

DEP SPECIFICATION

**GLASS-FIBRE REINFORCED PLASTIC PIPELINE AND
PIPING SYSTEMS**

(AMENDMENTS/SUPPLEMENTS TO ISO 14692)

DEP 31.40.10.19-Gen.

February 2019

DESIGN AND ENGINEERING PRACTICE

DEM1



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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the purchase and use of glass-fibre reinforced plastic (GRP) pipeline and piping systems, both onshore and offshore. Its objective is to enable the purchase of GRP components with known and consistent properties from any source.

This DEP is applicable to:

- a) Onshore pipeline and piping systems and offshore piping systems for non-hydrocarbon applications;
- b) Onshore pipelines transporting oil and gas;
- c) Pipeline and piping systems for chemicals;
- d) Onshore and offshore piping systems for hydrocarbon liquids.

The application of GRP piping classes for refining and chemicals is specified in DEP 31.38.01.14-Gen., and includes cooling water, boiler feed water, fire fighting water, demineralised water, and hydrochloric acid.

The abbreviation GRP is used as generic name for several glass reinforced plastic pipe systems like GRE, GRUP, and GRVE.

This DEP is not applicable to:

- a) Pipe systems that incorporate internal thermoplastic or elastomeric liners;
- b) Fibre reinforced plastic (GRP) downhole tubing and casing.

Application of fibre reinforced thermoplastic lined GRP spoolable pipe is specified in DEP 31.40.10.20-Gen.

This DEP is based on ISO 14692 Parts 1-4: 2017.

Parts III to VI of this DEP amends, supplements and deletes various clauses of ISO 14692 Parts 1-4: 2017.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards.

This is a revision the DEP of the same number dated February 2018; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production and gas handling. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific Definitions

Term	Definition
C-glass	Glass fibre having a better chemical resistance than E-glass Composition: Alkali-lime glass $\approx$ 8% Alkali content
Design Pressure	The highest gauge pressure that, according to mechanical design codes, a system or piece of equipment can be continually subjected to at or below the Upper Design Temperature, and above the Lower Design Temperature.
Design temperature	Maximum fluid temperature that can be reached during service
E-CR glass	Glass fibre having a better chemical resistance than E-glass. Composition: Alumina-limesilicate glass, $\leq$ 1% alkali content
E-glass	Glass fibre normally used to reinforce GRP pipes. Composition: Alumina-borosilicate glass, $\leq$ 1% alkali content
Lower Confidence Limit	97.5 % confidence limit of the long-term hydrostatic pressure or stress based on a 20-year lifetime
Pipe Spool	Work shop pre-assembled pipe section which often consist of pipe sections with e.g. fittings, tees, flanges, instrumentation. These test spools will be transported to the field and built into the piping or pipeline section.
Pipeline system	pipe with component parts subject to the same design conditions and typically used to transport fluids between wells and field facilities, processing plants and storage facilities.
Synthetic	Primarily polyester fibres, typically used as reinforcement material for the chemical resistant layer (CRL)

Term	Definition
Very Toxic	Includes very toxic – acute / very toxic – chronic / very toxic – environment. For details, see DEP 01.00.01.30-Gen.

1.3.3 Abbreviations not included in ISO 14692

Term	Definition
CRL	Chemical resistance layer
HDT	Heat deflection temperature
IPD	Cyclo aliphatic amine
LCL	Lower Confidence Limit
MDA	Aromatic Amine (Menthane diamine)
Pmax	Maximum pressure during pressure cycle
Pmin	Minimum pressure during pressure cycle
R	Ratio of minimum / maximum pressure during cyclic service
SPL	Single protective layer
TMA	Thermal mechanical analysis
TP1000hrs	Test pressure to be used in 1000-hour qualification test
UPVC	Unplasticised Polyvinyl Chloride

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (7).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2018. This is an administrative update only to correct references to DEPs that have been involved in either a merge or a split.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
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DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

PART II GENERAL

Parts III to VI of this DEP are written as amendments/supplements to ISO 14692:2017 all parts.

