

DEP SPECIFICATION

**DESIGN OF JETTY FACILITIES
(AMENDMENTS/SUPPLEMENTS TO
BS 6349-1-1/1-2/1-3/1-4, BS 6349-2 and BS 6349-4)**

DEP 35.00.10.10-Gen.

February 2018

DESIGN AND ENGINEERING PRACTICE



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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.

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PART I INTRODUCTION

1.1 SCOPE

This DEP specification gives requirements and recommendations for the design and engineering of fixed marine facilities for ships loading and unloading of: crude oil, oil products, LPG/LNG and petrochemical products.

Requirements for the design of topworks including piping, product transfer arms and other mechanical and electrical installations are not explicitly included in this DEP. Requirement for offshore structures are listed in separate DEPs, such as DEP 37.19.00.10-Gen.

Requirements for the design of buoy-moored marine facilities such as single point moorings and other offshore loading facilities are outside the scope this DEP.

Part III of this DEP amends BS 6349-1-1:2013.

Part IV of this DEP amends BS 6349-1-2:2016.

Part V of this DEP amends BS 6349-1-3:2012.

Part VI of this DEP amends BS 6349-1-4:2013.

Part VII of this DEP amends BS 6349-2:2010.

Part VIII of this DEP amends BS 6349-4:2014.

Parts III through VIII of this DEP amend, supplement and delete various clauses of BS 6349-1-1/1-2/1-3/1-4, BS 6349-2 and BS 6349-4. Parts III through VIII follow the clause numbering of BS 6349-1-1/1-2/1-3/1-4, BS 6349-2 and BS 6349-4 for easy reference.

This revision also updates and replaces the recommendations given in Clauses 5.1, 5.2, Annex A and Annex B in BS 6349-2:2010 with those given in BS 6349-1-2:2016 and modified in (Part IV) of this DEP.

All clauses of BS 6349-1-1/1-2/1-3/1-4, BS 6349-2 and BS 6349-4 not modified by this DEP remain valid as written.

For applications in countries other than the US that do not adopt BS 6349-1-1/1-2/1-3/1-4, BS 6349-2 and BS 6349-4, alternative national codes and design standards that meet the minimum requirements of those of BS 6349-1-1/1-2/1-3/1-4, BS 6349-2, BS 6349-4 and this DEP shall be used.

For applications in the US, ASCE Standard 61-14: Seismic Design of Piers and Wharves shall be used.

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, liquefaction, 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.

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

1.3.2 Abbreviations

The following abbreviations are used in this DEP. Other abbreviations are defined at the first place of use.

Term	Definition
CIRIA	Construction Industry Research and Information Association (UK)
CUR	Centre of Civil Engineering Research and Codes (The Netherlands)
ISGOTT	International Safety Guide for Oil Tankers and Terminals
OCIMF	Oil Companies International Marine Forum
PIANC	Permanent International Association for Navigation Conferences, which now refers to itself as "The World Association for Waterborne Transport Infrastructure"
ROM	Recomendaciones Obras Maritimas (Spanish Maritime Works Recommendation)
SIGTTO	Society of International Gas Tanker and Terminal Operators Ltd.

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 directly referenced in this DEP are listed in (Part IX).

Listed in (Part X) are documents on which certain requirements in this DEP have been based. In the text of this DEP, such references are identified by [Ref. x], where x denotes the reference number included in (Part X).

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
Part II	Updated References
Part III	Updated References (previous version Part III and IV). Revised in accordance with update of BS 6349-1:2000 to BS 6349-1-2:2016 Marine works - Part 1-2: General - Code of Practice for assessment of actions and BS 6349-1-1:2013. Previous comments on sections 29 and 31 of BS 6349-1:2000 incorporated in sections 20 and 21 of BS 6349-1-1:2013 respectively.
Part IV	Revised in accordance with update of BS 6349-1:2000 to BS 6349-1-2:2016 Maritime works – Part 1-2: General - Code of practice for assessment of actions

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.

PART II GENERAL REQUIREMENTS

1.1 GENERAL

Parts III through VIII of this DEP are written as amendments and supplements to BS 6349-1, BS 6349-2 and BS 6349-4 as in Table A.

