

DEP SPECIFICATION

**SELECTION AND DESIGN OF THERMOPLASTIC AND
COMPOSITE PIPELINE MATERIALS FOR ONSHORE USE**

DEP 31.40.20.38-Gen.

February 2017

DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for material selection and design of new pipelines manufactured from thermoplastic and composite materials that have been qualified for use as a pipeline system. It is intended for application to onshore services only.

This DEP also provides requirements/recommendations for refurbishing existing steel pipelines with high density polyethylene liners or flexible composite pipe liners.

This DEP is intended to be used in conjunction with the referenced DEPs and/or industry standards that specify detailed requirements for design, procurement and installation of specific non-metallic pipeline materials.

This is a revision of the DEP of the same number dated February 2015; 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 exploration and production. 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 word **should** indicates a recommendation.

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

1.3.2 Specific definitions

Term	Definition
flexible composite pipe	Thermoplastic pipe that is reinforced with thermoplastic composites, thermoset composites, steel wires, steel cords, or steel strips
glass reinforced plastic	Thermoset resin that is reinforced with glass fibre that can be in different forms, such as hand lay-up woven mats, chopped strand mats or filament winding
High Density Polyethylene	A class of polyethylene resins that has a density range of 0.941 to 0.965 g/cm ³ (0.0339 to 0.0347 lbm/in ³).
Hydrostatic Design Basis (HDB)	The categorized long-term hydrostatic strength (LTHS) in the circumferential or hoop direction, for a given set of end use conditions, as established by ASTM Test Method D 2837. The HDB is one of a series of established stress values (specified in Test Method D 2837) for a plastic compound.
Hydrostatic Design Stress (HDS)	The maximum tensile hoop stress in the wall of the pipe that if applied continuously for 100,000 hours will not cause failure of the pipe, with a high degree of certainty. It is determined by application of industry specified design factors to the categorized hydrostatic design basis (HDB). The design factor used is based on the specific properties of the polyethylene resin and specified in PPI TR-3.
Long-term hydrostatic strength (LTHS)	The estimated tensile hoop stress in the wall of the pipe that when applied continuously will cause failure of the pipe at 100,000 hours. This is the intercept of the stress regression line with the 100,000 hour coordinate.
Minimum Required Strength (MRS)	The categorized long term hydrostatic strength of HDPE pipe in the hoop direction for a given set of conditions (20 °C [68 °F]), 50 years established in ISO 9080 and classified in ISO 12162.
Polyethylene resin	Plastic resins prepared by the polymerization of no less than 85 % ethylene and no less than 95 % of total olefins with additional compounding ingredients.
resin Manufacturer	Party that manufactures or supplies pipe resin raw material, such as HDPE or epoxy, to the pipe Manufacturer.
riser	Vertical or angled section of pipeline that transitions between below-ground and above-ground locations
thermoplastic liner	Thermoplastic pipe fused together into certain lengths and inserted in a pre-welded carbon steel pipe which provides pressure containment
thermoplastic pipe	Stand-alone thermoplastic pipe such as HDPE, fused together and providing pressure containment

1.3.3 Abbreviations

Term	Definition
API	American Petroleum Institute
ASTM	ASTM International
AWWA	American Water Works Association
CRS	Categorized Required Strength
DP	Maximum Design Pressure
DR	Dimension Ratio
FCP	flexible composite pipe
GRP	Glass-Fibre Reinforced Plastic
HDB	Hydrostatic Design Basis
HDD	horizontal direction drilling
HDPE	High Density Polyethylene
HDS	Hydrostatic Design Stress
ISO	International Standards Organization
LCL	Lower Confidence Limit
LTHS	Long Term Hydrostatic Strength
MPR	Manufacturer's pressure rating
MRS	Minimum Required Strength
NPS	Nominal Pipe Size
PPI	Plastics Pipe Institute

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 (6).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2015. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced shall/should.

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.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://swwww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
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.

2. GENERAL

Thermoplastic and reinforced composite materials for use as pipelines and flow lines needs to be selected using a life cycle cost evaluation approach that includes integrity management requirements specific to these materials.

1. Refer DEP 31.40.10.19-Gen for requirements related to Glass-fibre reinforced plastic (GRP) pipelines.
2. Refer DEP 31.40.10.20-Gen for requirements related to Flexible composite pipe (FCP) pipelines.
3. Refer to DEP 31.40.20.39-Gen for requirements related to HDPE pipelines.

