under controlled tension in predetermined winding angles using dual helical winding pattern, thereby achieving optimum mechanical properties in both the principal axis, longitudinal and circumferential. Depending upon the requirements of chemical resistance, mechanical properties and temperature resistance, a suitable resin is selected. The whole process is fully selected. For GRE pipes, the structural wall is wound directly on a wet liner. But for GRP/GRV pipes, the inner liner is gelled by infrared ray heaters to ensure precise resin content and maximum corrosion resistance. After the curing, a layer of glass impregnated with resin is wound on the liner to enable a good bonding between the gel coat and the helical winding.

For the construction of the structural wall, a carriage, supporting glass roving spool, roving impregnation bath



and the automatic resin feeding, travels to and fro alongside the face of the mandrel. The movement of the carriage and the rotation of the mandrel are controlled by the computer. For each diameter, the machine has a program containing winding angles and the number of layers required. The angles at which the glass fibers are oriented in reference to the axis of the mandrel may vary from  $0^{\circ}$  to  $90^{\circ}$ . The ratio of axial stress to hoop stress in the pipe wall is linked to the winding angle. At 55° winding angle, the hoop stress will be twice that of axial stress. The greater the winding angle, the higher the hoop modulus of elasticity of the pipe. The tension of the roving is precisely adjusted to give the pre-stress

computer controlled. This unique manufacturing process enables the designer to select a system best suited to meet the specific end product requirements such as high strength, light weight, corrosion and weather resistance, low maintenance etc.

The steel mandrel on which the pipe is wound is solid type for nominal size upto 1400 mm and collapsible type for above 1400 mm. The mandrel is wrapped with a thin film of terphane (demolding agent). In case of pipes with integral socket, the tool for socket is checked and cleaned. If the socket is for rubber seal, the rubber mould for the groove is put in position.

The construction of the Inner liner, the internal resin rich chemical layer, varies with the type of the piping series

required by the design of the pipe. For gravity pipes, sand may be used as filler for nominal size above 400 mm.

After that the pipe is cured in the oven for one hour at 100°C. The pipe rotates during the curing to avoid uneven repatriation of the resin. After curing, the pipe is demolded from the steel mandrel. The pipe ends are calibrated according to the requirements.

Nominal size ranging from 25mm to 2000mm is manufactured by this process.

## **CONTINUOUS WINDING PROCESS (DROSTHOLM PROCESS)**

Continuous winding process employs a steel mandrel whose surface is made up of a steel tape moving longitudinally with a speed depending upon the tape width and the cam plate. The steel band is elliptically wound on supporting beams placed along the grooved discs which is fixed on the mandrel shaft.



wall of the pipe. The external layer also has the same characteristics as the inner layer.

The other two layers are applied between the inner layer and external layer. One is an anti-diffusion barrier, consisting of 70% resin and 30% chopped roving. The other is a mechanical resistant layer.

The thickness and composition of the mechanical resistant layer depends on the operating conditions the pipe shall withstand. Raw materials like resin,

chopped roving, hoop roving and silica sand (if needed) in predetermined proportions are fed on to the steel tape. As the steel tape moves forward longitudinally, the material on it also moves forward through four different heating zones having radiant heating units where the laminate gets cured. For each area, the heat to be supplied is controlled to maintain the required values of gel time, ISO-thermal peak and post polymerization in the oven.

Hoop roving supplies the required circumferential resistance of the pipe. Such roving, coming from the feeding systems through suitable tensioning device are wound circumferentially and continuously on the pipe wall. On the other hand, the chopped roving, 25-30mm in length, supplies an axial mechanical resistance which is the sum of axial resistance of each yarn.

The silica sand has the scope to increase the wall thickness, and therefore the pipe stiffness without using a quantity of glass fiber higher than those foreseen by the design.

The resin represent the GRP composite matrix. It is applied by means of two basins providing to the suitable distribution through gauged holes. The resin delivered to the distribution basins is already mixed in the required percentage with catalyst. The distribution of the resin, catalyst and other raw materials is controlled by a numerical controller according to the mandrel speed.

Curing of resin is carried out in a polymerization oven equipped with infra red lamps installed on four different areas. It is possible to control the power supplied to each area in order to set the gel time, the isothermal peak and the post curing process according to the theoretical curing curve.

The production line is equipped with gauging and automatic cutting devices. The complete process is computer controlled. The pipe cutting at the required length is made by means of a diamond disc tool following the progress of the product.

Nominal size ranging from 250 mm to 4000 mm is manufactured by this process.



## Redvantages of GRP PIPING SYSTEMS

ADPF pipes have many advantages over other conventional pipes as far as installation is concerned,

- The smooth interior of ADPF pipes results in low fluid resistance, which could lower horsepower requirements for pumped systems. This characteristic could contribute to a substantial cost savings over the life of a typical piping system. The interior pipe surface remains smooth over time in most fluid services. Therefore fluid resistance does not increase with age. The smooth interior allows the pipe diameter to be reduced while maintaining the desired flow.
- ADPF pipe, being highly corrosion resistant, no separate lining or Cathodic protection is required; hence virtually no maintenance cost. Expected life span of ADPF pipe is 60 years. No outside protection is needed against ground water, aggressive industrial gases and fumes or chemicals leaking from the neighbouring pipes and valves.
- The relatively high compliance (low modulus of elasticity) of ADPF pipe contribute to a self dampening effect as the pressure wave travels through the piping system. The magnitude of the pressure wave and hence surge pressure in a metallic piping system is much higher due to the higher modulus of elasticity of these materials.
- Since ADPF pipes are supplied in 12 m lengths, only less number of joints are required. This means less

chance of leakage and due to light weight and less number of joints, less time is required for installation resulting in substantial cost saving.

- Since ADPF pipes can have rigid joints, thrust blocks can be eliminated resulting in reduction of cost during the installation.
- The low Thermal conductivity of ADPF pipes not only causes low temperature losses, but also in many cases eliminates condensation or the need for additional thermal insulation.
- Since the Thermal end loads developed in ADPF pipes are small, restraining equipments like guides and anchors need not be as strong or heavy as for metallic piping.
- Short lengths, adjustment pipes or special fittings can be readily made available at a short notice. Unforeseen modifications can be made at site easily without delay at low extra cost.
- Since ADPF pipes are manufactured with an external liner, it acts as a barrier against ultra violet rays.
- ADPF pipes have good abrasion resistance.
- ADPF pipes are very light, hence easier handling, faster installation and low transportation costs. The use of heavy equipment is practically eliminated.

TYPICAL PROPERTIES OF ADPF GRP PIPES							
	TEAT METHOD		VALUE				
HIDROSTATIC PROPERTIES	TEST METHOD	GRP	GRV	GRE	UNIT		
Ultimate Hoop Stress-Rupture (Uni-axial)	ASTM D 1559	570	570	570	M Pa		
Hydrostatic Design Basis (Uni-axial)	ASTM D 2992 B	350	350	-	M Pa		
Hydrostatic Design Basis (Bi-axial)	ASTM D 2992 B	138	138	172	M Pa		
Hydrostatic Design Stress (Uni-axial)	ASTM D 2992 B	175	175	-	M Pa		
Hydrostatic Design Stress (Bi-axial)	ASTM D 2992 B	68	68	87	M Pa		
			VALUE				
MECHANICAL PROPERTIES	TEST METHOD	GRP	GRV	GRE	UNIT		
Axial Tensile Stress	ASTM D 2105	35	50	75	M Pa		
Axial Tensile Modulus	ASTM D 2105	13000	13000	15000	M Pa		
Hoop Tensile Stress	ASTM D 2290	250	250	300	M Pa		
Hoop Tensile Modulus	ASTM D 2290	24000	24000	30000	M Pa		
Hoop Bending Modulus	ASTM D 2412	25000	25000	25000	M Pa		
Poisson's ratio (Hoop loading)	-	0.45	0.45	0.45	-		
Poisson's ratio (Axial loading)	-	0.65	0.65	0.65	-		
THERWAL AND PHISICAL PROP	ERTIES	GRP	GRV	GRE	UNIT		
Coefficient of Linear Thermal Expansion		20 x 10 <sup>-6</sup>	20 x 10 <sup>-6</sup>	15 x 10 <sup>-6</sup>	mm / mm / °C		
Specific Gravity		1.8	1.8	1.8	-		
Glass content (by weight)			65	70	%		
Hazen William Coefficient			150	150	-		
Maximum Temperature			90	110	°C		
Thermal Conductivity			0.3	0.3	W / m-K		
Roughness factor (Including head loss over joints)	0.04	0.04	0.04	mm			
Effective Roughness (only pipe)		0.0015	0.0015	0.0015	mm		

Note : Bi-axial values - 55° Winding angle / Uni-axial values - 63° Winding angle



Our production range includes Glass Reinforced Plastic pipes of diameter 25 mm to 2600 mm.

