STANDARD FOR CERTIFICATION
No. 2.7-3

PORTABLE OFFSHORE UNITS

MAY 2011

This Standard for Certification includes all amendments and corrections up to June 2011.

DET NORSKE VERITAS

FOREWORD

DET NORSKE VERITAS (DNV) is an autonomous and independent foundation with the objectives of safeguarding life, property and the environment, at sea and onshore. DNV undertakes classification, certification, and other verification and consultancy services relating to quality of ships, offshore units and installations, and onshore industries worldwide, and carries out research in relation to these functions.

Standards for Certification

Standards for Certification (previously Certification Notes) are publications that contain principles, acceptance criteria and practical information related to the Society's consideration of objects, personnel, organisations, services and operations. Standards for Certification also apply as the basis for the issue of certificates and/or declarations that may not necessarily be related to classification.

All publications may be downloaded from the Society's Web site http://www.dnv.com/.

The Society reserves the exclusive right to interpret, decide equivalence or make exemptions to this Standard for Certification.

Introduction

DNV Standard for Certification No 2.7-3 covers all other types of portable offshore units, other than offshore containers. The standard is built on the DNV Standard for Certification No 2.7-1. It is also the intention that PO Units certified according to this standard will meet all relevant requirements in DNV Rules for Planning and Execution of Marine Operations.

This document supersedes the June 2006 edition.

Main changes:

The main changes are:

— Sec.1 (General) is extensively rewritten.
— Sec.2 (Certification Procedures) has been updated mainly to reflect the 2.7-1 2006 issue.
— Sec.3 (Design) is completely rewritten, examples are:
  — A new type E has been defined
  — Design classes are introduced
  — Design factor depending on weight (and design class)
  — Maximum weight 100t (or more).
— A new Sec.5 (Testing) describes both prototype and production testing.
— Sec.7 (Operational restrictions) has been removed and operational restrictions are instead clarified in sections 1 and 3.
— Sec.8 (Lifting sets) is new.
— A new (form 49.01a) tailor made certificate form and a 2.7-3 emblem (sticker) are described.
— Former appendices A and B are removed. (Appendix A is partly included in the new Sec.3, and Appendix B is covered by a Guidance note in 3.4.2).
— A new Appendix A on padeye design has been included.

Amendment 2011-06-06:

The introduction was moved and updated.

Any comments may be sent by e-mail to *rules@dnv.com*
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Computer Typesetting (Adobe Frame Maker) by Det Norske Veritas

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1. General

1.1 Scope

1.1.1 Application

This Standard for Certification covers suitable requirements to Portable Offshore Units (PO Units), see 1.4.2, with respect to design, manufacturing, testing and certification.

Guidance note:

Offshore containers according to the definition in 1.4.3 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 will decide whether the design can be certified to DNV 2.7-1 or DNV 2.7-3 or neither of these.

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It is the intension that a PO Unit that is certified by DNV according to this standard could be safely sea transported and lifted offshore including subsea (see 3.11) anywhere in the world.

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

Guidance note:

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

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The intention is that PO Units 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.

1.1.2 Considerations

There are a number of considerations that should be made before establishing design and manufacturing criteria for construction and transportation of different types or categories of "PO Units" suitable for transportation offshore. Such considerations could be:

— Single or reoccurring transportation event(s).
— Value of product may vouch for special design and fabrication precautions.
— Transport phases, e.g. road transportation, and transport conditions not adequately covered by the given requirements in this standard.
— Specially planned transportation events due to size, shape, weight or other special features.
— See 3.1 for design considerations.

1.1.3 Assumptions

The requirements in this Standard for Certification are based on a number of assumptions regarding the handling and operation of PO units:

A) They are lifted individually by one crane.
B) They are normally **not** designed to be lifted by a sling set including spreader bar(s). However, in well controlled lifting conditions spreader bars could be accepted, see 7.3.4.
C) They can be lifted anywhere (world wide) by any crane with sufficient capacity and speed if not otherwise specified, e.g. due to a single transport event.
D) 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, but see 1.1.4 below.
E) Cargo or loose installations are properly secured in the PO Unit.
F) They are handled according to IMO's "Code of safe practice for supply vessels" or according to a special made transport procedure.
G) Handling and operation is in accordance with local regulations.

1.1.4 Alternative solutions

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

1.1.5 Types of PO Units

This Standard groups the PO Units into five types, namely; *Type A, B, C, D and E.* Examples of types A through D are shown in the sketches in Fig. 1-1.

Type A is PO Units 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 R > 25 tonnes or because they are intended for a single transport event. PO Units which for other reasons are not able to comply with the requirements for containers in DNV 2.7-1 may also be accepted as PO Units 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 PO Units 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 PO Unit or other considerations.

Type C is PO Units 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 transportation 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 transportation generated loads. Examples of the type D PO Units would be control cabins or smaller modules for different services.

Guidance note:

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

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

Guidance note:

An example of a possible Type E PO Unit 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 connection between the lifting tool and the "cargo" is normally by bolts. It is only the lifting tool that is considered to be the PO Unit, not the detachable cargo.

