

DEP SPECIFICATION

STRUCTURAL STEEL DESIGN OF SMALL DEEPWATER OFFSHORE SKIDS, FACILITY PACKAGES, AND SUBSEA SLEDS AND MANIFOLDS

(BASED ON AISC STEEL CONSTRUCTION MANUAL ASD,
API RP 2A-WSD AND AWS D1.1)

DEP 37.81.10.31-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design of structural steel skids, facility packages, and other miscellaneous structural steel items such as subsea sleds for flowline terminations, and subsea manifolds. This DEP is based on industry practices in accordance with US Code of Federal Regulations and might not be directly applicable in other regions.

This DEP applies to small statically designed steel structures, less than 900 metric tonnes (1000 short tons), that are not subject to significant cyclic stress that may lead to fatigue failure over the structural life.

Facility packages and skids covered by this DEP are those that do not contribute to the overall integrity of the platform structural system. This DEP does not apply to deck modules, which by definition are vital to the integrity of the platform structural system.

This DEP is based on the following industry standards and the supplemental requirements in this DEP that exceed the minimum requirements of the following industry standards:

- AISC-ASD, 9th edition
- API RP 2A-WSD, 22nd Edition, November 2014
- API 2MOP, First Edition, July 2010, Reaffirmed, April 2015
- AWS D1.1/D1.1M:2015

This is a revision of the DEP of the same number dated September 2017; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to offshore oil and gas 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 **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 Specific definitions

Term	Definition
Approve/Approved or Approval	The Principal's written approval of the submitted document which is completed prior to ordering materials and/or beginning the Work.
Contract Drawings	Detailed drawings approved for construction (AFC) signed and sealed by a licensed engineer including any drawing revisions.
Standard Drawing	Standard drawings with standard details and general notes that can be used on different projects and meet industry standards.
Registered Professional Engineer	An engineer who is authorized to practice engineering, supervise engineering and provide engineering <u>professional services</u> to the public.

1.3.3 Abbreviations

Term	Definition
2D	2 dimensional
AISC	American Institute of Steel Construction
ASD	Allowable Stress Design
BOEM	Bureau of ocean energy management
NDT	Non-destructive Testing (also known as NDE)
OU	An Operating Unit of the Royal Dutch/Shell Group
PLEM	Pipeline End Manifold
PLET	Pipeline End Termination
ROV	Remotely Operated Vehicle
USCG	United States Coast Guard

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 September 2017. This is an administrative update only to correct references to DEPs that have been involved in either a merge or a split.

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://swww.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 SPECIFICATION VERSIONS

Care should be taken with application of external standards in North America because BOEM and USCG government regulations make reference to specific editions of some specifications, and do not allow substitution of more recent editions of specifications than those specifically referenced in the CFRs.

2. GENERAL REQUIREMENTS

2.1 GENERAL

1. The following specifications, regulations, and industry standards, where applicable, shall cover design, material, and construction of the steel structures in order of precedence:
 - a. Contract Drawings;
 - b. The contract Scope of Work;
 - c. DEP 37.81.10.31-Gen.;
 - d. Industry standards.
2. The Contractor shall provide a structural design criteria report with all the design codes and design requirements.

2.2 WORK

1. The Contractor shall be responsible for the detailed design of all components except for equipment, components, or designs supplied by the Principal.
2. All engineering work, drafting, administration and documentation referenced in this DEP shall be performed by the Contractor unless specifically indicated as being performed by the Principal.
3. All structural design shall be performed by or under the direction of a Registered Professional Engineer (1.3.2).
 - a. The engineer's stamp (or electronic signature) shall be applied to the structural design drawings.

3. GENERAL DESIGN REQUIREMENTS

1. Structural design shall include loads and load combinations based on operational loads, environmental loads, fabrication loads, erection/installation loads, loadout and transportation loads.
2. Basic allowable stresses shall be in accordance with section 6.1.1 of API RP 2A-WSD.
3. Increased allowable stresses may be increased by one-third in accordance with section 6.1.2 of API RP 2A-WSD.

4. MATERIALS AND INSPECTION

1. Steel material utilized in design for fabrication shall be in accordance with section 11 of API RP 2A-WSD and the standard specification drawings in (Appendix A) as applicable.