**Pressure Class:** Pipes and fittings are classified according to the Nominal pressure. Standard pressure classes are 4, 6, 10, 16, 20 and 25 bar. Intermediate and higher pressure classes are considered on request or depending on the design condition.

**Pipe Stiffness:** Pipes are also classified according to specific pipe stiffness. Standard stiffness classes are 1250, 2500, 5000 and 10000 N/m<sup>2</sup>. Intermediate of higher stiffness classes are available on request or depending on the design condition.

**Resin:** Pipes and fittings are classified as GRP, GRV and GRE, when the type of resin used for manufacturing is lsophthalic, Vinlyester and Epoxy respectively.

Standard pipes shall be supplied with any one of the following type of ends according to the requirement,

- a) with plain ends joined by lamination process
- b) with integral socket and spigot end joined using rubber rings
- c) with spigot ends joined with double bell coupling using rubber rings
- with integral socket and spigot ends joined using epoxy glue
- e) with spigot ends joined with taper coupling using epoxy glue
- f) with integral lock joint socket and spigot ends joined using rubber ring (single or double) and lock strip

g) with lock joint spigot ends - joined with lock joint double bell coupling using rubber ring (single or double) and lock strip

#### Standard length of pipes

DN 25 to DN 50		3.0 m
DN 80	1.1	6.0 m
DN 100 to DN 250	C.S.	9.0 m
DN 300 & above	-22.2	12.0 m

Also pipes can be supplied with spigots suitable for other pipes like PVC, AC pipes, etc.

tee

Saddle

We also produce all connected fittings like Elbows, Tees, Wyes, Concentric reducers, Eccentric reducers, Flanges, Blind flanges, Puddle flanges, Crosses, Couplings, Saddles, End caps etc.

Elbows are either mitered or swept. Number of sections of miter bend depends upon the angle and class of the pipe. Bends of angle other than the standard also can be manufactured on request.

Flanges are manufactured according to the drilling standards like ANSI, BS, DIN etc.



GRP pipe joints can be classified into two:

- 1) Un-restrained joints, which can with stand only hoop pressure.
- Restrained joints, which can accommodate also longitudinal forces.

## **RUBBER RING JOINT**



This is an un-restrained joint system which is used for the installation of long runs of buried pipe lines with only few accessories. Integral socket and spigot ends are joined together as in fig-1 or two spigot ends are joined with a double bell coupling as in fig-2. In this joint system, the hydraulic sealing is performed



by elastomeric rubber rings, installed in circumferential groove on the integral socket and the coupling. Rubber rings are available in different materials like NBR, Neoprene and EPDM to suit the individual application. The installation in very fast and easy. Since it allows angular deflection, changes of gradient or curve can be easily accommodated and it is also called flexible joint. Concrete thrust blocks are required at the directional changes, as it cannot accommodate longitudinal Forces.

## ADHESIVE BONDED JOINT (CYLINDRICAL TYPE)



This is a restrained joint system which is recommended for complex installation comprising many accessories, bends, reducers etc and is designed to sustain high pressure applications. The integral socket and spigot ends are joined with a two component epoxy adhesive as in fig-3 and two pipes with



spigot ends are joined with coupling using two component epoxy adhesive as in fig-4. In this joint system, no thrust blocks are required since it resists longitudinal forces. It is a rigid joint, as it will not allow any angular deflection.



## LOCK JOINT

This is a restrained joint system which combines the advantages of both glue joint and flexible joint. The integral socket and spigot ends are joined together as in fig-5 and two spigot ends are joined with a double bell coupling as in fig-6. The hydraulic sealing is performed by elastomeric rubber rings, installed in



circumferential groove on the integral socket and the coupling. The locking device, which provides longitudinal thrust restraint is inserted into a groove through an opening and can be removed to disassemble the joint at some later stage. Shear resistant plastic material is used for the locking strip. The necessity of thrust blocks are eliminated in this joint system.

\* Lock joint with double rubber ring can be manufactured on request





system which is normally used for joining fiber glass pipes with existing steel pipes and accessories like valves, pumps etc. It is also used where the installation has to be disassembled at a later stage. The fixed flanges are connected together as in fig-7 and two stub ends with steel



slip on flange are connected as shown in fig-8. The hydraulic sealing between the flanges is accomplished with an elastomeric gasket, which may be flat type or O-ring type depending on the specifications. The torque value depends on pipe size, pressure and application.

LAMINATION JOINT (UP TO DN	600mm)
EX	TERNAL LAMINATION
PLAIN END	PLAIN END
	FIG-9

### **AMINATION JOINT**

This is a restrained joint system used for joining plain end pipes which consists of overlapping layers of fiberglass reinforcement thoroughly impregnated with the resin to achieve the specified width and thickness. It provides continuity in both hoop and axial directions. This joint is also called butt and strap joint

States and the second second					
AMINATION JOINT (ABOVE DN 600mm)					
EXTERNAL LAMINATION					
PLAIN END					
	FIG-10				

and it results in high strength and requires skilled labour. Fig-9 shows the lamination joint for small diameters where there is no possibility to access the inside of the pipe to do the internal lamination. Fig-10 shows the lamination for nominal size 900mm and above.







Abu Dhabi Pipe Factory has a full-fledged Engineering Department, which can perform the following functions.

Designing of buried and aboveground fiber glass pipes according to AWWA C-950 and AWWA M-45 manual employing in-house software program. Design verification is done for the surge pressure, pressure class, allowable deflection, soil load and live load, buckling, combined strain, axial strain, buoyancy etc.

Creating Isometric drawings in Autocad format and generating Bill of Quantities for pipes, fittings, gaskets etc. Making spool drawings for pre-fabrication which will minimize material and installation time at site.

Stress analysis for above ground and under ground piping system using the most advanced computer program, CEASER II. The program will produce results in the form of deflections, loads and stresses through out the system from the input model created by the user and compare these results to their allowable limits.

Surge analysis using the software PIPENET Transient Module. It is a sophisticated computer program which analyzes water hammer in complex multi branch piping system under a variety of conditions. It can be used for predicting pressure surges,

1000

130

2000

130(1400

1070

1080

calculating hydraulic transient forces or even modeling control systems in flow networks.

Hydraulic calculation of pipe lines using PIPENET Standard Module. It is a powerful tool which can be used as an aid in designing a new network of pipes with appropriate pipe sizes and calculating the pressure loss occurring in different parts of the network. The piping system can be made up of pipes, ducts, pumps, fans, filters, valves, orifice plates, nozzles and pressure drop.

Design of Thrust blocks, Anchor blocks and different types of Supports.

Method statements for lamination, hydrotest, laying and installation, storage and handling, different types of joining etc.

230(2400

070

2080

3070

3080

70



Hydrostatic Pressure Test As per BS 5480 / AWWA C950

Abu Dhabi Pipe Factory is equipped with a full fledged Quality Control Laboratory. All the incoming raw material and finished products are subjected to various tests to ensure that only good quality pipes and fittings and delivered. Some of the tests performed are given below.

