

DEP SPECIFICATION

SHOP AND FIELD PRESSURE TESTING OF PIPING AND PROCESS SYSTEMS

DEP 74.00.10.10-Gen.

February 2018

DESIGN AND ENGINEERING PRACTICE

DEM1



© 2018 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.

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	6
1.5	SUMMARY OF MAIN CHANGES.....	6
1.6	COMMENTS ON THIS DEP	8
1.7	DUAL UNITS.....	8
1.8	NON NORMATIVE TEXT (COMMENTARY).....	9
2.	PRESSURE TESTING	10
2.1	GENERAL	10
2.2	STRUCTURAL SUPPORT AND LOADING GENERATED BY TESTING	11
2.3	PRESSURE TESTING EQUIPMENT	11
3.	HYDROSTATIC TESTING	12
3.1	TEST EQUIPMENT	12
3.2	TEST LIQUID QUALITY	13
3.3	PROCEDURES.....	16
4.	PNEUMATIC TESTING	17
4.1	PNEUMATIC TESTING APPLICATION CRITERIA	17
4.2	PRESSURE TESTING SAFETY CONSIDERATIONS.....	17
4.3	PRESSURE TEST PLANNING	20
4.4	PROCEDURE FOR PNEUMATIC TESTING	22
5.	REFERENCES	24

APPENDICES

APPENDIX A	PNEUMATIC TESTING PROCEDURE FORM.....	25
APPENDIX B	SAFETY DISTANCES FOR EACH ZONE.....	27
APPENDIX C	SAFETY DISTANCES FOR HYDROSTATIC LEAK TESTING	29

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for performing shop and field pressure testing of piping systems to establish integrity.

The testing of equipment is included in the field pressure testing of piping for certain cases (2.1).

Shop pressure testing of new equipment is excluded from the scope of this DEP. Reference is made to the relevant equipment/pressure vessel DEPs.

Pressure testing of new pipelines is excluded from the scope of this DEP and is covered in DEP 31.40.40.38-Gen.

This DEP is limited to application for new piping systems, and hence does not address risks associated with re-pressurisation after deterioration of condition of the pressure boundary, such as temper embrittlement or hydrogen embrittlement.

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 of the DEP of the same number dated February 2017; 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, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. 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
Hydrostatic Test	A test carried out using water or other relatively incompressible liquid to prove the integrity of a component or system, at a pressure specified by the design code. Referred to as hydrostatic leak test in ASME B31.3 para. 345.4. Referred to as hydrostatic testing in ASME B31.1 para. 137.4.
Piping	Assembly of straight and bent pipes, fittings, flanges, gaskets, valves and other components (e.g., expansion joints, swivel joints, strainers, devices for mixing, separating, distributing, metering and flow control). It also includes pipe supporting elements and insulation. Piping does not include supporting structures (such as frames of buildings, stanchions or foundations) or equipment (e.g., heat exchangers, vessels, columns, pumps) or instrument impulse pipes. Instrument specifications apply downstream the last joint of the last process to instrument valve or valve assembly, defined for the instrument connection in the mechanical piping class. This can include the 5 mm restriction nipple where applicable.
Piping Components	Mechanical elements suitable for joining or assembly into pressure-tight fluid-containing piping systems. Components include pipe, tubing, fittings, flanges, gaskets, bolting, valves, and devices such as expansion joints, flexible joints, pressure hoses, traps, strainers, inline portions of instruments, and separators.
Pipeline	System of pipes and other components used for the transportation of fluids between (but not within) plants. A pipeline typically extends from pig trap to pig trap (including the pig traps). If no pig trap is fitted, the pipeline extends to the first isolation valve within the plant boundaries.
Piping System	Interconnected piping subject to the same set or sets of design conditions.
Positive Isolation	A means of isolation that establishes a verifiable pressure gap between the pressure side and isolated side.
Pneumatic Test	A test carried out using air or inert gas to prove the integrity of a component or system, at a pressure specified by the design code. In ASME B31.3 para. 345.5 referred to as Pneumatic leak test, in ASME B31.1 para. 137.4 referred to as Pneumatic Testing.
Test Pack	The pressure envelope for a single pressure test scope envelope, inclusive of equipment and piping systems.