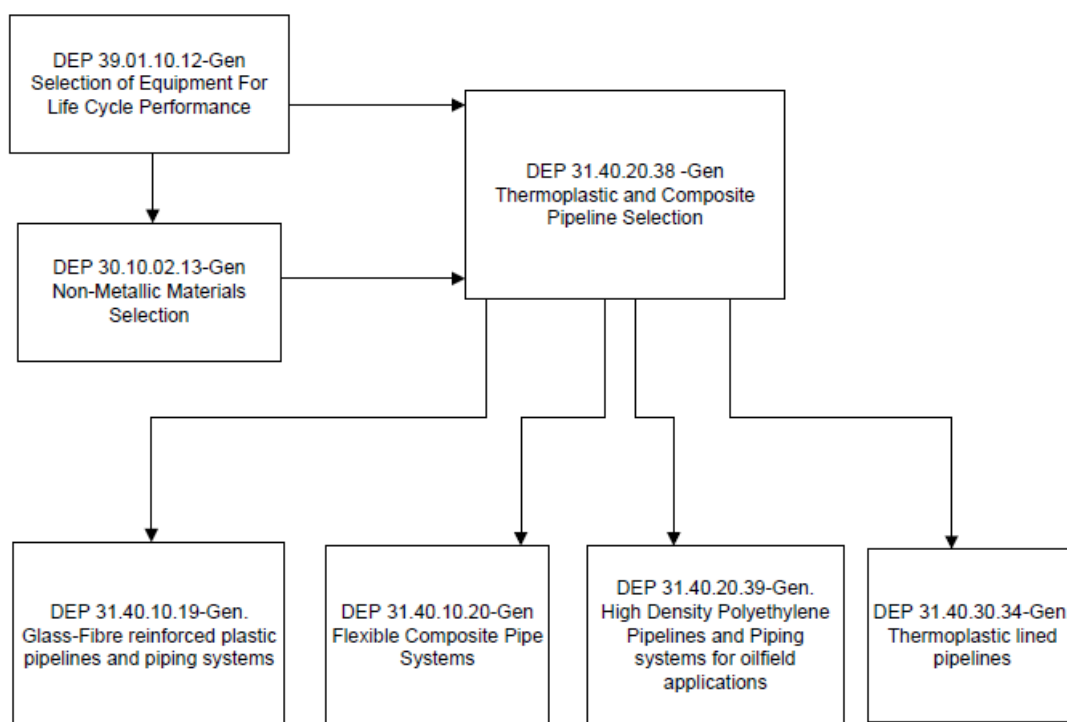
High density polyethylene (HDPE) is currently the only qualified material for use as a stand-alone thermoplastic material for pipelines.

4. Refer to DEP 31.40.30.34-Gen for requirements related to Thermoplastic lined pipelines.

High density polyethylene (HDPE) is currently the only qualified material for use as a liner material for thermoplastic lined pipelines.

A hierarchy of DEPs applicable to onshore thermoplastic and composite pipeline systems is presented in Figure1.

Figure 1 Hierarchy of DEPs applicable to thermoplastic and composite pipeline systems



3. DESIGN AND MATERIAL SELECTION CRITERIA

3.1 GENERAL

In addition to the standard parameters used in the sizing of steel pipelines, non-metallic pipelines require more upfront work in order to define limiting parameters.

1. The following parameters shall be defined in the design:
 - a. short listing of non-metallic materials based on their chemical compatibility with the service fluid composition;
 - b. operating pressure range of the pipeline, including the amplitude and frequency of pressure cycles;
 - c. operating temperatures for all operating modes and potential effects on the non-metallic material pressure capability;
 - d. pump/compressor operating conditions including starting/stopping effects and pulsation control;
 - e. other service requirements, such as UV resistance, collapse performance, permeation limitation, compatibility with chemicals to be exposed.

Throughout the design process, the pipe Manufacturer's technical department is to be consulted to provide technical assistance and input.

