

DEP SPECIFICATION

HYDROSTATIC PRESSURE TESTING OF NEW PIPELINES

DEP 31.40.40.38-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for hydrostatic pressure testing with water of new onshore and offshore pipelines after construction, to prove their strength and leak tightness.

The various stages of planning and carrying out hydrostatic pressure testing operations are specified in this DEP, including cleaning, gauging, filling, strength testing, leak testing and depressurising. It describes the selection and preparation of a test section, the safety and environmental precautions, the test medium and test equipment requirements, the specific parts of a pressure test and the documentation of the work.

It also includes the necessary dewatering activities for the rectification of any defects detected during the hydrostatic pressure test, but excludes final dewatering. It also covers the post-testing period where the pipeline may be left full of treated test water. If corrosion protection methods other than leaving the pipeline full of treated test water during the post-testing period are necessary, they are classified as pre-commissioning and do not form part of this DEP.

Refer to DEP 31.40.50.30-Gen for pre-commissioning of pipelines.

This DEP is restricted to pipelines where the minimum test pressure is not less than 24.5 bar (g) (350 psig) and the maximum test pressure is not above 1600 bar (g) (23,200 psig). It is also assumed that the hydrostatic pressure test is carried out at ambient temperature.

This DEP is restricted to rigid metallic pipelines including pipe in pipe constructed from carbon steel, clad steel and stainless steel line pipe material. It does not address flexible pipelines, cement-lined pipelines, or pipelines constructed from other materials such as Glass Reinforced Plastic (GRP) or Reinforced Thermo Plastic (RTP).

This DEP is not intended to cover hydrostatic pressure testing of pipelines which have been in service, although many of the same principles would apply.

The special provisions for pipelines constructed from the various types of stainless steel and clad steel line pipe materials are covered in (Appendix B).

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 2014; see (1.5) regarding the changes.

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This is a revision of the DEP of the same number dated February 2014; 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 refineries, chemical plants, gas plants and exploration and production facilities and supply/distribution installations. 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
Assembly	An arrangement of pipes/components, such as a crossing, pig trap, block valve station or riser.
Block valve	A valve for interrupting the flow or shutting in a section of a pipeline. A block valve is normally either fully opened or fully closed.
Golden weld	A weld which is not subject to a hydrostatic pressure test and as such has to pass additional non-destructive testing.
Hydrostatic pressure test	That part of the hydrostatic pressure testing operations during which the test section is pressurised. The hydrostatic pressure test includes a strength test and a leak tightness test.
Leak tightness test pressure	The pressure at which the pipeline is tested for leak tightness.
Line-fill water	Water, chemically treated if required, used as medium to fill and pressurise the test section.
Pre-test	A hydrostatic pressure test carried out on part or all of an Assembly prior to final installation.
Scope of Work	The contractual Scope of Work relating to the pressure testing of pipelines.
Strength test pressure	The pressure at which the pipeline is tested for strength.
Test supervisor	The specialist supervisor appointed and specifically named by the Contractor to be in full charge of all pressure testing operations.
Test equipment	All temporary fittings, piping, test heads, pumps, pigs, materials, equipment and consumables used for the pressure testing operations.
Test point	The primary point of pressure measurement of a test section. This is normally at the point of pressurisation.
Test procedure	The Contractor's procedure covering preparation, testing, rectifying and post-testing activities.
Test section	A section of the pipeline or the entire pipeline which is subject to a hydrostatic pressure test.

1.3.3 Abbreviations

Term	Definition
ALARP	As Low As Reasonably Practicable
MAOP	Maximum Allowable Operating Pressure
MSDS	Material Safety Data Sheet
SMYS	Specified Minimum Yield Strength
THPS	Tetrakis Hydroxymethyl Phosphonium Sulphate
TP	Test Pressure

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 full revision of the DEP of the same number dated February 2014. 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
3.1, item 2	SHALL [PS] requirement restructured.

