

DEP SPECIFICATION

DEEPWATER COLLET TYPE CONNECTOR SYSTEMS

DEP 37.81.40.35-Gen.

February 2017

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE



© 2017 Shell Group of companies

All rights reserved. No part of this document may be reproduced, stored in a retrieval system, published or transmitted, in any form or by any means, without the prior written permission of the copyright owner or Shell Global Solutions International BV.

This document contains information that is classified as EAR99 and, as a consequence, can neither be exported nor re-exported to any country which is under an embargo of the U.S. government pursuant to Part 746 of the Export Administration Regulations (15 C.F.R. Part 746) nor can be made available to any national of such country. In addition, the information in this document cannot be exported nor re-exported to an end-user or for an end-use that is prohibited by Part 744 of the Export Administration Regulations (15 C.F.R. Part 744).

This document has been supplied under license by Shell to:
UOP Honeywell ted.fuger@honeywell.com 19/01/2018 10:21:08

PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of Shell Global Solutions International B.V. (Shell GSI) and, in some cases, of other Shell Companies.

These views are based on the experience acquired during involvement with the design, construction, operation and maintenance of processing units and facilities. Where deemed appropriate DEPs are based on, or reference international, regional, national and industry standards.

The objective is to set the standard for good design and engineering practice to be applied by Shell companies in oil and gas production, oil refining, gas handling, gasification, chemical processing, or any other such facility, and thereby to help achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to Shell companies for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual Operating Units to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs, they shall be solely responsible for such use, including the quality of their work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will typically expect them to follow those design and engineering practices that will achieve at least the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal.

The right to obtain and to use DEPs is restricted, and is typically granted by Shell GSI (and in some cases by other Shell Companies) under a Service Agreement or a License Agreement. This right is granted primarily to Shell companies and other companies receiving technical advice and services from Shell GSI or another Shell Company. Consequently, three categories of users of DEPs can be distinguished:

- 1) Operating Units having a Service Agreement with Shell GSI or another Shell Company. The use of DEPs by these Operating Units is subject in all respects to the terms and conditions of the relevant Service Agreement.
- 2) Other parties who are authorised to use DEPs subject to appropriate contractual arrangements (whether as part of a Service Agreement or otherwise).
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, Shell GSI disclaims any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any DEP, combination of DEPs or any part thereof, even if it is wholly or partly caused by negligence on the part of Shell GSI or other Shell Company. The benefit of this disclaimer shall inure in all respects to Shell GSI and/or any Shell Company, or companies affiliated to these companies, that may issue DEPs or advise or require the use of DEPs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, DEPs shall not, without the prior written consent of Shell GSI, be disclosed by users to any company or person whomsoever and the DEPs shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of Shell GSI. The copyright of DEPs vests in Shell Group of companies. Users shall arrange for DEPs to be held in safe custody and Shell GSI may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

All administrative queries should be directed to the DEP Administrator in Shell GSI.

TABLE OF CONTENTS

1.	INTRODUCTION	4
1.1	SCOPE	4
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	4
1.3	DEFINITIONS	4
1.4	CROSS-REFERENCES	5
1.5	SUMMARY OF MAIN CHANGES.....	5
1.6	COMMENTS ON THIS DEP	6
1.7	DUAL UNITS.....	6
1.8	NON NORMATIVE TEXT (COMMENTARY).....	6
2.	GENERAL AND FUNCTIONAL REQUIREMENTS.....	7
2.1	GENERAL REQUIREMENTS.....	7
2.2	FUNCTIONAL REQUIREMENTS.....	8
2.3	LOAD CRITERIA	9
2.4	CORROSION PROTECTION	9
3.	CONNECTOR REQUIREMENTS.....	10
3.1	GENERAL	10
3.2	FEMALE CONNECTOR ASSEMBLY	10
3.3	MALE HUB ASSEMBLY AND CONNECTION STRUCTURE.....	13
3.4	METAL-TO-METAL SEAL RING	15
3.5	COARSE ALIGNMENT GUIDES FOR VERTICAL CONNECTION SYSTEMS.....	15
3.6	HYDRAULIC CONTROL SYSTEM.....	16
3.7	SEAL PRESSURE TEST SYSTEM.....	16
3.8	THERMAL INSULATION	17
4.	ACCESSORY HARDWARE.....	18
4.1	END CLOSURE FOR MALE HUB (PRESSURE CAP)	18
4.2	SEAL REMOVAL AND REPLACEMENT TOOLS	19
4.3	MECHANICAL OVERRIDE	20
4.4	JUMPER FABRICATION STANDS	20
4.5	JUMPER SHIPPING STANDS	20
5.	PIPING AND LIFTING	21
5.1	JUMPER PIPE	21
5.2	PIPE BENDS	21
5.3	LIFT RIGGING AND SPREADER BARS	21
6.	CONNECTOR SYSTEM DESIGN, FABRICATION AND TESTING REQUIREMENTS.....	22
6.1	GENERAL	22
6.2	DESIGN LOADS	22
6.3	STACK-UP TOLERANCE ANALYSIS	22
6.4	CATHODIC PROTECTION ANALYSIS.....	22
6.5	ROV ACCESSIBILITY ANALYSIS.....	23
6.6	TESTING REQUIREMENTS	23
6.7	CRA REQUIREMENTS	24
7.	REPORTS, RECORDS, AND DOCUMENTATION	24
8.	REFERENCES	26

1. INTRODUCTION

1.1 SCOPE

This new DEP specifies minimum requirements and gives recommendations for the design, testing, interfacing, and operation of subsea collet connectors and accessory equipment. In this context, the term “collet connectors” refers to all types of connectors using locking segments or fingers and a drive ring for engagement. It is the purpose of this specification to define functional, operational, testing and interface requirements.