Wherever reference is made to ISO 14692-X, it shall be understood to mean ISO Standard 14692-Part X:2017 as amended/supplemented by this DEP where X can be 1, 2, 3, or 4.

For ease of reference, the section and clause numbering of ISO 14692 is used in Parts III to VI of this DEP. The relevant part of ISO 14692 is given by the number prior to the hyphen in the section/clause number.

ISO 14692 is primarily intended for offshore piping. Wherever reference is made to "piping" it shall be understood to mean "pipelines and piping".

PART III AMENDMENTS/SUPPLEMENTS TO ISO 14692-1

The following sections are amendments to Part 1 of ISO 14692, Vocabulary, symbols, applications and materials.

4 Pressure rating

4.1 MPR_{xx}

Replace the third sentence “MPR_{xx} shall be defined at 65°C...” with the following:

1. MPR_{xx} shall be defined at 65°C (149 °F) for GRE and GRVE (MPR₆₅) and 21°C (70 °F) for GRUP (MPR₂₁).

Add the following informative text:

In the ISO 14692 standard, MPR is determined by regression testing. In this DEP regression testing is not a requirement, and LCL at a 20 year life as defined by ASTM 1598 is used as an alternative. Default values for LCL are given in Table 2 in Part IV.

Add the following:

1. For the purposes of this DEP, MPR shall be defined as is Equation 1.

Replace equation 1 with the following:

$$\text{MPR}_{xx} = 0.67 \cdot \text{LCL}_{xx} \quad \text{Eqn 1}$$

Where

MPR_{xx} is the maximum pressure rating at Temperature XX, expressed in MPa

LCL_{xx} is the lower confidence rating as defined by ASTM D1598 at 20 year life and temperature XX, expressed in MPa

Delete Equation 2

Replace the sentence “At the bid stage, an estimated....” With the following:

At the bid stage, the estimated value of MPR_{xx} can be determined using the default values for LCL given in Table 2 of Part IV.

Delete Equation 3

5 Classification

5.1 Joints

5.1.2 Classification of joints

Delete this section and corresponding sub-sections.

5.2 Resin matrix

Delete the sentence “This classification has an effect.”

Delete points 1 and 2

Delete Table 3

6 Materials

Add the following:

Experience of typical GRP systems suggests the following maximum temperatures (in air), depending on the resin type in Table 4.

Table 4 Temperature limitations for GRP

Type GRP	Maximum allowable operating temperature		Typical T _g value of fully cured resin	
	°C	°F	°C	°F
Glass-fibre/epoxy (GRE)				
- Aromatic-amine cured (MDA)	100	212	140	284
- Cyclo-aliphatic cured (IPD)	100	212	140	284
- Aliphatic-amine cured	85	185	115	239
- Anhydride cured	85	185	115	239
Glass-fibre/vinyl ester (GRVE)				
- Bisphenol A	90	194	120	248
- Novolac	100	212	140	284
Glass-fibre/polyester (GRUP)				
- Isophthalic	60	140	90	194

Add the following after Note 3:

Thermoplastic liners can be used as a chemical resistance layer (CRL), however requirements for design and testing are beyond the scope of this DEP.

Use of a thermoplastic liner might lower the maximum allowable operating temperature of the pipe system.

Add the following new sections:

6.1 Materials Selection

1. The selected materials shall meet the following pipeline/piping system requirements:
 - a. Design life;
 - b. Operating Temperature and Pressure;
 - c. Operational loading, including both environmental and service loads (including vibration induced fatigue);
 - d. Installation loads (buried, above ground);
 - e. Compatibility of all components (e.g., resin, fibres, adhesives, gaskets, ancillaries) with the transported fluid and external environment;
 - f. Fire resistance, where required by the hazardous area classification of the location where it is to be installed;
 - g. Electrical conductivity, where required by the hazardous area classification of the location where it is to be installed.

6.2 Resins

6.2.1 General

1. The resins selected shall be of a suitable commercial grade that complies with the technical requirements of the application.