#### Type tests

Beam deflection Strain corrosion test Hydrostatic Design Basis Long term stiffness and Creep factor Impact resistance test

#### **Test on Finished products**

#### 1- Loss on Ignition 2- Consistency (Glass/Resin Ratio) 3- Axial Tensile Strength 4- Flexural Strength 5- Flexural Strength Modulus 6- Hoop Tensile Strength (Split Disk) 7- Hoop Modulus 8- Impact Resistance 9- Initial Specific Ring Stiffness 10- Specific Ring Stiffness Modulus 11- Joint Tightness 12- Burst Test 13- Degree of Curing (Tg) 14- Water Absorption 15- Loss On Ignition (Glass Content) 16- Unit Axial Tensile Strength 17- Hoop Tensile Strength 18- Hydrostatic Pressure Test 19- Visual Inspection 20- Dimensional Check 21- Curing (Barcol Hardness)

Test on Raw Materials

TTTTTTTTTT

*Resin* Reactivity and Viscosity Solid contents

Glass Texture Moisture content Loss on ignition

Flexural Strength Test As per ASTM D790

> Long Term Strain Corrosion Test As per ASTM D 3681

YLF



Stiffness Test

& BS EN14364

As per ASTM D 2412





#### PRODUCT SPECIFICATIONS AND CLASSIFICATIONS

AWWA C 950	Standard for Fiberglass Pressure Pipe.
API - 15 LR	Specification for Low Pressure Fiberglass Pipe.
API - 15 HR	Specification for High Pressure Fiberglass Pipe.
ASTM D 2996	Standard Specification for Filament wound "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe
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
ASTM D 4161	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe joints using Flexible elastomeric seals
BS EN 14364	Plastics piping systems for drainage and sewerage with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP). Specifications for pipes, fittings and joints.
BS EN 1796	Plastics piping system for water supply with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP).
BS 7159	Design and Construction of Glass Reinforced Plastics (GRP) Piping systems for individual plants or sites
ISO 14692	Petroleum and natural gas industries Glass-reinforced plastics (GRP) piping Part 1 TO Part 4

#### **RECOMMENDED PRACTICES**

ASTM C 581	Standard Practice for Determining Chemical Resistance of Thermosetting Resins used in Glass- Fiber-Reinforced Structures intended for Liquid Service
ASTM D 2488	Standard Practice for Description and Identification of Soils
ASTM D 2563	Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate parts
ASTM D 2992	Standard Practice for obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber- Reinforced Themosetting-Resin) Pipes and Fittings Procedure B – Steady pressure
ASTM D 3567	Standard Practice for determining Dimensions of Reinforced Thermosetting-Resin Pipes (RTRP) and Fittings
ASTM D 3839	Standard Practice for Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Themosetting - Resin) Pipe
BS 8010	B.S. Code of Practice for Pipelines - Section 2.5 Glass Reinforced Themosetting Plastics

#### **TEST METHODS**

ASTM D 1598	Standard Test Method for Time-to-Failure of Plastics Pipe under constant Internal Pressure
ASTM D 1599	Standard Test Method for Short Term Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings
ASTM D 2412	Standard Test Method for determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2924	Standard Test Method for External Pressure Resistance of Reinforced Thermosetting-Resin Pipe
ASTM D 3681	Standard Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Themosetting -Resin) Pipe in a Deflected Condition
BS 5480	British Standard Specification for Glass Reinforced Plastics (GRP) Pipes, Joints and Fittings used for Water supply or Sewerage
BS EN 14364	Plastics piping for drainage and sewerage with or without pressure. Glass-reinforced thermosetting plastic (GRP) base on unsaturated polyester resin (UP). Specifications for pipes, fittings and joints

## **A**PPLICATIONS OF GRP PIPING SYSTEM



GRP pipes, designed and manufactured by ABU DHABI PIPE FACTORY are successfully used in a wide range of applications as,

#### UTILITY SERVICES

- · Sewerage.
- Drainage.
- · Contingency ducts.

#### CHEMICAL AND PETROCHEMICAL INDUSTRIES

- Piping for aggressive chemicals.
- · Utility lines for transport of water.
- · Fire fighting networks.

#### **POWER PLANTS**

- Transport of Chlorine solution, Hydrochloric acid and Sulphuric acid solution.
- Transport of high purity water and condensate.
- Transport of Salt water or Brackish water for indirect cooling system.





**R**PPLICATIONS OF GRP PIPING SYSTEM

#### WATER DESALINATION PLANTS

- · Sea water intake lines.
- Transport of demineralized water.
- · Potable water lines.

#### **OIL INDUSTRY**

- Utility lines such as salt water disposal lines, fire fighting lines etc.
- · Sea water injection lines, intake lines, outfall lines etc.

#### FOOD INDUSTRY

- · Transport of oils, alcohol, fats and solutions.
- Disposal lines.

#### AGRICULTURAL APPLICATIONS

- · Casing and tubing in oil wells.
- · Transport of water for land irrigation.