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.
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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. PROCEDURES

2.1 SEQUENCE, PERSONNEL AND PROCEDURES

1. The sequence of hydrostatic pressure testing operations of pipelines should be as follows:
 - a. Selection of test sections:
 - i. assemblies;
 - ii. pre-test sections.
 - b. Preparation of the test section:
 - i. cleaning;
 - ii. gauging;
 - iii. filling.
 - c. Preparation of the hydrostatic test:
 - i. temperature stabilisation;
 - ii. pressurising;
 - iii. air content check.
 - d. Hydrostatic pressure test:
 - i. strength test;
 - ii. leak tightness test;
 - iii. testing of "special" test sections.
 - e. Post-testing activities:
 - i. depressurising;
 - ii. documentation.
 - f. Rectification activities, if required:
 - i. leak locating during test;
 - ii. dewatering for rectification;
 - iii. rectification of defects.
2. The hydrostatic pressure testing operations shall be carried out by experienced test personnel.
3. Test personnel shall have no other duties during the hydrostatic pressure testing.
4. There should be a sufficient number of test personnel available.

The number of test personnel depends upon site location(s) and the number and size of test sections.
5. The test supervisor shall be in full charge of all activities related to the hydrostatic testing operations.
6. At least one qualified and experienced test supervisor shall be available on site at all times during each pressure testing operation.
7. The test supervisor should be mobilised sufficiently early to be familiarised with the specific job at hand.
8. The test supervisor shall prepare a procedure for all pressure testing operations, including a statement of the responsibilities of subordinates.

9. The test procedure shall be submitted to the Principal for approval not less than 28 days prior to commencement of testing or as specified in the Scope of Work.
10. No part of the hydrostatic pressure testing operations shall commence until approved of the Principal.
11. The hydrostatic pressure test procedure shall include:
 - a. List of nominated personnel who are to supervise the pressure testing operations with their qualifications, tasks, responsibilities and authorities and the required number of qualified supervising assistants.
 - b. Detailed schedule giving proposed dates of the main activities, tests and mobilisation dates of the nominated personnel.
 - c. Details of the selected test sections, including assemblies and pre-test sections.
 - d. Identification of potential safety and environmental hazards, including the necessary measures, exclusion zone/barrier distance and emergency plans.
 - e. Details of the line-fill water, including the source, treatment method (filtering and, use of chemicals), discharge/disposal and permits.
 - f. Details of the test equipment, including sparing and standby equipment, layouts and size and/or performance.
 - g. Details of the test section preparation, including cleaning, gauging and filling.
 - h. Details of the hydrostatic pressure test preparation, including temperature stabilisation period.
 - i. Details of the hydrostatic pressure tests, including pre-test, strength test and leak tightness test.
 - j. Details of the post-testing activities, including depressurising and documentation.
 - k. Details of rectification activities, including proposal for locating leaks, dewatering and leak rectification.
12. The test supervisor shall confirm that the strength test pressure does not exceed the pressure to which the pipe has been subjected during the mill test, and that it is not higher than the test pressure of the fittings specified for the pipeline.

2.2 TEST SECTIONS

1. The Test Procedure shall identify the test sections.
2. Test sections should be as long as practicable.
3. Test sections shall be piggable, either by temporary test heads or by pig launcher and receiver.
4. If an above-ground or above-water section length exceeds 3% of the total test section length, separate hydrostatic pressure tests for the above-ground/above-water and the buried/submerged sections shall be carried out.
This is to allow for the influence of temperature fluctuation.
5. The elevation profile shall be plotted to assist in checking that the test pressures at the low and high points will not result in hoop and/or equivalent stresses outside the limits specified in (8).
6. Welded tie-in of test sections shall be permitted only by "golden welds".
7. The mechanical connections used in subsea pipelines for jumpers that tie-in a subsea pipeline do not require hydrotest.
 - a. Mechanical connectors should be fully tested for strength and leak tightness, when feasible.
 - b. An external seal test may be acceptable for mechanical connectors provided this is allowed by regulation and approved by the Principal.
8. All flanged connections in the pipeline system shall be strength and leak tightness tested except for tie in of test sections which only require a leak test.
9. Refer to DEP 61.40.20.30-Gen., or DEP 37.81.40.31-Gen. for both radiography and ultrasonic examination of welds that will not be subjected to strength-, leak tightness- and hydrotesting ("golden welds").
 - a. The applicable welding DEP shall be specified by the Principal in the Scope of Work.
 - b. The requirement for radiography may be waived by the Principal if the weld is inspected with Automatic Ultrasonic Testing.
 - i. Refer to DEP 37.81.40.32-Gen. and DEP 37.81.42.35-Gen. for automatic ultrasonic testing.