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

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1.2 Design and Operation

1.2.1 Operational aspects

For all PO Units 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 transportation 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 for all PO Units, see 3.3.

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

1.2.2 Operational Procedures

The operation procedure shall include all relevant information required for safe transports of the PO Unit.

A specific operational procedure could normally also be considered as a mitigation to reduce the risk considered during selection of Operational Class, see 3.3.4.

The following should, as applicable, be included in the operational procedure:

A) Any special assumptions made in the design phase. E.g. sling angle limitations.
B) Any requirements/restrictions regarding support condition during sea transport.
C) Any requirements/restrictions regarding positioning of the PO Unit on vessel during sea transport, see 3.7.2.
D) Sea fastening requirements/restrictions, see 3.7.3.
E) Limitations due to stability, see 3.4.8.
F) Limitations due to reduced impact strength, see 3.6.
G) Safe distances to other objects during lift-off and, if applicable, set-down.
H) Safe handling of crane hook and sling set.
I) Restrictions due to any sensitive equipment transported in the PO Unit.
J) Control of horizontal motions of the PO Unit by e.g. use of tag-/tugger lines.
K) Guidelines/restrictions for subsea lifts, see 1.2.4

The need for using a specific operational procedure shall be clearly identified on the PO Unit, see 6.2.

1.2.3 Single or reoccurring transport(s)

All PO Units may be certified either for a single transport or for reoccurring transports. Some relaxations in the requirements are granted for single transport PO Units. See notations in the text of this Standard for further information.

1.2.4 PO Units for subsea use

All PO Units may in principle be certified for application Subsea. For these PO Units the requirements in subsection 3.11 applies in addition to the other requirements in this Standard.

Guidance note:
This standard only apply for the transport and subsea lift phase.

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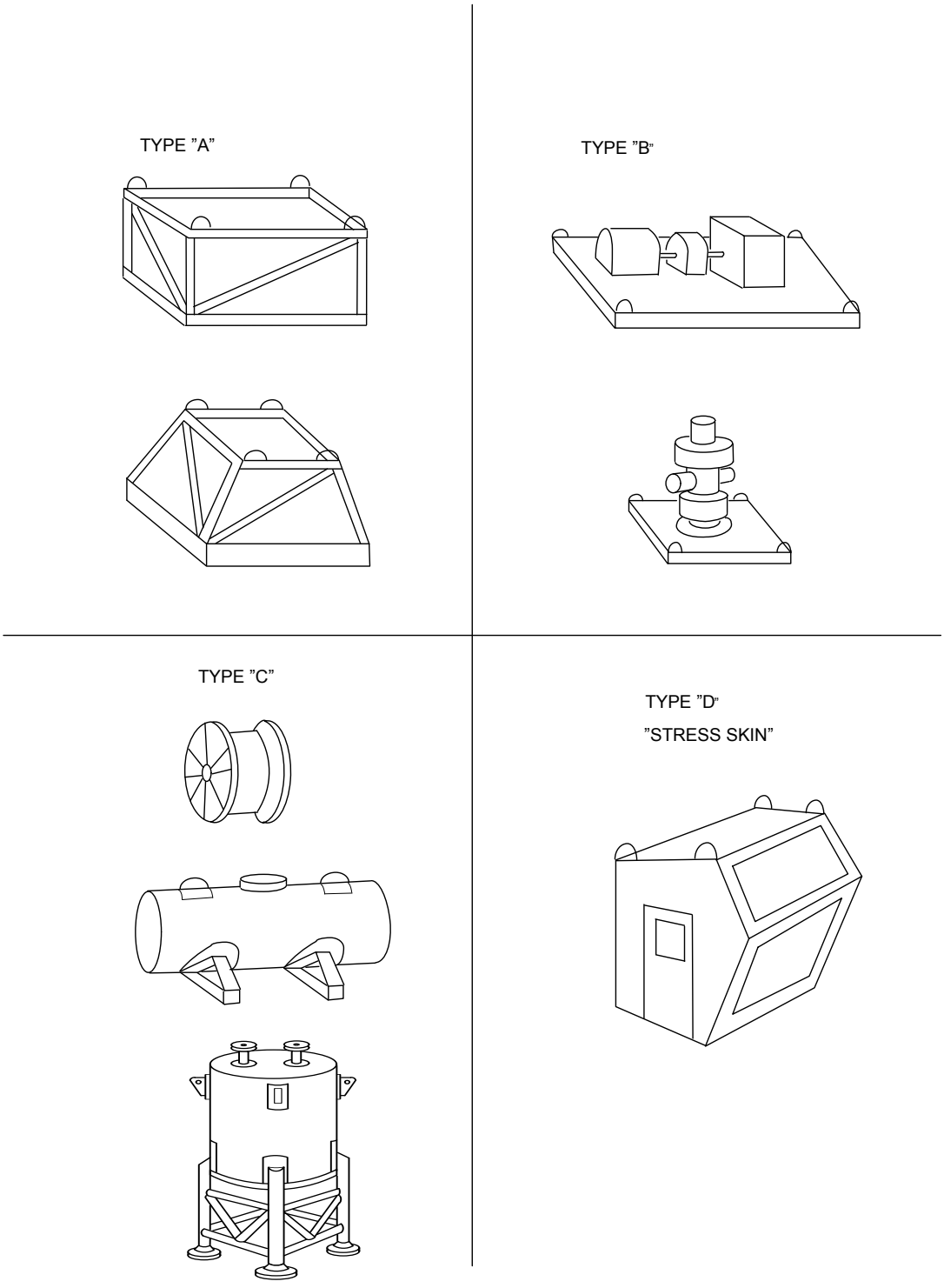

Figure 1-1
Examples of PO Unit types

1.2.5 Design basis

The appropriate design basis for an PO Unit could be found based on the flowchart in figure 1.2. The flowchart indicate how to define the 2.7-3 Operational Class with notations.

