

DEP SPECIFICATION

**QUALIFICATION OF GIRTHWELD INSPECTION WITH
AUTOMATED ULTRASONIC INSPECTION (AUT) SYSTEMS**

DEP 37.81.42.35-Gen.

February 2014

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE



© 2014 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 20/04/2018 03:55:16

AVA Documents
Document Sharing Hub

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	5
1.1	SCOPE.....	5
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	5
1.3	DEFINITIONS	5
1.4	CROSS-REFERENCES	6
1.5	SUMMARY OF MAIN CHANGES	7
1.6	COMMENTS ON THIS DEP	7
2.	RESPONSIBILITIES.....	8
2.1	GENERAL	8
2.2	RESPONSIBILITIES OF THE PRINCIPAL.....	8
2.3	RESPONSIBILITIES OF THE CONTRACTOR	8
2.4	RESPONSIBILITIES OF THE AUT-CONTRACTOR.....	8
3.	QUALIFICATION VARIABLE RANGES	9
4.	SYSTEM DETECTION AND ACCURACY REQUIREMENTS.....	9
4.1	GENERAL	9
4.2	SPECIFICATIONS FOR ACCURACY CATEGORIES A, B AND C	9
4.3	ACCEPTANCE CRITERIA CORRECTED FOR UNCERTAINTY WITHOUT ECA	12
4.4	ACCEPTANCE CRITERIA CORRECTED FOR UNCERTAINTY WITH ECA	12
4.5	ACCURATE SIZING AND POSITIONING OF THE DEFECTS IN THE WELD	12
4.6	ADDITIONAL REQUIREMENTS FOR CLAD WELDS OR CRA WELDED OVERLAY	12
5.	AUTOMATED ULTRASONIC TESTING SYSTEM.....	13
5.1	GENERAL	13
5.2	PHASED ARRAY SYSTEM	13
5.3	CALIBRATION STANDARDS.....	14
5.4	INSPECTION PROCEDURE.....	14
5.5	SCRIBE TOOL AND BAND SETTING	14
6.	QUALIFICATION TESTING	14
6.1	GENERAL	14
6.2	GENERAL RESPONSIBILITIES.....	15
6.3	AUT OPERATORS FOR QUALIFICATION TESTING	15
6.4	ESSENTIAL PARAMETERS	15
6.5	TEST WELD.....	16
6.6	SYSTEM CALIBRATION VARIATION.....	16
6.7	REPEATABILITY TESTING.....	16
6.8	WALL THICKNESS RANGE VERIFICATION	17
6.9	TEMPERATURE SENSITIVITY TESTING	17
6.10	DETECTION ABILITY AND SIZING ACCURACY TESTING	17
6.11	DATA REPORTING	18
6.12	WELD ANNOTATION	18
6.13	REPORTING OF AUT RESULTS BY THE AUT CONTRACTOR.....	18
7.	SUPPLEMENTAL NDE AND DESTRUCTIVE TESTING	19
7.1	GENERAL	19
7.2	DESTRUCTIVE TEST LOG	20
7.3	SAMPLE ANNOTATION.....	20
7.4	DESTRUCTIVE TESTING	20
7.5	RADIOGRAPHY	21
7.6	IMMERSION TESTING.....	21
7.7	MISSED DEFECTS AND FALSE CALL RATE.....	21
7.8	QUALIFICATION REPORT	22
8.	PERFORMANCE CHECK FOR FIELD INSPECTION.....	23
9.	IMMERSION TESTING.....	23

9.1	GENERAL	23
9.2	PROCEDURE FOR ULTRASONIC IMMERSION TESTING	23
9.3	ADDITIONAL REQUIREMENTS FOR EXTENSIVE IMMERSION TESTING WITH SIZING CAPACITY	25
9.4	REPORTING	26
10.	PROCEDURE FOR DESTRUCTIVE ANALYSIS OF PRODUCTION GIRTH WELDS	26
10.1	SCOPE	26
10.2	PROCEDURE	26
11.	REFERENCES	29

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the qualification and field operation of automated ultrasonic inspection (AUT) systems to be used for inspection of girth welds for onshore and offshore pipelines, flowlines and steel catenary risers with a wall thickness of 50 mm or less.

Within this DEP, three categories of accuracy are identified for different applications; SCR, Flowlines and Good workmanship (GWS).

This is a revision of the DEP of the same number dated February 2012; 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 authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in exploration and production facilities. 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 **AUT-Contractor** is the party that carries out the AUT inspection and, if required, manual ultrasonic inspection. The AUT-Contractor can be hired directly by the Principal or subcontracted by the Contractor. The AUT-Contractor is responsible for the delivery of the AUT inspection, AUT operators and necessary equipment and documentation for the qualification and production inspection of the AUT system, including the specified reporting. If the AUT-Contractor is contracted by the Contractor, and this DEP states that review and/or approval by the Principal is required, then this means that the Contractor's review and/or approval is also required, even if not stated explicitly in this DEP.