3. SAFETY AND ENVIRONMENT

3.1 SAFETY MEASURES

1. The Contractor shall take measures to ensure that all persons and property are adequately protected from the consequences of a possible system failure or other causes during the clearing, gauging, line filling and testing operations.
2. During all the operations in (3.1, item 1) and until completion of the depressurisation at the end of the test, the Contractor SHALL [PS] ensure that all access to, or work on or near, a pipeline section under test is properly authorised taking into account the associated hazards.
3. The Contractor shall confirm to the Principal in writing that he has instructed all employees engaged on testing work, or any work associated with testing, or any work in the immediate area (e.g., on platform) of the possible consequences of a pipeline or test fitting failure under pressure test conditions.
4. The Contractor shall comply with any permit-to-work system applicable at any location influenced by the hydrotest activities.

5. Sites for test equipment shall be set up in a safe location away from public places, roads and inhabited areas/living quarters.
6. The test work sites shall be closed off to unauthorised personnel.
7. The arrangement of the test equipment and the location of the test work sites shall be approved by the Principal.
8. Multiple test sites shall be provided with a radio or other means (including back-up equipment) of verbal communication to provide contact between all locations associated with the test work sites.
9. Warning notices reading 'KEEP AWAY - PIPELINE UNDER TEST' shall be placed at appropriate locations such as blanked ends of the test sections, areas where pre-tests or assembly testing are carried out and test equipment sites.
10. Notices shall be in both English and the local/working language.
11. The Contractor shall prepare an emergency plan.
12. The Contractor's emergency plan shall describe actions to be taken in case the test section or test equipment leaks or bursts.
13. The Contractor's emergency plan should include the following:
 - a. how to deal with washouts and other damage;
 - b. telephone numbers of standby crews;
 - c. telephone numbers of police, medical and other emergency services that may need to be summoned;
 - d. telephone number of the Principal's local operations base/control room which may have to be contacted;
 - e. list of equipment and machines available or needed;
 - f. list of personnel;
 - g. location of medical and first aid facilities;
 - h. how to deal with possible release of hazardous chemicals used during testing. See also (3.2).
14. The Contractor shall obtain the Principal's approval in writing of the emergency plan before commencing pressurisation.
15. Testing shall not commence until the Principal has received from the Contractor confirmation that notification has been given, in writing, to persons present in the vicinity of the pipeline (e.g., farmers, other construction contractors) that testing is to be carried out.
16. Testing shall not commence until the Principal has received from the Contractor confirmation that notification has been given, in writing, to local authorities that might need to be informed that testing is to be carried out.
17. Before any work, including tightening of leaking flanges, is permitted on the test section under pressure or associated connections, the pressure shall be reduced to a level not greater than static head plus 1 bar (15 psi).

It may be possible to isolate the leaking part by use of a double-block-and-bleed installation.
18. Tightening of subsea flanges by divers should have more stringent controls than for above-water flanges.

Tightening of subsea flanges is permitted at a pressure level where the outflow from the leak has ceased.