The flowchart is also offered in attempt to organize the requirements for the different type of PO Units that normally falls outside of established definitions such as Offshore Containers and IMDG Tank Containers.

Guidance note:
This Standard does not cover units that are pressurized during transportation.

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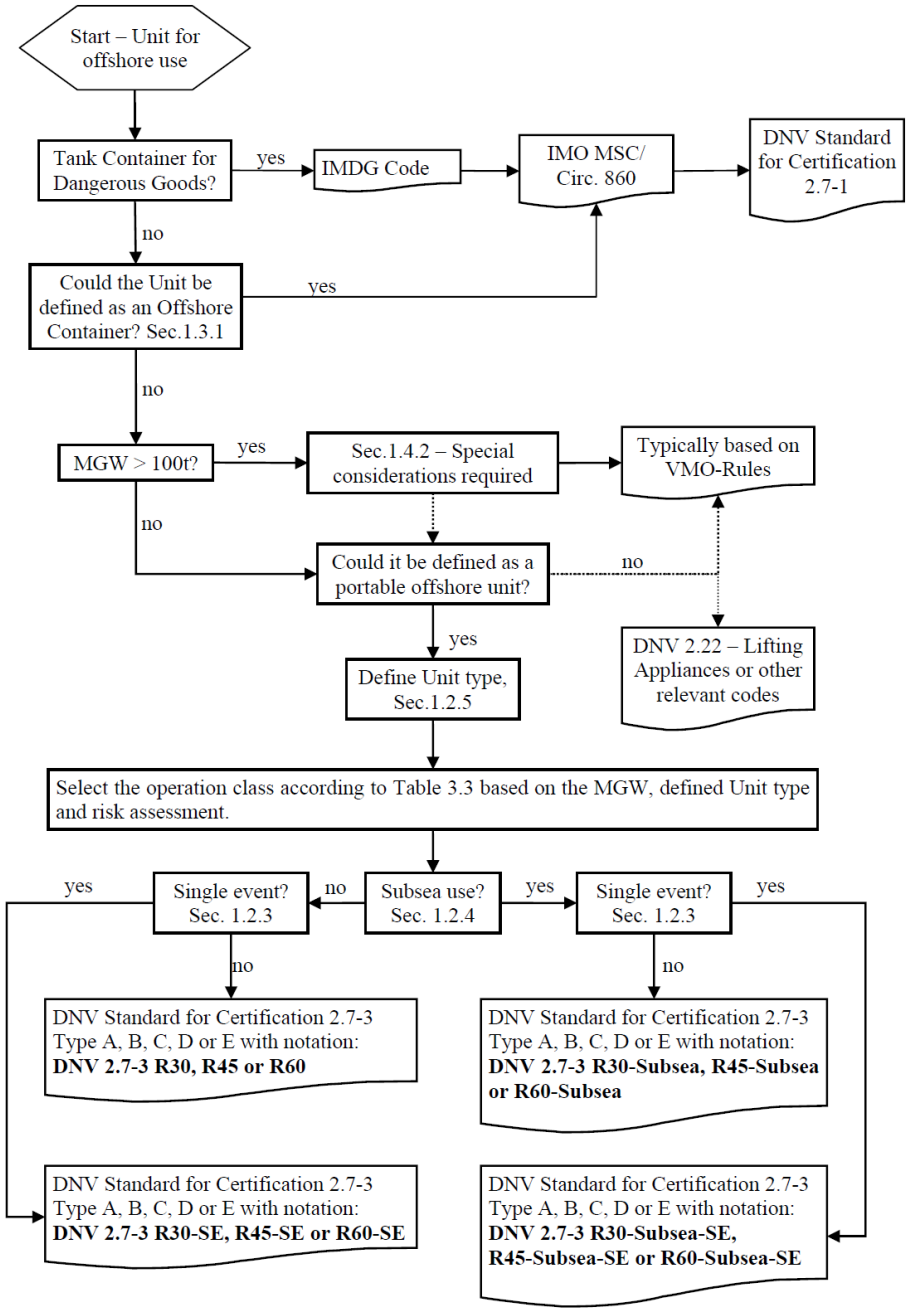

Figure 1-2
Flowchart to find the PO Units appropriate design basis

1.3 Relationship with other Codes

1.3.1 DNV Standard for Certification 2.7-1

This Standard does not apply for units that are defined as offshore containers. Offshore containers shall be designed, manufactured and certified according to DNV Standard for Certification 2.7-1, Offshore Containers.

