



Exploration & Production

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 148

**Glass - Reinforced plastic
Piping materials (tubes and accessories)**

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1. Scope

This document applies to the supply of piping materials (tubes and accessories) intended for the fabrication of networks carrying liquid products such as water, chemicals or drippings at a temperature of less than 90°C, the diameters of which being from 1" to a maximum of 40".

The Manufacturer must provide a complete and homogeneous assembly that can be connected by flanges to steel piping.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

The latest revisions of the following codes and standards shall apply to the supply of glass reinforced piping materials within the scope of the present specification.

Standards

Reference	Title
ASTM D 445	Standard Test method for kinetic Viscosity of Transparent and Opaque liquids (and calculation of Dynamic Viscosity)
ASTM D 543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 570	Standard Test for Water Absorption of Plastics
ASTM D 648	Standard Test Method for Deflection Temperature of Plastics Under Flexural Load
ASTM D 1599	Standard Test Method for Short-Time Rupture Strength of Plastic Pipe, Tubing And Fittings
ASTM D 1652	Standard Test Methods for Epoxy Content of Epoxy Resins
ASTM D 2105	Standard Test Method for Longitudinal Tensile Properties of Reinforced Thermosetting Plastic Pipe and Tube
ASTM D 2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D 2143	Standard Test Method for Cyclic Pressure - Strength of Reinforced, Thermosetting Plastic Pipe
ASTM D 2196	Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer
ASTM D 2310	Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2343	Standard Test Method for Tensile Properties of Glass Fiber Strands, Yarns and Rovings Used in Reinforced Plastics
ASTM D 2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel - Plate Loading

Reference	Title
ASTM D 2471	Standard Test Method for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins
ASTM D 2563	Standard Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts
ASTM D 2583	Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D 2584	Standard Test Method for Ignition Loss of Cured Reinforced Resins
ASTM D 2992	Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings
ASTM D 2996	Standard Specification for Filament Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting- Resin) Pipe
ASTM G 23	Standard Practice for Operating Light-Exposure Apparatus (carbon-arc type) with and without Water for Exposure of Nonmetallic Materials
ISO 11357-2	Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature
ISO 14692-1	Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Part 1: Vocabulary, symbols, applications and materials
ISO 14692-2	Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Part 2: Qualification and manufacture
ISO 14692-3	Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Part 3: System design

Professional Documents

Reference	Title
API SPEC 15 LR	API specification for low pressure fiberglass line pipe

Regulations

Reference	Title
Not applicable	



Codes

Reference	Title
ASME B16.5	Steel pipe flanges and flanged fittings
ASME B31.3	Chemical plant and petroleum refinery piping

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP PVV 178	Design and erection of Glass Reinforced Plastics (GRP) piping system
GS EP SAF 321	Fire pump stations and fire water mains
GS EP SAF 322	Fixed fire water systems
GS EP SAF 337	Passive fire protection: Basis of design

If there is a disagreement between this specification and one of these codes or standards, the Manufacturer must so inform the company who will decide; it is understood that in this case, the more stringent requirement shall be assumed to apply in the absence of formal approval by the company.

3. Design

Design and erection of GRP piping system is covered by Company specification **GS EP PVV 178**.

Dimensioned assembly drawings and/or isometric drawings are prepared by the Engineering Company.

The supporting of the piping must be determined by the Engineering Company on the basis of information furnished by the Manufacturer and according to [ISO 14692-2](#). The information provided by manufacturer must include standard drawings of supports, together with the general rules applicable to materials of the supply.

The Manufacturer is required to check these drawings, to perform related stress calculations and surge analysis, and to propose any appropriate changes or suggestions before fabrication.

The Manufacturer and the Engineering Company shall adopt a detailed final version of these drawings.



4. Fabrication

4.1 Structure of the tube

4.1.1 Inside layer (gel coat or liner)

This inside layer shall have a resin content of at least 70%. The gel coat may be reinforced by C glass cloth or woven polyester.

It shall be at least 0.5 mm thick. The resin used shall be free of pigment or other additives.

4.1.2 Layers providing mechanical strength

These layers shall be of glass-reinforced thermosetting resin. Generally, the same resin shall be used as for the gel coat. If not, the resins must be compatible and provide a bond as good as identical resins. The resin used must be pigment-free.

4.1.3 Outside layer

This generally consists of the same resin used as for the layer providing mechanical strength (layer made of pure resin, called "gel coat").

However, subject to the Company prior approval, the Manufacturer may use a "gel coat" containing the following additives:

- Pigments (for protection against UV)
- Graphite (to decrease the surface electrical resistivity)
- Antimony oxyde or alumina (to enhance the self extinguishing properties).

Carbon fibre may also be inserted in outside layer to insure electrical conductivity.

4.2 Raw materials

4.2.1 Resins

The only acceptable synthetic thermosetting resins are epoxy resins and vinylester resins.