Drawings in (Appendix A) define steel designations, steel properties, welding requirements, inspection, and typical structural weld details.
2. The latest revisions and legible copies of the drawings in (Appendix A) shall be included in the Contract Drawings.
3. Material selection shall be based on primary, secondary and tertiary steel classifications as indicated on the standards drawings in (Appendix A).
4. Strength and toughness requirements shall be in accordance with sections 11.1.2 and 11.1.3 of API RP 2A-WSD.
5. General inspection requirements on drawings in (Appendix A) shall be reviewed and confirmed to meet design requirements.
 - a. Contract Drawings shall include inspection and NDE testing requirements.

6. Inspection requirements for any critical elements identified during the design shall be added to the inspection requirements.
7. Refer to DEP 37.81.10.32-Gen. for additional weld requirements that could influence material selection for subsea structures.
8. Inspection and NDE testing requirements shown on the Contractor's AFC drawings shall be subject to review and approval by the Principal.

5. DESIGN LOADS

5.1 GENERAL

1. See (10) for design loads for subsea items such as sleds for flowlines and manifolds.

5.2 DEAD LOADS

Dead loads are the weights of the structure, piping loads and any permanent equipment that do not change with the mode of operation.

1. If future equipment is planned to be installed in the structure, the weight of the equipment shall be included in the dead load.
 - a. If the weight of the future equipment is not provided, a uniform dead load shall be applied based on engineering judgement.

5.3 LIVE LOADS

5.3.1 General

Live loads include all movable items, fluids, walkways, access/egress walkways and maintenance areas.

There are two levels of live loads that are used for design.

- *Local Loads - Local framing, intercostal floor beams, grating, and cladding are designed for relatively high localized loads to increase the capacity of the local framing only.*
- *Operational Loads – Girder beams, main truss members and main support framing are designed for lower live loads compared to local loads due to the probability that the live load is not permanent and the support reactions are more realistic.*

1. If specific laydown areas are provided in the project requirements, the proposed weight of the laydown area shall be used as the design live load.

5.3.2 Live Load Design

1. The minimum required area live load to be applied in the design for the local and operational design conditions shall be as Tables 5.3.1 through 5.3.5.

Table 5.3.1 Integrated Deck Packages

	Local kN/m ² (psf)	Operating kN/m ² (psf)
Lower Deck Interior Bays	7.2 (150)	3.6 (75)
Lower Deck Wing Decks	12.0 (250)	6.0 (125)
Upper Deck	24.0 (500)	12.0 (250)

Table 5.3.2 Major Production Facility Skids

	Local kN/m² (psf)	Operating kN/m² (psf)
Open Deck Areas With Top Access	12.0 (250)	6.0 (125)
Covered Deck Areas	7.2 (150)	3.6 (75)

Table 5.3.3 Quarters Buildings

	Local kN/m² (psf)	Operating kN/m² (psf)
Floors	4.8 (100)	4.8(100)
Roof (inaccessible)	3.0 (60)	3.0 (60)
Roof (accessible to traffic)	4.8 (100)	4.8 (100)
Walkways	4.8 (100)	4.8 (100)

Table 5.3.4 Generator, Switchgear, and Compressor Buildings

	Local kN/m² (psf)	Operating kN/m² (psf)
Floors	7.2 (150)	7.2 (150)
Roof	7.2 (150)	7.2 (150)
Walkways	4.8 (100)	4.8 (100)

Table 5.3.5 Other Steel Buildings

	Local kN/m² (psf)	Operating kN/m² (psf)
Floors	12.0 (250)	12.0 (250)
Roof	7.2 (150)	7.2 (150)
Walkways	4.8 (100)	4.8 (100)

2. The design load for walkways and access ways (which are considered local framing) shall be 4.8 kN/m² (100 psf).
3. If the area under design is likely to be traversed by hand trucks, the design load shall be 7.2 kN/m² (150 psf).
4. Design loads for mezzanine decks and well bay stands shall be 3.6 kN/m² (75 psf).
5. All open areas shall have a minimum operational load of 4.8 kN/m² (100 psf).
6. The unsupported span of grating shall be checked in the grating Manufacturer/Supplier's catalogue to ensure the grating span safe working loads and deflection limits are greater than the applied design loads.