1.3.2 DNV Standard for Certification 2.7-2

When a PO Unit is designed and equipped to be placed onboard a fixed or floating offshore installation to perform specific services, it may be subject to regulations applying on the installation and to the area where it is placed. Standard for Certification 2.7-2 “Offshore Service Containers” could be applicable as a supplementary code for PO Units designed for such requirements.

1.3.3 VMO Rules

For some PO Units special consideration and extensive planning are required. These events are typically governed by well defined weather condition and access to specialized lifting appliances. Often the

transportation and lift events fall outside of permanently installed crane capacities and require high capacity crane ships or lift barges.

It is recommended that such events are planned and executed according to the VMO Rules. PO Units that are DNV certified according to DNV 2.7-3 will fulfil the applicable strength requirements in VMO Rules considering the below restrictions:

— Operational Class R30 will normally be acceptable, but for operations that could be carried out e.g. under adverse weather conditions, R45 is recommended.
— Operational Class notation Subsea applies for PO Units that will be used Subsea. The design factor for this class is assuming an operation limitation that ensures no slack in the crane wire. See also 3.11.

1.3.4 International codes

PO Units certified by DNV according to this standard are not lifting accessories as defined by ILO, by the European Community's Machinery Directive or by DNV's Standard for Certification No. 2.22 Lifting Appliances. Instead they are considered to be cargo units as defined in these codes and directives.

Transportation 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. See 3.10.

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 General

Use of the word "shall" implies a mandatory requirement when seeking the Society's approval.

Use of the word "should" implies a recommended approach allowing comparable solutions that may also be acceptable.

This Standard for Certification often refers directly to various standards (EN, ISO etc.), or to "other recognised standard". The expression "recognised standards" means in this Standard for Certification, standards that are found to be acceptable by DNV.

1.4.2 Portable Offshore Unit

A "PO Unit" (Portable Offshore Unit) is a package or unit intended for repeated or single offshore transportation and installation/lifting. PO Units may also be designed for subsea lifting.

Guidance note:

PO Units typically carry equipment (or any kind of installation) intended for a service function offshore. The equipment could be an integrated part of the PO unit or detachable. Typical examples of PO Units are given in 1.1.5.

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

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The maximum gross mass should normally not exceed 100 tonnes.

Guidance note:

Certification of PO Units with gross mass exceeding 100 tonnes could be agreed with DNV. Applicable design conditions and factors will in such cases be defined by DNV on a case to case basis.

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1.4.3 Offshore container

An offshore container is a unit with a maximum gross mass not exceeding 25 000 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. This includes the requirement that offshore containers 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 or e.g. as portable cabins.

1.4.4 Freight container

Re-usable transport container, used for international traffic and designed to facilitate the carriage of goods by one or more modes of transport (including marine - but not for handling in open seas) without intermediate

reloading. Such containers must be certified and marked according to the International Convention for Safe Containers, CSC.

Freight containers typically are designed in accordance with ISO standards, and are often known as CSC/ISO containers.

See also DNV "Rules for Certification of Freight Containers, 1981".

Guidance note:
Standard Freight containers are not suitable for offshore use.

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1.4.5 Primary Structure

Primary structures are divided into two sub-groups:

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

— All members that participate in the global structural strength (calculations) of the PO Unit for sea transport and lifting (and fork lifting if applicable)
— Padeyes

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

— Lashing points
— Fork lift pockets
— Load distributing floor/deck beams/panels
— supporting structures for tanks
— supports for heavy equipment

1.4.6 Secondary Structure

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

— doors, wall and roof panels
— panel stiffeners and corrugations of non-structural nature
— structural components used for protection only

1.4.7 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.

1.4.8 Owner

The legal owner of the PO Unit or his delegated nominee.

1.4.9 Lifting set

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

1.4.10 List of symbols and abbreviations

DAF	=	Dynamic Amplification Factor
DF	=	Design factor
DVR	=	Design Verification Report
F	=	Design load, [kN], for lifting.
F_{Air}	=	Lift load, [kN], in air.
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 (~ 9.81 m/s^2).
L	=	Length of PO Unit, [m].
MGW	=	Maximum Gross Weight (mass), i.e. the maximum mass of the PO Unit including payload.
MGW_{Sub}	=	Maximum Gross Weight when fully submerged.

P	=	Payload. The maximum permissible weight (mass) of detachable installations and loose equipment which may safely be transported by the PO Unit, [tonnes], P = MGW - T.
R_e	=	Specified minimum yield stress at room temperature, [N/mm^2].
R30	=	Operational Class, see 3.3. (Also R45 & R60)
SE	=	Operational Class notation – Single Event use
SKL	=	Skew Load Factor to take into account effect of sling length tolerances
Sub	=	Operational Class notation – Subsea use
σ_e	=	Von Mises equivalent stress, [N/mm^2].
RSF	=	Resulting Sling Force on padeyes, in [kN].
T	=	Tare weight. Mass of empty PO Units [tonnes], alternatively [kg], including all accessories and outfitting details involved in the transportation of the PO Unit.
Tonnes	=	Metric Ton, i.e. 1000 kilograms [kg] or 2204.62 [Lbs]
T_D	=	Design air temperature is a reference temperature used for the selection of steel or aluminium grades used in PO Units and associated equipment [Deg. C].
t	=	Material thickness, [mm].
ν	=	Angle of sling leg from vertical, [degrees].