The scope of this DEP covers more components related to connector integration into subsea structures and jumpers than just the connectors themselves.

Project specific requirements will be provided within a separate specification (Scope of Supply, Basis for Design, or Data Sheet) that will be issued for each project.

This DEP replaces former Deepwater standard DEP 37.81.40.35-EPP dated September 2011.

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 authorization to any documents, data or information to which the DEPs may refer.

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.

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

1.3.2 Specific definitions

Term	Definition
Accessory hardware	Tools, equipment or materials required for the mounting, operation and testing of the installed connector system. This includes the male end closures, female end closures, seal removal and replacement tools, ROV interface panel (including hydraulic manifold(s) and tubing) for connector actuation, jumper fabrication jigs, measurement caps, trash caps, any tools used to run or make up the connection and seal test equipment.
Connector system	The actuated mechanical connector and related accessories required for its function. This includes the male hub, female connector assembly, alignment guides, anchor flanges, soft landing cylinders, flowline connection structures at the flowline sleds or tie-in manifold, line pipe, metal-to-metal seal ring, test seal, fluid coupling for actuation and connector function and seal pressure test. The hydraulic actuators for connector make-up might remain with the system, or might be recovered with a separable running tool.

1.3.3 Abbreviations

Term	Definition
CRA	Corrosion Resistant Alloy
FAT	Factory Acceptance Testing
NDE	Non-Destructive Examination
PLET	Pipeline End Termination
ROV	Remotely Operated Vehicle
SIT	System Integration Test

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 (8).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated September 2011. The changes followed a requirements quality review and were not a full technical update. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced use of shall / should / may for normative statements.

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 AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS

1. The Contractor's system design shall demonstrate to the satisfaction of the Principal that the equipment has a proven subsea service record in the project environment.
 - a. The Contractor shall provide a detailed list of previous projects utilizing the equipment proposed with reference to field data contained in the project specification documents.
2. The quantity and complexity of subsea components installed should be minimized and simple solutions be offered to enhance reliability and reduce the need for maintenance and repair throughout field life, as much as is practical.
3. The Contractor shall perform the engineering, design, and analysis of the connector system to meet the requirements of this specification.
 - a. The analysis shall include structural analysis, piping analysis, a complete stack-up tolerance analysis, and an ROV access analysis, as described in (6).
4. The Contractor shall prepare the following:
 - a. all fabrication and assembly drawings;
 - b. bills of materials;
 - c. manufacturing specifications (e.g., materials, welding, heat treatment);
 - d. assembly and test instructions; and
 - e. installation and operation & maintenance (O&M) procedures.
5. The Contractor shall provide the following:
 - a. all materials, parts, and sub-assemblies;
 - b. all labour, tools, and equipment required for fabrication, assembly and testing of the connector system.
6. The Contractor shall perform testing of the connector system, including the following:
 - a. design qualification testing;
 - b. prototype testing;
 - c. Factory Acceptance Testing (FAT); and
 - d. System Integration Testing (SIT) (when specified).
7. The Contractor shall prepare the connector system for shipment including the following:
 - a. clean up and refurbishment of the equipment after the FAT;
 - b. preservation fluids;
 - c. coatings;
 - d. handling; and
 - e. interim storage.
8. The Contractor shall provide support for the following:
 - a. equipment test fixtures, jigs, testing spares for performing the required FAT of the connector system;
 - b. engineering and technical support services as required during SIT to rectify any problems, or to make modifications to the connector system.

9. The Contractor shall have primary responsibility for the following:
 - a. developing designs to ensure that the connector system and mating components can be positively and repeatedly aligned subsea;
 - b. coordinating all interface information concerning the connector system;
 - c. ensuring the connector system works in conjunction with other mating equipment systems.

2.2 FUNCTIONAL REQUIREMENTS

1. The connector system shall be designed to meet the projects parameters specified in the datasheets provided by the Principal.
2. The connectors shall be designed to make permanent metal-to-metal sealed subsea connections between flow lines, trees, and manifolds.
3. Connections may include rigid pipe spools, flexible pipe spools, or hard piped modules.
4. Jumper spools or hard piped modules shall be designed to be lowered to the connection points at the seafloor.
5. The male hubs and guide funnel receivers shall be mounted on the connection structures on the flow line PLETs, trees and manifold and contain no moving parts.
6. The female connector assembly of the connector system shall be mounted on the jumper spool or hard pipe module.
7. The connectors may be actuated by means of either of the following:
 - a. integral controls that remain with the system on the seabed; or
 - b. running tools that are retrieved to the surface after setting or test operations are complete.

This specification primarily addresses integral controls for installing the connector.

8. The Contractor may elect to specify running tools to make the connections.
9. The following key operational considerations shall be addressed in the design of the connector system equipment:
 - a. the need to minimize size and weight to allow conventional installation techniques to be used from an ROV or light construction vessel;
 - b. the need to minimize size and weight to reduce the effects of hydrodynamic forces, both in the splash zone and on bottom, where current effects are a concern;
 - c. sufficient structural strength is required to protect piping and critical components, such as valves during launching operations on the surface and landing operations at the seafloor;
 - d. the potential for hydraulic lock where trapped air spaces might create a vacuum when submerged.
10. All connector system equipment installed on the seabed (e.g., all non-metallic components and anodes) shall be designed for the specified operating life without the need for planned maintenance.

This includes analysing the moving parts of the system to confirm that this level of reliability can be achieved over the design life.

11. All connector system installation, intervention and maintenance shall be diverless, to be completed by ROV.