5.4 ENVIRONMENTAL LOADS

5.4.1 Wind Loads

1. The design wind criteria to be used in the small skid design shall be as shown in Table 5.4.1, with all adjustments for height from the wind reference elevation.

Table 5.4.1 Design Wind Criteria

Condition	Return Period
Operating	3 second gust with a one (1) year return period
Storm	3 second gust with a one-hundred (100) year return period
Small skid Transport	Based on tow route and exposure

2. Shielding may be used based on the requirements of section 5.3.2.6 of API RP 2A-WSD.
3. If design wind data is not provided by the Principal, the wind data shown in Table 5.5.1 shall be used.
4. The wind force calculation shall be in accordance with section 5.3.2.3 of API RP 2A-WSD.
5. Minimum wind shape coefficients shall be in accordance with section 5.3.2.5 of API RP 2A-WSD.

5.4.2 Dynamic Loads

The dynamic loads for skids on floating platforms result from the global motion accelerations of the platform in its moored configuration. The dynamic loads are calculated based on accelerations that are applied in the three degrees of motion which are lateral, longitudinal and vertical.

1. The lateral/longitudinal accelerations shall include the gravity component due to tilt.
2. The global motion acceleration return periods shall be in accordance with Table 5.4.2.

Table 5.4.2 Dynamic Criteria

Condition	Return Period
Operating	one (1) year return period
Storm	one-hundred (100) year return period

3. If design acceleration data is not provided by the Principal, the accelerations shown in Table 5.5.2 shall be used.

5.4.3 Transport Loads

1. The dynamic transport loads for the small skid shall be based on accelerations during transport to the integration site or during transport of the supporting platform along its tow route to the site, whichever is the worst case.

Generally, the loads are specified as an acceleration to be applied in the three degrees of freedom.

2. The lateral accelerations shall include the gravity component due to tilt.
3. The global motions of the barge shall be based on the specific tow route, time of year, and the duration of the tow.

4. If design acceleration data is not provided by the Principal, the accelerations shown in Table 5.5.3 shall be used.
5. If the delivery of the small skid is by ground transportation, cargo securement devices and systems loads shall be in accordance with the Principal's Operating Unit (OU) and government regulations (e.g., 49 CFR Part 393, 393.102 or applicable local requirements).

5.5 DEFAULT DESIGN ENVIRONMENTAL CRITERIA

5.5.1 General

1. If specific environmental data is not provided by the Principal, default environmental criteria in sections 5.5.2, 5.5.3, and 5.5.4 shall be used.

5.5.2 Wind Speeds

The default design wind speeds to calculate wind loads are shown in Table 5.5.1 based on wind speeds referenced from Appendix C.4 of API RP 2MET (3-second gust as applicable for small skids/packages).

Table 5.5.1 Default Design Wind Speeds

Condition	Speed m/s (knots)
Operating	31 m/s (60 knots)
Storm	66 m/s (128 knots)
Skid/package Transport	Same as Operating Condition

1. Refer to (5.4.1) for requirements related to calculation of wind pressures, wind forces, shape coefficients and shielding.

5.5.3 Dynamic Loads

The default dynamic accelerations to calculate dynamic loads are shown in Table 5.5.2.

Table 5.5.2 Default Dynamic Acceleration Factors

Condition	Acceleration Factors
Operating	Lateral/Longitudinal Acceleration = 0.10 g
	Vertical Acceleration = 0.10 g
Storm	Lateral/Longitudinal Acceleration = 0.20 g
	Vertical Acceleration = 0.15 g

5.5.4 Transport

The default transport accelerations factors to calculate the transport loads based on small barge or small boat in an open water tow are shown in Table 5.5.3 for loads where the vertical centre of gravity (COG) will not exceed 9 m (30 feet) above the barge deck based on the default transport acceleration factors shown in Table 5.5.3.

Table 5.5.3 Default Transport Acceleration Factors

Condition	Acceleration Factors
Open Water Transport	Lateral/Longitudinal Acceleration = 0.50 g
	Vertical Acceleration = 0.25 g