1.5 Documents for acceptance and information

1.5.1 General

The DNV certification is based on document review and follow-up of the fabrication and testing. The documentation shall be submitted to DNV in ample time before manufacturing. The documentation shall include all information required for the certification. DNV may, if found necessary, at any time request additional/revised documentation.

The required production documentation is indicated in 4.7 and design documentation in 1.5.2 below.

1.5.2 Required design documentation

The following documentation should normally be submitted:

A) Drawings showing dimensions and general arrangement including any protruding parts.
B) Operational Class, maximum gross weight (MGW) and payload (P).
C) Design drawings of main structure including joints.
D) Design drawings of pad eyes and other design details, see 3.9, subject to acceptance.
E) 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, and
   d) sling set details as maximum and minimum slings angles and shackles.

F) Materials to be used, e.g. reference to the relevant material specifications.
G) Particulars of joining methods (welding, bolted and riveted connections).
H) If applicable, drawings/sketches, calculations, materials and certification scheme for lifting set.
I) Information about intended use, as applicable;

   a) single event or multiple transports,
   b) any special operation/handling procedures,
   c) equipment to be installed,
   d) service function, and
   e) special loads to be applied.

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

1.6 References

1.6.1 Normative references

The documents listed below include provisions that through references in this text, constitute provisions of this standard:

— DNV Standard for Certification 2.7-1, Offshore Containers.
— DNV Standard for Certification 2.7-2, Offshore Service Containers.
— VMO Rules = DNV Rules for Planning and Execution of Marine Operations, 1996/2000. (These Rules will be replaced by offshore standards DNV-OS-H101 through DNV-OS-H206)
— DNV-OS-B101 Metallic Materials

— DNV-OS-C101 Design of Offshore Steel Structures, General

1.6.2 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.

Informative regulations:

— International Convention for Safe Containers, CSC, UN/IMO 1974
— International Maritime Dangerous Goods Code (IMDG), UN/IMO
— IMO MSC/Circ. 860 - Guidelines for the approval of containers handled in open seas.

Informative standards:

— DNV-OS-C401 Fabrication and Testing of Offshore Structures
— ISO 9001-9003: Quality Systems (EN 29001-29003).
— ISO 1496: Series 1 freight containers - Specification and testing.
— ISO 1161: Series 1 freight containers - Corner fittings - Specification.
— ISO 898-1.2 and 6: Mechanical properties of fasteners.
— ISO 2415: Forged shackles for general lifting purposes - Dee shackles and bow shackles.
— ISO 7531: Wire rope slings for general purposes - Characteristics and specifications.
— EN 13411 - Terminations for Steel wire ropes - Safety - part 3: Ferrules and ferrule securing
— EN 13414-1 - Steel wire rope slings - Safety - part 1: Wire rope slings
— EN 13414-2 - Steel wire rope slings - Safety - part 2: Safety criteria and inspection procedures
— EN 13889 - Forged steel shackles for general lifting purposes Dee shackles and bow shackles - Grade 6 – Safety
— EN 1677 - 1 Components for slings - Safety - Part 1: Forged steel components - Grade 8
— EN 1677 - 4 Components for slings - Safety - Part 4: Links, Grade 8
— EN 818-4 - Short link chain for lifting purposes - Safety - Part 4: Chain slings - Grade 8
— US Federal Specification RR-C-271 - Shackles. Type IV, Class 6
— ISO 209: Wrought aluminium and aluminium alloys.
— ISO 630 pt. 13: Wrought Stainless Steel.
— EN 12079-1: Offshore Containers - Design, Fabrication, Testing, Inspection and Marking.
— EN 10045-1: Metallic materials. Charpy impact test.
— EN 287: Approval testing of welders.
— EN 288: Specification and qualification of welding procedures for metallic materials.
— EN 10002-1: Metallic materials. Tensile testing.
— EN 10204: Metallic products - Types of inspection documents.
— EN 10025: Hot rolled products of non-alloy structural steels. Technical delivery conditions.
— EN 10113: Hot rolled products in weldable fine grain structural steels.
— EN 10164: Steel products with improved deformation properties perpendicular to the surface of the product, Technical delivery conditions
— EN 15614 series for WPQTs
— AWS D1.1: Structural welding code. Steel.
— EN 1993: Eurocode 3
— AISC Manual of Steel Construction, Allowable Stress Design.

Guidance note:

International standards may e.g. be obtained from specialist bookstores or National standards organisation.

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Other informative documents:

— DNV Rules for Classification of Ships
— Rules for Certification of Freight Containers, Det Norske Veritas 1981.
— DNV – Standard for Certification No. 2.22 Lifting Appliances, October 2008.
— DNV - Standard for Certification No. 1.1: “General Description of the CMC Services”.
— DNV - Standard for Certification No. 1.2: “Conformity Certification Services - Type Approval”.
— DNV - Standard for Certification No. 2.9: “Approval Programmes – Components, Manufactures, Service Suppliers”.
— Det Norske Veritas Electronic Register of Type Approved Products: Welding Consumables.
— Det Norske Veritas Electronic Register of Type Approved Products: “Containers, Cargo Handling and Structural Equipment”.
— British: Health and Safety Executive, Offshore installations: Guidance on design and construction.

