

DEP SPECIFICATION

DEEPWATER PIPELINE END TERMINATIONS AND MIDLINE SLEDS

DEP 37.81.42.31-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for design, manufacturing, assembly, testing, and shipment of a deepwater subsea pipeline end termination, also referred to as a PLET, PLEM, sled, or FTA. This DEP also includes the requirements for midline sleds. It is the purpose of this specification to define functional, operational, testing and interface requirements.

This is a combination of two previous Deepwater standards, DEP 37.81.42.31-EPP, and DEP 38.81.42.32-EPP, dated February 2010; see [\(1.5\)](#) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to subsea oil and gas production. Application in other facilities may also apply.

When DEPs are applied, a Management of Change (MOC) process should 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.

1.3.2 Specific definitions

Term	Definition
Midline Sled	A structural and piping system installed as part of and inline with a pipeline and located along the pipeline rather than at either end that allows the connection to the flowline of wells, manifolds, jumpers, additional pipeline segments, or other flow connections as required.
Pipeline End Termination	In this document, Pipeline End Termination (PLET) shall include the full system installed along with the pipeline at either the first or second end to provide a stable point for initiating or terminating the pipeline, and to allow the connection of wells, manifolds, jumpers, additional pipeline segments or other flow connections as required. It includes the pipe work, valves, connection hubs, structure, foundation, control and chemical tubing, sensors and instrumentation, and installation tools and rigging. Other common terminology sometimes applied to systems meeting this definition of PLET are FTA, PLEM, or sled.

1.3.3 Abbreviations

Term	Definition
A&R	Abandonment and Recovery
AFC	Approved for Construction
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
CG	Center of Gravity
CFR	Code of Federal Regulations
CRA	Corrosion Resistant Alloy
FTA	Flowline Termination Assembly
HSE	Health Safety and Environment
IMR	Inspection, Maintenance and Repair
ISO	International Standards Organization
ITP	Inspection Test Plan
JSA	Job Safety Analysis
MAOP	Maximum Allowable Operating Pressure
MQC	Multiple Quick Connect
NDE	Non Destructive Examination
OGP	International Association of Oil and Gas Producers
PLEM	Pipeline End Manifold
PLET	Pipeline End Termination
ROV	Remotely Operated Vehicle
SCM	Subsea Control Module
SIT	System Integration Testing

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in [\(6\)](#).

1.5 SUMMARY OF MAIN CHANGES

This DEP combines and is a revision of former Deepwater standards DEP 37.81.42.31-EPP and DEP 37.81.42.32-EPP dated February 2010. Since most of the content comes from DEP 37.81.42.31-EPP, the “Old section” references below refer to that document. The following are the main, non-editorial changes.

Old section	New section	Change
1.	1.	Section revised to align with DEP-Gen. standards.
	1.3.2	Specific definitions added.
2.3		Eliminated section and included its provisions elsewhere in the document.
2.6	2.5	Kept functional requirements of this section, but moved specific or prescriptive requirements to (3.3) , to better align with the purpose of the section.
2.8	2.7	Added requirement specifying design for no routine maintenance during design life.
3.2	3.2	Added ISO 10423 and ISO 14723/API 6DSS as valve specifications referenced.
3.3	3.3	Added DEP 37.80.00.33-Gen. and DEP 37.80.02.37-Gen. as referenced specifications, and included provision for optical fibre service.
3.4.1	3.4.1	Removed the content of this section and addressed hydraulic and chemical injection tubing in the DEP-Informative.
3.4.2	3.4.2	Removed the content of this section and addressed electrical cabling in the DEP-Informative.
3.4.3	3.4.3	Removed the content of this section and addressed couplers in the DEP-Informative.
3.5	3.5	Added ISO 10423 and ISO 13628-4 as referenced specifications.
3.6	3.6	Added DEP 37.81.40.35-Gen. as a referenced specification, and eliminated requirement that connections be vertical.
3.7	3.7	Renamed, and combined with old (3.8). Added additional information on interface management and reference to (Appendix C) . Also added DEP 37.81.40.31-Gen., DEP 37.81.41.30-Gen., ISO 13628-1 Annex B, and ISO 13826-8 as reference specifications.
3.8		Combined into new (3.7) .
3.9	3.8	Added DEP 30.10.73.32-Gen. as a referenced specification.
3.10	3.9	Added DEP 37.81.41.36-Gen. and DEP 37.81.41.37-Gen. as referenced specifications.
4.	4.	Incorporated detailed material in this section from DEP 37.81.41.32-EPP relating to PLET testing.
	4.1	New section incorporating material from DEP 37.81.41.32-EPP.
	4.1.1	New section incorporating material from DEP 37.81.41.32-EPP.
	4.1.2	New section incorporating material from DEP 37.81.41.32-EPP, added OGP RP 376 as a referenced specification.
4.1	4.2	Added DEP 37.81.10.31-Gen. as a referenced specification.