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 Abbreviations

Term	Definition
AFC	Approved for Construction
AUT	Automated Ultrasonic Testing and Inspection
CL	Cold Lap
CRA	Corrosion Resistant Alloy
DSAW	Double Submerged Arc Welded
ECA	Engineering Critical Assessment
FBE	Fusion Bonded Epoxy
FBH	Flat Bottom Hole
FSH	Full Screen Height
GMAW	Gas Metal Arc Welding
ID	Inside Diameter
IP	Inadequate Penetration
IUT	Immersion Ultrasonic Testing
LOF	Lack of Fusion
MOC	Management of Change
NDE	Non Destructive Examination
OD	Outside Diameter
QC	Quality Control
PA	Phase Array
P/E	Pulse echo
POD	Probability of Detection
RT	Radiography Testing
SCR	Steel Catenary Riser
STT	Surface Tension Transfer
TOFD	Time of Flight Diffraction
TOF	Time of Flight or Transit Distance
WT	Wall Thickness

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 (11).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a minor revision of the DEP of the same number dated February 2012.

There have been numerous changes in Sections 1 through 7, and these changes are too numerous to list here. Other significant changes are listed below.

Section/Clause	Change
1 through 7	Numerous changes – too numerous to list here.
4, Table 2B	Addition of Table 2B covering wall thicknesses of 27.1 mm to 35 mm.
6.7	Added last paragraph regarding AUT systems required to complete a repeatability test.
10	Addition of Section 10 to define macro sectioning activities.
11	Added DEP feedback form.

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.

2. RESPONSIBILITIES

2.1 GENERAL

Unless otherwise defined by the Principal in the scope of work, the following defines the responsibilities.

2.2 RESPONSIBILITIES OF THE PRINCIPAL

The Principal shall be responsible for:

- specification of the contract
- management of, or the designation of an independent source to manage, the qualification activities, including preparation of the qualification report.
- specification of the minimum number of useable defects required to complete the qualification activities
- Final approval of all qualification activities.

2.3 RESPONSIBILITIES OF THE CONTRACTOR

The Contractor shall be responsible for:

- providing the AUT-Contractor with samples of pipe and the weld bevel design to be used in the qualification program in order for the AUT-Contractor to design and construct calibration block(s).
- ensuring weld samples have sufficient pipe lengths on each side to allow AUT scanning from either side of the weld. The Contractor shall submit for review the design and content of weld samples to assure that defect sizes of concern are contained in sufficient number.
- defining the pipe wall thickness ranges by completing end dimension survey, surface condition both ID and OD, and other variables that directly impact AUT performance.
- ensuring that the weld samples address the critical variables of expected wall thickness range and surface condition.

Under certain circumstances, the Principal may carry out some of the responsibilities of the Contractor. If responsibilities differ from what is stated in this DEP, then this will be clearly identified as a project specific requirement.

2.4 RESPONSIBILITIES OF THE AUT-CONTRACTOR

The AUT-Contractor shall be responsible for:

- designing and constructing the calibration block
- producing a written AUT procedure including qualification inspection and test plan; meeting the requirements of DEP 37.81.40.32-Gen. and shall be submitted for review.
- producing documented evidence of experience in the required AUT inspection accuracy if available.
- completing the required system performance checks prior to weld inspection.
- executing the inspection of the seeded defect welds in accordance with the approved AUT procedures.
- Sizing and documenting the results of the seeded defect weld inspection

If the AUT-Contractor is contracted by the Contractor for this Qualification effort, and this DEP states that review and/or approval by the Principal is required for certain items, this

automatically means that Contractor's review and/or approval is also required, even if not stated specifically in this DEP.

3. QUALIFICATION VARIABLE RANGES

Table 1 specifies the applicable qualification range for pipe wall thickness and diameter.

Table 1 **Applicable range for qualification variables (wall thickness and diameter)**

Qualification Variable	Applicable Range
Wall Thickness	- Valid for any lesser wall thickness - Valid for any greater wall thickness within 2.5 mm of actual qualified thickness
Diameter	- Valid for any greater diameter - Valid for any lesser diameter within 2 inches of qualified value - If the change in diameter requires change from half shell to clam shell scanner or vice versa, the results shall not be used without further demonstration

4. SYSTEM DETECTION AND ACCURACY REQUIREMENTS

4.1 GENERAL

The required detection capability and accuracy categories of the AUT system are defined in Table 2A for wall thicknesses less than 27 mm.

Table 2B defines the detection and accuracy requirements for wall thicknesses between 27.1 mm and 37.5 mm.

The AUT system, using the applied procedure, shall have the capability of segregating "surface" versus "embedded" defects.

4.2 SPECIFICATIONS FOR ACCURACY CATEGORIES A, B AND C

Three categories of welds are defined in Table 2 for different applications, with the required accuracy and allowable limits defined.

The applied procedure shall be capable of detecting and sizing defects as defined in Table 2 within wall thickness variations for the specified category of welds (± 1.5 mm for Category B and C welds and ± 1 mm for Category A welds).