Guidance note:
DNV documents may e.g. be ordered from the DNV web shop – http://webshop.dnv.com/

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2. Certification Procedures

2.1 Introduction

2.1.1 General

PO Units designed, manufactured, tested and marked in compliance with the following requirements may be certified by Det Norske Veritas. Once a successful certification process has been completed a Portable Offshore Unit Certificate is issued by DNV and the PO Unit‘s nameplate hard stamped with the allocated ID-number and DNV's scroll stamp. If requested DNV’s numbered certification emblem is affixed to the PO Unit. The certification process includes:

— Design verification, see 2.2.
— Production follow-up, see 2.3.

2.1.2 Application for DNV Certification

An application for approval and certification should be sent to DNV. The Application shall, as found relevant, include:

— Short description of the PO Unit (size, function, special features, etc.)
— Specification of any additional standards and regulations to be covered
— Preferred type of approval scheme (see 2.1.3)
— Place of manufacture

2.1.3 Lifting sets

To include the lifting set in the certification process is optional. If included the requirements in Section 7 apply.

Guidance note:
Lifting set certification could also be done as a separate process based on an internationally recognized standard. However, it is recommended that the design factors prescribed in section 7 are duly considered.

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2.1.4 Approval schemes

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

If series production is intended, or if further orders for the same PO Unit design is expected in the future, type approval is recommended. Type Approval Certificates are normally issued to the manufacturer of the PO Unit. If PO Units are made by a manufacturer on behalf of the owner of a design type, both the owner of the design type and the manufacturer will be listed in the Type Approval Certificate.

If a designer/design company wishes to obtain an approval certificate for a PO Unit design, either because they do not manufacture themselves, or because it will be built at a later date, DNV may issue a “Design Assessment for Type

Approval Certificate”. When the PO Unit design is built, it shall be type tested and a Type Approval Certificate may be issued to the manufacturer. If the manufacturer is a licensee, the Type Approval Certificate will refer to the designer/design company and to the Design Assessment for Type Approval Certificate. If several licensees shall make PO Units of the same design type, type testing shall normally be carried out at each manufacturing plant.

Certification of lifting set for an PO Unit could be carried out according to section 7. Lifting sets for PO Units may also be certified separately in accordance with National requirements and recognised standards. See also 7.1.

2.1.5 Approval to other standards

Upon request, or if considered a necessary part of the certification needed for a PO Unit, DNV may also certify PO Units to other international or national standards or regulations.

2.2 Design Verification

2.2.1 General

As a part of the certification process DNV will verify applicable parts of the PO Unit for sea transport and offshore lifting according to the design requirements in section 3. This design verification will normally include both review of documentation and independent calculations.

The final report from DNV will normally be a DVR approving the PO Unit design by referring to relevant drawings. The DVR shall clearly indicate any assumptions/conditions for the approval.

2.2.2 Content

The design verification will include at least:

— Applied design loads
— Strength of main structure, including lift points
— Design details, if applicable – see sub-section 3.9.
— Material specifications
— Welding and other joining methods

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

2.2.3 Optional

If found applicable the design verification will/shall also include:

— Lifting set
— Supports for permanent equipment including tanks
— Operational procedure

2.2.4 Exemptions

The following are not included in the DNV 2.7-3 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.
— Any seafastening arrangement.

Design verification of any of the above items could be agreed with DNV on a case by case basis.

2.3 Production follow-up

2.3.1 Production control

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

Production shall be carried out according to the manufacturer’s quality plan. During production, DNV will normally perform inspections in accordance with 2.3.2.

Alternatively, certification may be based on DNV'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 Det Norske Veritas and the manufacturer in connection with Manufacturing Survey and certification for a specific range of materials/components.

For each PO Unit produced, a product certificate, “Certificate for Offshore Portable Unit” (Form No. 49.01a, see Appendix B) will be issued by a Surveyor from the Society. The DNV surveyor need only fill in and sign the front page of the certificate form at the time of delivery, If other information is available; he may also include this on page 2 of the certificate.

Guidance note:

Since the lifting set is often not delivered from the PO Unit manufacturer, and normally will be replaced during the lifetime of a PO Unit, the certificate need not include the lifting set.

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2.3.2 Production inspection

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

A) General visual inspection with emphasize on checking;
   a) PO Unit design (details/members) according to approved drawings,
   b) weld dimensions and appearance, and
   c) design details according to the risk assessment, see 3.3.2.

B) Confirmation of design verification assumptions, e.g. applied weight.
C) Review of material certificates.
D) Review of NDT documentation and reports.
E) Visual inspection of marking.

In addition the DNV 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 WPS/WPQ, Welders Qualification Tests, welding consumables.
I) Review of equipment documentation.

2.3.3 Testing

Testing of PO Units shall be carried out as indicated in Section 5. The testing shall be witnessed by DNV.

