

DEP SPECIFICATION

MOORING AND BERTHING SYSTEMS, INCLUDING FENDERS, QUICK RELEASE HOOKS, AND DOCKING AID SYSTEMS

DEP 37.91.10.30-Gen.

February 2016

DESIGN AND ENGINEERING PRACTICE



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1 INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for detailed design, fabrication and installation of mooring equipment that are used for marine facilities.

Section (3) covers fenders required on marine facilities.

Section (4) covers bollards for marine structures.

Section (5) covers quick release hooks.

Section (6) covers docking aid and mooring systems to be installed to support the operation of the berth facility.

This is a revision of the DEP of the same number dated February 2013; 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 marine facilities related to oil and gas production, gas handling, LNG, oil refining, chemical processing, gasification, oil/gas exploration activities, hydrocarbon 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 word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Abrasion Resistance	Ability of a fibre or rope to withstand surface wear and rubbing due to motion against other fibres of rope components (internal abrasion) or a contact surface such as fairlead (external abrasion).
Anchors	Mounting hardware such as holding down bolts to fix the fender, bollard or quick release hook to the dolphin, jetty or quay wall structure.
Bollard	Vertical post ashore to which the eye of a mooring line can be attached.
Capstan	Device used to haul in a messenger line, which in turn pulls the mooring line to the quick release hook.
Coefficient of Friction	Limiting value of the coefficient given by dividing the force tending to cause one body to slide over another by the normal force between the two bodies. Generally, the higher the value, the lower the tendency of one object to slide over another.
Displacement	The total mass of a ship used in the energy calculation – can be fully laden for an import berth (unless berth is draft restricted) or ballast for an export berth.
Docking Aid System	System used by jetty operators and pilots to monitor the approach and docking of berthing vessels. System design can be based on lasers, differential GPS or Real Time Kinematic (RTK) GPS technologies.
Dolphin	Independent platform incorporation mooring hooks or bollards for securing ship's mooring lines. It may also incorporate berthing fenders such as breasting dolphins.
Fairlead	Guide for a mooring line that enables the line to be passed through a ship's bulwark or other barrier, or to change direction through a congested area without snagging or fouling.
Fasteners	Fixations within the assembled fender system or quick release hook to connect the fender panel, UHMW-PE plates and capstans.
Fender Systems	Provision primarily to absorb the berthing energy exerted by a berthing ship, and secondly to resist loads applied from a moored ship as part of the mooring system, keeping the ship in place during loading/unloading operations.
Minimum Breaking Load (MBL)	Minimum breaking load of a new dry mooring line or chain as declared by the Manufacturer.
Portable Pilot Units (PPUs)	Carry-aboard docking aid system used by pilots for precision navigation, swinging (turning) and docking manoeuvres with high accuracy, also able to supply data to control rooms and to interface with shore based laser docking aids.
Proof Load	Proof Load is the load applied to mooring equipment to prove the equipment's structural and operational integrity following manufacture. Proof Load is generally 1.25 or 1.5 x SWL. Yield is higher than Proof Load.
Quick Release Hooks (QRH)	Hooks that ensure that the vessel is secured fast to the jetty by providing solid, reliable anchor points for mooring lines. They enable mooring lines to be quickly and easily released, even under full load conditions.
Safe Working Load (SWL)	Safe Working Load (SWL) is the Manufacturer's designated safe operational working load limit for the equipment. The SWL is greater than the MBL of the largest mooring line that contacts the bollard or quick release hook.

Term	Definition
Safety Factor	Margin to allow for uncertainties.

1.3.3 Abbreviations

Term	Definition
AIS	Automatic Identification System
DAS	Docking Aid System
DGPS	Differential Global Positioning System
ESD	Emergency Shutdown Device
FAT	Factory Acceptance Test
GPS	Global Positioning System
IMO	International Maritime Organisation
ISO	International Organisation for Standardisation
ITP	Inspection Test Plan
LIR	Local Instrument Room
QRH	Quick Release Hooks
SAT	Site Acceptance Test
SIS	Safety Instrumented System
SWL	Safe Working Load
UHMW-PE	Ultra-High Molecular Weight Polyethylene

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 (7).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2013. The following are the main, non-editorial changes.

Section/Clause	Change
2.7, 2.8, 2.11	Commercial Specifications removed where applicable
2.10	Spare Specification alignment with DEP 70.10.90.11-Gen.
5.2.1, Item 2	Aligned electrical insulation requirements for QRHs with DEP 33.64.10.10-Gen.
6.2.2, Item 4	Updated requirement in order to minimise marine growth build up on sensors (docking aid systems)
7	Updated Codes and Standards

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://www.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.