## AMIST OF MAJOR PROJECTS

Project Name / Location	Diameter, Type & Working Pressure	Type of Joint	Quantity	Year of Supply	Client / Contractor
Borouge 4 Project - EPC Package 4 - U & O Unit	25 mm dia. to 1000 mm dia. GRE Pipes and fittings, PN 16 (Water)	Plain ends for Lamination Joint (Butt & Wrap joint)	>10 km+	2023	Client: M/s. Borouge /M/s. Technimont
Jubail Island Infra. Works Collective Contract (Package 1, 3A, 3B & 3C)	200 mm to 1000 mm dia. GRP Pipes & Fittings, PN1 (Irrigation Duct & Potable Water Duct)	Flexible Coupler joint with EPDM Rubber ring	> 3.5 Km	2023 – 2022	Client: Jubail Island Investment Co. / M/s. Gulf Contractors
ADSSC O-15015, Rehabilitation of Pumping Station & Network in Al Dhafra Region Ph. 1	200 mm to 1200 mm dia. GRP Pipes & Fittings, PN10 (Sewerage)	Flexible Coupler joint with EPDM Rubber ring	> 3.4 Km	2023 – 2022	Client: ADSSC / M/s. Purewater Technology
EMAAR South Dev. Ph 2 – Green View 3 on Plot GD01 Deep & Shallow Services	400 mm to 700 mm dia. GRP Pipes & Fittings, PN6 (Sewerage & Stormwater Drainage)	Flexible Coupler joint with EPDM Rubber ring	> 1.7 Km	2023 – 2022	Client: EMAAR Properties PJSC / M/s. Arabian Coast Contracting.
Hot Leaching Compaction Plant - Jordan	300 mm to 700 mm dia. GRP Pipes & Fittings, PN10 (Stormwater Drainage)	Flexible Coupler joint with EPDM Rubber ring	> 1.2 Km	2023 - 2022	Client: Arab Potash / M/s. Alghanem Trading & Con. Co.
RFX#2082075 – KOC Kuwait	50mm, 400mm & 600mm dia. GRE Pipes & Fittings, 47.1 bar (Effluent Water / Oily Water)	Key-Lock Joint & Plain ends for Lamination Joint (Butt & Wrap joint)	> 10.0 Km	2023 – 2022	Client: Kuwait Oil Company / M/s. Distribution Now
Basrah Refinery upgrading project, IRAQ	100 mm to 1200 mm dia. GRV pipes and fittings, PN1 / PN9 / PN20 (for Various Services)	Plain ends for Lamination	>12.5 Km	2023 – 2022	Client: The Ministry of Oil, South Refinery Co. / M/s. Hyudai Engg.
DS188, Sewerage & Drainage Network, Jebel Ali - Dubai	400 mm to 1600 mm dia. GRP Gravity / Pressure Pipes (Strom Water, Sewerage)	Flexible Coupler joint with EPDM Rubber ring	>23.0 Km+	2022 – 2020	Client: Dubai Municipaliaty / M/s. Arabtec Engineering Services
Gardens DCP-03 Cooling Tower Extension, Dubai (Discovery Gardens)	80 mm to 1100 mm dia. GRP Pressure Pipes for Condenser Water PN10	Plain ends for Lamination Joint (Butt & Wrap joint)	>1.0 km+	2021 – 2020	Client: Empower, Dubai / M/s. Araner
Etihad Rail Stage 2 & 3 Project, Package 2B	300 mm to 1500 mm dia. GRP Pressure & Gravity Pipes and fittings (TSE / SWD / Ducts)	Flexible Coupler joint with EPDM Rubber ring	>10 Km+	2022 – 2020	Client: Etihad Rail / M/s. CRCC – GTGC JV
Riyadh City South Phase 4, Infrastructure & Streetscape, Riyadh City – Abu Dhabi	300 mm to 1400 mm dia. GRP Presssure & Gravity Pipes (Strom Water, Sewerage & Duct)	Flexible Coupler joint with EPDM Rubber ring	>55.0 Km+	2022 – 2020	Client: M/s. Al Dar pjsc / Modon / M/s. Nurol LLC., Abu Dhabi
Etihad Rail Stage 2 & 3 Project D0201, Package 2F1	300 mm to 600 mm dia. GRP Gravity Pipes (Strom Water Drainage)	Flexible Coupler joint with EPDM Rubber ring	>1.2 Km+	2022 – 2020	Client: Etihad Rail / M/s. 2F1JV – Vinci – Archirodon JV
Design & Const. of OSA Infrastructure at KIZAD Area B, Abu Dhabi	300 mm to 900 mm dia. GRP Gravity Pipes Min Stiff 5000N/m², PN6 (Strom Water)	Flexible Coupler joint with EPDM Rubber ring	>3.8 km+	2022 – 2020	Client: Abu Dhabi Port Co. / M/s. Al Nasr Contracting Co.
MAG Eye Development Project, Meydan – Dubai	400 mm to 700 mm dia. GRP Gravity Pipes Min Stiff 5000N/m <sup>2</sup> , PN6 (Strom Water / Sewer)	Flexible Coupler joint with EPDM Rubber ring	>4.0 Km+	2021 – 2020	Client: MAG City Meydan / DM China National Engg. / Arar Infra
Jubail Island Infrastructure Works – Package 1, 3A & 3B, Abu Dhabi	300 mm to 800 mm dia. GRP Gravity Pipes (Strom Water & Sewerage Pipes)	Flexible Coupler joint with EPDM Rubber ring	>4.0 Km+	2022 – 2020	Client: Jubail Island Investment Co. / Gulf Contractors
ADNOC / NMDC - Hail & Ghasha Artificial Island Construction Project, Abu Dhabi	200 mm to 600 mm dia. GRE Pipes for AOC line PN 10 (AOC Drainage)	Flexible Coupler joint with EPDM Rubber ring	>5.6 Km	2022 – 2020	Client: ADNOC / NMDC (National Marine Dredging Co.)
ADNOC Bu-Hasa Integrated Field Development Project,	150 mm to 600 mm dia. GRE Pressure pipes and Fittings, PN45 - PN48	Key Lock Joint system / Butt & Wrap Lamination	> 65 Km	2022 – 2020	Client: ADNOC / TAKREER M/s. Tecnicas Reunidas
Salalah IWP Desalination Plant, Salalah, Oman	25 mm to 1400 mm dia. GRP Pressure Pipes & Fittings, PN 6 (Sea Water)	Plain ends for Lamination Joint (Butt & Wrap joint)	>1.0 Km	2020 – 2019	Client: Dhofar Desalination Co. (SAOC), Oman / M/s. Abengoa - Fisia Italimpianti
APCO Jordan Project: 2x35 MW Attarat Oil Shale Power Plant Jordan	100 mm to 400 mm, GRE Pressure Pipes and Fittings, PN16 for Fire Water Networ	Epoxy Adhesive (Glue)	> 9.2 km	2020 – 2019	Client: Attarat Power Co. (APCO) / China Energy Engg. Group / Guangdon Power Engg. Co. Ltd.
SWCC Duba SWRO 125000 m³ / day, (Intake & Outfall System), Kingdom of Saudi Arabia	1000 mm to 1600 mm dia. GRP Pressure pipes and Fittings, PN6 (Sea water)	Flexible Coupler joint with EPDM Rubber ring	>1.1 Km+	2020 – 2019	Client: SWCC (KSA), / M/s. METITO Saudi Arabia
ADP Fujairah Port Land Side Works, Fujairah	300 mm to 900 mm dia. GRP Gravity Pipes Min Stiff 5000N/m², PN6 (Strom Water)	Flexible Coupler joint with EPDM Rubber ring	>2.2 Km	2020 – 2019	Abu Dhabi Port Co. – Fujairah Al Nasr Contracting
Expansion of Fujairah Int'l. Airport, Fujairah	100 mm to 1000 mm dia. GRP Gravity Pipes Min Stiff 5000N/m <sup>2</sup> , PN6 (Strom Water)	Flexible Coupler joint with EPDM Rubber ring	>10.2 Km	2020 – 2019	Abu Dhabi Airport Co. / Fuj. Int'l. Airport – Civil Avaiation M/s. VOLTAS Ltd.
BAPCO Modernization Program (BMP), Bahrain	50 mm to 1900 mm dia. GRV / GRE Pipes and fittings, PN10, (Oily Water / Sewer )	Key Lock Joint – restrained joint	>44 Km	2020 - 2019	Client: BAPCO / Contractors: Technip Italy, Technicas Reunidas / Samsung Engg.
Al Hassyan 4x600 MW Coal Fired Power Plant Project, Dubai UAE	500 mm to 1600 mm dia. GRP Rain Water (Pressure & Gravity) pipes	Plain ends / Flexible Coupler joint with EPDM Rubber ring	>4.5 Km	2019	Client: M/s. DEWA M/s. Harbin Electric Int'l. Co. Ltd., Dubai
ADNOC Waste Heat Recovery Project, Ruwais – Abu Dhabi (WHRP)	25 mm to 2450 mm dia. GRV / GRE, PN3.5 to PN25 (for Various Services)	Adheisve Bonded joint / Plain ends for Lamination	>12 Km	2020 - 2019	Client: ADNOC / TAKREER M/s. Samsung Engg. Co. Ltd.