Table A List of references

<i>Part III</i>	<i>BS 6349-1-1:2013</i>	<i>Maritime Works – Part 1-1: General – Code of practice for planning and design for operations</i>
<i>Part IV</i>	<i>BS 6349-1-2:2016</i>	<i>Maritime works - Part 1-2: General – Code of practice for assessment of actions</i>
<i>Part V</i>	<i>BS 6349-1-3:2012</i>	<i>Maritime works - Part 1-3: - General – Code of practice for geotechnical design</i>
<i>Part VI</i>	<i>BS 6349-1-4:2013</i>	<i>Maritime works – Part 1-4: - General – Code of practice for materials</i>
<i>Part VII</i>	<i>BS 6349-2:2010</i>	<i>Maritime works - Code of practice for the design of quay walls, jetties and dolphins</i>
<i>Part VIII</i>	<i>BS 6349-4:2014</i>	<i>Maritime works - Code of practice for design of fendering and mooring systems</i>

Wherever reference is made to BS 6349-1-1/1-2/1-3/1-4, BS 6349-2 and BS 6349-4, it is intended to mean BS 6349-1-1:2013, BS 6349-1-2:2016, BS 6349-1-3:2012, BS 6349-1-4:2013, BS 6349-2:2010, and BS 6349-4:2014 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of BS 6349-1.1/ -1.2/ -1.3/ -1.4, BS 6349-2 and BS 6349-4 has been used throughout Part III through VIII of this DEP.

1. Clauses in BS 6349-1-1/1-2/1-3/1-4, BS 6349-2 and BS 6349-4, which are not mentioned in this DEP, shall remain valid as written.
2. Refer to DEP 34.00.01.30-Gen. and the amendments and supplements to BS 6349-2 for Structural design and engineering of jetties.
3. Reference to structural design to BS EN Eurocodes in BS 6349-2 is amended by this DEP and shall include the requirements of DEP 34.19.20.31-Gen. for reinforced concrete structures and DEP 34.28.00.31-Gen for Onshore steel structures.

**PART III AMENDMENTS/SUPPLEMENTS TO BS 6349-1-1:2013 MARITIME WORKS – PART 1-1:
GENERAL - CODE OF PRACTICE FOR PLANNING AND DESIGN FOR OPERATIONS**

Section 2. The maritime environment

5 Bathymetric and topographic surveys

5.2 Bathymetric surveys

5.2.1 General

6 Meteorological and oceanographic considerations and data acquisition

6.1 General

Add the following:

1. Typical 10 year continuous time series of critical metocean conditions shall be obtained at the early design stages (Assess/Select) of the project and be confirmed during subsequent design development (Define Stage).

A 20 year series is preferred.

- a. Sufficient data shall be obtained to determine design conditions for the facilities.

Reference is made to DEP 37.00.10.10-Gen.

2. On a risk based approach, data collection and analysis shall be performed for all relevant meteorological and oceanographic parameters including extreme and operating conditions and seasonal and annual variations in conditions.

Reference is made to DEP 37.00.10.10-Gen.

6.2 Particular considerations for surveys and data analysis

6.2.2 Meteorological data acquisition

6.2.2.1 Wind

6.2.2.4 Visibility

Add the following:

1. Visibility data should be collected and assessed for its effect on weather downtime for the marine facilities.

Add new section:

6.2.2.7 Lightning

6.2.2.7.1 General

1. Metal structures shall be bonded together to form a single conductive structure and connected to the earth grid.
2. For ship/shore electrical isolation and earthing/bonding refer to DEP 33.64.10.10-Gen. section 6.6 or DEP 33.64.20.10-Gen. section 6.6, whichever is applicable, for electrical isolation of jetties.

6.2.2.7.2 Lightning and static electricity

1. Refer to DEP 33.64.10.10-Gen. Section 5.5.4 or DEP 33.64.20.10-Gen., which ever is applicable, for Lightning and Static electricity.

8 Water levels

Add the following to this clause:

1. Design of jetties in areas remote from existing tidal monitoring stations with tidal differences in excess of 2 m (6.5 ft) shall be based on full astronomical tidal predictions through the 18.6 year tidal cycle relative to mean sea level.
 - a. Tidal data acquired by site-specific tidal measurements and analysis shall be carried out during preliminary design.