2.3.4 Certificate and DNV marking

When the surveyor has ensured that the design is approved (see 2.2.1), carried out necessary inspection including review of the production documentation and witnessed testing, the following will be done:

a) DNV "Certificate for Portable Offshore Unit" (form 49.01a) will be issued.
b) DNV's numbered emblem for portable offshore units will be affixed to the PO Unit.
c) "NV" and the certificate number will be hard stamped into the name plate and into the PO Unit primary member immediately below the name plate.

2.3.5 Maintenance of certificate

To maintain a safe condition and the validity of a certificate, the PO Unit shall be periodically inspected as described in Section 8.

Such periodic inspection may be carried out by DNV or by other inspectors 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 by DNV.

Inspection reports shall be attached to the PO Unit's DNV certificate and the inspection plate described in Section 6.3 shall be marked as appropriate.

After renewal or repair of damaged parts of the primary structure, the PO Units 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 PO Unit 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.

2.3.6 Certification of existing PO Units

An existing PO Unit that has not previously been certified according to this Standard for Certification may be certified after special consideration at the discretion of DNV.

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

Each existing PO Unit shall be thoroughly inspected, including the use of NDE to the extent required by the surveyor. The lifting tests as described in Section 3.7 may be required to be performed.

If the PO Unit is not found to comply fully with the requirements of this Standard for Certification, DNV may specify required modifications, de-rating or other limitations.

2.4 Summary of Procedures

The procedures for individual and type approval are outlined below.

2.4.1 Procedure for individual approval and certification:

1) Application sent to DNV.
2) Order confirmed and fees agreed.
3) Drawings, documentation and calculations reviewed and approval given by the approval office.
4) Prototype PO Unit manufactured under supervision of DNV's Surveyor.
5) PO Unit tested according to prototype test requirements, witnessed by DNV's Surveyor.
6) Production proceeds according to the agreed Quality Plan or Manufacturing Survey Arrangement. Production tests according to list in Section 4.5.
7) DNV surveyor issues 'Certificate for Portable Offshore Unit' (form 49.01a – See Appendix B) and affixes emblem.

2.4.2 Procedure for type approval and certification:

1) Application sent to DNV.
2) Order confirmed and fees agreed.
3) Drawings, documentation and calculations reviewed and approval given by the approval office.
4) Prototype PO Units manufactured under supervision of DNV's Surveyor.
5) PO Units tested according to prototype test requirements, witnessed by DNV's Surveyor.
6) Test report reviewed by the approval office.
7) A "Type Approval Certificate", valid for 4 years, issued to the Manufacturer.
8) Type approved PO Unit entered in our "Register of Type Approved Products, no. 3".
9) Production proceeds according to the agreed Manufacturing Survey Arrangement. Production tests according to list in Section 4.5.
10) DNV surveyor issues 'Certificate for Portable Offshore Unit' (form 49.01a) and affixes emblem.

2.4.3 Procedure for design assessment for type approval and certification:

1) Application sent to the approval office.
2) Order confirmed and fees agreed.
3) Drawings, documentation and calculations reviewed and approval given by the approval office.
4) A "Design Assessment for Type Approval Certificate", valid for 4 years, issued to the Designer by DNV.

A design assessment for type approval certificate enables the designer to type-approve the product with more than one manufacturer without repeating the design review process. In order to obtain a "Type Approval Certificate" and certificates for each PO Unit being built, the procedure described in Section 2.6.2 shall be followed. The "Type Approval Certificate" will contain a reference to the "Design Assessment for Type Approval Certificate"

3. Design

3.1 Design Conditions

3.1.1 General

PO Units shall be designed in accordance to a set of main principle and pre-established criteria to promote means for safe handling and transportation.

These principles and criteria shall be selected to ensure the structural integrity of the PO Units during it's exposure to dynamic conditions that are common for an offshore transportation event involving;

— sea voyages,
— lifting to and from vessels offshore, and
— if applicable, lifting into (and out of) the sea.

3.1.2 Sea transportation

The design condition for sea transportation is based on unrestricted (i.e. in any weather) transportation in any waters on any suitable vessel. However, special precautions may apply and if applicable a reduced criteria

could be used, see 3.7.

3.1.3 Offshore lifting

PO Units designed in compliance with this Standard for Certification 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 PO Units Operational Class, see 3.3.

The PO Units shall normally be calculated based on that all slings are intact. For PO Units in Operational Class R60 and R45 (see 3.3.3) special load conditions apply, see 3.5.3.

The PO Units should to the degree possible be designed to facilitate safe lifting. E.g. the following should be duly considered:

— Design details of protruding parts, if such parts are not possible to avoid.
— For PO Units to be mixed with other frequent handled goods details and parts that may catch or damage other structures should normally not be allowed. If allowed such parts should be clearly marked.
— Door handles, hinges, hatch cleats and similar details should be arranged in a recessed or protected fashion to avoid becoming catch points or contacting points that may complicate lifting and handling operations.
— Avoid elements that the lift hook accidentally could hook on to.
— Safe handling and tensioning of lift sling set. Normally this imply that use of 'loose' spreader bars is not allowed.