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Project	Diameter, Type & Working Pressure	Type of Joint	Quantity	Year of Supply	Client / Contractors
Expansion of Water Treatment Plant @ Layyah, Sharjah - UAE	25 mm to 1000 mm dia. GRE Pressure Pipes & Fittings, PN 16 (Potable Water line)	Plain ends for Lamination Joint (Butt & Wrap joint)	>4.5 Km	2019 – 2018	M/s. SEWA, Sharjah M/s. Ocean Oilfield Drilling & Marine Engg., Sharjah
Emergency Water Discharging Ponds, IRAQ	100 & 150 mm, GRE, Min Stiffenss 10000N/m <sup>2</sup> , PN16	Flexible Joint	>2.5 Km	2018	M/s. CNOOC, Iraq M/s. Anwar Muatafor
Upgradation of Sharjah STP Works, Phase 4 & 5	DN800 mm to 1200 mm dia. GRP Sewerage / STP Pipes and fittings, PN6 & PN10	Flexible Socket Spigot joint with EPDM rubber & Flanged	>5 km	2018	M/s. Directorate of Public Works, Sharjah / M/s. Metito Overseas Ltd
Jebel Ali Sewage Treatment Plant (STP), Phase 2, Dubai	DN25 mm to 600 mm dia. GRE for RE Network / PW Network, PN16	Key Lock Joint / Adhesive Bonded Joint / Flexible with EPDM rubber ring	>4 km	2018	M/s. Dubai Municipality / M/s. Universal Voltas LLC
MBR Gardens Development, Pkg 18, 19- PA27, PA26, 28 & 29 Roads & Shallow Services	DN200 mm to 600 mm dia. GRP Sewerage / Storm Drainage Pipes and fittings, PN6 & PN16	Flexible Socket Spigot joint with EPDM rubber & Flanged	>2.3 km	2017 – 2018	M/s. EMAAR Properties / DM / M/s. Arabian Coast Contracting LLC
<ol> <li>MBR Dubai Hills Estate PA-07 Pkg 27.</li> <li>MBR Gardens Development Dubai Hills Estate Pkg 20 - PA21 to PA25</li> </ol>	DN100 mm to 300 mm dia. GRP Irrigaiton Pipes and Fittings, PN16	Flexible Socket Spigot joint with EPDM rubber	>1.25 km	2017 – 2018	M/s. EMAAR Properties / DM / M/s. Al Nasr Contracting
Emirates Global Aluminum power & Stream Integration Project, Taweelah, Abu Dhabi	DN100 mm to 300 mm dia. GRE Fire Water network, PN16	Lamination (Butt & Wrap Joint)	>1.3 km	2017 – 2018	M/s. Emirates Aluminum / Nass Contracting / BEMCO
Al Jubail SWRO Desalination Plant, Phase 2	600 mm to 1800 mm GRP Water Line, PN16	Lamination (Butt & Wrap Joint)	>1.5 km	2017	M/s. Al Fatha Int'l. for Water & Power Co. Ltd.
AKOYA OXYGEN – Backbone infrastructure- Ring Road & Pumpstation	400 mm to 800 mm GRP Drainage & Irrigation, PN6 & PN16	Flexible (with EPDM rubber)	>15.5 km	2016 – 2018	DAMAC / China State Const. (Dubai Municipality Specs.)
ADNOC- 7012, Design & Construction of Service Harbour & Control Tower @ Ruwais	300 mm to 500 mm GRP Drainage, PN16	Flexible (with EPDM rubber)	> 1.5 km	2017 -2016	ADNOC / CODE Contracting
Construction of Additional Outfall for Ruwais Refinery (east)	20 mm to 1100 mm GRVE Water Line, PN12 & PN16	Plain end / Lamination Joint	> 1.2 km	2017 -2016	TAKREER / DHAFIR TECH
Fire water line Expansion in New Landfill Area fo BeAAT in Ruwais Refinery	150 & 250 mm GRE Fire Water, PN25	Plain end / Lamination Joint	> 1.8 km	2017 -2016	TAKREER / GOGAS
GASCO, Power Gerneration Unit Retirement (5283)- Asab, Buhasa, Bab & Habshan	6" & 8" dia. GRE Firewater, PN20	Epoxy Adhesive (Glue)	> 2.3 km	2015 – 2016	GASCO / Tyco Fire & Security
MIRFA Independent Water & Power, Abu Dhabi (MIRFA IWPP)	DN25 to DN3800 GRP Sew Water / Potable Water / AUX Cooling Water	Key Lock Joint / Lamination Joint	>18 KM	2015 – 2017	ADWEA / MIPW / Hyundai Engineering
EPC Works for Fire Training Ground at MPS Habshan (IPIC / ADCOP)	50 to 400 mm dia. GRP, Sewerage / Pressure PN25	Key Lock Joint	> 2.2 KM.	2015 – 2016	IPIC / ADCOP / Alsa Engg.
Ruwais Housing Complex, Phase III – New Sewerage Treatment Pant	100 to 1200 mm dia. GRP, Sewerage / Pressure upto 16 Bar	Flexible (with EPDM rubber)	> 4.5 KM.	2015 – 2016	ADNOC / METITO
AMMROC – MEP Works, Nibras in Al Ain	300 to 1800 mm dia. GRP, Sewerage / Pressure upto 10 Bar	Flexible (with EPDM rubber)	> 8 KM.	2015 – 2016	AMMROC
STEP Link Sewers Contract LS-01 & LS-02	400 mm – 900 mm dia. GRP Pipes for Sewer	Flexible (with EPDM rubber)	> 10.8 KM	2015 – 2017	ADSSC / M/s. Zublin
New Abu Dhabi Int'l. Airport (ADIA) Aviation Fuel Depot, Project No. 5643	50 mm – 500 mm dia. GRE Pipes for Water Supply, 16 Bar pressure	Key Lock Joint System / Lamination (Butt & Strap)	> 2.5 KM	2015 – 2017	TAKREER, Abu Dhabi
Emirates Flight Training Orga- nization Facilities at DWC Dubai	400 mm – 700 mm dia. GRP Stromwater Driange Pipes and Fittings (PN 6)	Flexible (with EPDM rubber)	> 1.5 KM	2015 – 2016	Client : DWC / M/s. Al Shirawi

Project	Diameter, Type & Working Pressure	Type of Joint	Quantity	Year of Supply	Client / Contractors
Borouge ISO Container Storage Yard	2" (50 mm) to 10" (250 mm). GRE PN 20 for Fire Water Potable Water	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	1.5.0 KM.	2015 – 2016	BOROUGE / M/s. Gogas LLC.
The Mall of Emirates Expan- sion, Dubai	300 mm – 500 mm dia. GRP Sewerage Pipes and Fittings (PN 6)	Flexible (with EPDM rubber)	> 1.0 KM	2014 – 2016	Client : Majid Al Futtaim / Cont.: M/s. Drake & Scull Engg LLC.
Yas Island Development Zone K – Non Residential	350 mm – 700 mm dia. GRP Stromwater Driange Pipes and Fittings (PN 6)	Flexible (with EPDM rubber)	> 2.0 KM	2015	Client : ALDAR Properties / M/s. Royal Advance LLC.
FEWA Project : Improvement & Upgrading of Sheikh Mak- toum Bin Rashid Road & Link Road to Zawra Road, Ajman	300 mm – 700 mm dia. GRP Stromwater Driange Pipes and Fittings (PN 6)	Flexible (with EPDM rubber)	> 17.5 KM	2014 – 2016	Client : FEWA / Contractor : M/s. Combined Group Contracting Co.
Emirstes Sky Cargo Build- ing at Dubai World Central (DWC), Package 2 Infrastr. Works	400 mm – 800 mm dia. GRP Stromwater Driange Pipes and Fittings (PN 6) + GRE Fire Water Pipes (DEWA)	Flexible (with EPDM rubber) Key Lock Joint for Fire Water	> 7.5 KM	2014 – 2016	Client : M/s. Emirates, Cont. : M/s. Heilbronn Cont. & Developers
RPLC Deep Conversion Project, Venezuela	Key Lock joint for pipes Lamination (Butt & Strap) for fittings	50mm to 1100 mm dia. GRV Pipes and fittings	>14.0 KM.	2013 – 2014	PDVSA Petróleo, S.A, Vene-zuela, / M/s. Hyundai Engg.
Prai CCGT Power Plant Project, Malaysia	2600, 3200 & 3700 mm dia. GRP Pipes for Onshore and Offshore Piping, 7.5 Bar pres- sure	Key Lock joint for DN 2600 & 3200, Lamination (Butt & Strap) for DN3700	> 5.5 KM.	2013 – 2014	M/s. Samsung Engineering M/s. HSL Constructor, Singopore
Musandam Gas Plant (MGP) Project, Oman	1" to 36" mm Dia. GRE / GRV Pressure Pipes and Fittings, 16 Bar Pressure	Epoxy Adhesive (Glue) & Lamination (Butt & Strap)	> 16.5 KM.	2013 – 2014	M/s. Oman Oil Co. (OOCEP) / Hyundai Engineering
Carbon Black & Delayed Coker (CBDC), UAE	4" to 48" mm Dia. GRE / GRV Pressure Pipes and Fittings, 15 Bar Pressure	Epoxy Adhesive (Glue) & Lamination (Butt & Strap)	> 19.5 KM.	2013 – 2014	M/s. TAKREER / M/s. Samsung Engineering
OLKARIA IAU GEOTHERMAL POWER PLANT (PROJECT B2)	Lamination (Butt & Strap) for fittings	150mm to 2100 mm dia. GRP Pipes and fittings	>2.5 KM.	2014 – 2015	M/s. KENGEN / Hyundai E&C
PTC Jubail Polysilicon Project, Saudi Arabia	25 mm – 1200 mm dia. GRE Pipes for Water Supply, 16 Bar pressure	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	> 10.0 KM	2012 – 2013	KCC E&C / Hyundai E&C. (JV)
Bypass for Borouge 2 Seawater Basin, Ruwais, Abu Dhabi	100 to 1800 mm Dia. GRE / GRV, 13.5 Bar Pressure	Lamination (Butt & Strap)	> 2.0 KM.	2012 – 2013	BOROUGE / M/s.GOGAS
Exxon Mobil FUN Project, Nigeria	50 mm – 200 mm dia. GRE Pipes for Water Line, 16 Bar pressure	Epoxy Adhesive (Glue)	> 3.2.0 KM	2012	Exxon Mobil / Dorman Long FZCO
SUR IPP (Independent Power Plant), Oman	100 mm – 300 mm dia. GRE Pipes for Firewater Water Supply, 14 Bar pressure	Key Lock joint / Lamination (Butt & Strap)	> 6.5 KM.	2012	M/s. Daewoo E&C. Co. Ltd., Korea / Oman Water & Power
BAPCO Wastewater Treatment Plant, Bahrain	25 mm – 900 mm dia. GRP Pipes for Oily Waste Water, 8 Bar pressure	Epoxy Adhesive (Glue)	> 12.0 KM	2011 – 2013	BAPCO / GS Engineering Co.
Inter Refineries Pipeline Project Ph. II, Mussafah Terminal Package, Mussafah Abu Dhabi	25 mm – 750 mm dia. GRE Pipes for Fire Water / Drinking Water / Accidentally Oily Sewer	Epoxy Adhesive (Glue)	> 14 KM	2011 – 2012	TAKREER / M/s. Daewoo E&C. Co. Ltd., Korea
BAPCO Oily Water Sewer Line Replacement, Bahrain	700 mm – 1000 mm dia. GRE Pipes for Oily Water Sewer Line, 8 Bar pressure	Lamination (Butt & Strap)	2.5 KM	2011 – 2013	BAPCO (Bahrain Petroleum Co.)
Khalifa Port Ind. Zone, Offshore Terminal Area, Contract No. 1000-211	300 mm – 1950 mm dia. GRP Pipes for Sewer / Stormwater Drainage	Flexible (with EPDM rubber)	> 15 KM	2010 – 2012	Abu Dhabi Ports Company / M/s. Hyundai Engg. & Const. Co.
Habshan – 5, Utilities & Offsites, Proj#5247	50 mm – 1300 mm dia. GRV Pipes – PN 16	Key Lock / Lamination (Butt & Strap)	> 33 KM	2010 – 2012	GASCO - HYUNDAI
ADCOP – Abu Dhabi Crude Oil Pipeline Project Habshan to Fujairah	50 mm to 900 dia. GRV Pipes - PN 23	Key Lock joint / Lamination (Butt & Strap)	> 95 KM.	2010 – 2012	ADCOP / Int'l. Petroleum Inv. Company

