

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 321

Glass Reinforced Epoxy (GRE) Pipelines Design, Manufacturing, Construction and Integrity Management
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1. Scope

This specification defines the Company general requirements for:

- Design
- Pipe manufacturing and inspection
- Field joining and inspection
- Field laying and final inspection

of glass reinforced epoxy pipelines.

This specification shall be used in conjunction with a Project Particular Specification (PPS) to be made for purpose detailing the additional tests and requirements or the possible modifications to the present specification, based on the special design conditions of the pipeline project.

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 supplements, is the latest revision published at the effective date of this document.

Reference	Title
1/ Design	
ASTM D2992	Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-fiber-reinforced Thermosetting-Resin) Pipe and Fittings.
ISO 14692-3	Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Part 3: System design
2/ Manufacturing	
ASTM D2310	Standard classification for machine-made "fibreglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D2996	Standard specification for filament wound "fibreglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D5685	Standard specification for "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) pressure pipe Fittings
ISO 14692-2	Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Part 2: Qualification and manufacture
3/ Testing	
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins

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Reference	Title
ASTM D2105	Standard test method for longitudinal tensile properties of "fibreglass" (glass-fiber-reinforced thermosetting-resin) pipe and tube
ASTM D2196	Standard Test Method for Rheological Properties of Non Newtonian Materials
ASTM D2343	Standard Test Method for Tensile Properties of Glass Fiber Strands, Yarns, and Rovings Used in Reinforced Plastics
ASTM D2471	Standard Test Method for Gel Time and Peak Exothermic Temperature of Reactivity Thermosetting Resins
ASTM D2563	Standard practice for classifying visual defects in glass reinforced plastic laminate parts
ASTM D2584	Standard Test Method for Ignition Loss of Cured Reinforced Resins
ASTM D2925	Standard test method for beam deflection of "fibreglass" (Glass-Fiber-reinforced Thermosetting Resin) pipe under full bore flow
ASTM D3567	Standard practice for determining dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
ASTM D570	Standard Test Method for Water Absorption of Plastics
ISO 11357-2	Plastics - Differential scanning calorimetry (DSC) - Part 2: determination of glass transition temperature
4/ Construction and installation	
ASTM D3835	Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ISO 14692-4	Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Part 4: fabrication, installation and operation
5/ Non destructive examination	
ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel - General principles
ISO 11699-1	Non-destructive testing - Industrial radiographic film — Part 1: Classification of film systems for industrial radiography

Reference	Title
5/ Quality assurance	
ASTM D1599	Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D3839	Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe
ASTM D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
ISO/TS 29001	Petroleum, petrochemical and natural gas industries - Sector-specific quality management systems - Requirements for product and service supply organizations

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
Not applicable	

3. General

3.1 Definition

Throughout this specification, the following definitions apply:

Purchaser	Means the Company or the Supplier (as applicable), which have placed the Purchase Order to the Manufacturer.
Inspector	Means the Company's representative(s) of member(s) from an Inspection Agency duly appointed by the Company or the Supplier (as applicable) to act as its representative(s) for the purpose of the contract.
Approval	Means the authorisation in writing given by the Company to the Supplier to proceed with the performance of a specific part of the work without releasing in any way the Supplier from any of its obligations or liabilities under the contract or at law; Approve, Approved and Approval shall be construed accordingly.
May	Used to indicate that a provision is optional.
Shall	Used to indicate that a provision is mandatory.
Should	Used to indicate that a provision is not mandatory but is recommended as good practice.
PPS	Designates the Project Particular Specification.
Batch	Material produced in the same manufacturing run.

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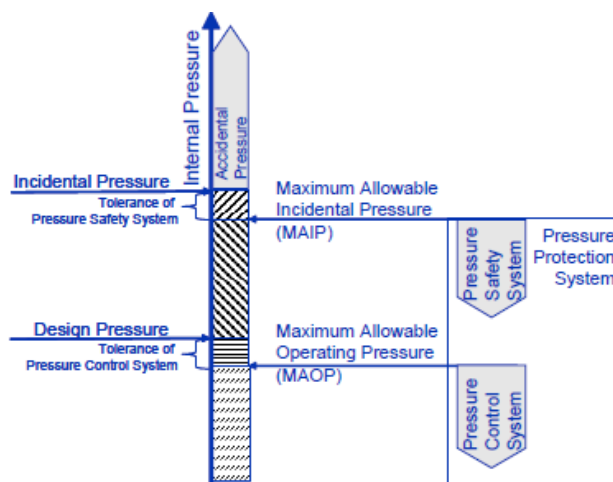
3.2 Quality Assurance/Quality Control