1.9 RESPONSIBILITIES

Unless otherwise specified in the project contract documents, the Manufacturer/Supplier is responsible for the design, fabrication, testing and shipping of all components, hardware and software in accordance with the requirements of this DEP.

The Contractor shall install and commission the systems in accordance with the criteria as set by the Manufacturer/Supplier.

2. GENERAL REQUIREMENTS

2.1 RELIABILITY, MAINTENANCE AND OPERATIONS

1. Mechanical and electrical systems supplied shall be of adequate duty, robustness and reliability to ensure that these systems do not require replacement during the design life.
2. The design of the mooring and berthing systems shall be such that any maintenance necessary to achieve the design life can be undertaken safely, with minimum disruption to the ongoing marine operations, and without the need for removal of the complete units.
3. The fender and quick release hook units shall be capable of being in continuous operational use and shall allow for maximum extremes within the site specific design data of loading, fatigue effects, weather or other environmental occurrences as specified within the project specifications.

2.2 STEEL WORK

1. Steelwork for berthing and mooring systems shall comply with DEP 34.28.00.31-Gen. for onshore steel structures and the applicable regional codes and standards as listed in Table 2.1 of that DEP.
2. All welding shall comply with DEP 30.10.60.18-Gen.

2.3 ANCHORS

1. Anchors shall be installed as per Manufacturer/Supplier instructions with the following minimum requirements:
 - a. Fenders, quick release hooks or bollards on new concrete deck structures shall be installed by means of cast-in-place embedded anchors.
 - i. Cast-in-place anchors shall be set in place with the aid of a template frame to set the anchors within the nominated tolerances.
 - ii. The template frames shall be supplied by the Manufacturer/Supplier.
 - b. For installation into existing concrete structures, alternative methods by drilling holes and use of adhesive anchors are acceptable.
 - c. The required embedment depth shall be designed according to the local regulatory codes or standards and shall comply with the relevant ASTM or Eurocode Standard.
 - d. The required embedment depth shall take into account the following:
 - i. concrete strength,
 - ii. reinforcing bar design,
 - iii. the various applicable load combinations.
 - e. Carbon steel anchor bolts shall conform to ASTM A307, ASTM A325 or BS EN ISO 898.
 - f. Carbon steel anchors shall be coated in accordance with the options for coating of fasteners for marine environment as listed in Section 3.1 of DEP 30.48.00.32-Gen.
 - g. Stainless steel anchor bolts and nuts shall be grade 316 stainless steel and comply to ASTM F593/ASTM F594 or BS EN ISO 3506.
2. Refer to sections in this DEP on fenders (3), bollards (4), quick release hooks (5) and docking aid systems (6) for additional requirements.

2.4 ELECTRICAL INSTALLATION

2.4.1 Standards, codes and regulations

1. Electrical systems and equipment shall be designed, constructed and installed in accordance with DEP 33.64.10.10-Gen., Section 2.1 or DEP 33.64.30.30-Gen., Section 2.2 for North America (US and Canada), as stated in the requisition DEP 37.91.10.94-Gen.

2.4.2 Protection against site specific conditions, explosion and fire

1. As a minimum, all electrical installations shall be contained in a weather-proof enclosure.
2. All electrical instruments shall be capable of correct operation under the site specific conditions (ambient air temperature range, relative humidity range), after allowance for any de-rating.
3. Electrical equipment installed in hazardous areas shall be selected with a type of protection suitable for the relevant zones in accordance with Section 2.3 of DEP 33.64.10.10-Gen. or Section 2.4 of DEP 33.64.30.30-Gen. for North America (US and Canada), as stated in the requisition DEP 37.91.10.94-Gen.
4. Electrical isolation of vessels to the berths shall be in accordance with DEP 33.64.30.30-Gen.

2.4.3 Site operating conditions

1. Equipment shall be suitable for the site environmental conditions stated in the requisition DEP 37.91.10.94-Gen., with a minimum ingress protection of IP 55 or NEMA Type 4.

2.4.4 Electrical supply

1. The nominal system voltage and frequency shall be stated in the requisition.
2. Communications equipment shall be supplied from an uninterruptible power supply (by others) as stated in the requisition DEP 37.91.10.94-Gen.

2.4.5 Earthing/grounding system

1. Earthing and bonding of jetties shall be in accordance with Section 6.6 of DEP 33.64.10.10-Gen., or Section 5.5 of DEP 33.64.30.30-Gen. for North America (US and Canada).

2.4.6 Cabling and wiring

1. Cabling and wiring shall be in accordance with Section 5.3 of DEP 33.64.10.10-Gen., or DEP 33.64.30.30-Gen. for North America (US and Canada), as stated in the requisition DEP 37.91.10.94-Gen.