Old section	New section	Change
	4.3	Added section to address material requirements, referencing DEP 39.01.10.12-Gen., DEP 31.40.20.37-Gen., DEP 31.40.20.33-Gen., DEP 37.81.20.39-Gen., DEP 31.40.20.32-Gen., and DEP 31.40.21.37-Gen.
4.5	4.7	Added DEP 30.10.73.32-Gen. as a referenced specification.
4.7	4.9	Added DEP 37.81.10.32-Gen., DEP 37.81.40.31-Gen. and DEP 37.81.41.30-Gen. as referenced specifications.
4.9	4.11	Section expanded to include detailed material from DEP 37.81.41.32-EPP.
	4.11.1	Added section adapting provisions from DEP 37.81.41.32-EPP
4.9.2	4.11.3	Expanded section on FAT adapting provisions from DEP 37.81.41.32-EPP, including new sections (4.11.3.1) through (4.11.3.7). (4.11.3.4) includes testing for insulation resistance and optical attenuation where applicable, an addition to DEP 37.81.41.32-EPP.
4.9.3	4.11.4	Expanded section on SIT adapting provisions from DEP 37.81.41.32-EPP, including new sections (4.11.4.1) through (4.11.4.7).
	6.	Reference specification section added to align with DEP-Gen. standards.
	Appendix C	Added interface drawing and matrix to document.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

2. GENERAL AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS

2.1.1 Design philosophy

The Contractor shall design, manufacture and test the PLETs and associated equipment in accordance with the following basic design philosophies:

- The Contractor's system design shall be based on the use of equipment with a proven subsea service record in the particular project environment.
- The Contractor shall provide a fully detailed list of previous projects utilizing the equipment as proposed by the Contractor for this project.

2.1.2 Design analysis

The PLET design analysis can be divided into two major categories:

- Pressure piping
- Steel structure

2.1.3 Steel structure primary components

The steel structure of the PLET can be divided into the following primary components, as illustrated in Figure 1:

- a) Foundation (mud mat – may be hinged depending on installation requirements)
- b) Yoke
- c) Pipe support frame
- d) Hub support frame
- e) End termination – stress joint transition to pipeline or flowline

2.1.4 Other key considerations

The quantity and complexity of components installed subsea shall be minimized, and simple solutions shall be offered to enhance reliability and reduce the need for maintenance and repair throughout field life as much as is practical.

There are several key considerations that shall be addressed in the design of the PLET. These comprise, but are not limited to, the following:

- a) Interface of the PLET to the installation vessel and lay system
- b) Keeping size and weight of equipment to a level consistent with use of conventional installation techniques
- c) Keeping size and profile of equipment compact to reduce the effects of hydrodynamic forces in the splash zone, in the water column, and on bottom
- d) Ensure equipment has sufficient structural strength and profile to protect piping and critical components during launch operations, travel through the water column, and landing operations
- e) All installation, and IMR activities shall be completed by ROV, without assistance of divers
- f) Access area and grab bars shall be designed to withstand all the forces developed by ROV's in the course of their operational activities
- g) Equipment, especially seal surfaces, shall be designed to minimize the probability of impact damage due to construction activities (such as landing of jumpers) and construction hazards (such as dropped objects).
- h) Potential use of supplemental buoyancy to reduce submerged weight and/or provide means to prevent undesired rotation during installation

The design of a PLET shall be based on the given design criteria, installation criteria, applicable codes and standards, and functionality for the intended purpose. The design may take different shapes and sizes depending on the specific requirements.

The design shall address all relevant factors to be considered fit for function. Fit for function implies that all factors relevant to the design concerning regulatory requirements, Principal requirements, design and structural analysis requirements, installation requirements, and operational requirements are satisfied.

