

STANDARD

DNVGL-ST-E273

Edition April 2016

2.7-3 Portable offshore units



FOREWORD

DNV GL standards contain requirements, principles and acceptance criteria for objects, personnel, organisations and/or operations.

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CHANGES – CURRENT

General

This document supersedes DNV Standard for Certification 2.7-3, May 2011. The previous edition of this standard should not be used for design or certification of new portable offshore units after July 30, 2016. Portable offshore units certified by DNV/DNV GL according to previous editions of this standard before this date will still be valid provided that mandatory annual inspections have successfully been carried out.

Text affected by the main changes in this edition is highlighted in red colour. However, if the changes involve a whole chapter, section or sub-section, normally only the title will be in red colour.

On 12 September 2013, DNV and GL merged to form DNV GL Group. On 25 November 2013 Det Norske Veritas AS became the 100% shareholder of Germanischer Lloyd SE, the parent company of the GL Group, and on 27 November 2013 Det Norske Veritas AS, company registration number 945 748 931, changed its name to DNV GL AS. For further information, see www.dnvgl.com. Any reference in this document to "Det Norske Veritas AS", "Det Norske Veritas", "DNV", "GL", "Germanischer Lloyd SE", "GL Group" or any other legal entity name or trading name presently owned by the DNV GL Group shall therefore also be considered a reference to "DNV GL AS".

Main changes April 2016

- Title
 - Addition of 2.7-3 in title of document.
- General
 - Reference to DNV has been changed to DNV GL.
 - Reference to DNV Portable Offshore Unit Certificate has been changed to DNV GL product certificate.
 - Reference to DNV 2.7-3 has been changed to DNV GL 2.7-3.
 - Addition of guidance notes, comments or clarification of existing requirements within the standard.
- Sec.1 General
 - Important recommendations regarding use of the standard have been added, see [\[1.1.2\]](#).
- Sec.2 Approval and certification procedures
 - Description of certification/verification procedures have been modified to reflect current practice and the DNV 2.7-1 June 2013 revision.
- Sec.3 Design
 - One additional Class R00 has been introduced to cover onshore, inshore and shipboard lifting.
 - How to consider the wave limitations for lifts in air and subsea have been clarified.

Editorial corrections

In addition to the above stated main changes, editorial corrections may have been made.

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SECTION 1 GENERAL

1.1 Scope

1.1.1 Application

This standard DNVGL-ST-E273 covers suitable requirements to portable offshore units (POUs), see [1.4.3], with respect to design, manufacturing, testing and certification.

Guidance note 1:

Offshore containers according to the definition in [1.4.4] should always be certified according to DNV 2.7-1.

Units which are neither portable offshore units nor offshore containers accordingly will not be certified to these standards. In cases where it is not obvious if a design is a portable offshore unit or an offshore container DNV GL will decide whether the design can be certified to DNV 2.7-1 or DNVGL-ST-E273 or neither of these.

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It is the intention that a POU that is certified by DNV GL according to this standard could be safely sea transported and lifted offshore including subsea (see [3.11]) anywhere in the world. Standardized frames/skids used for sea transport only may also be certified as a POU, see [3.3.3].

This standard covers the POU's main structure, supports for any permanent equipment and features important for the functionality during the transport phase.

Guidance note 2:

Structural strength etc. related to the in-place use of e.g. equipment mounted in the POU is not covered.

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The intention is that POUs shall meet the following requirements:

Be safe in use with regard to:

- life
- environment
- hazard to the vessel/installation.

Be suitable for single or repeated use in applicable cases through choice of:

- material
- protection, and
- ease of repair and maintenance.

It shall be noted that this standard covers only the POU design and it is the responsibility of the transport/installation contractor to ensure that all handling is carried out safely with due consideration to applicable HSE requirements.

1.1.2 Users and use of this standard

This standard is primarily issued to help the industry to design and produce POUs that safely can be handled during the transport phase. It is however assumed that all users of this standard have fundamental knowledge within structural engineering and safety discernment. Owners, designers and manufacturers should have a basic understanding of the requirements and limitations outlined in this standard.

The certification scheme described in this document is the scheme used by DNV GL. Organisations other than DNV GL providing certification services related to this standard may also use this scheme or they may use schemes provided by other parties. DNV GL has however no obligations or responsibility for any services related to this standard delivered by others.

DNV GL has a qualification scheme mandatory to approval engineers and surveyors providing services related to this standard. This ensures that all design approvals and certifications delivered are carried out by well qualified personnel who understand the intention behind the standard, the limitations and the correct interpretations.

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DNV GL currently brands its services in the form of "DNV 2.7-3". The term "DNV GL 2.7-3" is considered synonymous, reflecting the merger referred to in the foreword. DNV GL intends to cease the use of the term "DNV 2.7-3" from 2017-07-01 onwards; thereafter, adherence to and validity of the preceding paragraph will be unaffected.

1.1.3 Considerations

There are a number of considerations that should be made before establishing design and manufacturing criteria for construction and transport of different types or categories of POU's suitable for transport offshore. Such considerations could be:

- Single or reoccurring transport.
- Value of product may require special design and fabrication precautions.
- Transport phases, e.g. road transport, and transport conditions not adequately covered by the given requirements in this standard.
- Specially planned transport events due to size, shape, weight or other special features.

See [3.1] for design considerations.

1.1.4 Assumptions

The requirements in this standard are based on a number of assumptions regarding the handling and operation of POU's:

- A) They are lifted individually by one crane, if not otherwise specified.
- B) The maximum allowable wave height during lifting from vessel to/from vessel/platform is restricted according to the POU's operational class, see [3.3.3].
- C) Any wave restriction for subsea lifting, if applicable, needs to be assessed for each POU.
- D) The handling/lifting is carried out according to the agreed operational procedure, see [1.2.2], if any, see [1.2.1].
- E) The POU is lifted with an adequate lifting set, see e.g. [7.3].
- F) They can be lifted anywhere (world-wide) by any crane(s) with sufficient capacity and speed if not otherwise specified, e.g. due to a single transport.
- G) They are only stacked if they are designed for this and in this case only onshore or on offshore installations where permitted. Stacking during transport on ships is not covered by this standard, see [1.1.5].
- H) Cargo or loose installations are properly secured in the POU.
- I) They are handled according to IMO CSS Code, OSV Code or according to a special made transport procedure.
- J) Handling and operation is in accordance with local regulations.

Guidance note:

Local regulations may be stricter than the requirements stated in this standard and should therefore be checked.

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1.1.5 Alternative solutions

DNV GL may approve alternative solutions that are found to represent an overall safety standard equivalent to the requirements in this standard. Such approval may be revoked if subsequent information indicates that the chosen alternative is not satisfactory.

1.1.6 Types of portable offshore units

This standard groups the POU's into five types, namely; Type A, B, C, D and E. Examples of types A through E are shown in the sketches in Figure 1-1.

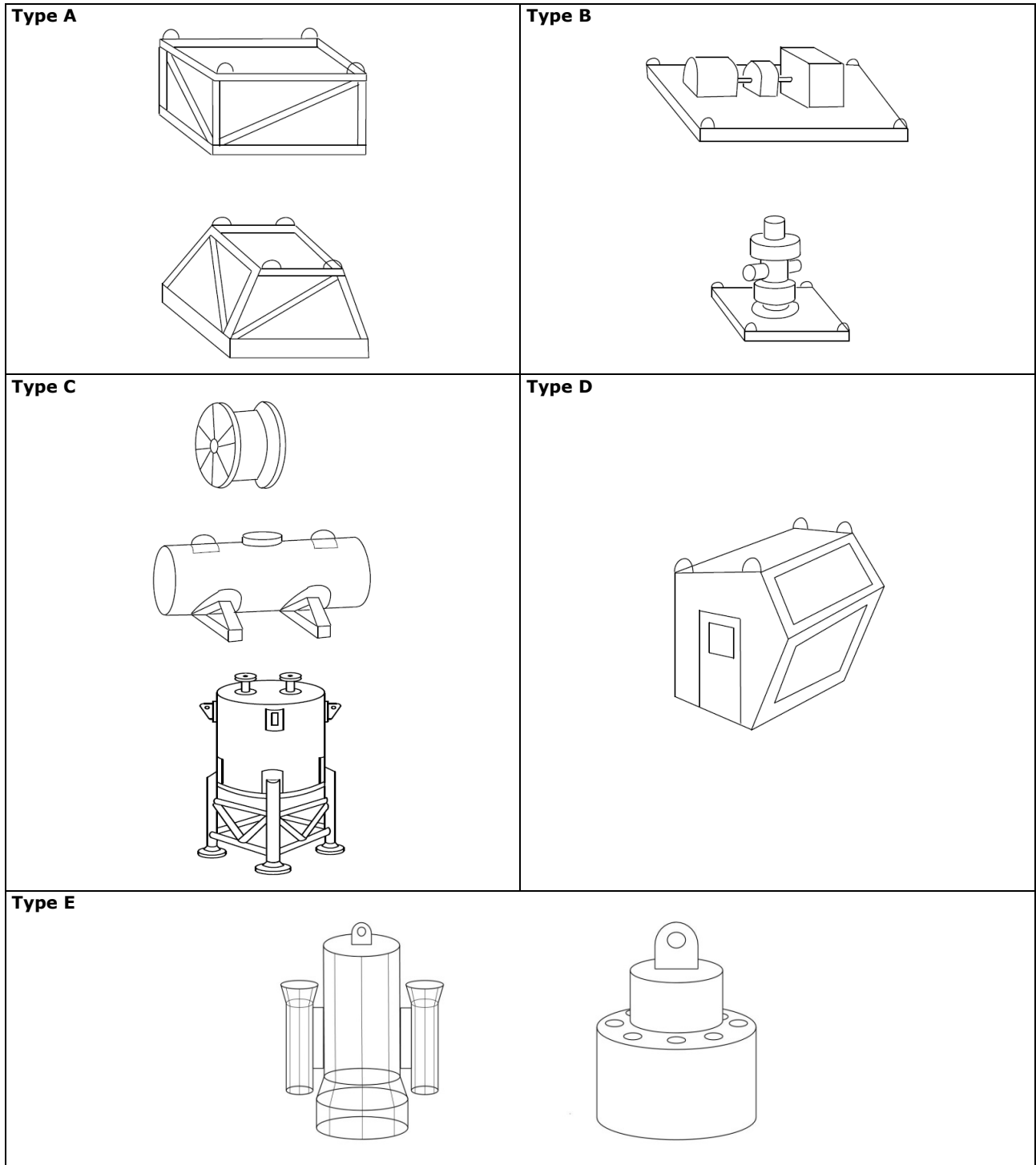


Figure 1-1 Examples of POU types

Type A is POU's with a primary structure frame (including skids arranged with crash frames). Type A units typically share many characteristics with Offshore Containers, but deviate from the definition given in DNV 2.7-1, e.g. with MGW > 25 tonnes or because they are intended for a single transport. POU's which for other reasons are not able to comply with the requirements for containers in DNV 2.7-1 may also be accepted as POU's of Type A. Type A units will typically be service packages such as pumps, generation units, coiled tubing units, skid mounted manifolds, pressure vessels or process arrangements of portable nature.

Type B is POU with skid based installations but without a primary structure frame (skids arranged without crash frames). Type B units could have installations with the same type of main functions as mentioned for Type A units. The reason for omitting the crash frame may be related to the size or shape of the POU or other considerations.

Type C is POU that lack a dedicated skid or frame. Type C units may be arranged with self-supporting feet, skirts or support points integrated in the units' own structure. Example of this type could be: x-mas trees, reels, manifolds, pressure vessels with stools, etc.

Type D is mainly boxes or units of stress skin design, where the suitability for transport is arranged in the shell through attachments and reinforcements to achieve adequate structural integrity. These types of structures do normally depend on the shell or skin to resist transport generated loads. Examples of the Type D POU would be control cabins or smaller modules for different services.

Guidance note 1:

Units which are intended for repeated offshore transport and lifting without operational restrictions should normally be Offshore Containers according to DNV 2.7-1.

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Type E is a POU that does neither fall into any of the POU types A through D nor is a DNV 2.7-1 container. It shall be agreed with DNV GL in each case if it is applicable to certify a Type E unit as a POU.

Guidance note 2:

An example of a possible Type E POU could be a tailor made type of lifting tool that is connected to a "cargo". (The cargo may be some type equipment for offshore use.) The joining between the lifting tool and the "cargo" should be a fixed connection normally by bolts, hydraulic locks or similar. It is only the lifting tool that is considered to be the POU, not the detachable cargo. Example of this type could be: running tools, pull-in heads, etc.

Type E POU are typically used when it is not practical to use either a Type C unit, where the load carrying structure of the POU is also the structure of the equipment being transported, or a load carrying skid (Type B).

See [3.5.2] for definition of design loads for some Type E POU.

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Guidance note 3:

Purpose made lifting tools (e.g. spreaders, yokes or running tools) intended for lifting of an explicitly defined unit can be certified according to DNVGL-ST-E273, either as a Type E POU or as part of a lifting set included in the certification of a POU (which is then considered as an integrated part of the POU).

Lifting equipment for general handling of cargo is not covered by DNVGL-ST-E273.

Lifting tools (loose gear) or load carrying accessories to be used in combination with a certain lifting appliance (i.e. crane) should be certified according to DNV 2.22.

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1.2 Design and operation

1.2.1 Operational aspects

For all POU it should be evaluated if there are any aspects that require special consideration or attention that may affect the design as well as arrangement and procedures for the transport event.

In many cases operational aspects could be considered adequately covered by selecting Operational Class and notations as outlined in this section. The appropriate operational class shall be agreed with DNV GL for all POU, see [3.3].

In cases where operational procedures and/or special design precautions are deemed necessary (or found beneficial) for safe handling of a POU an operational procedure shall be part of the design documentation. The procedure should if requested be submitted to DNV GL for information/review.

A procedure is always required if;

- special precautions are required to reduce the risk considered during selection of operational class, see [3.3.4], and/or
- any of the items listed in [1.2.2] below is applicable.

1.2.2 Operational procedure

The operational procedure shall include all relevant information required for a safe transport of the POU and normally include, as applicable:

- 1) Any special assumptions made in the design phase, e.g. sling angle limitations.
- 2) Any requirements/restrictions regarding support condition during sea transport.
- 3) Any requirements/restrictions regarding positioning of the POU on vessel during sea transport, see [3.7.2].
- 4) Seafastening requirements/restrictions, see [3.7.3].
- 5) Limitations due to stability, see [3.4.8].
- 6) Limitations due to reduced impact strength, see [3.6].
- 7) Safe distances to other objects during lift-off and, if applicable, set-down.
- 8) Safe handling of crane hook and lifting set, plus spreader bar if applicable.
- 9) Restrictions due to any sensitive equipment transported in the POU.
- 10) Control of horizontal motions of the POU by e.g. use of tag-/tugger lines.
- 11) Guidelines/restrictions for subsea lifts, see [1.2.4].
- 12) Description of the acceptable modes of transport, if more than one. For single transport see [1.2.3].

The need for using a specific operational procedure shall be clearly identified on the POU, see [6.2].

1.2.3 Single or repeated transport

All POUs may be certified either for a single transport or for repeated transport. Some relaxations in the requirements are granted for single transport POUs.

“Single transport” means a limited and clearly defined number of single offshore lifts throughout life time of the POU, with potentially multiple onshore, inshore and shipboard lifts included as well. Number and type of lifts should be agreed with DNV GL in each case.

Guidance note 1:

If the complete sequence of lifts throughout lifetime of a POU is clearly defined in advance, it may be certified as a “single transport event”. E.g. a unit for power supply is intended for a specific operation on board two neighbouring offshore installations. The certification may then include load-out, shipboard handling, lift from vessel to platform A, return to vessel, lift from vessel to platform B, return to vessel and finally return to shore.

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Guidance note 2:

The design requirements for a POU certified for single transport event may be somewhat relaxed. Relaxations may be related to e.g. minimum material thickness, extent of testing, exceptions from testing, marking requirements and sling minimum dimensions.

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1.2.4 Portable offshore units for subsea use

All POUs may in principle be certified for application Subsea. For these POUs the requirements in [3.11] apply in addition to the other requirements in this standard.