2.4.7 Equipment and cable numbering and marking

1. Equipment and cable numbering shall be in accordance with the requisition DEP 37.91.10.94-Gen.
2. Refer to DEP 01.00.09.10-Gen. for tagging requirements.
3. Equipment and cable marking shall be in accordance with Sections 2, 3 and 4 of DEP 30.00.60.21-Gen., or DEP 33.64.30.30-Gen. for North America (US and Canada), as stated in the requisition DEP 37.91.10.94-Gen.
4. The method of fixing of nameplates shall prevent contact and corrosion between dissimilar metals.

2.5 FABRICATION

1. Fenders, quick release hooks and bollards shall be manufactured in accordance with this DEP and in line with the ISO 9000 series quality procedures.
 - a. Each unit shall be marked to trace the production condition.
 - b. Material and production records shall be provided.
 - c. Bollard and anchorage calculations and installation instructions shall be provided.
2. All structural welding and welded joint details shall meet the following:
 - a. conform to DEP 30.10.60.18-Gen.;
 - b. undergo non-destructive testing (NDT) in accordance with the procedures specified in DEP 34.28.00.31-Gen.
3. All corrosion protection coating work, including hot-dip galvanising, shall be inspected before and after the application of the coating.
4. All coated surface shall be measured during the post-painting inspection to ensure the minimum film thickness is achieved.

2.6 TESTING

1. All testing methods shall receive prior approval from the Principal.
2. The Manufacturer/Supplier shall carry out a factory acceptance test for all systems and shall invite the Principal (or Principal's Nominee) to witness these tests.

The factory acceptance test is intended to verify that the system and its components function properly, that all manufacturing, assembly, software generation and configurations/databases have been implemented correctly and completely and that the systems performance, in all respects, complies with the criteria of the agreed procurement specifications.
3. Qualified Inspectors from classification societies with IACS membership shall be engaged by the Manufacturer/Supplier, for witnessing the tests identified in the ITP as "hold" points.
4. Reports of all tests shall be certified and signed by both the testing institution and the appointed Inspecting Agency.
5. Reports of all tests shall be submitted to the Principal for review prior to delivery of the fender, bollard or quick release units to Site.
6. The Principal reserves the right to witness the tests. The Manufacturer/Supplier shall notify the Principal in writing at least two weeks prior to testing and shall submit a CV of the Manufacturer's representative (e.g., certifying body) for Principal's acceptance.
7. All testing laboratories shall be international accredited institutes, approved by the Principal, and holding a valid approval of acceptance from the Principal to undertake the tests required.
8. The testing laboratories shall be fully equipped with all necessary testing apparatus, qualified technical personnel, supervision and transportation to perform the testing in accordance with the specification.
9. All testing equipment shall be calibrated in accordance with the relevant codes and standards.
10. For additional requirements, refer to sections in this DEP on fenders (3), bollards (4), quick release hooks (5) and docking aid systems (6).

2.7 PACKING, SHIPPING, HANDLING, INSTALLATION AND COMMISSIONING

2.7.1 Packing, shipping and handling

1. The fenders, bollards, quick release hooks, and all associated components shall be handled and stored in accordance with the Manufacturer's instructions.
2. The use of canvas slings, wood cradles, protective devices, or other appropriate means shall be used to avoid damage to the supplied components.
3. System components shall be stored in a clean, properly drained location, out of direct contact with the ground, in a manner that will prevent distortion and other damage.
4. The Manufacturer/Supplier shall prepare, package, ship and deliver the system, spare parts and three (3) copies of approved Installation Manual to the project site.

2.7.2 Installation and commissioning

1. The on-site installation of each unit shall be carried out under the strict supervision of the Contractor-nominated representative, in accordance with the Manufacturer's detailed installation plan.
2. The commissioning of each unit and the overall system, shall be carried out under the strict supervision of the Contractor, in accordance with the Manufacturer's commissioning plan.
3. The Manufacturer/Supplier shall provide on-site assistance for the assembly, erection, testing, integration, and commissioning of all equipment containing electrical installation and instrumentation (e.g., quick release hooks, fenders with compression measurement system, berthing aid systems, etc.).
4. Manufacturer/Supplier personnel providing onsite assistance for installation and commissioning (2.7.2, Item 3) shall be approved by the Principal prior to mobilisation to the site.
5. The Manufacturer/Supplier's representative shall be fully experienced in the assembly, erection, and commissioning of the Manufacturer/Supplier's products.
6. Site safety training is mandatory before commencement of work.

2.8 QUALITY ASSURANCE

2.8.1 General

In this Section, general quality assurance requirements are given. In the various sections (Fenders/Bollards, Quick Release Hooks and Docking Aid Systems) additional and/or prevailing requirements may be prescribed.

