

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 178

Design and erection of Glass Reinforced Plastic (GRP) piping system
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1. Scope

This standard specification defines:

- The basic principles and the information needed to design and product support systems for glass fibre reinforced (GRP) piping made by filament winding.
- The minimum recommendation concerning:
 - Prefabrication
 - Assembly
 - Erection
 - Tests
 - Final document set-up related to piping installation.
- Minimum requirements for staff qualification required to execute assemblies by adhesive bonding or manual lamination (in the workshop or on site) of pipes and fittings.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

Reference	Title
ASME B31.3	Process Piping
ASTM D1599	Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
ISO 11357-2	Plastics - Differential scanning calorimetry (DSC) - Part 2: Determination of glass transition temperature and glass transition step height
ISO 14692 (Parts 1; 3; 4)	Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Parts 1; 3; 4
ISO 16276-2	Corrosion protection of steel structures by protective paint systems - Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating - Part 2: Cross-cut testing and X-cut testing

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

Reference	Title
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 351	External protection of structures and equipment by painting. Floating structures
GS EP COR 353	Design and application of passive fire protection coatings
GS EP COR 354	External protection of onshore structures and equipment by painting
GS EP PVV 107	Piping Stress Analysis
GS EP PVV 148	Glass - Reinforced plastic Epoxy Resin Piping materials (tubes and accessories)
GS EP SAF 228	Liquid drainage
GS EP SAF 321	Fire pump stations and fire water mains
GS EP SAF 322	Fixed fire water systems

3. Definition

Manufacturer, Installer, Contractor, Designer, Principal are defined by [ISO 14692-1](#) (§ 2.1).

Engineering Company is the Designer and can be either the Contractor or the Manufacturer.

Company is the Principal as defined by [ISO 14692-1](#).

Managing Entity is as defined on the front page of present document.

4. Design

4.1 General principles

Design of Glass Fibre Reinforced Plastic (GRP) piping network shall take account of the specific features of GRP. It shall conform to [ISO 14692-3](#) & [ISO 14692-4](#), and the present specification.

[ASME B31.3](#) chapter 7 describes the main rules to take account of these specific features.

All piping with a nominal diameter of 80 mm or above and with operating temperatures of 60°C or above shall be verified by a preliminary flexibility calculation as per [GS EP PVV 107](#). Given the specific nature of the products supplied by each Manufacturer, these calculations shall be based on the specifications of the products to be installed.

Vendor shall indicate the minimum Allowable stress (pipe/fittings) guaranteed for the supplied products including bonded or laminated joints.

Each support shall be symbolised and marked on piping and on isometric drawings. The workshop shall not be in charge of the definition of supports.

The spacing between supports shall be as defined in the documents supplied by the pipe Manufacturer.

For flange connections at least one support will be needed for each length of pipe.

When the support system already exists, no support shall coincide with a joint.

Reference is made to **GS EP SAF 321** and **GS EP SAF 322** for the design of fire water systems, and to **GS EP SAF 228** for Closed and Open drains

4.2 Choice of pipe Manufacturer

Wherever possible, the type of piping and pipe and fitting Manufacturer shall be selected early enough in the design phase to optimise this design according to the Manufacturer's product characteristics.

Since there is as yet no standardisation of products, differences exist, in particular in the dimensions of the accessories (bends, tees, etc.), which shall be taken into account in the layout of the lines.

The pipe Manufacturer shall be involved in the design process. The pipe Manufacturer shall mandatorily perform stress analysis and surge analysis and approve the GRP network design (including pipe routing and support studies).

4.3 Deformation - Water hammer

Since GRP pipes are more flexible than steel pipes, they can be subject to greater oscillations.

Risk of overpressure due to surge effect and water hammer shall be taken into account in the design. When such a risk exists design shall incorporate an analysis of dynamic forces. Such analysis shall be performed using actual characteristics of rotating (pumps...) or active protective equipments.

Moreover it is important to observe the appropriate engineering practices to minimise such water hammer. Care shall be taken in the design to avoid air pockets. Where necessary piping system shall incorporate a mean of limiting the risk of water hammer (surge/pressure control system, overpressure protection, non slam axial check valves etc.).

4.4 Adjacent piping

The possible consequences of accidents occurring on adjacent piping shall be taken into consideration when designing the layout of GRP piping. In particular, the proximity of flanges on steam pipelines shall be avoided since a jet of steam can irrevocably damage GRP piping.

GRP elements shall be protected against abrasion from contact with the supports or any other objects (by the use of skidding devices, for example).

4.5 Air trap in Firewater systems

Air trap areas are creating hot spot in case of fire and may lead to leakage. Air traps shall be avoided.

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4.6 Butterfly valves

For butterfly valves fitted between flanges, the upstream and downstream sections of piping must be strictly aligned (to avoid possible colliding between the butterfly trim and the flange). Consequently, on a horizontal line, a fixed support shall be provided on one side. Compatibility between the valve and the GRP flange surfaces which are often ribbed and which can cause sealing problems shall be ensured.

4.7 Underground buried piping

The design of buried piping system shall consider all kind of permanent or occasional loadings including soil external pressure, road loadings, seismic conditions, etc.

Mechanical connections are not permitted in buried conditions.

In case the use of flanged connections cannot be avoided, they shall be installed in a pit.