1. The Suppliers shall operate a Quality Assurance system in accordance with [ISO TS 29001](#), approved by a recognised authority. The Quality Assurance Manual shall be submitted prior to the start of work.
2. Four weeks prior to the commencement of pipe manufacturing, the Supplier shall prepare and submit a Quality Control Plan which describes the inspections to be performed during the supply of pipes. The Quality Control Plan shall set forth "witness", "hold", "review", and "random" points.
3. Just before production starting, mill QA Representative accompanied by Inspector shall check at every production and inspection station, that the relevant working instructions and procedures are available, complete, conform to the procedures agreed by Company or to Company specification requirements. A report shall be issued by Supplier, signed by Inspector and enclosed with the final dossier.

3.3 Project Particular Specification (PPS)

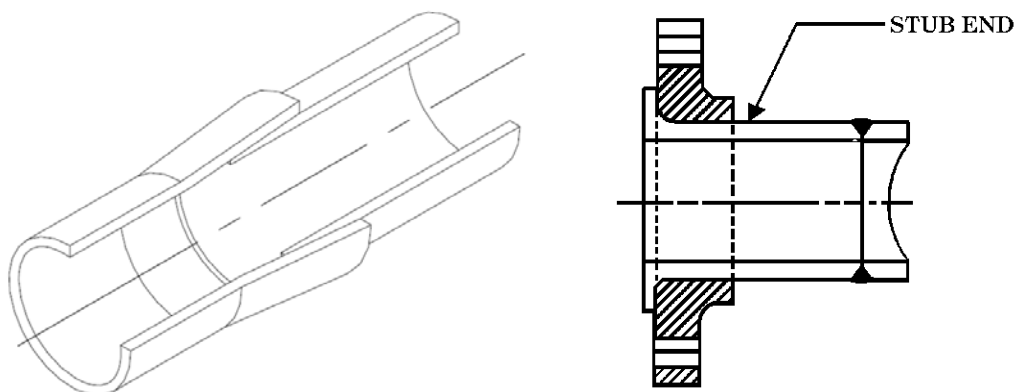
The following information shall be provided in the PPS (see also proposed table in **Appendix 1**):

1. Effluent chemical composition
2. Type of pipe: GRE (Glass Reinforced Epoxy)
3. Field layout drawings including isometrics
4. Maximum Allowable Incidental Pressure (definition is given on the following sketch) which will stands for "system design pressure" for design calculations



5. Design temperature: technical feasibility for $T_{\text{design}} > 65^{\circ}\text{C}$ shall be previously checked with Manufacturer
6. Design life: shall not exceed 20 years
7. Pipe geometry (OD and WT)
8. Live (LL) and dead (DL) loads if any

9. Occurrence of cyclic loading and corresponding amplitude (F_{min} , F_{max} and ΔF) and frequency (f)
10. Type of joints: only adhesive bonded joints (straight-taper and taper-taper) are allowed and stub-end (lap joint) type flange (see picture below). Mechanical O-ring elastomeric bell and spigot seal-lock joints and threaded joints are not allowed.



11. Requirements for fire performance (if any)
12. Requirements for static electricity check (if any)
13. Requirements for low temperature application (if relevant)
14. Requirement for beam deflection test (mainly for unburied pipelines).

4. Inspection by the Company

1. All procedures shall have prior approval of TEC/PLR Company department. All qualification tests shall take place under the supervision of the Inspector.
2. The Supplier shall notify the Inspector sufficiently in advance to enable him to be present at qualification tests and at all other tests or stages of manufacture subject to acceptance in accordance with this specification.
3. The Supplier shall ensure that the Inspector has full and free access to all parts of the Mill during all fabrication and inspection stages.
4. The Inspector shall ensure that materials and pipes are fabricated in accordance with all the specified requirements and Company's approved procedures.
5. At pipe mills: offices, workshops, storage yards etc., information on paper and/or in computers (procedures, working instructions, data, records, tracking system, etc.) concerning the order manufacturing and inspection, shall be made fully available and comprehensible to Inspector reading. Where the mill country language is not English, all these information shall be written in double language, i.e. mill country language and English language.
6. It shall be made available in the Inspector office, a free access to the mill computerised system:
 - Tracking system of production and inspection
 - All data and results of mechanical tests, NDE results

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- Any other information considered pertinent by the Inspector for his monitoring
 - Computer, software environment compatible with the mill software, software interface where necessary for data exploitation with EXCEL shall be made available by the Supplier
 - Company's Inspector shall be provided with facilities/equipments for sending and receiving faxes, communicating by emails and fast Internet access.
7. Inspection by the Inspector shall be carried out during pipe production in order to avoid any special or additional handling. Inspection will be made in such a manner to avoid delay in pipe production insofar as the pipes which are presented to him meet the specified requirements.
8. The Inspector shall finalize (when required) its inspection by the application of a special stamp (to be mutually agreed with the Manufacturer).
9. The Inspector shall notify the Company without delay of any difficulty, irregularity, problem or delay likely to occur during pipe production.
10. The Company reserves the right to check tests carried out by the Supplier. For this purpose, the Company may request the delivery of the corresponding samples or specimens to be analyzed in an independent laboratory chosen by the Company.