Guidance note:

This standard does not apply for any subsea in-place (permanent) function of the POU. Any given class restriction (i.e. the Rxx notation) applies only for lifting in air of the POU. Wave height (and period if applicable) restrictions for the subsea lift need to be evaluated/defined for each POU.

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1.2.5 Design basis

The appropriate design basis for a POU could be found based on the flowchart in Figure 1-2. The flowchart indicates how to define the Operational Class including notations.

The flowchart also indicates the requirements applicable for the different types of POUs that normally falls outside of established definitions such as offshore containers and IMDG tank containers.

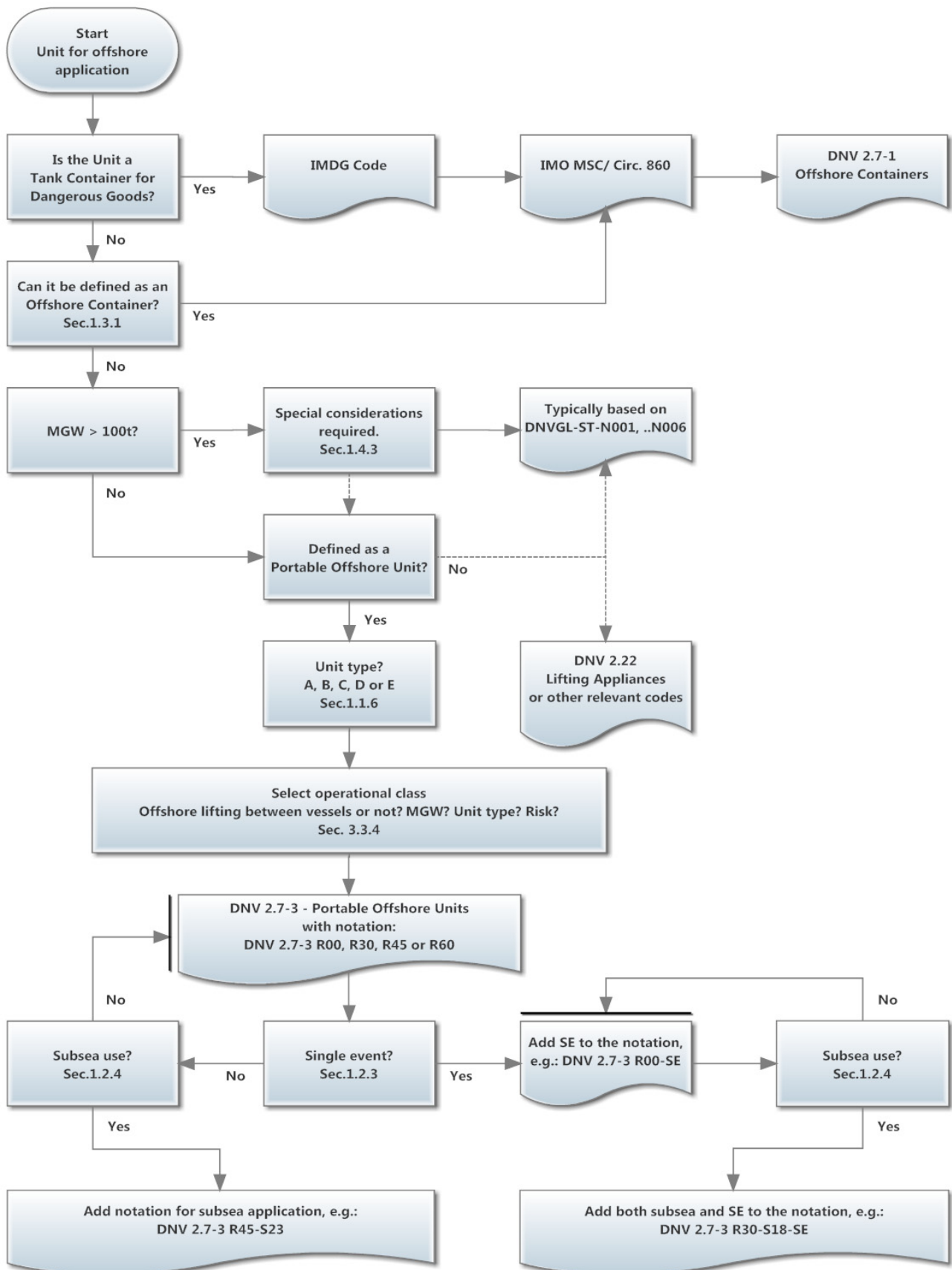


Figure 1-2 Flowchart for design basis

1.3 Relationship with other standards

1.3.1 DNV 2.7-1 - Offshore containers

This standard does not apply for units that are defined as offshore containers. Offshore containers shall be designed, manufactured and certified in accordance with the requirements in DNV 2.7-1.

1.3.2 DNVGL-ST-E272 - Offshore service modules

When a POU is designed and equipped to be installed on board a vessel/platform to perform specific services, it may be subject to regulations applying on the installation and to the area where it is placed. DNVGL-ST-E272, Offshore service modules, could be applicable as a supplementary standard for such requirements.

1.3.3 VMO Standard

For some POUs special consideration and extensive planning may be required. These events are typically governed by well-defined weather conditions and access to specialised lifting appliances. Often the transport and lifting activities fall outside of permanently installed crane capacities and require high capacity crane ships or lift barges.

It is recommended that such activities are planned and executed according to the VMO Standard. POUs that are certified by DNV GL to this standard will also fulfil the applicable strength requirements in the VMO Standard with the following restrictions:

- Operational Class R00 will normally be acceptable for onshore, inshore and shipboard lifting offshore.
- Operational Class R30 will normally be acceptable for offshore lifting to/from vessels/platforms. For operations that could be carried out under potentially adverse weather conditions ($H_s > 3.0$ m), R45 is recommended.
- Operational class notation Subsea applies for units that will be used Subsea. The design factor for this operational class assumes no slack in the crane wire, see [3.11].

1.3.4 International standards and codes

Units certified by DNV GL to this standard are not considered to be lifting accessories as defined by ILO (International Labour Organization), by the European Community Machinery Directive or by DNV GL standard for certification No. 2.22, Lifting appliances. Instead they are considered to be cargo units as defined in these codes, directives and standards.

Transport of dangerous goods (hazardous materials) in marine environment is governed by the SOLAS Convention and the IMDG Code. The IMDG Code contains definitions on requirements for different types of containers, tanks and packaging for substances to be transported.

1.3.5 National authorities

In cases where national authorities have stricter requirements, these may be incorporated in the certification procedures.

1.4 Definitions

1.4.1 Verbal forms

Verbal forms of special importance are defined as indicated below.

Table 1-1 Verbal forms

<i>Term</i>	<i>Definition</i>
shall	verbal form used to indicate requirements strictly to be followed in order to conform to the document
should	verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required
may	verbal form used to indicate a course of action permissible within the limits of the document

1.4.2 Terms

Terms of special importance are defined as indicated below.

Table 1-2 Terms

Term	Definition
DNV 2.22	generally used as a short term for DNV Standard for Certification No. 2.22 Lifting Appliances.
DNV 2.7-1	generally used as a short term for DNV Standard for Certification No. 2.7-1 Offshore Containers.
2.7-3 / DNV 2.7-3 / DNV GL 2.7-3	generally used as a short term for DNVGL-ST-E273 Portable offshore units, i.e. this standard.
lift between vessels/ platform	expression used to describe lifting of a POU from/to a vessel with a crane that is placed on another vessel or platform I.e. there may be significant relative vertical velocity between the crane tip/hook and the deck where the POU is lifted from/to.
recognised standard	national or international, code or standard, which is recognised by the majority of professional people and institutions in the marine and offshore industry It is assumed that the standard is applied correctly and that it is applicable for the intended use. If there is any doubt the acceptable use of such standard in a POU certification shall be agreed with DNV GL.
shipboard lift	expression used to describe lifting of a POU in air on a vessel/platform with a crane that is placed on the same vessel/platform I.e. there is NO significant relative vertical velocity between the crane tip/hook and the deck where the POU is lifted from/to.
subsea lifting	subsea deployment or retrieval using the available lifting equipment, such as cranes, winches or both Commonly, subsea lifts may be performed by over-boarding the POU or deploying it through the moonpool.
VMO Standard	generally used as a short term for the DNV offshore standards covering marine operations, i.e. DNV-OS-H-series, as defined in DNV-OS-H101.

1.4.3 Portable offshore unit

A POU (portable offshore unit) is a package or unit intended for repeated or single offshore transport and installation/lifting which may also be designed for subsea lifting.

Guidance note 1:

POUs typically carry equipment (or any kind of installation) intended for a service function offshore. The equipment could be an integrated part of the POU or detachable. Typical examples of POUs are given in [1.1.6].

Note that POUs are not intended to carry goods (general cargo) as their primary function but may be used for goods that is not possible/impractical or too heavy (MGW > 25 tonnes) to transport in offshore containers. Units intended for subsea application may be designed/used to carry general cargo.

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The MGW should normally not exceed 100 tonnes.

Guidance note 2:

Certification of POUs with gross mass exceeding 100 tonnes may be agreed with DNV GL. Applicable design conditions and factors will in such cases be defined by DNV GL on a case-by-case basis.

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1.4.4 Offshore container

An offshore container is a unit with a MGW not exceeding 25000 kg, for repeated use in the transport of goods or equipment, handled in open seas, to, from or between fixed and/or floating installations and ships. Offshore containers are also defined by the requirements given in DNV 2.7-1 which includes the requirement that they must have an outer framework with padeyes.

Offshore containers may be used for any purpose, either to carry cargo or with any type of fixed installations such as a winch or control cabin.

1.4.5 Freight container

A freight container is a re-usable transport container, used for international traffic and designed to facilitate the carriage of goods by one or more modes of transport (including maritime) without intermediate reloading. Freight containers are also known as CSC Containers or ISO Containers.

Guidance note:

Standard freight containers are not suitable for offshore use/lifting.

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1.4.6 Primary structure

Primary structures are divided into two sub-groups:

A - *Essential* primary structure includes the following main structural components:

- lift points
- all complex joints that participate in the global structural strength (calculations) of the POU for sea transport and lifting (and fork lifting if applicable).

Guidance note:

Complex joints mean joints where the geometry of connected elements and weld type leads to high restraint and to tri-axial stress pattern.

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B – *Other* elements, if present, which normally should also be considered as primary structure are:

- all other parts contributing to the global structure strength (calculations) of the POU not included in A
- lashing points
- fork lift pockets
- load distributing floor/deck beams/panels
- supporting structures for tanks
- supports for major equipment.

Guidance note:

Supports for equipment with a mass not exceeding 1000 kg may normally be regarded as secondary structure. However, supports for special (i.e. critical and/or with unusual geometry) equipment should be considered as primary structure also if the equipment mass is less than 1000 kg.

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1.4.7 Secondary structure

Parts which are not essentially load carrying. Secondary structure includes the following structural components:

- doors, wall and roof panels
- supports for secondary equipment
- panel stiffeners and corrugations of non-structural nature
- structural components used for protection and /or guiding only.

1.4.8 Prototype

An equipment item, considered to be representative of the production and the product to be approved, used for prototype testing. The prototype may either be manufactured specially for type testing or selected at random from a production series. If manufactured specially, it is assumed that the tools and the production process are comparable to those used for subsequent production.

1.4.9 Owner

The POU owner is the legal owner of the POU or his delegated nominee.

1.4.10 Lifting set

Items of integrated lifting equipment used to connect the POU to the lifting appliance (i.e. shackles, hooks, swivels, sockets, chains, links, rings and wire ropes).

1.4.11 List of symbols and abbreviations

Table 1-3 Symbols and abbreviations

Abbreviation	Description
CoG	centre of gravity
CoB	centre of buoyancy
DAF	dynamic amplification factor
DF	design factor
DVR	design verification report
F	design load, [kN], for lifting
F _{Air}	lift load, [kN], in air
FD	design load defined based on maximum dynamic load, [kN]
F _{Dyn}	maximum dynamic load, [kN]
F _F	fork lifting design load, [kN]
F _{Sub}	lift load, [kN], subsea
F _{HI}	horizontal design impact load, [kN]
F _{VI}	vertical design impact load, [kN]
F _H	horizontal design load sea transport, [kN]
F _{Vmin}	vertical minimum design load sea transport, [kN]
F _{Vmax}	vertical maximum design load sea transport, [kN]
g	standard acceleration of gravity ($\sim 9.81 \text{ m/s}^2$)
GN	guidance note
L	length of POU, [m]
MBL	minimum breaking load
MGW	maximum gross weight (mass). The maximum total mass of the POU including Payload, [tonnes]
MGW _{Sub}	maximum gross weight when fully submerged, [tonnes]. $\text{MGW}_{\text{Sub}} = \text{MGW} - \text{buoyancy}$
NDT	non-destructive testing
P	payload The maximum permissible weight (mass) of detachable installations and loose equipment which may safely be transported by the POU, [tonnes], $P = \text{MGW} - T$.
POU	portable offshore unit
R _e	specified minimum yield stress at room temperature, $[\text{N/mm}^2]$
R30	operational class, see [3.3.3]. (Also R00, R45 and R60)
SE	operational class notation, single transport, see [1.2.3]
SKL	skew load factor, to take into account effect of sling leg length tolerances
Sxx	operational class notation, subsea use, see [3.3.3]. (xx is limiting wave height in decimetre)
SXX	POUs without a pre-defined limiting wave height for subsea lifting
σ_e	von Mises equivalent stress, $[\text{N/mm}^2]$
σ_{ea}	allowable von Mises equivalent stress, $[\text{N/mm}^2]$
RSF	resultant sling force on padeyes, in [kN]
T	tare The mass of empty POU including all accessories and outfitting details involved in the transport of the POU, [tonnes].
TAC	type approval certificate

Table 1-3 Symbols and abbreviations (Continued)

Abbreviation	Description
tonnes	1000 kilograms [kg] or 2204.62 [lbs]
T_D	minimum design air temperature is a reference temperature used for the selection of structural material properties and associated equipment, [Deg. C]
t	material thickness, [mm]
ν	angle of the lifting set leg from vertical, [degrees]

1.5 References

1.5.1 Normative references

The documents listed below include provisions that, through references in this text, constitute provisions of this standard. The latest issue of the references shall be used unless otherwise stated.

Table 1-4 References

Document code	Title
DNV Standard for Certification No. 2.7-1	Offshore Containers
DNV-OS-H101	Marine Operations, General
DNVGL-OS-B101	Metallic materials
DNVGL-OS-C101	Design of offshore steel structures, general - LRFD method
DNVGL-RU-SHIP Pt.2 Ch.2	Rules for classification: Ships — Part 2 Materials and welding, Chapter 2 Metallic materials
EN 10164	Steel products with improved deformation properties perpendicular to the surface of the product. Technical delivery conditions

1.5.2 Informative references

The documents listed in this section include information that through references in this text, clarify and indicate acceptable methods of fulfilling the requirements given in this standard.