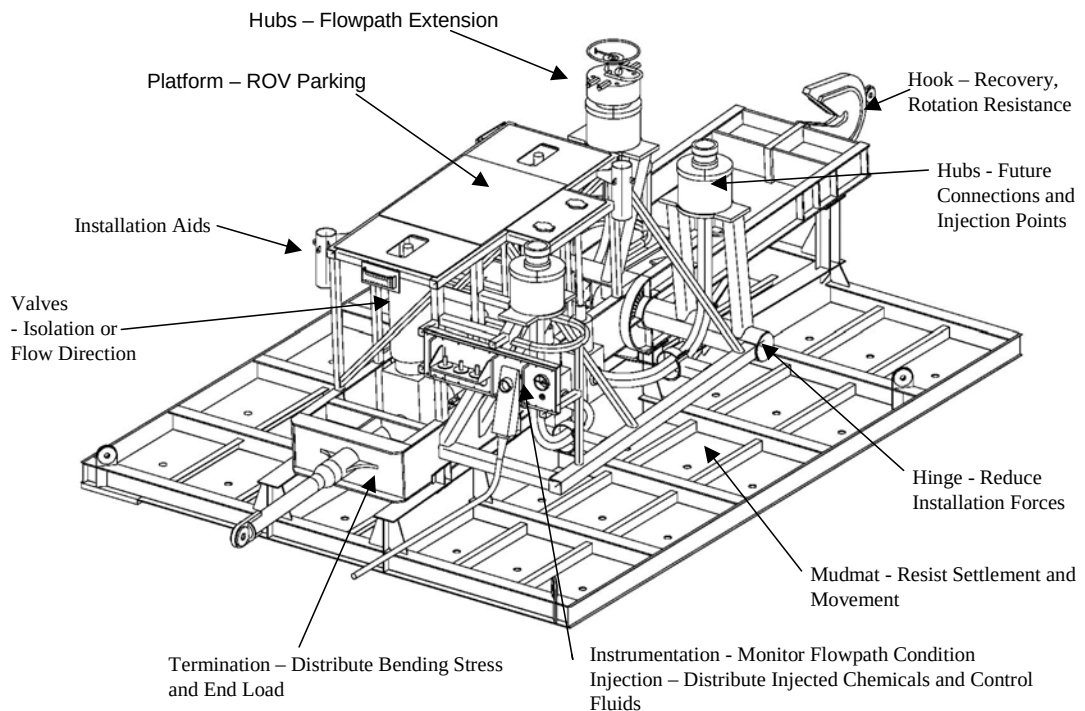


Figure 1 – Typical PLET Components and Functionality

2.2 FUNCTIONAL REQUIREMENTS

A PLET provides the stable terminating or initiating point at the end of a subsea pipeline, and provides a mechanism to join the pipeline with other subsea equipment such as a subsea tree, manifold, or another pipeline end termination.

As required by this DEP and the project specification, the PLET shall:

- a) Facilitate safe deployment with the pipeline/flowline to the seafloor
- b) Allow recovery of the pipeline/flowline to the surface with the line in the flooded condition
- c) Provide sufficient bearing surface to limit soil penetration, resist torsion imparted by the pipeline or jumper, and accommodate flowline loads due to thermal or pressure expansion

Note: Typically accommodation of flowline loads requires a slide mechanism between piping and mudmat.

- d) Provide an interface between the production flowlines and/or the wells
- e) Provide a means to commingle or isolate produced fluids from individual subsea wells connected to it
- f) Serve as an installation aid to ensure the PLET piping remains in an upright position through the water column

- g) Provide lifting points for pipeline installation and retrieval
- h) Provide a support platform for ROV activities during installation and interventions
- i) Provide control fluid pressure to actuate valves
- j) Provide location and mounting for pipeline instrumentation such as pressure, temperature or pig signal devices
- k) Provide electrical power and control signal for sensors or other devices as required
- l) Provide location, guidance, and mounting for any retrievable components that may be located on the PLET, such as chokes, or flowmeters

2.3 MIDLINE SLED SPECIAL CONSIDERATIONS

In general, the PLET requirements of this document also apply to midline sleds. A few provisions, mainly related to the PLET support structure and installation methods are not applicable. A midline sled requires a few special design considerations that are not applicable to first or second end PLETs. Figure 2 illustrates typical midline sled features.