Project	Diameter, Type & Working Pressure	Type of Joint	Quantity	Year of Supply	Client / Contractors
ADSSC Project, Contract No. O-1086 Lot B, Const. of Trunk Sewer & Associated TSE System for Al Wathba	250 to 2100 mm dia. GRP, Sewerage / Pressure upto 10 Bar	Flexible (with EPDM rubber)	> 115 KM.	2008 – 2012	ADSSC / ADMAC, Abu Dhbai
Early Works for 4 <sup>th</sup> NGL Train – Ruwais - 5248	800 to 1400 mm dia. GRV / GRE – PN 16	Lamination (Butt & Strap)	> 4 KM	2009-2011	GASCO – GALFAR
OSBL Package A – of ASU Ruwais / Elixier Project	50 mm to 350 dia. GRE Pipes – PN 20	Key Lock joint / Epoxy Adhesive (Glue) Joint	> 2 KM	2009 – 2010	GASCO - IMECO
OSBL Package B - 5246	750 mm dia. GRV Pipes – PN 16	Lamination (Butt & Strap)	>6 KM	2009 – 2010	GASCO - DESCON
Borouge 2 – Expansion Project	100 to 900 mm Dia. GRE / GRV, 13.5 Bar Pressure	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	12.0 KM.	2009 – 2010	BOROUGE / Tecnimont
Az-Zour South Combined Cycle Power Station, Kuwait (M/s. Alghanim In'l. Kuwait)	800 mm to 2700 mm dia. GRP, Pressure Pipes (5.5 bar)	Lamination (Butt & Strap)	> 4 KM.	2008-2009	Ministry of Electricity & Water, Kuwait
Jebel Ali Power & Desalination Station 'M', Power Package 'P' (M/s. Fisia)	900 mm to 3000 mm dia. GRP, Class G6 Pipes	Lamination (Butt & Strap)	> 5 KM.	2008-2009	DEWA, Dubai Contractor : M/s. Fisia, italy
Jebel Ali Power & Desalination Station 'M', Power Package 'P' (M/s. Doosan)	50 mm to 2100 mm dia. GRP, PN 6 to PN 16 pressure pipes and fittings	Lamination (Butt & Strap)	> 10 KM.	2008-2010	DEWA, Dubai Contractor M/s. Doosan, Korea
Dubai Water Front, Madinat Al Arab: District B,C&D	100 mm to 1600 mm dia. GRP Pre-insulated Chilled Water Line, 16 bar	Lamination (Butt & Strap) / Lock Joint	44 KM.	2008	Nakheel
Dubai Maritime City	100 mm to 1400 mm dia. GRP Pre-insulated Chilled Water Line, 16 bar	Lamination (Butt & Strap) / Lock Joint	25 KM.	2007 – 2009	Nakheel
Dubai International City, Phases 2 & 3 Stage 2	100 mm to 1200 mm dia. GRP Pre-insulated Chilled Water Line, 16 bar	Lamination (Butt & Strap)	>30 KM.	2007 – 2009	Nakheel
Taweelah 'B' New Extension water and power Project – Abu Dhabi	300 – 2600 mm dia. GRP pressure pipes PN 10	Lamination (Butt & Strap) / Lock joint	20 KM.	2006 – 2007	ADWEA – Abu Dhabi Contractor: M/s. Hanjung, Korea
Jebel Ali Power & Desalination Station 'L', Phase 2	25 – 2000 mm dia. GRP, 10 to 17 bar pressure	Lamination (Butt & Strap) / Lock joint	> 20 KM.	2006 – 2008	DEWA, Dubai Contractor : M/s. Fisia, Italy
ERC 1400/D3/C3 : West Bay, Zone 33 and 60 – 68, Road works and Infrastructure	600 – 1600 mm dia. Gravity Sewer pipes	Flexible (with EPDM rubber)	4.5 KM.	2007	Qatar – Sewerage Proj. Dept.
KOC Project, RFP 1212 – Upgrading of Brackish Water Network in West Kuwait	GRE Pressure Pipes Design Pressure : 20.6 bar	Lock joint	74 KM.	2006 – 2007	Kuwait Oil Company
Al Ansab STP Project, Muscat - Oman	150 to 1200 mm dia. GRP Pressure Pipes, PN 10	Flexible (with EPDM rubber)	4.0 KM.	2006 – 2007	Oman Waste Water Projects Dept.
Desalination Plant – Ras Abu Fontas, Qatar	200 – 900 mm dia. GRP pres- sure pipes PN 10	Lamination (Butt & Strap)	4.2 KM.	2006 – 2007	Water & Elect. Authority - Qatar
Wafi City DCCP 01	200 – 600 mm dia. GRP Condenser Water Pipes, PN 10	Lamination (Butt & Strap)	2.0 KM.	2006	Al Futtaim Group
Discovery Gardens, Dubai	100 mm to 1500 mm dia. GRP Pre-insulated Chilled Water Line, 16 bar	Lamination (Butt & Strap)	> 46 KM	2005 – 2007	Nakheel
The Palm Jumeirah, Trunk – Chilled water piping network	250 mm to 1200 mm dia. GRP Pre-insulated Chilled Water Line, 16 bar	Lamination (Butt & Strap)	> 30 KM.	2005 – 2007	Nakheel
Jumeirah Lake Tower - Chilled water piping	350 mm to 1400 mm dia. GRP Pre-insulated Chilled Water Line, 16 bar	Lamination (Butt & Strap)	30 KM.	2005 – 2007	Nakheel
The Palm Jumeirah, Crescent works – Chilled water piping network	350 mm to 1200 mm dia. GRP Pre-insulated Chilled Water Line, 16 bar	Lamination (Butt & Strap)	20 KM.	2005 – 20067	Nakheel
Ruwais 3 <sup>rd</sup> NGL Train (GASCO)	25 mm to 3200 mm dia. GRE / GRV Pipes and fittings Pressure upto PN 20 (20 bar)	Epoxy Adhesive (Glue)	25 KM.	2005 - 2009	Gasco / Snamprogetti