5. Design

Design shall be performed following [ISO 14692](#) requirements and the following recommendations. The pipe Manufacturer is required to check design calculations and to propose changes when it is required.

5.1 Pressure containment

5.1.1 Plain pipe

The factor qualified pressure " p_{qf} " shall be determined following [ISO 14692-3](#) and:

- Regression curves of the pipe materials shall be established according to [ASTM D2992](#).
- Qualified pressure shall be determined for the design life and the design temperature.

Please note that no extrapolation of regression curve to higher temperature is allowed and the following requirements shall apply:

- Regression curve at 20°C can be used for design temperature $\leq 20^\circ\text{C}$
- For $20^\circ\text{C} < T_{\text{design}} \leq 65^\circ\text{C}$, the regression curve at 65°C shall be used unless a regression curve at $T_c \geq T_{\text{design}}$ is available (in this case the regression curve at T_c can be used)
- Design at higher temperature than 65°C is allowed only if a full regression curve is available at $T_c \geq T_{\text{design}}$ (in this case the regression curve at T_c can be used).
- " A_1 " coefficient shall be taken to 1
- " A_2 " coefficient shall be taken to 1 (for water and oil applications)
- " A_3 " coefficient shall be determined in case of cyclic loading applications,

The maximum system design pressure shall be determined following [ISO 14692-3](#) and:

- “ f_2 ” = 0.89 for hydrotest and 0.67 in all other cases
- “ f_3 ” shall be determined following [ISO 14692-3](#).

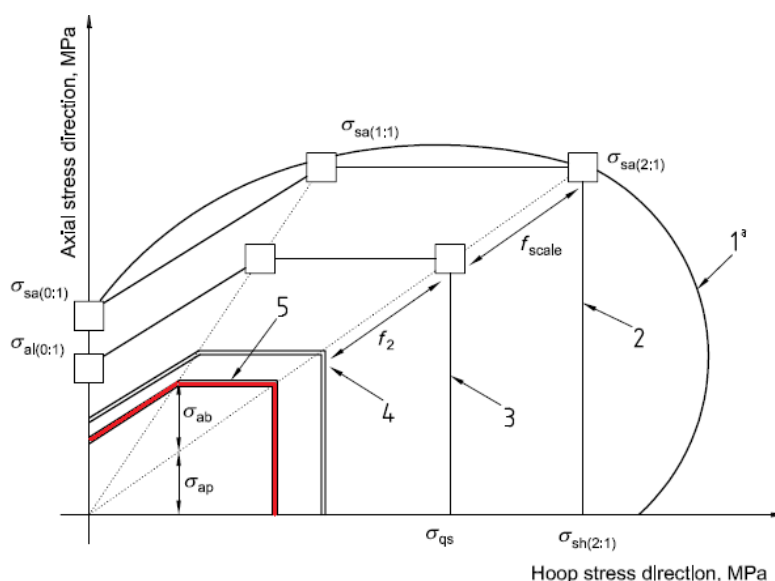
5.1.2 Fittings (bends, tees...)

Recommendations of [ISO 14692-3](#) shall be followed.

5.2 Axial and hoop stress combination

Both sums of maximum axial and hoop stresses shall be determined. Maximum axial stress determination shall at least consider all possible combinations of internal pressure, bending (pipe walking, lateral buckling, occurrence of free spans, stresses due to pipe supports...) and thermal expansion.

The operating point shall be plot on the (x = sum of hoop stresses and y = sum of axial stresses) and be within the factored long term design envelope (see below).



5.3 Buckling resistance

Pipes buckling resistance shall be checked according to [ISO 14692-3](#).

5.4 Span lengths

Span calculation shall be performed following [ISO 14692-3](#). The maximum allowable span length “ L_s ” shall be determined.

6. Pipe and fittings manufacturing

Only “type I: Filament Wound” machine made fiber glass pipes and fittings as defined in [ASTM D2310](#) are acceptable.