Isophthalic or orthophthalic polyester resins shall not be used.

However, in the case of fluids having a high content of especially corrosive chemicals (acids or bases), reference shall be made to the Manufacturer's recommendations for the selection of the appropriate resin, which may then be a polyester of the isophthalic, orthophthalic or bisphenol type.

4.2.2 Glass fibers

Two types of glass, having different chemical compositions, shall be used to reinforce thermosetting resins (they are known as "C" glass, and "E" glass):

- Inside layer
 - "C" glass is used in the form of light-weight fabrics (30 to 50 g/m²) to reinforce the gel coat.

- Layers providing mechanical strength
 - "E" glass is a reinforcing glass for the layers of composite materials providing mechanical strength. It is used in various forms: rovings, mats, fabrics, chopped fibers.

4.3 Fabrication processes for tubes and accessories

4.3.1 Tube fabrication processes

The tubes covered by this specification shall be made by filament winding of "rovings" of resin-impregnated glass. They must comply with the standard [ASTM D 2996](#). These tubes must also belong to one of the following classes, described in [ASTM D 2310](#):

- Type 1, Grade 1 (epoxy), Class F (reinforced epoxy liner)
- or
- Type 1, Grade 2 (vinylester), Class E (reinforced vinylester liner).

The usual winding angle is $54^\circ \pm 2^\circ$; other angles may be used with justification (calculation note). Asymmetrical winding angles may be considered if they combine transversely and longitudinally oriented fibers (two different angles close to 90° and 0°). The ends of the tubes must be removed if, because of the fabrication process, they have glass fibers wound at a different angle from those of the central portion of the tube.

4.3.2 Fabrication processes for accessories

The accessories covered by this specification are 45° elbows, 90° elbows, tees, reductions, couplings, collars for loose flanges, and fixed flanges.

The same materials as for the tubes shall be used for accessories.

The following fabrication processes may be used for these accessories:

- Filament winding
- Injection
- Contact moulding
- Press moulding.

Preference shall be given to accessories produced by filament winding, since they have greater mechanical strength.

Accessories shall have at least the same chemical and mechanical properties (with respect to bursting, internal pressure, crushing, external pressure, load along a generating line and axial tension stresses) as the tubes on which they are intended to be fitted.

4.4 Various types of connections

Connections shall be made by cemented joints of the bell and spigot type, or by flanges. Butt-cemented joints are not authorised, except in the case of networks having a pressure less than or equal to 5 bars conveying especially corrosive chemical fluids (case of use of polyester resins, § 4.2.1).

The Manufacturer shall guarantee the same service pressure for the connections as for the tubes.



The dimensions of the connections are determined by the Manufacturer. Yet, for critical joints (as identified by Stress analysis) and all fields' joints, overlenght of glued connections shall be foreseen.

The validity of the connections is proven by the tests called for in § 5.

4.4.1 Cemented joints

The Manufacturer must give a detailed description of the bonding method he recommends (for both shop and site fabrication).

He must supply all materials and equipment necessary, together with the following information concerning the adhesive:

- The curing time as a function of temperature
- Long-term variations in hardness after curing at various temperatures
- The time at which the piping system may be put into service.

There must be not gel-coat on the surface of the female part to be cemented.

Fittings fabricated by filament winding shall have female sockets at all ends ("bell" ends), except as otherwise indicated.

Fittings fabricated with glass strips may have only male ends ("spigots").

The Manufacturer shall indicate the dimensions of the male and female parts, together with the fabrication tolerances. He shall also indicate the shear stress on the glued surface at the service pressure, acting with full end thrust under pressure.

Socket connection parts must be delivered in a machined condition by the Manufacturer.

There are three types of bell and spigot connection, classified in decreasing order of preference:

- Cone to cone
- Male cylinder to female cone.

Preference shall be given to cone-to-cone connections.

Cylinder-to-cylinder connections are not allowed.

4.4.2 Fixed-flange connections

The fixed flanges are added on and glued to the tube or fitting, with the cemented joint made as per § 4.4.1 above. They may also be fabricated directly on a piping or accessory end.

They may be fabricated by the winding of rovings or fabrics, or by hot pressure moulding with a reinforcement of chopped glass fibers.

The contact face of the flange must be perfectly perpendicular to the centre line of the tube; it is designed for a gasket extending out to the outside diameter of the flange.

This contact face must be naturally flat and rough-wound or rough-moulded, without retouching. It is forbidden to grind it, even if the glass fibers are intended to be covered with a coat of resin after grinding; this face must have grooves in relief (at least 2) to hold the gasket in place.

The outside dimensions of the flanges, in particular the bolt-hole circle, and the outside diameter, must be in accordance with the values specified in the standard [ASME B16.5](#) for the relevant ratings (generally 150 lbs).