1. The Contractor shall submit a quality plan, for approval of the Principal, detailing the intended quality management process for the supply, manufacture and installation.
2. The quality plan shall include, but not limited to:
 - a. Organisation and responsibilities
 - b. Inspection and test plan (ITP)
 - c. Notification of inspection
 - d. Non-conformance control
 - e. Manufacturer's data record (MDR)
 - f. Inspection release certificates
3. The ITP shall detail the inspection plan, testing programs, proposed "hold" points and the parties that will be responsible for ensuring that all materials comply with the requirements of the drawings and this Specification.
4. The ITP shall include details of the testing laboratories, the testing personnel and shall enclose samples of accredited certificates from previous tests of a similar nature.

5. The Principal shall be given weekly notice of the progress of the works and shall have access to the work at all times.
6. Work shall not commence until the above plans are approved by the Principal.
7. Further guidance on quality plans may be obtained from DEP 82.00.10.10-Gen.

2.8.2 Quality management certificate

1. The Contractor and/or Manufacturer/Supplier shall maintain and operate a quality assurance system approved by the Principal, in accordance with ISO 9001:2008.

2.9 INSPECTION AND MAINTENANCE

1. The Manufacturer/Supplier shall provide an inspection and maintenance procedure for approval by the Principal, which when approved ensures the design lifetime can be achieved.
2. This procedure shall include requirements for safe access to execute the inspection and maintenance in a safe manner.
3. The inspection and maintenance procedure shall take into account local conditions including the following:
 - a. accessibility;
 - b. metocean conditions;
 - c. berth utilisation.

2.10 SPARE PARTS/SPECIAL TOOLS

1. The Manufacturer shall list the service life of the key components with any of the following characteristics:
 - a. not easily replaceable;
 - b. have long lead times (>3 months);
 - c. have a service life of less than 5 years.
2. The Contractor shall provide, for Principal consideration, a list of the parts which the Principal should keep at site as spares.
3. As a minimum, the Contractor shall provide all recommended spare parts for two year operation including consumables as per DEP 70.10.90.11-Gen.
4. Special tools supplied by the Contractor to install, adjust, or maintain equipment during the commissioning shall be turned over to the Principal at the completion of all work.
5. Special tools that may be needed for subsequent maintenance, but not supplied by the Manufacturer/Supplier during commissioning, shall be incorporated into the spare parts list submitted with the Manufacturer/ Supplier's proposal.

2.11 SUBMITTALS

2.11.1 Bid documentation

1. The Contractor and/or Manufacture/Supplier shall submit the following with its bid:
 - a. Contractor and/or Manufacturer/Supplier's quality assurance program and supporting documentation, such as the quality assurance manual, quality plan and ISO certificates;
 - b. Full equipment list with functional description of each item;
 - c. Materials of manufacture including specifications, grades, and country of origin;

- d. Preliminary design drawings including the following as a minimum:
 - i. General arrangement drawings indicating all components;
 - ii. Drawings of individual components;
 - iii. Assembly and installation drawings;
 - iv. Electrical and instrument layouts and diagrams.
- e. Recommended spare parts list as per DEP 70.10.90.11-Gen. requirements including the following:
 - i. Installation spares;
 - ii. Commissioning spares;
 - iii. Operational spares.
- f. List of consumables;
- g. A list of deviations taken to this Specification; or if there are no deviations, a statement to this effect;
- h. Schedule of works;
- i. Proof test certificates and accreditation certificate;
- j. Change-over strategy, ensuring all existing systems will be fully functional until completion of installation of new system;
- k. List of references;
- l. List of Suppliers/Subcontractors.

Specific items to be supplied by the Contractor and/or Manufacturer/Supplier, as part of the bid submission, are outlined in the appropriate sections.

2.11.2 Contract documentation

- 1. The Contractor and/or Manufacturer/Supplier shall submit the information and the documents listed below for approval by the Principal:
 - a. Final design documentation, including but not limited to the shop drawings, assembly and erection drawings, specifications, and procured equipment descriptions, and/or foundation loads.
 - b. Test documentation as listed below:
 - i. Inspection and test plan;
 - ii. Test procedures document covering details of the proposed tests, implementation, special equipment, and results to be achieved, both for shop and field tests.
 - iii. Material test report (also known as "mill test report" or "test report") providing material Manufacturer records and the results of tests required by the basic material specification.
 - iv. In addition to the test results, the document shall also:
 - 1) Identify the material represented and the applicable material specification, including year of issue.
 - 2) Show the heat, lot, or melt identification number.
 - 3) State the type of heat treatment, if any.
 - 4) State results of tests, including chemical analysis, mechanical tests, and non-destructive tests, required by the basic material specification.
 - 5) Include on or with the material test report any supplementary or