Table 1-5 Informative standards, codes and regulations

Document code	Title
DNV Standard for Certification No. 2.22	Lifting Appliances
DNV-OS-H205	Lifting Operations (VMO Standard Part 2-5)
DNV-RP-H103	Modelling and Analysis of Marine Operations
DNVGL-CG-0051	Non-destructive testing
DNVGL-OS-C401	Fabrication and testing of offshore structures
DNVGL-RU-SHIP-Pt.2 Ch.4	Rules for classification: Ships — Part 2 Materials and welding, Chapter 4 Fabrication and testing
DNVGL-RU-SHIP Pt.3 Ch.4	Rules for classification: Ships — Part 3 Hull, Chapter 4 Loads
DNVGL-ST-E272	2.7-2 Offshore service modules
AISC-ASD	AISC Specification for Structural Steel Buildings
ASME BPVC-IX	ASME Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications
ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
CSS Code	Code of Safe Practice for Cargo Stowage and Securing
EN 10204	Metallic products - Types of inspection documents
EN 13414-1	Steel wire rope slings - Safety - Part 1: Slings for general lifting service
EN ISO 10042	Welding - Arc-welded joints in aluminium and its alloys - Quality levels for imperfections
EN ISO 10675-2	Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 2: Aluminium and its alloys
EN ISO 11666	Non-destructive testing of welds - Ultrasonic testing - Acceptance levels
EN ISO 15607	Specification and qualification of welding procedures for metallic materials - General rules

Table 1-5 Informative standards, codes and regulations (Continued)

<i>Document code</i>	<i>Title</i>
EN ISO 15609-1	Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 1: Arc welding
EN ISO 15614 Series	Specification and qualification of welding procedures for metallic materials - Welding procedure test
EN ISO 23277	Non-destructive testing of welds - Penetrant testing - Acceptance levels
EN ISO 23278	Non-destructive testing of welds - Magnetic particle testing - Acceptance levels
EN ISO 5817	Welding. Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded). Quality levels for imperfections
EN ISO 9606-1	Qualification testing of welders - Fusion welding - Part 1: Steels
EN ISO 9606-2	Qualification test of welders - Fusion welding - Part 2: Aluminium and aluminium alloys
IMDG Code	The International Maritime Dangerous Goods Code
ISO 10675-1	Non-destructive testing of welds -- Acceptance levels for radiographic testing -- Part 1: Steel, nickel, titanium and their alloys
ISO 1161	Series 1 freight containers - Corner fittings - Specification
ISO 1496	Series 1 freight containers - Specification and testing
ISO 17020	Conformity assessment - Requirements for the operation of various types of bodies performing inspection
ISO 8501-1	Preparation of steel substrates before application of paints and related products -- Visual assessment of surface cleanliness -- Part 1
ISO 898	Mechanical properties of fasteners made of carbon steel and alloy steel
ISO 9001:2015	Quality management systems - Requirements
OSV Code	Code of safe practice for the carriage of cargoes and persons by offshore supply vessels

Guidance note:

See DNV 2.7-1 App.A List of References for further relevant informative documents.

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SECTION 2 APPROVAL AND CERTIFICATION PROCEDURES

2.1 General

POUs designed, manufactured, tested and marked in compliance with the following requirements may be certified by DNV GL. At the end of the certification process a product certificate for POU is issued by DNV GL and the DNV GL certification emblem is affixed to the POU, see [App.B](#).

The certification process includes:

- design verification
- production follow-up.

2.1.1 Application for approval

An application for approval and certification should be sent to the local DNV GL office that will forward this to the approval office, - or alternatively by email to: 273@dnvgl.com. The application shall, as found relevant, include:

- short description of the POU (size, function, special features, etc.)
- specification of any additional standards and regulations to be covered
- preferred type of approval scheme (see [\[2.1.2\]](#))
- place of manufacture
- if individual approval is sought: the number of units to be manufactured.

2.1.2 Approval schemes

If a manufacturer plans to build only one POU, or a single, limited batch of POUs, DNV GL may give an individual (case-by-case) approval valid for that batch only. The manufacturer must specify the number of POUs to be covered by the approval.

If series production is intended, or if further orders for the same POU design are expected in the future, type approval is recommended.

The company applying for type approval of a POU type must be the owner of the design, or have a written acceptance from the owner of the design that the type approval certificate can be issued in the name of the company. The company must take the sole responsibility for the conformity of the product to the applicable requirements. The company must provide information about all places of manufacture. When the POU design is manufactured at different places of manufacture, prototype testing shall normally be carried out at each manufacturing plant. Each POU manufactured according to a case-by-case or type approval shall be certified by DNV GL.

To include the lifting set in the certification process is optional. The approval schemes for lifting sets are described in [Sec.7](#).

Guidance note:

Lifting set certification may also be done as a separate process based on an internationally recognised standard. However, it is recommended that the design factors prescribed in [Sec.7](#) are duly considered.

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2.1.3 Approval to other standards

Upon request, or if considered to be a necessary part of the certification needed for a POU, DNV GL may also certify POUs to other international or national standards or regulations.

2.2 Documents for approval and information

2.2.1 General

The documentation shall be submitted to DNV GL electronically, preferably as PDF-files correctly formatted for printing, in ample time before manufacturing. The documentation shall include all information required for the certification. DNV GL may, if found necessary, at any time request additional/revise documentation.

2.2.2 Required design documentation

The following documentation shall be submitted for approval:

- A) Design drawings of main (primary) structure including:
 - a) materials to be used, e.g. reference to the relevant material specifications
 - b) dimensions and element properties
 - c) joints and particulars of joining methods (welding, bolted and pinned connections)
 - d) NDT requirements.
- B) Design drawings of lifting points, see [3.8], and other design details, see [3.9], subject to acceptance.
- C) Design drawings of other elements considered as part of the primary structure, see [1.4.6] B).
- D) Operational procedure (if deemed necessary by DNV GL). See [1.2.2].
- E) Drawings of lifting set (if applicable) showing detailed information about:
 - a) dimensions and capacities
 - b) materials
 - c) each single component including reference to certificates
 - d) certification scheme for lifting set.

The following documentation shall be submitted for review/information:

- F) General arrangement drawings showing:
 - a) any protruding parts
 - b) main dimensions
 - c) operational class
 - d) maximum gross weight (MGW), tare weight (T) and payload (P).
- G) Lifting and transport arrangement drawings showing:
 - a) sling angles
 - b) sling lengths
 - c) CoG location
 - d) lifting set components
 - e) seafastening layout
 - f) operational restrictions.
- H) Design calculations including information and justification of:
 - a) selected operational class
 - b) applied weight and CoG
 - c) applied design loads for main structure and design details
 - d) lifting set details as maximum and minimum sling angles and shackles
 - e) if applicable; calculations for lifting set.
- I) Information about intended use, as applicable:
 - a) single or multiple transports

- b) any special handling restrictions and/or an operational procedure
- c) equipment to be installed
- d) service function
- e) special loads to be applied.

J) Particulars of corrosion protection and painting (type, application, dry film thickness).

2.2.3 Survey information documents

The following documentation shall be presented to the attending DNV GL surveyor before manufacturing starts:

- A) welder qualification records
- B) welding procedures
- C) NDT operator qualifications
- D) NDT procedures
- E) corrosion protection and painting details (type, application, dry film thickness)
- F) plating and marking
- G) lifting set details, if applicable.

2.3 Design verification

As a part of the certification process DNV GL will verify applicable parts of the POU for sea transport and inshore/offshore/subsea lifting according to the design requirements in [Sec.3](#). Design verification will include review of documents and independent calculations as appropriate.

Upon completion of the design verification, DNV GL will issue a Design Verification Report (DVR) approving the POU with reference to the relevant drawings. The DVR shall clearly indicate all assumptions, conditions and limitations for the approval.

2.3.1 Content

The design verification shall include:

- applied design loads
- strength of main structure, including lift points
- design details, if applicable, see [\[3.9\]](#)
- material specifications
- welding and other joining methods.

Items that may prove a safety hazard to personnel or other equipment shall be duly considered.

Where experience and/or other findings show that safety hazard(s) may arise in connection with items not covered directly by the existing requirements, DNV GL may decide to lay down at any time supplementary requirements to maintain the overall safety standard.

2.3.2 Optional

If found applicable the design verification shall also include:

- lifting set
- supports for permanent equipment including tanks
- operational procedure.

2.3.3 Exemptions

The following are not generally included in the POU verification/certification:

- strength for in-place load conditions (e.g. of winch foundations)
- strength of any equipment, including (empty) tanks in the unit

- secondary structures
- seafastening arrangement (strong points for seafastening are included).

Design verification of any of the above items may be agreed with DNV GL on an individual basis.

2.4 Production follow-up

2.4.1 Production control

Before production starts, DNV GL should verify that the manufacturer has qualified welders and approved welding procedures, and that they are capable of manufacturing the POU.

Production shall be carried out according to the manufacturer's quality plan. During production, DNV GL will normally perform inspections in accordance with [2.4.2].

Alternatively, certification may be based on DNV GL's surveillance of the manufacturer's quality assurance system. On the basis of this system, the terms of survey and testing and the frequency of attendance by a surveyor may be defined in a manufacturing survey arrangement (MSA).

An MSA is an agreement in the form of a document stating the role of DNV GL and the manufacturer in connection with manufacturing survey and certification for a specific range of materials/components.

For each POU produced, a product certificate for POU, will be issued by an authorised DNV GL surveyor.

Guidance note 1:

An authorised DNV GL surveyor is a DNV GL employee holding the required competences for providing certification services related to this document, see [1.1.2].

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Guidance note 2:

The lifting set is often not delivered with the POU and will often be removed and replaced during the lifetime of a POU. It is not mandatory for the lifting set to be included on the product certificate.

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2.4.2 Production inspection

Manufacturing shall be under survey according to approved drawings and specifications. As a minimum DNV GL manufacturing inspection will include:

- A) General visual inspection with emphasize on checking:
 - a) POU design (details/members) according to approved drawings
 - b) weld dimensions and appearance
 - c) design details according to the risk evaluation, see [3.3.2].
- B) Confirmation of design verification assumptions, e.g. applied weight.
- C) Review of material certificates.
- D) Review of WPS/WPQ, Welders Qualification Tests, and welding consumables.
- E) Review of NDT documentation and reports.
- F) Visual inspection of marking.

In addition the DNV GL surveyor may request to include the following to the extent considered necessary:


- F) Dimensional control by independent checks and/or review of survey reports.
- G) Visual inspection of weld preparation, welding, alignment, material marking etc.
- H) Review of equipment documentation.
- I) Monitoring the adherence to essential fabrication procedures and parameters e.g. welding procedures.
- J) General monitoring of manufacturers adherence to the particular quality system requirements which could influence the overall quality of the finished product e.g. materials/consumables storage and traceability etc.

2.4.3 Testing

Testing of POU shall be carried out as indicated in [Sec.5](#). All mandatory testing shall be witnessed by the attending DNV GL surveyor.

2.4.4 Certificate and DNV GL marking

When an authorised DNV GL surveyor has ensured that the design is approved, see [\[2.3\]](#), carried out necessary survey, reviewed the production documentation and witnessed testing, the following shall be carried out:

- DNV GL product certificate for POU will be issued
- DNV GL emblem will be affixed to the POU
- "VL"  and the certificate number will be hard stamped into the name plate and into the POU primary member immediately below the name plate.

2.4.5 Maintenance of certificate

To maintain a safe condition and the validity of a certificate, the POU shall be periodically inspected as described in [Sec.8](#).

Such periodic inspection may be carried out by DNV GL or by other surveyors authorised by national authorities to carry out such inspections. However, major repairs or modifications which may alter the basis of the certificate shall be approved and recertified by DNV GL.

Inspection bodies should meet the requirements for type B inspection bodies in ISO/IEC 17020 or equivalent standards.

Inspection reports shall be attached to the POU DNV GL certificate and the inspection plate described in [\[6.4.3\]](#) shall be marked as appropriate.

After renewal or repair of damaged parts of the primary structure, the POU shall be recertified. This may include strength testing. Renewal or repair of damaged parts shall be carried out using approved manufacturing procedures and at least equivalent materials.

The repair shall be noted on the certificate and the repair report shall be attached to the certificate as an appendix.

If the POU is rebuilt, repaired with different materials or scantlings or otherwise significantly modified, a new certificate shall be issued. The old certificate shall be marked "Deleted" and attached to the new certificate.

2.4.6 Certification of existing portable offshore units

An existing POU that has not previously been certified according to this standard may be certified after special consideration by DNV GL.

All relevant available documentation shall be submitted for review. If the documentation is incomplete, additional requirements may be specified by DNV GL. This may include calculations, taking out samples to determine material properties and re-welding of important welds.

Each existing POU shall be thoroughly inspected, including the use of NDT to the extent required by the surveyor. The lifting tests as described in [Sec.5](#) may be required to be performed.

If the POU does not fully comply with the requirements of this standard, DNV GL may specify additional modifications, de-rating or other limitations.

Guidance note:

The start of the re-certification process does not necessarily mean that the units will pass it successfully. This has to be evaluated on case-by-case bases.

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2.5 Summary of procedures

The procedures for case-by-case and type approval are outlined below.

Before production starts, DNV GL shall verify the qualifications of the manufacturer. Certification emblems as shown in [App.B](#) are allocated and distributed to the local survey office by the responsible unit in DNV GL.

2.5.1 Procedure for case-by-case approval and certification

- A) Application sent to DNV GL.
- B) Order confirmed and fees agreed.
- C) Drawings, documentation and calculations reviewed and approval given by the approval unit.
- D) Prototype POU manufactured under supervision of DNV GL surveyor.
- E) POU tested according to prototype test requirements, witnessed by DNV GL surveyor.
- F) Production proceeds according to the agreed Quality Plan or Manufacturing Survey Arrangement.
- G) Production tests according to list in [\[5.4\]](#).
- H) DNV GL surveyor issues product certificate for POU and affixes emblem.

2.5.2 Procedure for type approval and certification

- A) Application sent to DNV GL.
- B) Order confirmed and fees agreed.
- C) Drawings, documentation and calculations reviewed and approval given by the approval unit.
- D) Prototype POU manufactured under supervision of DNV GL surveyor.
- E) POU tested according to prototype test requirements, witnessed by DNV GL surveyor.
- F) Test report reviewed by the approval unit.
- G) A TAC, valid for 4 years, issued to the manufacturer.
- H) **Type approved POU registered and made visible via the DNV GL website.**
- I) Production proceeds according to the agreed quality plan or manufacturing survey arrangement.
Production tests according to list in [\[5.4\]](#).
- J) DNV GL surveyor issues product certificate for POU for each POU produced and affixes emblem.

SECTION 3 DESIGN

3.1 Design conditions

3.1.1 General

A POU shall be designed in accordance to a set of main principle and pre-established criteria to promote means for safe handling and transport.

These principles and criteria shall be selected to ensure the structural integrity of the POU during its exposure to dynamic conditions that are common for an offshore transport event involving;

- sea voyages,
- lifting onshore, inshore and on board vessels/platforms offshore,
- if applicable, lifting to and from vessels/platforms offshore, and
- if applicable, lifting into (and out of) the sea.

If the POU is intended for single transport only, see [1.2.3].

3.1.2 Sea transport

The design condition for sea transport is based on unrestricted (i.e. in any weather) transport in any waters on any suitable vessel. However, special precautions may apply and if applicable reduced criteria could be used, see [3.7].

3.1.3 Offshore lifting

A POU designed for offshore lifting between vessels/platforms in compliance with this standard shall have sufficient strength and integrity to withstand dynamic forces generated when handled in a sea state of up to the significant wave height defined by the POU Operational Class, see [3.3].

The POU assessment shall be carried out based on the assumption that all lift rigging are intact during lifting. For a POU in Operational Classes R60 and R45, see [3.3.3], special load conditions apply, see [3.5.4].

The POU should be designed, where possible, to facilitate safe lifting. The following should be considered:

- Avoid protruding parts, e.g. door handles, hinges, hatch cleats and similar details should be arranged in a recessed or protected fashion.
- If protruding parts are required they shall be designed (including marking) to minimize the risk of:
 - snagging of lift rigging
 - catching with other cargo or transport vessel cargo area walls/rails.
- Avoidance of elements that the lift hook accidentally could hook on to.
- Safe handling and tensioning of lifting set. Normally this implies that use of 'loose' spreader bars is not allowed.

For POU's that will not be lifted between vessels offshore, see [3.1.4].

3.1.4 Onshore, inshore and shipboard lifting

Some POU's may not be lifted between vessels/platforms offshore. These units may be designed to only be lifted onshore, inshore or on board vessels/platforms.

For these POU's an Operational Class R00 may be selected, see [3.3.3].

3.1.5 Subsea lifting

Units lifted subsea require special design considerations, see [3.11]. POU's for subsea lifting shall also be designed (verified) for lifting in air, see [3.1.3] and [3.1.4] for alternatives.

Guidance note:

A POU may be designed for subsea handling only and no other lifting (i.e. deployed through the splash zone using an installation basket, or another method). See [3.3.3] GN-1.

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3.1.6 Design details

The applicable requirements to design details, see [3.9], should be duly considered.