19. The diving superintendent shall be given full details from the risk evaluation, as required for diver safety.

3.2 ENVIRONMENTAL MEASURES

1. Before purchase of chemicals, including corrosion control products and leak detection dyes, the Contractor shall obtain from the chemicals' Manufacturer/Supplier material safety data sheets (MSDS) including hazard and risk phrases and written recommendations for handling, storage and disposal.
2. The Contractor shall be responsible for carrying out any Chemical Hazard Assessment and Risk Assessment required by local authorities before using the proposed chemicals.
3. The Contractor shall obtain permits from local authorities for the use and handling of all chemicals, unless the Principal has agreed in advance to obtain such permits.
4. The Contractor shall submit to the Principal for approval a comprehensive plan for all chemicals to be used.
5. The Contractor shall ensure that any Manufacturer/Suppliers' proposed measures are followed, and that the information is available, known and understood by the personnel carrying out the work.
6. The chemicals shall be stored in the original packing.
 - a. All packaging shall have the original markings/labels clearly visible.
7. The chemicals shall be handled and stored in accordance with the HSE requirements stated in the Manufacturer/Supplier's MSDS.
8. Suitable protective clothing, gloves and goggles shall be worn when handling chemicals.
9. A safety shower and eye-bath shall be available at appropriate locations.
 - a. The safety shower and eye-bath should shown on the test equipment layout drawing(s).
10. The seasonal/environmental status of the source of line-fill water and the dilution and dispersion of the line-fill water after its use shall be taken into account when specifying the locations, methods, rates and timing.
11. The Contractor shall ensure that the disposal recommendations of the Manufacturer/Supplier are implemented and that all current environmental regulations applicable to the pipeline system are met.
12. The Contractor shall have the written consent of the owner/local authorities of any source or property before any water is taken from or discharged into that source or property.
13. The test sites shall be left in a clean condition and free of debris.
14. All waste, e.g., chemicals or dyes shall be disposed of by the Contractor in accordance with the Principal's waste disposal and regulatory requirements.
15. The Contractor shall ensure that the Manufacturer/Suppliers of all chemicals used in the Hydrotest provide material safety data sheets (MSDS) with each shipment of the chemical.
16. The MSDS shall be provided in an appropriate format for the jurisdiction at the location of the pipeline to be flooded.
 - a. The language used shall be English and local working language.
17. The Contractor shall ensure that noise levels do not exceed 85 dB (A) in areas accessible to the general public.

4. LINE-FILL WATER

1. Water for testing and flushing shall be clean and free from any suspended or dissolved substances which:
 - a. could be harmful to the pipe material or internal coating (where applied), or
 - b. could form deposits within the pipeline, or
 - c. may be unacceptable at the disposal location.
2. Only fresh water taken from a river, aquifer or a potable water system or sea-water taken from the open sea should be used for testing and flushing.
3. Brackish water from estuaries or harbours should be avoided as a source of line-fill water wherever possible.
4. The Contractor shall be responsible for obtaining all necessary permits from the owner/local authority concerning the supply and the disposal of line-fill water.
5. The water used for pressure testing should be selected from a location that will minimise the temperature stabilization period.
6. The water shall be filtered before entering the pipeline through 50- μ m (2 mils) filters except for water injection lines.
7. Water for water injection lines shall be filtered through 2- μ m (0.08 mils) filters or as specified by the Principal.
8. If matrix injection is followed, the level of filtration shall be specified by Principal in the Scope of Work.
9. The arrangement of filters at the test work sites should enable back-flushing without disconnecting the pipe work.
10. Treatment of the line-fill water with a biocide and/or oxygen scavenger may be required depending on the following:
 - a. quality of water;
 - b. the duration of contact of line-fill water with the interior of the test section;
 - c. the pre-commissioning requirements;
 - d. the future use of the pipeline.
11. The Contractor shall demonstrate the environmental acceptability of any proposed treatment package, such as toxicity, biodegradation, biochemical oxygen demand and chemical oxygen demand after filtering/separation and/or neutralisation.
12. Environmentally acceptable line-fill treatment packages should be used.

Seawater from the open sea is expected to be of predictable composition and no chemical analysis is required.
13. The Contractor shall obtain samples from all water sources other than seawater from the open sea proposed as line-fill water for analysis by a testing laboratory approved by the Principal.
14. The line-fill water analysis shall include:
 - a. sulphate concentration;
 - b. low-molecular-weight fatty-acids concentrations;
 - c. ammonium concentration;
 - d. phosphorus concentration;
 - e. for aquifer water only: also sodium, potassium, magnesium, calcium, strontium, barium, iron, chloride and bicarbonate.