9 Currents and water movement

11 Water quality

11.5 Marine life

Add the following to this clause:

1. Intake velocities and velocity gradients shall be reduced to minimise the risk of marine life such as fish and other species being drawn into the intake screens.
2. Determination of drag factors, wave and current loading shall allow for the marine growth on piles.

12 Sediment transport

12.1 General

Add the following to this clause:

1. An assessment shall be made of the anticipated effect on sediment transport processes and shoreline morphology on the following:
 - a. selection of the location, form and layout of the jetty structure;
 - b. the sedimentation at the berth and approaches;
 - c. the consequent need for maintenance dredging.

The scope and methodology of the assessment could include desk studies, field data collection, comparison of historical aerial or satellite imagery and numerical modelling.

12.2 Assessing the present sediment transport regime

12.2.4 Local currents and wave conditions

Add the following:

1. The impact of the jetty/causeway structure on coastline and river bank erosion, accretion and morphology shall be evaluated.
2. Refer to PIANC Minimising harbour siltation (Part X, Bibliography Ref. 19) for guidance on strategies for design and operation of marine facilities to minimise the requirements for maintenance dredging arising from sediment accretion in muddy environments.

12.3 Assessing impacts of works on sediment transport

12.3.2 Scour

Section 3. Safety and operational considerations

14 Health and safety

Add the following:

1. Refer to (Part X, Bibliography reference 28 and 27) for the health and safety requirements.

19 Navigation channels and ship manoeuvring

19.2 Planning and design studies

Add the following:

1. The following shall be addressed according to the risk-based approach in the PIANC MarCom Working Group 116, Safety Aspects of Berthing Operations of Oil and Gas Tankers (Part X, Bibliography reference 27).
 - a. layout, alignment and dimensions planning and design of approach channels;
 - b. the particular requirements of oil and gas tanker operations.
2. Refer to SIGTTO Simulation Information paper when planning application of simulation in the LNG shipping and terminal interface areas.

19.3 Vertical channel and manoeuvring area dimensions

19.3.1 General

Add the following:

1. The nautical depth approach in the design of new channels used by oil and gas carriers should be adopted in exceptional circumstances, for example when there are environmental constraints on dredging or expected excessive sedimentation rates.
2. MDS-02 Shell Shipping Under Keel Clearance policy shall be consulted at an early stage (during Assess/Select) in planning of a facility.

This Under Keel Clearance Standard (UKC) provides a common approach to the management of under keel clearance on all vessels managed or chartered by Shell.

19.3.4 Net under-keel clearance

Add the following:

1. The net UKC shall be in accordance with MDS 02 - Shell UKC policy.
 - a. Where government, state, or local regulations require greater UKC than prescribed by this standard, then the larger UKC shall be adopted.

19.4 Horizontal channel and manoeuvring area dimensions

19.4.1 Alignment and width of channels

Add the following:

For preliminary design purposes, the width of the approach channel is normally assessed on the basis of the recommendations included in (Part X, Bibliography reference 3) for the section where no tugs are used or are effective.

1. The width of the approach channel shall be confirmed with navigation studies as Clause 19.2 of BS 6349 Part 1-1:2013, if either of the following apply:
 - a. the available width of the approach channel is less than the value concluded from (Part X, Bibliography reference 3); or
 - b. where it is appropriate to reduce the width in view of the availability of tug assistance.

19.4.2 Harbour entrances and manoeuvring areas

Add to Note 3:

1. If tug assistance is available, then the preliminary layout of turning areas should be based upon a circle of diameter of two times the length of the ship.
2. Design of a turning area shall be verified by navigation simulations, using the limiting environmental conditions and the proximity of other facilities and hazards.

19.4.3 Numerical simulation methods for channel and manoeuvring area spatial design

Add the following:

1. The environmental operating limits for the facility shall be determined with numerical simulation studies, in order to inform the design-stage assessment of weather downtime for the operations envisaged at the facility.