3.2 Materials

3.2.1 Design temperature

The design temperature T_D shall not be taken higher than the (statistically) lowest daily mean air temperature for the area where the POU shall operate. For subsea units the lowest possible water temperature also needs to be considered. In the absence of a design temperature designation, the design temperature shall be -20°C .

3.2.2 Minimum material thickness

The following minimum material thickness shall apply:

- A) See Table 3-1.
- B) Applicable thicknesses for Type D POUs should be evaluated case-by-case.
- C) Secondary structure made of metal: $t = 2 \text{ mm}$.

Table 3-1 Minimum thickness

MGW	Single transport		Multiple transports	
	outer framework	Other	outer framework	Other
0 to 1 t	3 mm	3 mm	4 mm	4 mm
>1 to 25 t	5 mm	4 mm	6 mm	4 mm
> 25 t	6 mm	5 mm	8 mm	6 mm

Guidance note 1:

Outer frame work = base structure, corner posts etc. as per DNV 2.7-1, i.e. anything on external perimeter that may be subject to impact loading, and that forms part of the main load path

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Guidance note 2:

The thickness may be decreased below these values after special consideration. Operational Class, transport method and lifting procedures may be taken into account in such evaluations.

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3.2.3 Wrought steel

Steel shall comply with the material requirements of a recognised standard and the additional requirements specified below. The chemical composition, mechanical properties, heat treatment and weldability shall be satisfactory for the service as well as the fabrication process.

Steel shall possess adequate fracture resistance energy to avoid the initiation of brittle fracture. Steel for primary structure, see [1.4.6], should be Charpy (V-notch) impact tested in accordance to a recognised standard, e.g. DNVGL-OS-B101, ASTM A370. Austenitic stainless steels are exempt from the Charpy testing requirement.

Requirements for impact energy depend on the specified minimum yield stress of the steel. The average energy absorption for 3 base material specimens with their axis parallel to the final rolling direction shall not be less than given in Figure 3-1. For requirements to impact testing of steels with yield strength above 500 N/mm² and or thickness above 50 mm see DNVGL-OS-B101.

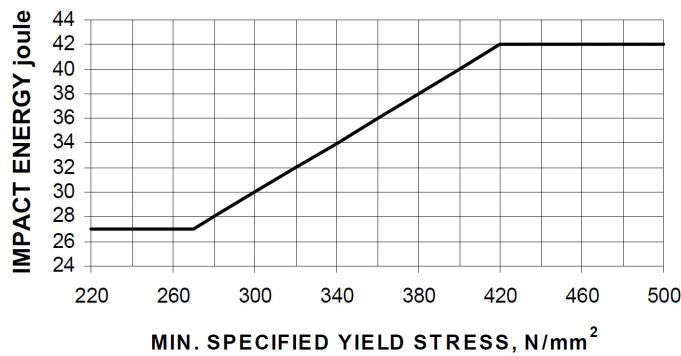


Figure 3-1 Charpy V-notch requirements for steel

Impact test temperatures shall be equal to or less than the temperatures given in [Table 3-2](#).

Table 3-2 Impact test temperature. Structural steel for primary structural members, where T_D is the nominated design temperature for the structural part affected by transport.

Material thickness, t , in mm	Impact test temp. in °C
$t \leq 6$	testing not required
$6 < t \leq 12$	$T_D + 10$
$12 < t \leq 25$	T_D
$25 < t \leq 50$	$T_D - 20$

Note: For base material specimens with their axis transverse to the final rolling direction the requirement is 2/3 of that for longitudinally oriented specimens. No single value shall be less than 70% of the required average values. If standard specimens cannot be made, the required energy values are reduced as follows:
 10×7.5 mm \rightarrow 5/6 of above values
 10×5.0 mm \rightarrow 2/3 of above values

Normalized, killed, fine grain steel with specified yield strength equal to or less than 345 N/mm² is exempt from Charpy impact testing for minimum operating temperatures of 0°C or higher if the thickness is 25 mm or less.

Steel with aging properties and steel with minimum yield strength above 690 N/mm² should not be used.

3.2.4 Lift points

Lift points shall be constructed from special or primary steel, see DNVGL-OS-C101 Sec.4 Table C1 for guidance. References for acceptance criteria are given in DNVGL-OS-B101, EN 10164 or compatible ASTM specification.

Plates that will be subjected to tensile loads, through the thickness of the plate, shall comply with EN 10164 or DNVGL-RU-SHIP Pt.2 Ch.2 Sec.2 with quality Z25 or greater.

All welds transferring load in tension shall be full penetration type. Full penetration is also recommended for welds transferring loads in shear. Fillet/partial welds may be accepted for single event lifts and may also be used for other lifts on a case-by-case basis, but see [3.4.5].

3.2.5 Steel bolts, nuts and pins

Bolt assemblies considered essential for structural integrity and operating safety shall conform to ISO 898 or other recognised standard. Impact energy shall be documented where the bolt size allows a Charpy-V specimen to be taken out, and shall be a minimum of 42J at -20°C. Nuts are normally exempt from toughness testing.

Pins used in structural connections shall conform to relevant part of EN 10083 Quenched and tempered steels or other recognized standard.

Bolts and pins for connection of padeyes and/or between a lifting tool Type E POU and the cargo shall have individual fabrication certificates, i.e. documented quality checks (proof load, ultrasonic or radiographic testing) of each single bolt.

3.2.6 Aluminium

The chemical composition, mechanical properties, heat treatment and weldability shall be satisfactory for the service as well as the fabrication process. Only wrought material, i.e. rolled or extruded, is permitted. Cast aluminium parts are not acceptable.

Aluminium alloys and tempers listed in Sec. 3.2 of DNV 2.7-1 or in DNVGL-RU-SHIP Pt.2 Ch.2 Sec.10 are acceptable for use. Other alloys or tempers will be considered subject to special evaluation.

Guidance note 1:

When materials of different galvanic potential are joined together, the design of the joint shall, in a suitable manner, prohibit galvanic corrosion.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

Special attention shall be given to the use of portable aluminium structures in areas classified as Hazardous; as National legislation may prohibit this.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

3.2.7 Non-metallic material

Timber, plywood, reinforced plastics and other non-metallic materials shall not be used in primary structure, but may be used in secondary structure.

Due regard shall be given to strength, durability, suitability and possible hazards caused by the use of non-metallic materials.

3.3 Operational class

3.3.1 General

POUs shall be assigned to an operational class that shall be selected based on the following:

- whether offshore lifting between vessels/platforms is intended or not
- design load/mass
- risk evaluation, see [3.3.2]
- type of POU, see [1.1.6].

3.3.2 Risk evaluation

The operational risk involved in offshore lifting of POUs is in this document defined as 'Low' or 'High'. Both possible consequences and probability of an incident will define the risk. The following elements are considered to increase the risk and should at least be included in the risk evaluation:

- A) Installed/transported equipment especially sensitive to impact loads.
- B) Protruding parts where the crane hook and/or lifting set could catch during tensioning.
- C) Protruding parts that may damage and/or get stuck on other (transported) items or on the transport vessel. Possible relative angles, see [3.4.8] and [3.5.6] item C, between vessel deck and POU shall be considered.
- D) Lack of roof protection so it is considered possible for the crane hook to accidentally hook onto items inside the POU.
- E) Lift points in positions where they could be damaged by impacts.
- F) Lack of proper crash framing and there is installed/transported equipment that could be damaged due to impacts.
- G) POUs of exceptional geometry or awkward (big) size.
- H) Lifting sets including (loose) spreader bar(s).

If one of the elements above is clearly applicable or at least two elements are partly present the risk level should normally be defined as "High".

In addition the following will influence the possible consequences and probability of an incident and should be considered as found applicable:

- value of the POU including equipment
- single or (number of) reoccurring transport event(s).

An operational procedure, see [1.2.2], could be used to reduce the risk level.

Guidance note:

For example if the operational procedure requires ample safety distances to other transported items and vessel rails the risk increase related to elements C), E) and F) are clearly reduced. Also ample deck space for lifting set connection combined with an extra single top leg on the lifting set could eliminate the risk involved with element D).

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3.3.3 Operational classes

The following operational classes and limiting significant wave heights are used:

- Class **R60** – Lift between vessels/platform in max Hs = 6.0 m.
- Class **R45** – Lift between vessels/platform in max Hs = 4.5 m.
- Class **R30** – Lift between vessels/platform in max Hs = 3.0 m.
- Class **R00** – Lift onshore, inshore and on board vessels/platforms offshore, but not between vessels/platform offshore.

In addition the following notations shall be used if applicable:

- POU for Subsea use: **Sxx**, where **xx** is the limiting significant wave height in decimetre (e.g. 1.3 m would be written **S13**), see [3.11.4]. Alternatively for POU without a pre-defined limiting wave height for subsea lifting: **SXX**.
- POU for single event/transport only: **SE**.

For example, for a R45 class POU for a single event and subsea use without any pre-defined wave height limitation for the subsea lifting (see [3.11.6]) the following identification applies:

DNV 2.7-3 R45-SXX-SE.

Guidance note 1:

In cases where a POU is designed for subsea handling only the operational class Rxx is not applicable and should be omitted. The notation used for such cases could e.g. be DNV 2.7-3 SXX-SE. This limitation should be clearly indicated in the certificate and also on the POU itself by e.g. the following text: "For Subsea Handling Only".

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

This format is covered by the stipulations of [1.1.2]. Accordingly, the format "DNV GL 2.7-3 R45-SXX-SE" is considered synonymous.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

For standardized frames/skids certified for sea transport only, see [1.1.1], the following POU class notation applies: **RT**.

Guidance note 3:

POU certified for sea transport only is considered as a special case and specific guidance on which requirements that apply is not given in this standard. However, generally all requirements not related to lifting should be taken into account. Further details should be agreed with DNV GL in each case.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

3.3.4 Selection of operational class

The appropriate Operational Class for a POU should be selected based on a total evaluation and agreed with DNV GL.

By using *Type*, *Risk* and *MGW* as input, Table 3-3 should be used as guidance for the (maximum) Operational Class selection for POU that will be lifted offshore between vessels/platform.

Table 3-3 Maximum operational class

Type	Risk	MGW	Class ^{c)}
A	Low	MGW ≤ 25 t	R60
A	Low	MGW > 25 t	R45
A	High	MGW ≤ 25 t	R45
A	High	MGW > 25 t	R30
B	Low	MGW ≤ 15 t	R60
B	Low	MGW > 15 t	R45
B	High	MGW ≤ 15 t	R45
B	High	MGW > 15 t	R30
C	High ^{a)}	MGW ≤ 15 t	R45
C	High ^{a)}	MGW > 15 t	R30
D	High/Low ^{b)}	MGW ≤ 10 t	R45
D	High/Low ^{b)}	MGW > 10 t	R30
E	Low	MGW ≤ 15 t	R60
E	Low	MGW > 15 t	R45
E	High	MGW ≤ 15 t	R45
E	High	MGW > 15 t	R30

a) Type C have normally no requirements to impact load calculations, see notes in [3.6.2] and [3.6.3], and should be considered as "High" risk POU.

b) R60 (R45 for MGW > 10 t) could be applicable if it is documented that the evaluated risk is "Low" and the POU global structural integrity is not sensitive to substantial local skin damage.

c) Lower Operational Class than stated above may be used.

POUs not to be lifted offshore between vessels/platform, but only on board, inshore and/or onshore may be defined as Class R00.

3.4 Analysis and acceptance criteria

3.4.1 Calculation methods

In performing design analyses for verification of structural strength alternative approaches are acceptable. It is assumed that the calculation approach covers critical details in an acceptable way and is representative for the true (planned) load (mass) distribution within the POU and the support conditions for the POU.

Only the primary structure shall be included in the design calculations. Strength of frame members may be calculated using manual calculation, 3-dimensional beam analysis or finite element modelling.

3.4.2 Load combinations

The POU shall be calculated/analysed for all relevant load combinations. Guidance on relevant load combinations is included in the design load sections. See especially [3.5.3].

3.4.3 Allowable stresses

Design loads defined in this section shall not produce von Mises equivalent stresses, σ_e , exceeding $\sigma_{ea} = 0.85 \times R_e$ (yield stress).

Guidance note 1:

$\sigma_{ea} = 0.85 \times R_e$ is valid also for impact loads as the specified magnitude of these loads have been adjusted accordingly.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

The requirement $\sigma_e \leq \sigma_{ea} = 0.85 \times R_e$ is generally applicable for stresses calculated according to beam theory.

For stresses found by FE analysis local stress $\sigma_e > \sigma_{ea}$ may be accepted, i.e. local peak stresses from linear elastic analysis in areas with pronounced geometrical changes, may exceed the yield stress provided the adjacent structural parts has capacity for the redistributed stresses.

Guidance note 2:

Advice regarding applicable accept criteria may be found in DNVGL-RU-SHIP Pt.3 Ch.7.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

For allowable stresses in aluminium, reference is made to DNVGL-RU-SHIP Pt.2 Ch.2 Sec.10 Other materials may be approved after special consideration.

Guidance note 3:

The von Mises equivalent stress design calculation method specified in Sec.3 may be replaced by the principal stress method, defined in AISC-ASD. If the principal stress method is chosen, all calculation in the sections noted below must be made by the principal stress method. The following (main) limiting stresses apply:

- tension stress: $0.6 \times R_e$
- combined tension and bending stress in beam: $0.66 \times R_e$
- shear stress: $0.4 \times R_e$.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

3.4.4 Buckling resistance

All plates and members subject to compression stress shall be verified/assessed for buckling. The allowable buckling stress/capacity shall be calculated based on a recognised standard applying elastic stress distribution.

The maximum allowable utilisation factor shall be taken as 0.85.

3.4.5 Welding

Essential and non-redundant primary structural members should be welded with full penetration welds, see also [3.2.4] and [3.9.3].

Weld strength shall be based on the nominal weld area and the stress intensity produced by the design load. The allowable stress for the weld shall be $\sigma_{ea} = 0.85 \times R_e$ (yield stress). R_e is the lowest yield stress in the base materials, but does not need to be taken less than 355 MPa for fillet welds in steel structures.

The utilization factors for fillet welds and partial penetration welds if used in the essential and non-redundant primary structure shall be maximum as indicated in Table 3-4.

Table 3-4 Welding maximum utilization factors

Case/weld	Fillet	Partial penetration ¹⁾
Single event	0.8	1.0
Multiple event	0.6	0.8

¹⁾ Also for partial penetration weld plus fillet weld where the throat area of the fillet weld is equal to or less than the stress area of the partial penetration weld.

3.4.6 Deflections

Deflections of single members under any load condition shall not:

- A) be greater than specified by the owner/buyer
- B) complicate safe handling
- C) introduce unacceptable loads in equipment due to relative deflection of their supports
- D) **cause impact of the structure with the cargo.**

3.4.7 Minimum material thicknesses

Minimum material thicknesses are specified in [3.2.2] to ensure durability and a minimum resistance against local damages in the design of portable POUs.

3.4.8 Stability against overturning

The sea transport design loads should not cause uplift in any corner of the POU, see [3.7]. If necessary, uplift shall be prevented by use of appropriate seafastenings, see [3.7.3].

In order to ensure adequate stability prior to lift-off, after removal of seafastenings, the POU should be stable at the following design angle of tilt:

- Operational Class R60: 30°

- Operational Class R45: 23°
- Operational Class R30: 15°
- **Operational Class R00: 15°**

In cases where the above criteria cannot be met the operational procedure shall describe appropriate actions, including maximum allowable angle of tilt. The allowable tilting angle should in this case be taken as maximum 1/2 of the design tilting angle.

Guidance note:

Maximum allowable angle of tilt shall be marked on the POU.

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3.4.9 Maximum gross weight

The maximum gross weight (MGW) - mass, is defined as: $MGW = T + P$, where;

- T is tare weight (mass) of the POU. The weight should be found by weighing or documented by a reasonable conservative weight estimate.
- P is maximum allowable pay load for the POU. Normally this will be known equipment for which the weight should be found by weighing or documented by a reasonable conservative weight estimate.