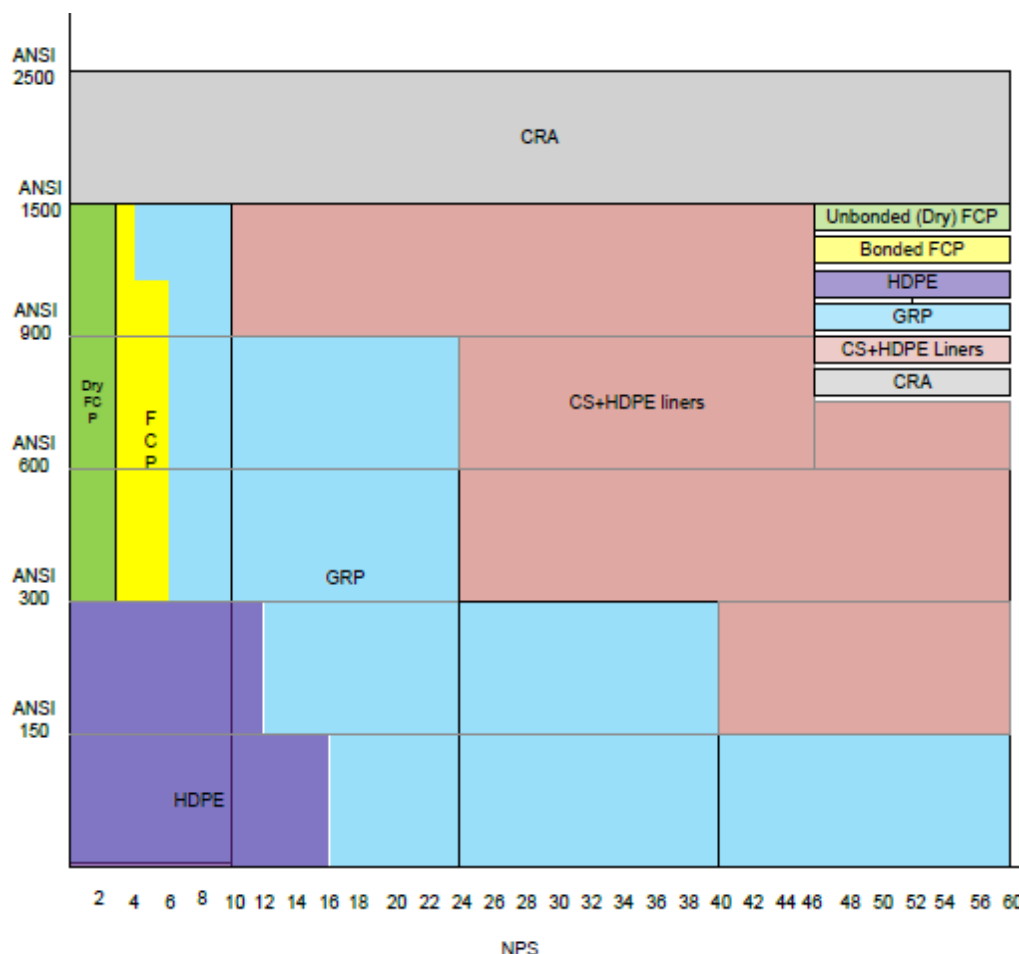
3.2 PRESSURE RATING

3.2.1 General

1. The materials selection and choice of pipe product shall take into account the pressure-temperature limitations of potential products under consideration for the pipeline application.

For exact data, refer to the TAMAP for line pipe, which summarizes the design pressure and temperatures for each qualified system by product code.

Figure 2 Pressure ratings of thermoplastic and composite pipelines



3.2.2 Reinforced composite pipelines (GRP and FCP)

1. The DP of GRP pipe shall be qualified at the maximum operating temperature and in accordance with DEP 31.40.10.19-Gen.
2. The nominal pressure rating of FCP shall be qualified in accordance with DEP 31.40.10.20-Gen.

Reinforced composite pipeline design generally starts with determining the maximum design pressure (DP). The DP is based on the pipe Manufacturer's maximum pressure rating (MPR), which is sometimes known as nominal pressure rating (NPR).

3. The DP shall include a safety factor applied to the Manufacturer's maximum pressure rating (MPR) of the pipe product at the pipeline maximum design operating temperature. Safety factors may be required for cyclic service or for material compatibility with the service fluid.

Safety factors may also be specified in local regulations.

4. In selecting a suitable pipe product and MPR, the pressure test requirements following field construction shall be included.
5. Reinforced composite pipes should not be pressure tested above their specified MPR unless approved by the pipe Manufacturer.
6. The pipeline design Contractor should review the pressure testing requirements with the pipe Manufacturer and include it in the selection of a suitable reinforced composite pipe product.