Where anchor blocks are necessary to thwart material longitudinal elongation induced by thermal expansion or end cap effect location of those anchor blocks shall be endorsed by the GRP component manufacturer or supplier and is subject to Managing Entity approval.

5. Design of supports

In addition to [ISO 14692-3](#) paragraph 5.3, the following requirements are applicable.

5.1 Support systems for piping with diameters up to 40 mm

The supports for these lines shall be defined and implemented by the Contractor directly on site, after approval by the Company.

5.2 Support types

Supports for GRP piping shall be designed to ensure that they cannot damage the piping elements: a 3 mm minimum thick elastomer lining shall be inserted between the metal collars and the pipes.

Different types of support are described in the Appendix 1; these are examples which can be used by adapting the dimensions.

5.2.1 Supports with one or more degrees of freedom

Hangers, which can move around their fixing rod, allow considerable longitudinal and lateral movement. At regular intervals, longitudinal guides shall be provided to compensate for the effects of wind and prevent vibration in the piping.

Fixed supports allow the pipes longitudinal and sometimes lateral movements. A steel pipe rack constitutes a typical fixed support which allows both longitudinal and lateral movement. A pipe on a support of this kind must be protected against external abrasion by appropriate skidding devices.

Guides can limit lateral movements and allow longitudinal and rotational movements. Guides are recommended for lines subject to vertical transverse movement, for example: lines subject to pressure surges, frequent filling and draining, lines (particularly when empty) which can be

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raised or moved by the wind or other external forces. Guides shall be used for the vertical sections.

Light anchorages, designed solely to hold the pipe in position between parallel lines or at changes of direction in a free system, may be made of fixed supports.

For bearing surfaces subject to movement, wear plates may be glued to the pipes. For diameters of 200 mm and above, these plates may be made of half sections of the same pipe. Wherever it is likely that relative movement between the pipe and the support could occur, these plates shall be glued or firmly secured to the pipe.

5.2.2 Fixed supports

A straight line pipe is normally fixed using collars or fixing rings. The supports used in immobilised lines are clamps. Saddles should preferably be inserted between the pipe and the clamp to ensure that the pipe is not crushed when the clamp is tightened. Glued saddles may also be used as an immobilising key either side of an anchoring clamp.

Guides are needed at regular intervals in immobilised systems, even though no significant longitudinal movement is permitted.

Valves and pumps in a GRP piping system must be supported separately. Figure 7 in Appendix 1 shows how these supports should be bolted to a flange to take the weight of the valve, withstand the thrust and torque forces and provide earthing.

Vertical sections shall normally be anchored using saddles or flanges attached to a guide, or a reinforced clamp Appendix 1/Figure 8).

5.3 Maximum loads on supports

Support of concentrated loads (valves, control instrumentation, etc.) shall be specially designed. In particular, the piping shall not be designed to support the weights of the equipment to which it is connected (valves, etc., must be self-supported).

Manufacturer's documentation provides details on this subject.

5.4 Position of supports

5.4.1 Location

Supports allowing movement in the piping shall normally be positioned under the pipe and must not coincide with a coupling or bend or tee. Movement of the pipe shall not be hampered longitudinally or laterally by a flange or coupling located near the support.

Support position shall also consider change in shape of any equipment connected to the GRP system, for example the consequence of storage tank increased diameter during hydrotesting.

Anchor points shall be positioned on the pipe for immobilised lines. Apart from flanged joints, overhead anchorages shall be positioned on the pipe rather than on the couplings. Anchorages located on sections that are free to move must be positioned at appropriate points to control movement in the lines or changes of direction.

5.4.2 Vertical lines

A support shall be installed (anywhere along the piping) for any vertical section more than 3 m high. Figure 8/Appendix 1 shows typical examples of this type of support. If the vertical section is supported near its base, guide collars with protecting saddles must be used, as shown in Figure 8B.

Vertical sections of less than 3 m may, as a general rule, be supported by the horizontal parts of the pipe. In all cases, as part of the flexibility study, the consequences of horizontal and vertical movements at changes of direction shall be checked

For the vertical parts of the piping, variations in length shall be permitted by an appropriate support structure.

Very high columns (suspended or riser) must be considered as special cases and be covered by a specific study taking into account: supporting structure, variations in length, effects of wind, vibration, etc. During erection, any movement due to the wind or vibration of the supports shall not be permitted during polymerisation if bonded joints are executed on site.

5.5 Anchored points

Fixed points shall be made by adding a thickness of GRP by manual lamination either side of the fixed point collars after the collars have been fitted and the elastomer lining shaved flush. Areas to be laminated shall be unpolished first.

Laminations may be replaced by GRP shells glued to the previously unpolished piping.

5.6 Connection to metallic lines

When a GRP line is connected to a metallic line, the metallic line shall be securely anchored at the point of connection, so that its movements are not transferred to the GRP pipeline, generating major stresses.

6. Fabrication of supports

6.1 Fabrication

Before making the collars, the Contractor shall check that the dimensions given are compatible with the dimensions of the piping to be installed.

The various supporting parts shall be deburred and shall not have any sharp edges.

Each support shall be marked with the code used on the support system drawing by means of labels, in such a way that neither sandblasting nor successive layers of paint can obliterate the marking.

6.2 Materials

The materials used to make the supports shall be weldable and submitted to the Company for approval.

All weld beads shall be continuous.