3.4.10 Load application

The design loading should be applied as accurately as possible. The loading shall be distributed to members and joints according to the mass distribution. Loads from equipment and associated supports shall be taken into consideration.

3.4.11 Equipment supports

Equipment supports shall be designed to withstand maximum dynamic loading during transport and lifting operations. These shall be assessed according to the relevant equations in [3.5], [3.6] and [3.7]. MGW should be substituted with the equipment weight in the equations.

Applied equipment weights shall include relevant weight contingency.

Both vertical and horizontal loads shall be applied at the equipment CoG in order to obtain accurate support reactions.

3.5 Design loads – lifting

3.5.1 Design load basis

The design loading shall be calculated based on F (in kN), where F is the greater of F_{Air} , F_{Sub} and F_D (as applicable). The following definitions apply:

For all POUs: $F_{Air} = DF \times MGW \times g$

Where the design factor, DF, is defined according to the operational class and MGW (in tonnes) in Table 3-5:

Table 3-5 Design Factors – DF

Operational Class	MGW < 50 tonnes	MGW ≥ 50 tonnes
R60	$1.4 + 0.8 \times \sqrt{50 / MGW}$	2.2
R45	$1.4 + 0.6 \times \sqrt{50 / MGW}$	2.0
R30	$1.4 + 0.4 \times \sqrt{50 / MGW}$	1.8
R00	$1.4 + 0.1 \times \sqrt{50 / MGW}$	1.5

For subsea POU: $F_{Sub} = 2.5 \times MGW \times g$ is normally adequate, but see also [3.11].

For calculation of F_D , see [3.5.2].

3.5.2 Calculated dynamic load

For some POU's Type E it is not relevant to calculate the design load based on MGW. For these POU's, e.g. running tools, pull-in heads, the maximum dynamic load, $F_{D_{yn}}$, shall be found by calculations/analysis.

The design load (F_D) is defined by: $F_D = 1.4 \times F_{D_{yn}}$

All possible load directions shall be included in the calculations and any limitations shall be indicated in the operational procedure.

The certification may be based on a defined $F_{D_{yn}}$ that needs to be considered and verified when using the POU, see [3.11.6].

3.5.3 Design load application

For normal lift condition the design loading global strength analysis shall be based on F.

Guidance note:

Combined lifting and impact stresses should be analysed based on un-factored loads. Stresses due to vertical impact loads do not need to be combined with stresses due to other load cases.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Skew load effect shall be considered for the POU for relevant cases and members, see [3.5.4] for details.

Design of lift points and their connections shall be assessed using RSF. Combined in-plane [3.5.5] and out-of-plane [3.5.6] loads shall be considered for these elements.

3.5.4 Skew load effect

The POU shall be verified for the effect of inaccuracies in sling lengths.

POUs that need to be assessed for 2-point lifting shall be checked by considering at least one slack or inactive sling. The design load for this case shall be taken equal to $0.6 \times F$ for the structure.

Guidance note:

Lift point design (loads) should be based on the lift conditions described in [3.5.5] and [3.5.6]. For unsymmetrical rigging configurations lift points should normally be checked for 2-point lift condition as well, especially if the 2-point condition gives significant out-of-plane loads on the lift points.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Normal design lifting parameters should be sufficient to cover inaccurate lifting lengths for designs that are not subject to 2-point lift test. If accurate lifting length control sling is not possible then the above check should always be included in the design calculations.

3.5.5 Lift points – in-plane loads

The in-plane design load for a lifting point is equal to the RSF. The formula below considers both normal and skew loads.

For a single lift point: $RSF = 1.2 \times F$

For 2, 3 or 4 leg lifting arrangements, without spreader bars, the RSF on each lift point shall be calculated as follows:

$$RSF = \frac{1.2 \times SKL \times PL \times F}{\cos(\nu)}$$

Where:

ν = the angle between the sling leg and vertical. The equation is valid for 2, 3 and 4 leg lifting sets where $\nu \geq 30$ degrees. For $\nu < 30$ degrees the equation is not valid.

Guidance note 1:

The design factors should be increased for lifting sets that do not fulfil the indicated limitations, see DNV-OS-H205 for further guidance.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

SKL = Skew Load Factor due to sling length tolerances. SKL shall be taken as minimum 1.33 (assuming sling sets made of matched slings) for a 4 leg lifting set and 1.1 for 2 and 3 leg lifting sets.

Guidance note 2:

Tolerances for matched slings are indicated in EN 13414-1.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

PL = Percentage Loading of F (quasi-static calculations) in the most loaded padeye, taking into consideration most extreme location of CoG.

Guidance note 3:

For a 4 leg double symmetric lifting set, with no significant uncertainty in CoG, PL = 0.25 (25%).

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

For lifting sets with more than 4 legs, spreader bar(s) and/or $\nu < 30$ degrees; RSF on each padeye shall be calculated based on the following equation:

$$RSF = \frac{1.2 \times PL_{SKL} \times F}{\cos(\nu)}$$

PL_{SKL} = Percentage Loading of F in the padeye shall consider all skew load effects due to:

- A) most extreme location of CoG
- B) lifting set geometry
- C) maximum sling leg length tolerances
- D) maximum hoist line angle (at lift-off).

Guidance note 4:

The design factors should be increased for sling sets that does not fulfil the indicated limitations, see DNV-OS-H205 for further guidance.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

3.5.6 Lift points – out-of-plane loads

Out-of-plane loads on lift points are due to:

- A) For padeyes; design angle between sling and padeye plate planes.
- B) Lift point fabrication tolerances and deviations in sling set design considered (e.g. due to hook size).
- C) Angle of the hoist line in relation to lift points and POU CoG. For example due to:
 - a) inclined transport vessel deck during lift-off
 - b) hoist line inclination during lift-off
 - c) horizontal loads on POU from such factors as tugger lines and impact
 - d) horizontal loads from waves and current, for subsea units
 - e) tilt of object due to buoyancy, for subsea units.

Guidance note 1:

Out-of-plane load effects due to C) may be disregarded for 3 and 4 leg lifting sets, assuming slack slings are avoided.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

A) above should normally be avoided, otherwise out-of-plane loading shall be considered.

To take into account the effect of B) a 3% out-of-plane loading shall be applied in the point of action for the sling. See e.g. DNV-OS-H205 App.B for the definition of point of action for a padeye with shackle.

The following minimum hoist line angles should be considered in order to take into account effect C) (a-c):

- Operational Class R60: 20 degrees
- Operational Class R45: 15 degrees
- Operational Class R30: 10 degrees
- Operational Class R00: 5 degrees

The following combination (adding) of effects from A, B and C shall be taken into account:

- If effect of C is included B may be disregarded, but A (if applicable) shall be added.
- If effect of C is not included B and A (if applicable) shall be added.

The effect of subsea horizontal loads (d) and of possible tilt due to buoyancy (e) shall be agreed with DNV GL for each POU.

Guidance note 2:

The applicable angle to be considered needs to be assessed considering POU weight and geometry, buoyancy/CoB, lift configuration and the applicable wave limitation for the subsea lift. An angle smaller than 5 degrees should not be considered, see also [3.11.6].

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

3.5.7 Lifting with fork lift truck

The design load F_F on the primary structure shall be taken as:

$$F_F = 1.65 \times \text{MGW} \times g$$

Where fork pockets are only intended for empty handling of the POU, the design load shall be taken as

$$F_F = 1.65 \times T \times g. \text{ For marking of POU's with such pockets see [6.2].}$$

Guidance note:

See [3.9.3] for requirements to fork lift openings design details. The design load may normally be distributed equally between the two prongs. Reaction load distribution along each prong should be realistic considering the fork lift truck that will/may be used.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

3.6 Design loads - impact

3.6.1 General

Impact loads may occur during lift-off or set-down as a result of the relative velocities between transport vessel deck and the suspended load.

3.6.2 Horizontal impact

The primary structure shall be capable of withstanding a local horizontal impact at any point. Where relevant, the impact stress shall be combined with a lifting stress based on the unfactored loads.

The impact force may act in any horizontal direction on the outer framework. The load is considered to act perpendicular to the surface.

The following values shall be used for the static equivalents of impact load for corner posts and bottom rails/edge:

- R60 & R45: $F_{HI} = 0.08 \times$ the test load in Table 5-2
- R30 & R00: $F_{HI} = 0.05 \times$ the test load in Table 5-2.

For all other external primary structure reduced design loads, $F_{HIR} = 0.6 \times F_{HI}$ applies.

Guidance note:

For exposed members in a skid frame without crash frame (Type B) only impact on bottom rail/skid will apply.

Type C units are normally not structurally suitable for side impact resistance and these criteria need not be evaluated in the design review. These units should be handled as a planned transport event and due consideration should be given to handling and stowage.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Units transported in isolation from other equipment, or designated for a *single* transport, 50% of the above defined F_{HI} and F_{HIR} shall be applied.

Horizontal impact loads may be disregarded for a POU R00 that will not be lifted offshore (on own deck).

3.6.3 Vertical impact

Vertical impact shall be calculated as follows:

- 1) R45, R60 and R60-SE units shall be capable of withstanding an impact from lowering on one corner of the structure on a flat surface. This may be simulated by the test described in [5.3] or by calculation. Inertia forces acting on elevated parts of the structure shall be addressed.

Guidance note 1:

Normally non-linear dynamic FE analysis is required for the simulation of impact load testing by calculation. Analysis details should be agreed with DNV GL.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

- 2) Effect of impact loads on the bottom outer edge, due to lowering onto an uneven surface, shall be taken as: $FVI = 0.08 \times$ the test load in Table 5-2.

Guidance note 2:

Some Type C and E units may not be structurally suitable for vertical impact resistance and the above design criteria do not apply to these units. The Operational Class should be selected accordingly and a proper operational procedure should be created.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

3.7 Sea transport

3.7.1 General

The strength, including equipment supports, and stability shall be checked for loads due to the maximum accelerations and wind pressure that could occur during transport. It may also be applicable to consider forces due to sea pressure. If unknown, realistic assumptions regarding support conditions and seafastenings should be made.

3.7.2 Design forces

The accelerations, if relevant, could be based on motion data for the actual transport vessel(s), orientation of POU on vessel and maximum weather/wave conditions. Appropriate design factors considering the allowable stress given in [3.4.3], should be applied.

Guidance note 1:

The design factors and transport limitations to be noted on the POU to be agreed with DNV GL in each case.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

If no information is available a horizontal design load due to vessel motions of:

$$F_H = MGW \times g$$

should be considered in any direction and in combination with both maximum and minimum vertical loads as defined below:

$$F_{V_{max}} = 1.3 \times MGW \times g$$

$$F_{V_{min}} = 0.7 \times MGW \times g$$

In addition a horizontal design wind force of 1.0 kN/m² shall normally be considered.

Guidance note 2:

This standard does not include specific design forces for the POU due to green water loads. However, sea pressure, due to breaking waves, can induce significant loads. If not explicitly defined, due consideration shall be given to the positioning of the POU on the vessel, see [1.2.1] and [1.2.2]. Design sea pressure requirements for deck houses may be applicable, see DNV GL ship rules or alternatively DNVGL-ST-E272.

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3.7.3 Seafastening

Seafastening design details are not part of the scope of this standard.

Guidance note 1:

It is assumed that the requirements for seafastening shall be assessed for each transport taking into consideration vessel particulars, position of POU, transport route and expected weather conditions.

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POUs for multiple transports and especially POUs that may become unstable during a voyage shall have suitable strong points for securing if other solution has not been agreed with DNV GL.

Guidance note 2:

Strong points including the supporting structure in the POU should have sufficient strength to transfer the design loads. The layout of the strong points should make it feasible to secure the POU against translation and, if applicable, overturning in all directions. Easy

access to the points should be ensured. As suitable lashing securing points on the ship could be limited it is recommended to define ample direction ranges of the lashings both vertically and horizontally, see item C) below.

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The design loads for lashing points should be based on:

- A) POU MGW and applicable design accelerations, see [3.7.2].
- B) Number and position (relative to POU CoG) of the lashing points.
- C) Defined (range of) direction(s) of the lashings.
- D) Zero friction between POU and deck. If only transported on wooden deck a friction coefficient of 0.3 may be assumed.
- E) A design factor of 1.3 to account for possible uneven load distribution in an indeterminate (redundant) system and/or additional safety if a determinate (not redundant) system.

Guidance note 3:

It is recommended that the allowable load (without the 1.3 design factor) and allowable lashing (range) directions are indicated clearly on the POU.

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3.8 Lifting points

3.8.1 General

Units shall have robust lift points with ample safety against failure due to:

- material or welding failure
- overloading
- loading in unintended direction
- damage, e.g. due to impact
- inadequate fit of lifting equipment (shackles).

The above intention will be obtained by applying padeye type lifting points and following the requirements in [3.8.2] through [3.8.5].

Alternative designs could be used if equal or better safety is documented. If e.g. padears (lifting trunnions) are used the possibility of accidental disconnection of lifting set shall be duly considered.

Material requirements to lift point are given in [3.2.4].

3.8.2 Structural strength

Acceptable strength of the lift points shall be documented for the design loads defined in [3.5.5] and [3.5.6].

Distribution of the padeye forces into the load bearing structure must not exceed the allowable stress in the structure. Localized reinforcement may be necessary, i.e. for tanks, for attachments to shell plates and stressed skin POU's.

Guidelines on an acceptable method to evaluate padeye strength are given in App.A.

3.8.3 Position of lifting points

Lifting points should as far as practicable be located so that;

- they do not protrude outside the vertical boundaries of the POU,
- the sling leg loads are equal,
- the risk of fouling the lifting set by the POU or its contents is insignificant, and
- adequate stability of the lift is ensured, see also [3.11.3] item E).

3.8.4 Padeye geometry requirements

The outside radius of the padeye main plate shall be no less than the diameter of the pin hole.

The padeye thickness including cheek-plates at the hole shall not be less than 75% the inside width of a shackle suitable for the RSF of the padeye.

The padeye hole diameter should be carefully selected to fit the shackle pin diameter. For strength purposes the difference in hole and pin diameter should be as small as possible, but shackle pin maximum diameter including tolerance should be considered in order to ensure that the pin will enter the hole.

For padeyes with significant (i.e. > 10%) out-of-plane loading, it is recommended that the shackle pin diameter is not less than 94% of the padeye hole diameter.

Nominal shackle pin- and hole diameter should/could normally be applied in the strength calculations, see [App.A](#).

3.8.5 Eye bolts

Eye bolts intended for lifting may be accepted on a case-by-case basis by DNV GL for single transport events. The documented ultimate strength of the eye bolt shall be at least 3 times the RSF. De-rating of eye bolts due to angular loads shall be done in accordance with the manufacturer's recommendation. The padeye and/or nut must be positively secured to prevent accidental loosening of the threaded joint.

Guidance note:

Requirements of properties related to selected design temperature also apply to these types of padeye.

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3.9 Design details

3.9.1 ISO-corner castings

If found beneficial POU may be fitted with corner fittings according to ISO 1161 at the top and bottom for lashing purposes. However, as these corner fitting are not originally designed for conditions experienced when lifting in open seas, they shall not be used for offshore lifting.

3.9.2 Drainage

Pocket and recesses in structural arrangement that may trap liquid must have provision for drainage.

3.9.3 Fork lift pockets

POUs may be fitted with one or more sets of fork lift pockets in the bottom structure. In such cases the following shall apply:

- A) The minimum opening of the fork lift pockets shall be 200 mm × 90 mm.
- B) Fork lift pockets shall be located such that the container is stable during handling with fork lift truck. POU length, height, width, extreme position(s) of CoG and MGW (T if only empty handling) shall be taken into account.
- C) Fork pockets shall pass through the base or be attached to the base. If attached to the underside of the base rails, deflector plates shall be used.
- D) Fork pockets shall have closed top and sides.
- E) Pockets shall be located as far apart as practical considering POU geometry and applicable fork lift dimensions.

Guidance note 1:

[Table 3-6](#) indicates recommended minimum distances. For POU with well-defined CoG in loaded condition the recommended minimum distances in empty condition could be considered in the loaded condition.