Project	Diameter, Type & Working Pressure	Type of Joint	Quantity	Year of Supply	Client / Contractors		
Al Ezzel C.C. Power Plant - Bahrain	1800 & 2800 mm dia. GRP Pipes (2.3 & 1.0 bar pressure)	Flexible (with EPDM rubber) / Lamination (Butt & Strap)	2.2 KM>	2005 – 2009	Al Ezzel Power Co., Bahrain Cont. : M/s. Nass, Bahrain		
Tabreed Bahrain : District Cooling Network project in Al Seef Area – Bahrain	450 mm dia. GRE Pressure pipe, PN 10	Lamination (Butt & Strap)	2.0 KM>	2005	Tabreed – Bahrain		
Sudan Project : Marine Terminal, Project #20037	300 mm dia. GRE, 16 bar for Fire Fighting Pipeline	Lock joint	0.5 KM.	2005	M/s. Higleig Petroleum Service & Investment Co.		
Bahrain Financial Harbour Infrastructure	800 mm dia. GRP Gravity, PN 6 450 & 500 mm dia., PN 16	Lock joint	1.5 KM.	2005	Bahrain Financial Harbour		
Dubai Int'l. Airport Expansion Project CUC 4	250 to 1100 mm dia. GRE, 16 bar Fire Fighting and Condenser Water	Lock joint / Lamination (Butt & Strap)	15 KM.	2005	Dubai Int'l. Airport Authority		
Dubai Int'l Airport Expansion Projects, AX 090, AX 094, AX 096, AX 102, AX 103, AX 151, AX 106, AX 243, AX 305, AX 307 etc	100 to 500 mm dia. GRE, 16 bar pressure pipe (Water sys- tem & Fire fighting)	Lock joint	25 to 30 KM.	2004 – 05	Dubai Int'l. Airport Authority		
Dubai Int'l Airport Expansion Project, AX 151, Dubai Airwing Facilities	25 to 800 mm dia. GRE, 16 bar pressure pipe (Water sys- tem & Fire fighting)	Lock joint	8.5 KM.	2004 - 05	Dubai Int'l. Airport Authority		
Ghalilah Reverse Osmosis Desalination Plant – Ras Al Khaimah (M/s. Fisia Italimpianti)	20 to 600 mm dia. GRP, 16 bar pressure	Lamination (Butt & Strap)	> 10 KM.	2004 - 05	Client : FEWA Contractor : M/s. Fisia, Italy		
Umm Al Nar Independent Water and Power Project (M/s. Hitachi Zosen)	80 to 1800 mm dia. GRP, 15 bar pressure	Lamination (Butt & Strap)		2004 – 06	ADWEA / Arabian Power Co. Cont. M/s. Hitachi Zosen		
Jebel Ali Power & Desalination 'L' Station, Phase I (M/s. Fisia Italimpianti & M/s.Doosan)	25 – 2000 mm dia. GRP, 10 to 17 bar pressure	Lamination (Butt & Strap) / Lock joint	> 20 KM.	2004 – 05	Client : DEWA Contr. M/s. Fisia Italy (Desal) M/s. Doosan, Korea (Power)		
Sea Water Pipeline Project – Ras Lanuf - Libya	200 to 400 mm dia. GRE Pressure pipe, 20 bar	Lock joint	11.0 KM.	2004	Veba Oil Operation, Libya		
EPIC of Potable Water Transmission System & Landscaping Mains (Part 1) at Ras Laffan, Contract : GTC 221/ED/03.	200 – 600 mm dia. GRP pres- sure pipes PN 19	Lamination (Butt & Strap)	18.5 KM.	2004 – 2007	Qatar Petroleum / Al Jaber Engineering L.L.C. Qatar		
Project No. 112, Twin DN 1000 mm dia. pipeline	1000 mm dia. 16 bar pressure	Flexible (with EPDM rubber)	>15 KM.	2004	Private Dept. for H.H. Sh. Zayed Bin Sultan Al Nahyan		
Installation of GRE Pipeline from main header to Bb-558 (Bab -ADCO)	100 mm dia. GRE Class 300	Epoxy Adhesive (Glue)	1 KM.	2003	ADCO		
Replacement of Hydroskimmer Pre-stressed Concrete	800 - 1400 mm dia., GRV / GRE Pipes	Lamination (Butt & Strap)	2 KM.	2003	TAKREER		
Unleaded Gasoline / Low Sulphur Gas Oil Project – Ruwais	100 - 2000 mm dia., GRE Pipes	Flexible (with EPDM rubber) / Lock joint / Epoxy Adhesive (Glue)	12 KM.	2003	TAKREER		
Replacement of Plant Fire Water Network at Bab and Buhasa	100 & 400 mm dia., 15 Bar Pressure	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	6.1 KM.	2003	GASCO		
Cont. No. 34/2002, Abu Dhabi	300 & 400 mm dia., 16 Bar Pressure	Flexible (with EPDM rubber)	60 KM. & 115 KM.		Forest Dept., Abu Dhabi Municipality		
Cont. No. 99/2001, Abu Dhabi	600 mm dia., 16 Bar Pressure	Flexible (with EPDM rubber)	160 KM.		Abu Dhabi Municipality		
Al Ashoosh – Ajban Water Pipe line, Al Ain	600 mm dia., 16 Bar Pressure	Flexible (with EPDM rubber)	120 KM.	99 – 00	H.H. Sh. Zayed Private Dept.		
Al Ashoosh – Ajban Water Pipe line, Al Ain	600 mm dia., 16 Bar Pressure	Flexible (with EPDM rubber)	120 KM.	99 – 01	Al Ain Municipality		
Contract No. 1128/2000, Abu Dhabi Municipality	500 mm dia., 15 Bar Pressure	Flexible (with EPDM rubber)	200 KM.	98 – 00	Abu Dhabi Municipality		