20 Berths and mooring

20.1 General

Add the following after Note 1:

1. Jetty-based and hand-held electronic instrument systems shall be provided on all new LNG, LPG and VLCC jetties to indicate approach velocity and distance from the jetty during this manoeuvre.
2. Provision of approach velocity monitoring systems should be evaluated for jetties handling vessels other than LNG, LPG and VLCC, where berthing operations are difficult or critical.

20.2 Mooring and mooring conditions

20.2.2 Methods for assessment of acceptable wave conditions for moored ships

20.2.2.4 Numerical models

Add the following to the beginning of this clause:

1. Analytical methods shall not be used for assessment of the non-linear behaviour of a moored ship in shallow waters; unless these methods have been proven to be accurate (validation of the results is available).
2. Mathematical models that can deal with the non-linear characteristics of mooring lines, hydrodynamic damping and interacting wave fields shall be used in the evaluation of moored ship dynamic response.

Such models are based on a time-domain analysis of the response.

- a. Quasi-static models shall only be used for sheltered sites (i.e., no wave action) and subject to approval by the Principal.
3. For complex conditions where mathematical models do not accurately allow simulation of the dynamic responses of moored ships, then the use of physical modelling to evaluate dynamic response shall be subject to approval by the Principal.

21 Operability and weather downtime

Add the following to the end of this section:

1. Metocean conditions shall be defined for the assessment of expected weather downtime occurrence and persistency at the proposed location of a new or expanded jetty.
2. Metocean conditions derived by hindcasting or other forms of numerical modelling shall be validated with actual site measurements.
3. Weather downtime shall be assessed using the corresponding limiting environmental (weather, sea state, currents, visibility, ice, negative storm surges) conditions, as are derived from navigation studies and moored ship analyses.
4. Downtime analysis results should be presented as a value for the downtime ratio (duration of berth weather downtime/total duration, expressed as a percentage).
5. Downtime analysis results should include a statistical presentation of downtime persistency and on seasonal and annual variations.

**PART IV AMENDMENTS/SUPPLEMENTS TO BS 6349-1-2:2016 MARITIME WORKS - PART 1-2:
GENERAL – CODE OF PRACTICE FOR ASSESSMENT OF ACTIONS**

Section 2. Combinations of actions and structural design

4 Limit state design principles

4.2 Partial factors and combination formulae

Replace Table 1 by the following table:

Table 1 Partial factors for use in BS 6349-1-2

Action	Scenario	Item	Symbol from EN 1990	EQU (Set A)		STR/GEO (Set B)		STR/GEO (Set C)	
				unfavourable	favourable	unfavourable	favourable	unfavourable	favourable
Permanent actions ^{A)}		Steel self-weight	$\gamma_{G,sup}$ $\gamma_{G,inf}$	1.05	0.95	1.35	0.95	1.00	1.00
		Concrete self-weight	$\gamma_{G,sup}$ $\gamma_{G,inf}$	1.05	0.95	1.35	0.95	1.00	1.00
		Weight of soil and other materials	$\gamma_{G,sup}$ $\gamma_{G,inf}$	1.05	0.95	1.35	0.95	1.00	1.00
		Superimposed dead loads ^{B)}	$\gamma_{G,sup}$ $\gamma_{G,inf}$	1.05	0.95	1.35	0.95	1.00	1.00
		Geotechnical actions	$\gamma_{G,sup}$ $\gamma_{G,inf}$	1.05	0.95	1.35	0.95	1.00	1.00
		Ground water ^{C)}	$\gamma_{G,sup}$ $\gamma_{G,inf}$	1.05	0.95	1.35	0.95	1.00	1.00
		Uneven settlements	$\gamma_{G,sup}$ $\gamma_{G,inf}$	-	-	1.20 ^{D)}	-	1.00	-
		Prestressing	γ_p	As defined in EN 1992 or in the relevant Eurocode or for the individual project					
Variable actions	Road traffic actions	Road vehicles (gr1a)	γ_Q	1.35	-	1.35	-	1.15	-
		Pedestrian loads (gr1a)	γ_Q	1.35	-	1.35	-	1.15	-
		Horizontal forces (gr2)	γ_Q	1.35	-	1.35	-	1.15	-
		Pedestrian loads (gr3)	γ_Q	1.35	-	1.35	-	1.15	-