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Table 3-6 Recommended fork pocket distances and operational limitations

POU length - L (m)	Min. distance between centres of pockets (mm)	Comments
L < 6	25% of L, minimum 900	Loaded handling
	900	Empty handling only
6 ≤ L ≤ 12	25% of L, maximum 2050	Loaded handling
	15% of L	Empty handling only
12 < L ≤ 18	2050	Empty handling only
L > 18	-	No pockets

- F) The bottom face of fork pockets may be fully closed or have partial openings. Such openings are not allowed in way of the bottom side girders or less than 200 mm from the inside of these girders. Openings in the bottom may be damaged by fork lift trucks. This shall be taken into account in the design and when inspecting the POU.

Guidance note 2:

Openings in the bottom of fork pockets will facilitate inspection and maintenance and will reduce the risk of loose items being retained in the pockets which could subsequently fall out during lifting operations. Placing the pockets clear of the ground will reduce the risk of picking up gravel and rocks. Openings in bottom plates shall have such size and location so as to minimize the risk that the fork prongs may penetrate or seize in the opening.

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The shear area in the bottom side rail shall be sufficient taking into account the reduction of vertical shear area in way of the fork lift pockets. If additional strengthening is placed on top of the side girder, this shall be in line with the web(s) of the bottom girder, extend at least 100 mm outside the pocket opening at each end and be welded with full penetration welds.

Guidance note 3:

The area surrounding the fork pocket openings may be damaged by the fork lift truck. Strengthening, protection or guides on the side girders at fork pocket openings may reduce damage to the side girders.

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3.9.4 Doors and hatches

This paragraph is not applicable to Type B or C POU.

Doors and hatches including hinges and locking devices shall be designed for at least the same horizontal forces as the primary structure. Locking devices shall be secure against accidental opening of the doors during transport and lifting. Double doors shall have at least one locking device on each door, locking directly to the top and bottom frame.

Locking arrangements shall be protected to prevent dislodgement by impact. Hinges shall be protected against damages from impact loads.

Doors shall be capable of being secured in the open position. If weather-tightness is required the doors shall be equipped with gaskets.

3.9.5 Tugger points

If tugger points (attachment points for handling without lifting) are fitted, they shall be:

- designed for a load equal to the MGW,
- be placed as low on the structure as practical.

3.10 POU with tanks

3.10.1 Application

This standard does not generally apply to tanks to be used for transport of cargo. I.e. it is normally assumed that any tank in a POU is empty during transport. If loads from (partly) filled tanks are requested to be included in the certification, then the following shall apply:

- A) The (maximum) loads from tank content shall be properly assessed and included both in the sea transport and lifting load cases.
- B) Maximum allowable content in tanks shall be specified in the POU operational procedure.
- C) The POU certification does not include the tank itself and hence the tank strength for transport has to be verified according to a recognised standard.
- D) Transport of dangerous goods, see [1.3.4], is not allowed in a POU.

For cargo transport tanks reference is made to DNV 2.7-1.

3.10.2 Tank mounting features

A tank may be mounted in a framed package, mounted on a skid or mounted on supports that provide tipping stability. Piping, gauging and other associated features are a part of the package. The package must meet the provisions of this standard, i.e. strength, impact resistance etc. unless specifically prohibited by the tank design standard.

3.11 Subsea application

3.11.1 General

The design requirements stipulated in this sub-section are based on the following main assumptions:

- A) The applied installation/lift procedure will ensure no slack lifting.
- B) The requirements do not cover the actual subsea use/function of the POU.

It may be found relevant to design to the POU for other conditions than indicated in [3.11.2]. In such case the design conditions may be based on DNV-OS-H206 and DNV-RP-H103. The installation procedure (e.g. stated operational restrictions) and certification marking shall take into account the applied design conditions.

3.11.2 Design condition

The effective weight of a POU and the dynamic amplification factor will vary during a subsea lift. The calculation of maximum effective weight shall include possible trapped water (when lifted out of water) and possible suction when lifted from the sea bottom.

The worst realistic combination of effective weight and dynamic amplification shall be considered. Normally it is considered adequate to base the design condition on the following factors that give the total design factor, 2.5, indicated in [3.5.1]:

- A) DAF = 2.0.
- B) (Partly) submerged weight is $0.9 \times \text{MGW}$.
- C) General design factor = 1.4.

Alternatively, it may be found applicable to define the design condition based on the calculated dynamic load, see [3.5.2].

The applied design condition always needs to be verified against the actual installation condition, see [3.11.6]. However, see also [3.11.4].

3.11.3 Design considerations

The following main design considerations shall apply:

- A) POU geometry to weight relation. In order to avoid that the final check, see [3.11.6], gives (too) low installation wave height limitations the POU drag area (A) and volume (V) should be carefully considered, see [3.11.4]. A is the POU drag area in m^2 . V is the volume of the POU + added (water) mass/volume in m^3 . See DNV-RP-H103 for further information.
- B) Structural strength requirements, see [3.11.1] and [3.11.5].
- C) Functional requirements, e.g. installation aids, as defined by contract specifications, etc.
- D) All air filled members shall be designed for the maximum hydrostatic pressure, or proper ventilation/water filling shall be ensured.
- E) Lift points below CoG should normally be avoided.
- F) Proper draining when lifted out of the water (if applicable).
- G) Lift points should be placed/installed in such a way that the risk of damage and/or accidental release of lifting set is negligible.
- H) Extended subsea application and retrieval thereafter is not covered by the basic requirements in this standard, and additional requirements shall be considered. See also [3.11.5].

3.11.4 Limiting installation wave heights

This standard does not explicitly indicate a limiting sea state for the subsea lift. However, the values in [Table 3-7](#) may be used as a rough (normally conservative) guidance.

Table 3-7 Limiting significant wave heights

Drag area (A)		Volume (V)		Limiting H_s
$A/MGW_{Sub} < 0.5$	And	$V/MGW_{Sub} < 1.0$		4.5m
$A/MGW_{Sub} < 1.0$	And	$V/MGW_{Sub} < 2.0$		3.0m
$A/MGW_{Sub} < 1.5$	And	$V/MGW_{Sub} < 3.0$		2.3m
$A/MGW_{Sub} < 2.0$	And	$V/MGW_{Sub} < 4.0$		1.8m

The following has been assumed:

- DAF = 2.0 has been used in the design, i.e. the no slack slings criteria.
- MGW_{Sub} is in tonnes, A in m^2 and V in m^3 .
- A reasonably sized installation vessel with optimised heading considering the crane position.
- Lifting through the splash zone is the critical condition. I.e. any restrictions due to landing at the bottom and/or lift wire rope resonance is not governing.
- Moonpool deployment, if applicable, is equally or less critical than deployment over vessel side.
- Horizontal wave loads corresponding to the indicated limiting wave height have been properly accounted for, see [\[3.5.6\]](#).

Guidance note:

The MGW_{Sub} should be assessed considering the maximum possible buoyancy. I.e. the POU should be considered fully submerged and a conservative water filling rate should be assumed for temporarily air-filled volumes.

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More accurate assessment of the allowable sea state may be carried out as part of the POU design process. DNV GL may review (and verify by calculations if required) such assessments and indicate the limiting sea state (significant wave height) as an optional part of the certification, see [\[3.3.3\]](#).

3.11.5 Other design loads and considerations

In addition to the basic lift load case, see [\[3.5\]](#) and [\[3.11.2\]](#), the following loads, as applicable, shall be considered:

- Local design for hydrodynamic loads, e.g. slamming loads.
- Tugger points for horizontal and rotational control.
- Guiding system for final positioning.
- Sea bottom landing loads.
- Retrieval loads.
- Hydrostatic pressure, see [\[3.11.3\]](#) D).
- For units that will be located subsea for a longer period of time it may be necessary to consider:
 - marine growth
 - corrosion
 - increased/high retrieval loads.

This standard does not offer specific design values for the above loads and verification against these loads is hence not normally a part of the DNV GL POU certification. However, the designer should consider these loads and DNV GL will request calculations if considered critical for the feasibility of the intended use of the POU. Upon request any of these loads and related design details may be included in the DNV GL certification scope.

3.11.6 Operational aspects

All assumed operational limitations shall be clearly indicated in the POU design documentation. Critical limitations should be indicated in the certificate and normally marked on the POU. Such limitations could be:

- A) Installation wave height/periods (if evaluated/applicable).
- B) Special considerations, e.g. the POU should pass splash zone with inclination.
- C) Maximum allowable water depth.
- D) Maximum allowable loads on tugger points and guiding systems.
- E) Acceptable sling angles (range).

The installation contractor needs to do a final assessment of the operation limitations based on the actual installation vessel and –procedure. See also [\[1.1.1\]](#).

Installation means on the POU, e.g. as marking, ROV grab bars, tag/tugger line connection points, skids for monitoring systems/equipment, should be installed as agreed.

SECTION 4 MANUFACTURE

4.1 General

Manufacture shall be performed according to approved drawings, specifications and procedures.

The manufacturer should present a quality plan for acceptance before production starts. Relevant production documents, see [2.2.3] and [4.7], should also be presented for acceptance before start of production.

The manufacturer shall ensure the quality of procedures and facilities by implementing a quality management system at least in accordance with ISO 9001. The quality management system shall be to the satisfaction of DNV GL. DNV GL may perform an audit at the manufacturer to verify the quality management system and that they are qualified to manufacture POUs according to this standard.

Guidance note 1:

If the quality management system at a manufacturer is not fully satisfactory, DNV GL can consider if certification of POUs is still possible, provided the scope of DNV GL surveys is adjusted accordingly.

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Guidance note 2:

It is recommended that a meeting is arranged between the manufacturer and DNV GL before the start of production of any new POU type, to agree on production and inspection procedures.

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Materials and fabrication processes used for the primary structure shall be identified with the required documentation during fabrication and on the finished product.

4.2 Materials

Metals utilized in primary structures shall as a minimum be supplied with a "Works Certificate" equivalent to an inspection certificate of type 3.1 as defined in EN 10204.

During production, and on the finished product, it shall be possible to identify the materials used for the primary structure with the corresponding documentation. A log shall be kept of the components to identify and ensure traceability of the materials. This log shall be available for final DNV GL review and in the event of later repairs.

Materials used for secondary structures shall as a minimum be supplied with a "Works Certificate" equivalent to a test report of type 2.2 as defined in EN 10204.

4.3 Welding

Welders shall be approved by DNV GL according to a recognised standard, e.g. DNVGL-OS-C401, EN ISO 9606-1, EN ISO 9606-2 or ASME BPVC-IX.

Welding procedure specifications, welding procedure qualification tests and approval of welding procedures shall be in accordance with relevant parts of DNVGL-OS-C401, DNVGL-RU-SHIP Pt.2 Ch.2, EN ISO 15607, EN ISO 15609-1, EN ISO 15614-1, EN ISO 15614-2, ASME BPVC-IX, or another recognised standard.

Welding procedures for base materials not listed in the above standards shall be qualified individually or as a group based on weldability, tensile properties and composition. The qualification requirements of ASME BPVC-IX or EN ISO 15607 shall apply to these additional qualifications.

Where approval of welding procedures and certification of welders is performed by other independent organisations, e.g. accredited or nationally approved certification bodies, recognition of such certification will be evaluated on a case-by-case basis. DNV GL reserves the right, however, to require verification of the approval when deemed necessary. Such verification may include additional NDT and/or welding tests.

A welding log shall if required by attending surveyor be maintained for final DNV GL review and in the event of later repairs.

4.4 NDT

4.4.1 Methods

NDT methods shall be chosen with due regard to the conditions influencing the sensitivity of the methods and to the welding method used.

Structural welds of all POU's shall be examined as stipulated in [Table 4-1](#) after production testing (if required).

If the welding is an oxyacetylene process (oxyfuel welding), ultrasonic and radiographic examination shall be required in addition to magnetic particle examination.

If the inspection method required in columns III and IV is not applicable, the extent of inspection in column II may be increased.

Table 4-1 NDT of structural welds

Category of member see [1.4.6]	Type of joint	Type of examination			
		I Visual	II Magnetic ¹⁾	III Ultrasonic ²⁾	IV Radiography ³⁾
Primary - Essential	Butt welds	100%	100%	-	100%
	T-joints – Full penetration welds	100%	100%	100%	-
	T-joints – Fillet- & partial penetration welds	100%	100%	-	-
Primary - Other	Butt welds	100%	20%	-	10%
	T-joints – Full penetration welds	100%	20%	20%	-
	T-joints – Fillet- & partial penetration welds	100%	20%	-	-
Secondary	All types	100%	Spot ⁴⁾	Spot ⁴⁾	Spot ⁴⁾

¹⁾ Dye penetrant examination shall be used where magnetic particle examination is not possible.
²⁾ Depending on material thickness and geometry.
³⁾ May be partly or wholly replaced by ultrasonic testing upon agreement.
⁴⁾ Spot means random examination at the discretion of the surveyor, normally 2-5%.

4.4.2 Quantity

Welds are subject to visual inspection and non-destructive testing (NDT). Unless otherwise agreed, all welds shall be 100% visually inspected.

The specified percentages refer to the total length of weld for each structural assembly in question. The categories of the structural members shall be agreed with DNV GL in each case.

Frequent repairs shall result in increased extent of NDT.

4.4.3 NDT procedures and NDT operators

NDT personnel qualifications shall be in accordance with DNVGL-CG-0051. Operators shall be certified at minimum level 2 in the testing method and industrial sector concerned. Supervisors shall, unless otherwise agreed, be certified at level 3 in the testing method and industrial sector concerned.

NDT shall be performed in accordance with agreed written procedures. The procedures shall be in accordance with DNVGL-CG-0051. Other recognised standards may be agreed based on a case-by-case consideration. The procedures shall be approved by level 3 qualified personnel.

The NDT operators shall issue reports in accordance with DNVGL-CG-0051. The NDT reports shall be approved by a minimum level 2 qualified examiner other than the operator.

4.4.4 Weld acceptance criteria

The soundness of welded joints shall comply with [Table 4-2](#), DNVGL-OS-C401 or DNVGL-RU-SHIP Pt.2 Ch.4 Sec.7. Compliance with other standards / levels may be accepted if agreed in advance.

Table 4-2 NDT acceptance criteria

Visual	Magnetic Particle	Dye Penetrant	Ultrasonic	Radiography
EN ISO 5817 ¹⁾ Level B	EN ISO 23278 Level 1	EN ISO 23277 Level 1	EN ISO 11666 Level 2	ISO 10675-1 ²⁾ Level 1

¹⁾ for aluminium EN ISO10042
²⁾ for aluminium EN ISO 10675-2

The stipulated acceptance criteria may in certain cases be modified or made more severe, at DNV GL's discretion, dependent on the local stress conditions and the limitations of the NDT-methods to determine location and size of defects.

The soundness of welds shall comply with the acceptance criteria for each of the NDT methods used. Defects exceeding the limits shall be repaired and after repair welding has been performed, the complete weld, (i.e. the repaired area plus at least 100 mm on each side) shall be subjected to at least the same NDT method(s) as specified for the original weld.

4.5 Secondary structure

Manufacturing procedures should ensure that secondary structures are fabricated and erected adequately to perform its designated function, e.g. to prevent cargo from falling out of the POU or prevent water from entering.

Welds between primary and secondary structures shall be performed as for secondary structures and shall be examined as such.

The welding procedures used for secondary structure shall be according to the relevant part of EN ISO 15607, ISO 15614-1 or other recognised standard.

Welds on secondary structures shall be examined as stipulated in Table 4-1. The requirements to qualifications of NDT operators and the NDT methods in [4.4.3] apply.

4.6 Coating and corrosion protection

POUs shall be suitable for the offshore environment by means of construction, use of suitable material and/or corrosion and paint protection.

Corrosion protection should be specially considered for POUs intended for subsea application over a longer period with no or limited access for performing periodical inspections.

All POU roofs of permanent nature, intended for access, including those constructed from checker plate shall be coated with a permanent non-slip medium.

Guidance note 1:

Steel: Surfaces to be painted should be blast cleaned to SA 2 ½ according to ISO 8501-1. Shop primers shall be inorganic zinc/ethyl/silicate based or equivalent. Paint shall have good adhesion, wear resistance and durability.