Project	Diameter, Type & Working Pressure	Type of Joint	Quantity	Year of Supply	Client / Contractors		
Pumping Main from PS 1 to STW, Sharjah, for	700 mm dia., Sewerage, 16 Bar Pressure	Flexible (with EPDM rubber)	8.0 KM.	2002	Sharjah Municipality		
JO/HC09/MP02 – Trunk Line Replacement Upgrading – Kuwait	300 & 400 mm dia. GRE, 31 Bar Pressure	Lock joint / Lamination (Butt & Strap)	5.7 KM.	2003 - 2004	Joint Operations (KOC – Saudi Arabian Texaco Inc)		
RFP 342, Upgrading of exist- ing Brackish Water Network in Magwa Area SEK Fields	300 mm dia. GRE, 31 Bar Pressure	Lock joint / Epoxy Adhesive (Glue)	32.0 KM.	2002 -03	K O C. (Kuwait Oil Co.)		
RFP 309, Improvement of Fire Protection System at GCMB –Burgan	200 mm dia. GRE, 31 Bar Pressure	Lock joint / Epoxy Adhesive (Glue)	3.5 KM.	2002	K O C. (Kuwait Oil Co.)		
Ras Laffan Power and Desalination Project – Qatar	25 mm to 2000 mm dia. GRV/ GRP, 10 Bar Pressure	Lock joint / Epoxy Adhesive (Glue)	4.5 KM.	2002 – 03	Ras Laffan Power Co. (RLPC)		
Shuweihat S1 Independent Water and Power Project	25 to 2000 mm dia. GRV/ GRP, 10 Bar Pressure	Lamination (Butt & Strap)	32 KM.	2002 – 2004	Shuweihat CMS Int'l. Power Co.		
Fujairah Water & Power Project	50 to 1600 mm dia. GRV, 10.3 Bar Pressure	Lamination (Butt & Strap)	2.5 KM.	2002 – 03	UAE Offsets Group Cont. M/s. Doosan, Korea		
Repl. of Hypo-chlorite Header in Hypo-chlorination plant, Taweelah 'B' Power Stn.	80 to 500 mm dia. GRV Pipes and fittings, 10 Bar Pressure	Flanged	Spools	2002	ADWEA		
FEWA Tender No. 157/7/437- 445/2002	200 mm dia. GRP, Class 40 & Class 30 Pipes and Fittings	Flexible (with EPDM rubber)	8.2 KM.	2002	Federal Electricity & Water Authority		
Jebel Ali Power & Desalination 'K' Station, Phase II	25 to 2000 mm dia. GRP, 10 Bar Pressure	Flexible (with EPDM rubber) / Lamination (Butt & Strap)	15.0 KM.	2001 – 02	DEWA		
Tender No. 17/D, Ras Al Khaimah Municipality	400 to 900 mm dia., GRP Sewerage, 10 Bar Pressure	Flexible (with EPDM rubber) / Lamination (Butt & Strap)	98 KM.	2001 - 02	Ras Al Khaimah Municipality and PWD		
Mirfa Desalination Station 'B'	2,600 mm dia. GRP, 3 Bar Pressure	Flexible (with EPDM rubber)	2.4 KM.	2001 – 02	ADWEA		
Umm AI Nar Desalination Stn. 'B'	80 to 1800 mm dia. GRP, 15 Bar Pressure	Lamination (Butt & Strap)	5.0 KM.	2000 – 02	ADWEA M/s. Doosan		
Taweelah A2 Power and Desalination Plant	80 to 1800 mm dia. GRP, 15 Bar Pressure	Lamination (Butt & Strap)	5.0 KM.	2000 – 02	ADWEA		
Ruwais Housing Complex Expn. Infrastructure, Project No. 1215	80 to 800 mm dia. GRE / GRP, 13.8 Bar Pressure	Epoxy Adhesive (Glue)	8.0 KM.	2000 – 01	ADNOC		
Q-Chem Petrochemical Complex, Qatar	100 to 400 mm dia. GRE, 16.5 Bar Pressure	Epoxy Adhesive (Glue)	12.6 KM.	2000 – 01	Qatar Chemicals		
WE 39, Seih Al Rahiel Water Project, Al Ain	100 – 400 mm dia. GRP, 16 Bar Pressure	Epoxy Adhesive (Glue)	4.9 KM.	2000	RASCO		
Dubai Investment Park Combined Inf. & Roads, St. 1	500 mm dia. to 1200 mm, Sewerage,	Flexible (with EPDM rubber)	4.5 KM.	1999	Dubai Municipality		
Rebar Rolling Mill at Mussafah Ind. City, Abu Dhabi	150 – 500 mm dia. GRP, 4.0 Bar Pressure	Flexible (with EPDM rubber)	5.8 KM.	1999 – 00	General Industry Corporation		
ADNOC / Borouge Polyethylene Plant, Ruwais	80 to 1200 mm Dia. GRE / GRV, 18.6 Bar Pressure	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	7.0 KM.	1999 – 00	ADNOC / BOROUGE		
OGD Phase II, Habshan	50 to 1200 mm dia., GRE, 22.5 Bar Pressure	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	33.0 KM.	1999 – 00	ADNOC		
MW/1853, Sea Water Supply to Al Hamra Camp	300 mm dia. GRE, 25 Bar Pressure	Epoxy Adhesive (Glue)	1.2 KM.	1999	Dept. of Military Works, Ruwais		
Jebel Ali Tanker Berth 5 & 7	100 – 450 mm dia. GRE, 16 Bar Pressure	Lock joint / Lamination (Butt & Strap)	3.2 KM.	1999 – 00	Dubai Ports Authority		
Gasco – Buhasa Project : Order No. 100690201	100 – 200 mm dia. GRE, 16 Bar Pressure	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	0.4 KM	1999	GASCO		
Umm Al Nar Refinery Effluent System upgrade	100 – 600 mm dia. GRP / GRE, 16 Bar Pressure	Lamination (Butt & Strap)	1.2 KM.	1999	ADNOC		
Replacing High Capacity Water Chillers at Umm Al Nar Power Stn.	200 – 500 mm dia. GRP, 4.0 Bar Pressure	Lamination (Butt & Strap)	Spools	1999	ADWEA		
Ruwais Refinery Expansion Project, Stage II	150 to 1500 mm dia., GRV, 15 Bar Pressure	Lamination (Butt & Strap)	7.0 KM.	1998 – 00	ADNOC		

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Project	Diameter, Type & Working Pressure	Type of Joint	Quantity	Year of Supply	Client / Contractors		
Replacement of BCDS Produced water piping project (ADCO)	50 to 400 mm dia., GRE 27 Bar Pressure	Epoxy Adhesive (Glue)	22.0 KM.	1998 – 99	ADCO		
New Compost Liquor Treatment Plant, Al Ain City	100 – 600 mm dia. GRP, 4.0 Bar Pressure	Flexible (with EPDM rubber)	Short pipe & Fittings	1998 – 99	Al Ain Municipality / Satec Ltd., UK.		
Relocation of 1 MIGPD R.O. Desalination Plant from Mirfa to Sila	800 mm dia. GRP, 10 Bar Pressure	Lamination (Butt & Strap)	0.8 KM.	1998	ADWEA		
LPG Blending Facilities at Ruwais	450 to 700 mm Dia. GRE, 18 Bar Pressure	Epoxy Adhesive (Glue)	1.3 KM.	1997 – 98	ADNOC		
Additional Gas Treating Facilities Saudi Aramco – Uthmaniyah Plant	100 to 600 mm dia. GRP, 10 Bar Pressure	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	7.4 KM.	1997 – 98	ARAMCO – Saudi		
Dubai Transport Corporation main taxi stand at Al Ghusais – Dubai	100 – 200 mm dia. GRE, 25 Bar Pressure	Lamination (Butt & Strap)	0.8 KM.	1997	Dubai Transport Corporation		
Salt & Chlorine Line, Ruwais	800 mm Dia. GRV, 20 Bar Pressure	Epoxy Adhesive (Glue)	0.8 KM.	1985 – 86	ADNOC		
Water & Chlorine Line, Ruwais	600 to 1200 mm Dia. GRV, 20 Bar Pressure	Epoxy Adhesive (Glue) / Lamination (Butt & Strap)	7.0 KM.	1985 – 86	ADNOC		
Contract 22, Ruwais	1400 to 1600 mm dia. GRV, 7.2 Bar Pressure	Flexible (with EPDM rubber)	1.5 KM.	1983 – 84	ADNOC		
Ruwais Housing Complex	400 mm dia. GRE 15 Bar Pressure	Epoxy Adhesive (Glue)	15.0 KM.	1983 – 84	ADNOC		
Ruwais Hydrocracking Project	1200 mm dia. GRV, 15 Bar Pressure	Epoxy Adhesive (Glue)	6.0 KM.	1984 – 85	ADNOC		
Various ADSS / ADSSC (Abu Dhabi Sewerage Scheme Projects), Various Abu Dhabi Municipality / TRIP Projects & Various AI Ain Municipality Projects	100 to 2800 mm dia. GRP, Sewerage / Drainage / Pressure upto 16 Bar	Flexible (with EPDM rubber)	4500+ KM	1982 -2018	SPC / ADSS / ADSSC - Abu Dhabi Abu Dhabi Municipality Al Ain Municipality		

## CLASSIFICATION OF GRP PIPES - ASTM D 2310

General Designation Requirements for Machine-made Reinforced Resin Pipe															
Des	Designation Cell Limits														
1	Туре	1						2				3			
		Filament wound						Centrifugally Cast			Pre	Pressure Laminated			
	Grade	1		2			3		4	5	6	6		7	
2		Glass Fi reinforc Epoxy Ro	bre ed esin	Glass Fibre reinforced Polyester Resin		Glas reir Ph F	s Fibre A forced re enolic F tesin		sbestos inforced olyester Resin	Asbestos reinforced Epoxy Resir	Asbes reinfor Phenolic	Asbestos reinforced Phenolic Resin		Glass Fibre Reinforced Furan resin	
		Α		в	С		D		Е	F	G		н	1	
3	Class	No Liner	Pol Resi n rein	lyster in liner ion- forced	Epox Resin nor reinfoi	xy liner 1- rced	Phenolic Resin line non- reinforce	lic ner Resin line reinforce		Epoxy Resin liner reinforced	Phenolic Resin line reinforcec	c Plastic er resin ed liner -specif		Furan resin Liner rein- forced	
-					Но	op S	tress-Hy	dro	static Des	ign Basis				_	
	Cyclic			в	С		D		Е	F	G	н			
4	psi (Mpa)	2500 (17.2)		3150 (21.7)	4	000 ?7.5)	500 (34.4	0 6300 4) (43.4)		8000 (55.1)	10000 (68.9)	1250 (86.	00 1)		
	Static	Q R S		т		U	w	Х	Y		z				
	psi (Mpa)	5000 (34.4)		6300 (43.4)	8(5	000 5.1)	1000 (68.9	)0 9)	12500 (86.1)	16000 (110.0)	20000 (137.0)	2500 (172	00 .0)	31500 (217.0)	



## **GRP PIPING SYSTEM**

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