Special design considerations that shall apply to midline sleds include:

- a) For an S-lay installation, fit of the midline sled through the pipeline assembly line. For a J-lay installation, fit in the pipeline assembly tower.
- b) For an S-lay installation, fit through the stinger of the pipelay vessel.
- c) Hinged mud mats or other features such as detachable mud mats that allow passage through the stinger or pipeline assembly tower may be required.
- d) Buoyancy modules and yokes to prevent rotation of the pipeline and sled as it is laid.
- e) For S-lay, additional analysis of the sled frame because of the bending loads when the sled traverses the stinger. This shall be done in conjunction with the pipeline analysis to ensure the sled does not overstress the pipeline.
- f) Detailed analysis of the pipeline wye component.
- g) Detailed analysis of the rotation of the sled during installation.

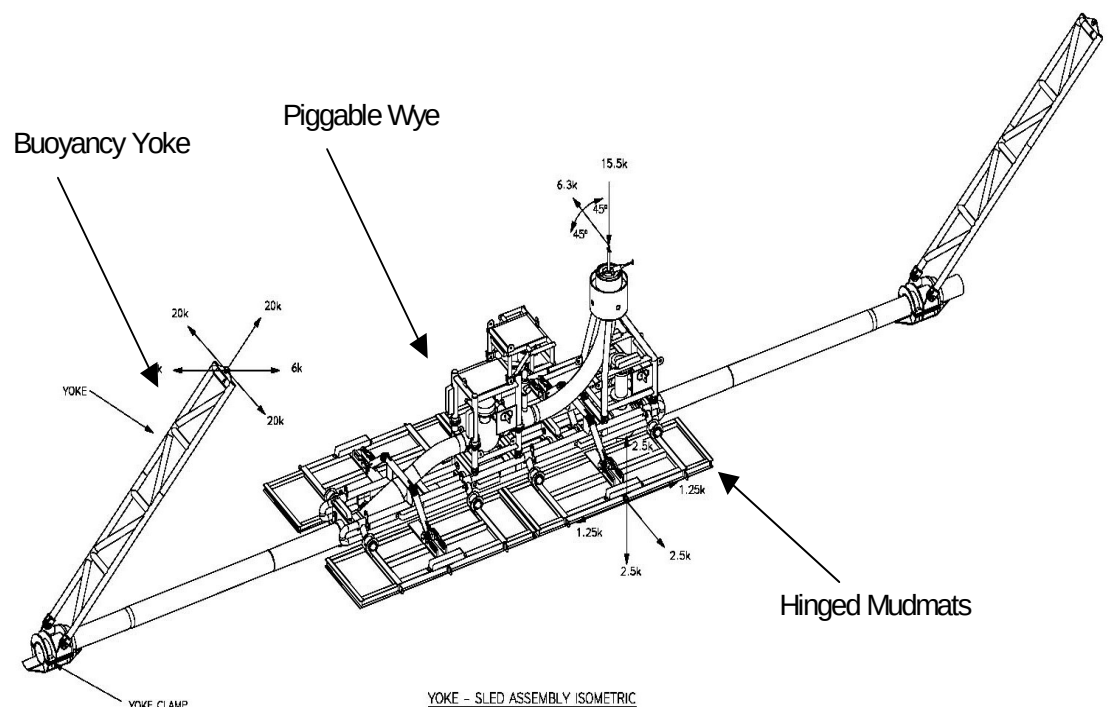


Figure 2 – Typical Midline Sled Components

2.4 SUBSEA MARKINGS AND COLORING

Unless otherwise specified by the Principal in project specifications or drawings, all markings and coloring shall comply with requirements of ISO 13628-1 Annex B.

2.5 ELECTRICAL HYDRAULIC DISTRIBUTION

The electro-hydraulic system, if applicable, shall be capable of accommodating the following functions as required:

- Control for valve actuation
- Control for choke actuation
- Monitoring of sensors, such as temperature, pressure, flow meter, pig signals, erosion detector, sand detector, choke position indicator

The Principal's strong preference regarding control and data acquisition functionality is for the SCM to be mounted on an adjacent tree or distribution skid and not on the PLET itself. If specific project conditions make mounting the SCM on the PLET desirable, the project may make this choice and specify so in the project specifications. Controls and chemical distribution shall be integrated into the PLET as per the requirements of this specification and the project specifications and drawings.

2.6 PLET SUPPORT STRUCTURE

The PLET structure, including the pipe support structure, shall be supported on the seabed by a foundation system to prevent excessive settling of the PLET on the seabed. Detailed requirements for design are found in DEP 37.81.10.31-Gen.

The pipe support structure on the PLET (or equivalent component) shall be required to slide when the flowline load exceeds the friction resistance between the pipe support structure and the foundation (mud mat) beams on the sled. The friction resistance shall be