Aluminium: Surfaces to be painted shall be blast cleaned to SA 2 ½. Primer should be vinyl or epoxy based.

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Guidance note 2:

For POUs that are to be stored subsea over a longer period, the design of lifting set need to carefully consider that all lift points are sufficiently protected by the unit's corrosion protection system. Any loose lift rigging where corrosion protection cannot be guaranteed should be designed for removal/re-connection in connection with the lifting operation.


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4.7 Production documentation

4.7.1 Basis for certification

The certification of each POU shall be based on the following documentation, which is retained by the manufacturer:

- A) drawings, including a general arrangement drawing
- B) structural strength calculations/analysis
- C) design approval certificate (DVR or TAC)
- D) material documentation
- E) welding procedure qualifications (WPQ)
- F) specifications for welding procedures (WPS)
- G) welders certificates
- H) report on traceability of materials
- I) report from manufacturing inspection

- 
- J) report from dimensional control
 - K) report from non-destructive testing (NDT)
 - L) report from prototype testing
 - M) report from production testing
 - N) report from final inspection.

Parts of this documentation shall be collated in an "As Built" dossier which shall be delivered with the POU. (One dossier may cover a batch of identical POUs.)

4.7.2 As built dossier

The "As Built" dossier should at least include:

- A) general arrangement drawing
- B) material documentation
- C) welding procedure specifications (WPS)
- D) report on traceability of materials
- E) report from manufacturing inspection
- F) report from dimensional control
- G) report from non-destructive testing (NDT)
- H) report from production testing
- I) report from final inspection
- J) **DNV GL product certificate for POU).**

The various reports may be combined as practical.

SECTION 5 TESTING

5.1 Extent of testing

A test program shall be agreed with DNV GL for each POU or series of units. The program shall include prototype testing, see [5.2], [5.3] and, if applicable, production testing, see [5.4]. The extent of the testing shall be based on the guidance in Table 5-1.

Table 5-1 Extent of testing

Class	Lift testing?	2-point?	Drop test?
R60&R45	Yes	Yes	See [3.6.3]
R30	Yes	No	No
R00	Yes	No	No
R60-SE	Yes ¹⁾	Yes ¹⁾	See [3.6.3]
R45-SE	Yes ¹⁾	No	No
R30-SE	Yes ¹⁾	No	No
R00-SE	Yes ¹⁾	No	No

¹⁾ This test may be substituted by an additional design factor, see [5.2.5].

Guidance note:

Prototype tests shall not damage the POU. Hence, no special prototype has to be built for testing.

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5.2 Prototype testing - lifting

5.2.1 Test set-up

The test load shall mimic the POU MGW distribution as reasonably possible. See DNV 2.7-1 for further information.

Guidance note:

It is advised that the MGW is verified by weighing before a lift test is performed to avoid repeated load tests.

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The POU should be lifted by a lifting set with an angle to the vertical equal to the design angle. Test lifts shall be made slowly and carefully with no significant acceleration. The lift should be held for 5 minutes before measurements are made.

5.2.2 Acceptance criteria

All welds joining primary structural elements, see [1.4.6], shall be thoroughly visually examined after the testing is complete. At least 20% of the most stressed of these welds shall also be examined through NDT. Defects are not acceptable. Following the lift there shall be no permanent deformation.

Normally the deflections during the lift could be considered acceptable if they are deemed reasonable by eye. If accurately limited deflections are considered important, see e.g. [3.4.6], the following apply:

- A) Acceptance criteria for deflections shall be established.
- B) Deflections shall be monitored during the test lifts.

5.2.3 All point lifting

POUs shall be load tested with a test load according to Table 5-2. For POUs with four lifting points the all point lifting test could in some cases be substituted by carrying out the 2-point lift test for both diagonals. Such test modification shall be in agreement with DNV GL and be subject to that design calculations indicate 2-point testing as sufficient.

Table 5-2 Total test load for all point lifting test:

<i>MGW</i> ²⁾	<i>Test Load</i>
Less or equal to 25 tonnes	Minimum of F and $2.5 \times MGW \times g$
25 tonnes to 50 tonnes	$[1 - 0.01 \times (MGW^1) - 25] \times F$
50 tonnes to 100 tonnes	$0.75 \times F$
Above 100 tonnes	To be agreed with DNV GL

¹⁾ Numerical value of MGW in tonnes to be used.
²⁾ MGW to be replaced by $F_{D_{yn}}$ when applicable.

5.2.4 2-point lifting (diagonal lift test)

POUs with four padeyes that require a 2-point test shall be lifted from two diagonally located padeyes. For asymmetric structures and/or if the 2-point lift test is substituting the 4 point lift test; both diagonals shall be tested.

The test load should be taken as minimum of $0.6 F$ and $1.5 MGW \times g$ for all MGW.

Following the lift there shall be no permanent deformation.

5.2.5 Exceptions for single transport

POUs intended for a single installation and/or decommissioning lift do not require lifting tests if the design loads for lifting are increased by a factor of 1.3.

Should a situation arise that necessitates a second transport event for a POU, the related lifting may be accepted at the discretion of a DNV GL surveyor after a thorough visual inspection, and, if found necessary, also NDT inspection.

5.3 Prototype test – impact

5.3.1 General

Impact testing is optional, see [Table 5-1](#) and [\[3.6.3\]](#).

5.3.2 Test alternatives, procedures and precautions

The POU, with an internal test weight corresponding to payload P , could be either dropped (alternative 1) or lowered (alternative 2) on to a workshop floor of concrete or other rigid structure. The workshop floor may be covered with a sheeting of wood planks with thickness not exceeding 50 mm.

Warning: This test may cause tremors in buildings.

The suspended POU shall be so inclined that each of the bottom side and end members connected to the lowest corner forms an angle of not less than 5° with the floor. However, the greatest height difference between the highest and lowest point of the underside of the unit corners need not be more than 400 mm.

The impacting corner should be the one expected to have the lowest rigidity. No significant permanent damage shall occur. Cracks in welds and minor deformations may be repaired.

If the POU will contain delicate equipment, i.e. gauges or instruments, the test should occur before these items are installed.

5.3.3 Alternative 1 - drop test

This test shall simulate the POU final MGW. Internal loads equal to payload (P) or omitted equipment shall be sufficiently secured and the POU should be inclined as noted above. The POU should be suspended from a quick release hook. When released, the POU should drop freely for at least 5 cm, to give it a speed at initial impact of at least 1 m/s.

5.3.4 Alternative 2 - lowering test

Possible internal loads equal to payload (P) or omitted equipment shall be sufficiently secured and the offshore POU should be inclined as detailed above. The POU should be lowered to the floor at a constant speed of not less than 1.5 m/s.

5.4 Production testing

5.4.1 Lifting test

Provided that the exempt rule given in [5.2.5] does not apply, some POUs should be strength tested during production. An all point lifting test shall be carried out. The number of POUs to be tested shall be agreed in advance and will depend on the total number in the production series. POUs for testing shall be chosen at random after the production of a batch is finished.

Table 5-3 may be used as a guide to decide the number of POUs to be tested.

Table 5-3 Production testing

<i>Total number in series</i>	<i>Number to be tested ¹⁾</i>
1 – 5	1
6 – 10	2
11 – 20	3
21 – 40	4
> 40	10%

¹⁾ Including the prototype test.

5.4.2 Weatherproof testing

If a type of POU is specified to be weather tight, the following weather tightness tests shall be carried out:

For the prototype and 10% of the POUs in a production series, this testing shall be done with water as described in ISO 1496-1, clause 6.14 "Test No. 13 Weatherproofness".

For the remaining POUs, the water test may be replaced by simple light test, using the following procedure:

A surveyor will enter the POU. The doors are then closed, and the surveyor shall accustom him/herself to the darkness for at least 3 minutes before powerful light is shone on all external surfaces.

The enclosure shall be free from any observable light penetration.

SECTION 6 MARKING

6.1 General

Marking shall be located in a prominent place. The location and elevation shall allow the marking plates and marking text to be easily read by a person standing beside the POU.

For single event POUs the requirements to marking could be relaxed in agreements with DNV GL.

6.2 Operational class and safety marking

The following information shall be displayed on minimum two locations in characters of a contrasting colour not less than 50 mm high:

- A) The 2.7-3 Operational class identification, see [3.3.3].
- B) The maximum gross weight (mass) also if applicable the tare mass, and the payload. Alternatively, if applicable, maximum dynamic load, F_{Dyn} .
- C) If the POU needs handling according to a specific operational procedure this should also be indicated by also writing: 'Operational restrictions'.
- D) When a POU is fitted with fork pockets designed for handling the POU when empty only then the words "Empty Lift Only" shall be displayed near each set of fork pockets.
- E) Other safety markings that may be required by DNV GL.

If relevant, see [3.4.8], the maximum allowable tilting angle should be marked on the POU with e.g. a simple pictogram.

6.3 Identification and certification markings

Valid certification of a POU will be identified through a DNV GL certificate number that will be found on the information plate, see [6.4.2]. For multiple units the POU Certificate number may be complemented with a serial number as a suffix.

Further identification marking may be applicable. See DNV 2.7-1 for further guidance.

6.4 Information plates

6.4.1 General

POUs shall be fitted with an information plate. POU that is intended for multiple transport events over a period exceeding one year shall be fitted with an inspection plate.

Guidance note:

If found beneficial the information- and inspection plates may be combined in one physical plate.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Plates shall be made of corrosion resistant material securely attached in a manner designed to avoid unauthorised or accidental removal. The plates shall be fitted externally to a door, or, on POUs with no doors, in a prominent position. The location and elevation shall allow the plates to be easily read by a person standing beside the POU.

Aluminium plates and rivets have been found to be unsuitable in the offshore environment and shall not be used.

The information on the plates shall be in the English language (provision for a second language may be made at the option of the owner).

The text shall be permanently and legibly marked on the plates in characters not less than 4 mm in height.

6.4.2 Information plate

When POUs are certified by DNV GL, the information plate shall be headed

“PORTABLE OFFSHORE UNIT – DNV 2.7-3”

The plate shall contain the following information:

- A) type of POU and operational class
- B) name of manufacturer
- C) month/year of manufacture
- D) manufacturer's serial number
- E) owner's identification number
- F) maximum gross weight (tonnes/kg), or alternatively F_{Dyn} see [6.2] B)
- G) tare mass (tonnes/kg) if relevant
- H) payload (tonnes/kg) and intermediate deck payload (if applicable)
Alternatively, if applicable, the maximum dynamic load.
- I) design sling angle(s), and/or any other relevant design assumptions regarding the sling set
- J) design temperature
- K) operational restrictions and/or reference to operational procedure
- L) DNV GL certificate number
- M) DNV GL's surveyor stamp.

A recommended format for the information plate when certified by DNV GL is shown in Figure 6-1.

PORTABLE OFFSHORE UNIT		
DNV 2.7-3		
Type of POU and Operational Class		
Name of manufacturer		
Month/year of manufacture		
Manufacturer's serial number		
Owner's identification number		
Maximum gross weight	kg at	° sling angle to vertical
Tare mass	kg	
Payload	kg	
Design sling angle(s)	°	
Design temperature	°C	
Operational restrictions		
DNV GL Certificate No. and stamp		

Figure 6-1 Information plate

Guidance note:

This format is covered by the stipulations of [1.1.2]. Accordingly, the format “PORTABLE OFFSHORE UNIT DNV GL 2.7-3” is considered synonymous.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

6.4.3 Inspection plate

When POU are certified by DNV GL, the inspection plate shall be headed

“INSPECTION DATA - PORTABLE OFFSHORE UNIT – DNV 2.7-3”

The plate shall contain the following information:

- 1) DNV GL Certificate number
- 2) **Owner’s identification number**
- 3) Owner's name
- 4) Owner’s international telephone number(s)
- 5) Date of last inspection, see [8.2.2].

To avoid confusion, the plate shall not carry the date of the next inspection. Provision should be made on the plate to facilitate permanent marking to record a minimum of 9 inspections.

At each periodic or other inspection, the plate shall be marked as described in [8.2.2].

A recommended format for the inspection plate when certified by DNV GL is shown in Figure 6-2.

INSPECTION DATA		
PORTABLE OFFSHORE UNIT		
DNV 2.7-3		
DNV GL certificate number		
Owner's identification number		
Owner's name		
Owner's international telephone no(s)		
Date of last inspection		

Figure 6-2 Inspection plate

Guidance note 1:

Users of POU should regard the data plate as prima facie evidence of certification status. POU with less than 30 days currency of certification should not be shipped to any offshore installation, except by prior agreement with the shipper.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

This format is covered by the stipulations of [1.1.2]. Accordingly, the format “INSPECTION DATA - PORTABLE OFFSHORE UNIT DNV GL 2.7-3” is considered synonymous.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

If a spreader bar is certified according to this document as part of a lifting set considered as an integrated part of a POU, also the spreader bar shall be fitted with an inspection plate as described in this section.

6.5 Additional information markings (optional)

On each POU a matt black square not less than 400 × 400 mm should be provided for information markings such as destination, cargo hazard etc. This should be located on one door (where fitted), on the end of a POU without doors or the end of the tank of a tank POU.

Guidance note:

When the owner is a leasing or rental company, the words "on hire to" or "leased to" and the name of the lessee should appear immediately above the matt black square to identify the user.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Immediately below the matt black square any additional marking for electrical hazard classification (e.g. zone marking etc.) should be displayed.

6.6 Other marking

The user of the POU may add additional information marking such as owners name etc. However, to avoid misinterpretation additional marking should be kept to a minimum.

If the POU is fitted with an intermediate deck the payload of the deck shall be displayed immediately adjacent or on the edge of the deck in a position where it is clearly visible at all times, in characters of a contrasting colour not less than 50 mm high.

SECTION 7 LIFTING SETS

7.1 General requirements

The lifting set (chain or wire rope slings and shackles) shall be specially designed for use on POUs and fulfil all the strength- and quality requirements given in this section. Alternatively lifting sets certified according to DNV 2.7-1 for equal (or greater) MGW (Rating) could be used. However, DNV 2.7-1 lifting sets should normally not be used if the shackles are subject to out-of-plane loading.

Guidance note 1:

Local regulations to lifting sets may be stricter/different than the requirements stated in this standard. This standard does not identify/consider such possible local requirements.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Sling sets that are referred to in the POU certificate shall normally not be removed from the POUs except for replacement, but if properly documented, a sling set may be interchanged with an identical duplicate at the discretion of DNV GL surveyor.

Guidance note 2:

When a POU is installed for an extended period on an offshore installation, the lifting set may be removed for the duration of the installation period.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

When a lifting set on a POU is replaced, the new set shall be made to the original specification or equivalent and certified and marked accordingly.

The slings shall normally be attached to the POU by shackles in padeyes. Shackle bolts shall be secured to prevent unwanted opening of the shackle. Other attachment details shall be accepted by DNV GL on a case-by-case basis.

The manufacturer shall ensure the quality of procedures and facilities by implementing a Quality Management System at least in accordance with ISO 9001.

7.2 Approval and certification of lifting sets

Normally lifting slings (chain or wire rope) and the main components shall be type approved. Type approval procedures shall be according to DNV 2.7-1 Appendix 1 *Type Approval of Lifting Sets for Offshore Containers*. Before a type approval certificate can be issued, manufacturers of lifting sets and lifting set components will be audited by DNV GL. In order to retain the type approval, manufacturers will be audited regularly by DNV GL.

Guidance note 1:

The components which require type approval are shackles, chains, links (including master links and master link assemblies intermediate links, end links) and couplings. Wire rope, ferrules and thimbles do not have to be type approved.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

All Type Approval Certificates issued by DNV GL are made public available through DNV GL's website.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Product certificates issued by the manufacturer based on their type approval shall be according to [7.5].

In special cases DNV GL may issue product certificates instead of type approval certificates. This procedure may be used if no type approved products are available or if a manufacturer has not received a type approval certificate at the time the products are delivered. Such DNV GL product certificates may be issued for individual products or batches of products.

Lifting sets and components shall comply with a recognised standard and with the additional requirements given in this section. Design, testing and certification shall be according to the specified standard.