1.3.3 Abbreviations

Term	Definition
ALARP	As Low As Reasonably Practicable

Term	Definition
CRA	Corrosion Resistant Alloy
ITP	Inspection and Test Plan
MIC	Microbiologically Induced Corrosion
NDE	Non-destructive Examination (also known as NDT)
PMI	Positive Materials Identification
RT/UT	Radiographic Testing / Ultrasonic Testing

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 full revision of the DEP of the same number dated February 2017. The following are the main, non-editorial changes.

Section/Clause	Change
1.3.2	Updated definition of hydrostatic test, piping systems and pneumatic test and added definition of piping.
1.3.3	Added CRA
1.3.3	Updated definition for NDE
2.1 Item 3	Changed SHALL [PS] into shall
2.1 item 6	Rectified and updated figure 1
2.1 Item 7-10	added: DEP requirements as per this DEP also applies for tubing
2.1 Item 7-10	moved general requirements from hydro test and pneumatic test sections to this section
2.3	Renumbered and moved requirements specific for hydrotest and pneumatic test to sections 3.1 and 4.3.7
2.3 Item 5	Clarified DEM 1 statement
3.1	Moved hydro test specific items from section 2.3 to this section
3.1 Item 4	Added requirements for using Flange Weld Testers, Weld Test Plugs and Internal Weld Testers
3.2.1	clarified test medium
3.2.1	items renumbered
3.2.1	added formula for calculating freezing time
3.2.3	Items Renumbered
3.3.1	Added minimum safety distance requirements for hydrostatic testing
3.3.1	Items renumbered

Section/Clause	Change
3.3.1	general items moved to section 2.1
4	reworded to make the DEM 1 statement clearer and deleted the DEM 1 to comply with design code and Principal approval pneumatic testing on an operating plant.
5,6,7	Chapters all combined in one chapter (chapter 4 PNEUMATIC TESTING): all requirements are applicable for pneumatic testing
4.2.1.1	Items renumbered and item 2 clarified
4.2.2.1	changed description of zone 1 to include "injury/fatality from window breakage or fragments"
4.2.2.1	Combined two DEM 1 statements
4.2.2.2	changed description of zone 2 to include "injury/fatality from fragments"
4.2.2.3	items renumbered
4.2.2.3	barricade requirements added
4.2.2.3	Updated DEM 1 statement: Added safety distance for Stainless Steel and CRA tubing systems ≤ 12.5 mm ($\leq 1/2$ ") diameter used as impulse lines to field instrumentation
4.2.4	removed table 1
4.2.4	clarified item 2
4.2.4	added item 3
4.3.1	items renumbered
4.3.1	changed items 2 and 4 into requirements
4.3.1	items 5 and 6 reworded
4.3.1	removed prohibition of painting of welds before pneumatic testing
4.3.2	Item 1: added reference to requirements as per section 8.5 of DEP 31.38.01.11- Gen
4.3.2	item 2: added for which materials requirement applies
4.3.3	Removed approval requirements covered in 4.1 (eliminating one SHALL [PS] statement.
4.3.5	Removed requirement for single supervisor
4.3.7	moved requirement for test fluid to section 4.3.9
4.3.7	moved pneumatic test equipment requirements from section 2.3 to this section
4.3.7 item 3	Changed SHALL [PS] into shall
(6.8 in Feb 2017 version)	Removed section "control of personnel" and moved content of this section to 4.2.2.3
4.3.9	Updated the requirements for test fluid
4.3.10	Clarified that the nitrogen test is a pneumatic test as per ASME B31.3 par 345.5 or ASME B31.1 para 137.5

Section/Clause	Change
4.3.10	Clarified the requirements for use of breathing apparatus
4.4.1	Removed requirement to adhere to local regulations (local laws always apply)
4.4.2. Item 2	Made the test procedure compliant to ASME B31.3 and added ASME B31.1 specific requirement
4.4.3 item 1	Changed SHALL [PS] into shall
4.4.4	Changed SHALL [PS] into a shall and referred to DEM 1 in section 4.2.2.1 (eliminating one SHALL [PS] statement)
4.4.4	moved items 3 to section 4.2.4
5	Added ASME B31.1
APPENDIX 1	Renamed APPENDIX A
APPENDIX 2	Renamed APPENDIX B
APPENDIX C	Safety distance for hydrostatic leak testing added in metric and SI units

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.