Guidance note 3:

Lifting sets for offshore POUs approved and certified according to this section are generally also considered to be loose lifting equipment and this should be reflected in the certificates. Where appropriate, the lifting set should be CE marked.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

7.3 Design of lifting sets

7.3.1 General

Slings shall be rated for their intended angle of use.

Normally the sling leg angle from vertical for two, three and four leg slings should be between 45° and 30°. Other sling angles can be accepted by DNV GL on a case-by-case basis.

In order to facilitate handling and improve safety, it is often advisable to use an extra (top) leg with a ring and/or link above the master link. The top link should be sized to facilitate hooking on to a crane forerunner.

Guidance note 1:

It is recommended that the master link to be attached to the crane hook should have minimum internal dimensions 270 × 140 mm.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

The lifting set shall be of sufficient length to allow easy handling by operators. The top link or master link shall be able to reach down to a height of no more than 1.3 m above the POU bottom when the sling hangs over the long side of the POU.

Where two 2-legged slings are selected to function as a 4-legged sling, they shall be calculated as for a 4-legged sling. See also [7.6] for special marking requirement.

Guidance note 2:

When 2 separate 2-legged slings are used, the angle from vertical is not the same as the angle between the 2 parts.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

7.3.2 Sling minimum dimensions and minimum breaking load

The MBL for wire rope- and chain slings connected to the POUs lift points are defined by the following requirement:

$$MBL \geq 2.0 \times RSF$$

where, MBL is the documented minimum breaking load of the sling after any required reductions due to end terminations and bending have been considered. RSF is defined in [3.5.5]. For extra top leg slings (forerunners) the RSF for a single padeye is used in the equation.

For offshore handling of POUs the minimum dimensions for wire rope slings and chain slings in Table 7-1 apply.

Table 7-1 Minimum sling diameter (D)

Class	Wire rope slings		Chain slings	
	Single event	Multiple use	Single event	Multiple use
R60	D ≥ 13 mm	D ≥ 16 mm	D ≥ 8 mm	D ≥ 10 mm
R45	D ≥ 11 mm	D ≥ 13 mm	D ≥ 7 mm	D ≥ 8 mm
R30	D ≥ 9 mm	D ≥ 11 mm	D ≥ 6 mm	D ≥ 7 mm
R00	D ≥ 9 mm	D ≥ 11 mm	D ≥ 6 mm	D ≥ 7 mm

Guidance note:

The single event limitations could also be found acceptable by DNV GL for POUs that will be subjected to a limited (≤ 10) number of transports. The slings shall be thoroughly re-inspected before each transport.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

7.3.3 Shackles

The WLL for shackles connected to the POUs lift points are defined by the following requirement:

$$WLL \geq 2.25/SF \times RSF/g \quad (SF \leq 6, \text{ see below})$$

Where:

- SF is the documented minimum safety factor, i.e. MBL/WLL, for the shackle. SF shall be limited to 6 in the equation.
- WLL is the documented Working Load Limit of the shackle in tonnes.

- RSF in kN is defined in [3.5.5]. For shackles connecting extra top leg slings (forerunners) the RSF for a single padeye is used in the equation.

Shackles that can experience significant out-of-plane loading, see [3.5.6], shall be adequate for such loading according to the manufacturer. Their WLL shall be de-rated according to the manufacturers' specification.

Guidance note:

If manufactures specification regarding de-rating due to out-of-plane loading is not available

$$WLL \geq (2.15 + 0.05 \times \text{ang})/SF \times RSF/g$$

should be fulfilled for out-of-plane angels greater than 2 degrees, where "ang" is the out-of-plane angle in degrees. $SF \leq 6$ as above.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

7.3.4 Spreader bars

Spreader bars are not considered adequate for offshore lifting without special precautions. For lifts with detailed operational procedures including weather limitations, spreader bars may be applied.

Guidance note:

Offshore lifting including spreader bars are normally limited to Operational Class R30. Higher operational class may be considered on a case-by-case basis.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

The design loads for spreader bars should be calculated based on RSF, and the acceptance criteria are defined in [3.4].

Spreader bars shall be included in the POU load test, or (e.g. in case of replacement) they shall be tested separately with the corresponding test load. For purpose built spreader bars for single transports [5.2.5] applies.

The requirements to materials, fabrication and NDT in Sec.4 apply.

Marking shall be in accordance with Sec.6.

7.3.5 Master links

The strength of master links and end links should correspond (according to a recognised standard) to the applied sling MBL and sling set geometry.

Alternatively the master link WLL (documented working load limit) shall fulfil the requirement to shackles in [7.3.3]. The RSF, in kN, defined in [3.5.5] for a single lift point shall be used in the equation.

7.4 Materials

Steels shall comply with the material requirements of the recognised standard, have good ductility at low temperatures, and be able to withstand dynamic loads.

Steels in chains, links, shackles and couplings shall be impact tested by the Charpy impact (V-notch) method in accordance with [3.2.3]. The impact test temperature shall be equal to the design air temperature T_D and the minimum average impact energy shall be 42 J. However, for welded components (chains, links etc.) it shall be sufficient only to take impact test samples in the weld with the notch centred in the fusion line. The position of the weld shall be accurately identified by etching with a suitable reagent before cutting the notches. The minimum average impact energy of the weld shall be 27 J.

Materials in wire ropes, ferrules and thimbles shall be in accordance with applicable standards.

Galvanising shall only be carried out under the control of the manufacturer of the component.

Materials used in each separate component of the lifting set (e.g. chains, bows and bolts for shackles, links and wire ropes) shall be supplied with traceable works material certificates (inspection certificates, type 3.1) according to EN 10204, or equivalent.

Other items such as thimbles and ferrules shall be supplied with material certificates according to EN 10204, test report type 2.2, or equivalent

7.5 Certificates for lifting sets and components

7.5.1 General

The certificates required by [7.2] for lifting sets and lifting set components shall contain the information specified in the relevant product standard, together with that specified in [7.5.2] or [7.5.3] as appropriate.

The lifting set certificate numbers should normally be entered on page 2 of the POU certificate and the lifting set certificates attached to the POU certificate. However, if the owner or operator has a system for keeping track of each POU and lifting set, other procedures may be used.

7.5.2 Sling certificates

Certificates for chain or wire rope slings shall at least include the following information:

- A) manufacturer's name, mark and location
- B) date of issue for the certificate (preferably in ISO format: YYYY-MM-DD)
- C) sling certificate number
- D) reference to DNV GL type approval certificate when relevant
- E) description of the sling, including unique identification number or mark; reference to each single component's unique identification mark (if new components are installed before re-certification reference to previous certificate number and the new components unique identification mark)
- F) nominal size and length of the sling
- G) minimum breaking load (MBL)
- H) date of sling manufacture or re-certification
- I) confirmation that the sling described has been designed, manufactured and tested in accordance with this standard
- J) signature of the DNV GL surveyor, or the manufacturer when they have an MSA agreement with DNV GL.

In addition:

- K) for wire rope slings, the grade of terminal fittings and the rope together with information about which standard the sling conforms to;
- L) for chain slings, the grade mark together with information about which standard the sling conforms to. For chain slings assembled by welding, cross reference to the results of any final testing of mechanical properties after heat treatment;
- M) for assembly secured slings, reference to the certificates for the shackles.

7.5.3 Component certificates

Certificates for chains, shackles, master links and master link assemblies and couplings shall at least include the following information:

- A) manufacturer's name, mark and location
- B) date of issue for the certificate (preferably in ISO format: YYYY-MM-DD)
- C) certificate number
- D) working load limit (WLL)
- E) minimum guaranteed ratio MBL/WLL
- F) reference to DNV GL type approval certificate when relevant
- G) description of the component
- H) information about which standard the component conforms to
- I) reference to material certificates or material specification including chemical composition and mechanical properties
- J) results from tests specified in the relevant product standard and this document
- K) record of the unique identification number or mark carried by the component
- L) signature of the DNV GL surveyor, or the manufacturer when they have an MSA agreement with DNV GL.

7.6 Marking of lifting sets

The various components in the lifting set shall be marked according to the applicable standard.

Shackles shall be indelibly marked with a unique identification.

Guidance note:

Such marking must be applied using "low stress" stamps, the height of which should be a minimum of 5 mm, and positioned away from areas of highest tensile stress i.e. applied to the straight section of the body adjacent to the eye.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

Slings should be marked with an identification tag permanently attached to the top assembly of the sling. More detailed requirements for marking may be found in DNV 2.7-1.

Where two 2 leg slings are selected to function as a 4 leg sling, both shall be marked as a 4 leg sling.

Marking on tags for chain and wire rope slings shall include:

- A) when applicable: the CE mark
- B) reference to this standard¹⁾
- C) the certificate number and, if applicable, the unique identification number of the sling²⁾
- D) the number of legs
- E) diameter of chain or wire rope used, including the top leg where fitted
- F) maximum MGW and corresponding Operational Class for POU to be lifted
- G) maximum angle of the sling legs from the vertical
- H) identification number of each shackle.

1) This marking shall be "DNV 2.7-3". The marking "DNV GL 2.7-3" is considered synonymous, see [1.1.2].

2) Since one certificate may cover several lifting sets, it may be necessary to include both the certificate number and a unique identification number to get a unique identification.

SECTION 8 PERIODIC EXAMINATION, TESTS AND REPAIRS

8.1 General

It is the responsibility of the owner or his appointed representative to retain current certification for each POU, to arrange for periodic inspection, to record substantial repairs, modifications or changes in identification etc., and to maintain adequate records to ensure the traceability of equipment.

The surveyor should refer to the initial certificate and the last inspection report before carrying out a periodic examination or test.

8.2 Inspection, test and repairs of portable offshore units

8.2.1 Schedule of examination and tests

POUs shall be periodically examined and tested in accordance with the schedule listed in [Table 8-1](#). The surveyor may require other or additional tests and examinations, and dismantling if found necessary.

Guidance note:

National authorities may have stricter requirements for periodical inspections.

---e-n-d---of---g-u-i-d-a-n-c-e---n-o-t-e---

When a lifting test is required, the non-destructive examination and thorough visual examination shall both be carried out after the lifting test.

After renewal or substantial repair of damaged parts of the primary structure or after modification of a POU, it shall be recertified. This may include strength testing. Renewal or repair of damaged parts shall be carried out using approved manufacturing procedures and at least equivalent materials.

The repair shall be noted on the certificate and the repair report should be attached to the certificate as an appendix.

Table 8-1 Schedule of examination and tests

Time or interval	Test/Examination			
	Lifting test as described in Sec.5	Non-destructive testing (NDT) of lifting points ²⁾	Thorough visual examination	Suffix (to be marked on plate)
At intervals not exceeding 12 months	At the discretion of the surveyor	At the discretion of the surveyor	Yes	V
At intervals not exceeding 48 months	At the discretion of the surveyor	Yes	Yes	VN
After substantial repair or alteration ¹⁾	Yes	Yes	Yes	T

¹⁾ A substantial repair or alteration means any repair and/or alteration carried out, which may, in the opinion of an inspecting body, affect elements which contribute directly to the structural integrity of the POU.
²⁾ Including primary supporting structure, if relevant

- Suffix T = indicate proof load test, non-destructive examination, and visual examination.
- Suffix VN = indicate non-destructive examination and visual examination.
- Suffix V = indicate visual examination only.

8.2.2 Marking of the inspection plate

On satisfactory completion of the examination and/or test(s), the plate should be marked with the date of inspection, the surveyor's mark and the relevant suffix as detailed in [Table 8-1](#).

8.2.3 Lifting sets

If applicable, inspection, test and repairs on lifting sets should be carried out as described in DNV 2.7-1.

8.2.4 Inspection report

When, in the opinion of the surveyor, a POU is suitable for service, an inspection report is issued. The inspection report shall be included in the "As Built" dossier, and must show the following information (as a minimum):

- A) POU identification
- B) owner's name, or delegated nominee
- C) certificate number
- D) date and number of the preceding certificate of examination, name of person who issued it and of his employer
- E) the total gross weight in kilograms applicable to the all points lifting test and the method of test (where relevant)
- F) details of NDT carried out (where relevant)
- G) a statement that the POU described was thoroughly examined and that the particulars are correct
- H) reference where appropriate to any report issued to the owner arising from the test/inspection process
- I) confirmation that the inspection plate was marked
- J) date of examination (date of signature or report also to be shown if different from date of examination)
- K) name of organisation and the signature and unique identification mark of the inspector/inspection body carrying out the examination.

Any defect or deviation from the requirements of this standard shall be recorded. The report may refer to the reasons for failure and any recommended corrective action, or note that the POU is accepted for use, but shall be kept under close scrutiny.

The report, signed by the inspector, shall be issued to the owner.

APPENDIX A PADEYE CALCULATIONS

A.1 General

Normally the design checks listed below are sufficient to verify a padeye design. However, for special padeye designs additional checks may be necessary, and the need for such checks should hence be evaluated in each case.

Cheek plates may be considered both for tear out and bearing if they are properly welded, see [A.5], and their pin hole has the same diameter and is aligned with the main plate hole.

A.2 Definitions

In the equations in this sub-section the below listed definitions are applied. Nominal dimensions could be considered.

RSF Padeye in line design load, see [3.5.5]. Note that RSF in N shall be used as input in the equations in this appendix.

σ_e Allowable stress of padeye material in MPa, see [3.4.3].

E Elastic modulus, i.e. 210 000 MPa for steel

D_{pin} Diameter of shackle pin (mm)

D_H Diameter of pinhole (mm)

t Total thickness of padeye at hole including cheek plates (mm)

a Weld throat thickness (mm)

UF Maximum allowable fillet weld utilization, see Table 3-4

R_{pad} Radius of padeye, taken as: $R_{pad} = \frac{R_{pl} \times t_{pl} + 2 \times R_{ch} \times t_{ch}}{t}$

Where: R_{pl} is minimum distance from centre hole to edge of plate

R_{ch} is radius of cheek plates (two equal plates assumed)

t_{pl} is the thickness of the padeye plate

t_{ch} is the thickness of the cheek plates

A.3 Bearing pressure

If $D_{pin} \geq 0.94 \times D_H$ the following criterion applies:

$$\sigma_e \geq 0.045 \times \sqrt{\frac{RSF \times E}{D_H \times t}}$$

For smaller pin diameter (i.e. $D_{pin} < 0.94 \times D_H$) the following criterion shall be fulfilled:

$$\sigma_e \geq 0.18 \times \sqrt{\frac{RSF \times \left(\frac{1}{D_{pin}} - \frac{1}{D_H} \right) \times E}{t}}$$

A.4 Tear out

A tear out check is normally considered sufficient to check the padeye material above the hole (i.e. in the load direction). The following criterion shall be fulfilled:

$$\sigma_e \geq \frac{2 \times RSF}{(2 \times R_{pad} - D_H) \times t}$$

A.5 Cheek plate welds

The cheek plate welds should fulfil the following criterion:

$$\sigma_e \geq \frac{RSF \times t_{ch}}{t \times D_{ch} \times a \times UF}$$

The above equation is based on the following assumptions:

- 1) The cheek plate welds will be fillet welds all around the outer edge of the cheek plate with a throat thickness of "a" in mm.
- 2) The cheek plate will be so stiff (in plane) that it is reasonable to assume that the complete weld will be active in transferring load.
- 3) The fillet welds stress components will vary all around the weld. Pure shear on the throat has been assumed.
- 4) In order to take into account possible uneven (bearing) load distribution between cheek plates and main plate the cheek plate load has been multiplied by a factor of ≈ 2 .

A.6 Combined stress

All relevant sections of the padeye from centre hole and below shall be checked for combined stresses. It shall be documented/justified that the most critical section(s) has been considered in the design calculations.

The calculated von Mises equivalent stresses shall not exceed σ_e . The single stress components may be calculated based on the following assumptions:

- 1) Shear and axial stresses: Evenly distributed.
- 2) Bending stresses: Beam theory, elastic distribution.

APPENDIX B EXAMPLE OF EMBLEM ISSUED FOR UNITS CERTIFIED BY DNV GL

B.1 Example POU emblem



Figure B-1 DNV GL emblem for POU



Figure B-2 Old DNV emblem for POU



DNV GL

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