3.1.4 Subsea lifting

For structures that will be lifted subsea special design considerations apply. See 3.11.

3.1.5 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 shall not be taken higher than the (statistically) lowest daily air temperature for the area where the PO Unit shall operate. 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 thicknesses apply:

A) See Table 3-1.
B) Applicable thicknesses for Type D PO Units should be evaluated case by case.
C) Secondary structure made of metal: t = 2 mm.

Table 3-1 Minimum Thicknesses

MGW	Single events		Multiple events	
	Corners	Other	Corners	Other
0-1t	3 mm	3 mm	4 mm	4 mm
1-25t	5 mm	4 mm	6 mm	4 mm
> 25t	6 mm	5 mm	8 mm	6 mm

Guidance note:

The thickness may be decreased below these values after special consideration.

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3.2.3 Wrought steel

Steel shall comply with the material requirements of a recognized code. 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 1.4.5, should be Charpy (V-notch) impact tested in accordance to a recognized code, e.g. DNV-OS-B101, ASTM A370. Austenitic stainless steels are exempt from the Charpy testing requirement.

Impact energy requirement depends on the specified minimum yield strength of the material and is given in Fig. 3-1.

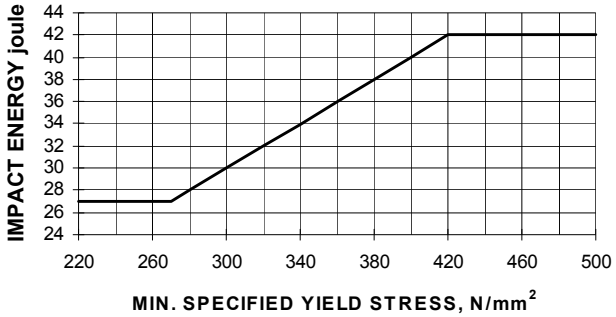

Figure 3-1
Charpy V-notch requirements for steel

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 transportation.

Material thickness, t, in mm	*Impact test temp. in °C*
$t \leq 12$	$T_D + 10$
$12 < t \leq 25$	T_D
$T > 25$	$T_D - 20$

Normalized, killed, fine grain steel with specified yield strength equal to or less than 345 N/mm^2 (50 000 psi) is exempt from Charpy impact testing for minimum operating temperatures of 0°C or higher if the thickness is 1 inch or less.

Steel with aging properties and steel with minimum yield strength above 690 N/mm^2 should not be used.

3.2.4 Lift points

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

If the lifting load is transferred through the plate thickness (z axis) plates with specified (documented) through thickness properties must be used.

All welds transferring load in tension shall be full penetration type. Full penetration is also recommended for welds transferring loads in shear. Nevertheless, for these latter welds fillet- or partial penetration weld may be accepted, but see 3.4.5.

3.2.5 Steel bolts, nuts and pins

Bolts and pins considered essential for structural integrity and operating safety shall conform to a recognized code or standard. For minimum operating air temperatures of 0°C or higher Charpy testing is not required. Lot testing is satisfactory for Charpy tests. Nuts are normally exempt from toughness testing.

Bolts for connection of padeyes and/or between a lifting tool Type E PO Unit and the cargo should have individual fabrication certificates.

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 Section 3.2 of DNV's "Standard for Certification 2.7-1, Offshore Containers" or in "DNV Rules for Ships/High Speed, Light Craft and Naval Surface Craft, Pt.2 Ch.2 Sec.9" 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.

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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.

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3.2.7 Non-metallic material

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

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

PO Units shall be assigned to a Operational Class for the offshore lift. The class should be selected based on the following:

— Weight/mass.
— Risk evaluation.
— Type of structure, see 1.1.5.

3.3.2 Risk evaluation

The operational risk involved in offshore lifting of PO Units is in this standard 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 specially sensitive to impact loads.
B) Protruding parts where the crane hook and/or sling 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 3.5.5 item C, between vessel deck and PO Unit shall be considered.
D) Lack of roof protection so it is considered possible for the crane hook to accidentally hook onto items inside the PO Unit.
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) PO Units of exceptional geometry or unhandy (big) size.
H) Sling 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 PO Unit including equipment.
— Single or (number of) reoccurring transportation event(s).

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

Guidance note:

E.g. 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 sling set connection combined with an extra single top leg on the sling set could eliminate the risk involved with element D).

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3.3.3 Operational Classes

The following three Operational Classes with operational limiting significant wave height as indicated are used in this certification note:

— Class **R60** – Lift from/to vessel in max Hs = 6.0m.
— Class **R45** – Lift from/to vessel in max Hs = 4.5m.
— Class **R30** – Lift from/to vessel in max Hs = 3.0m.

In addition the following notations shall be used if applicable:

— PO Unit for Subsea use: **Subsea**.
— PO Unit for single event/transport only: **SE**.

E.g. for a R45 class PO Unit for a single event and Subsea use the following identification applies:

DNV 2.7-3 R45-Subsea-SE.

3.3.4 Selection of Operational Class

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

By using *Type, Risk* and *MGW* as input, Table 3-3 could be used as guidance for the Operational Class selection.

Table 3-3 Selection of Operational Classes

Type	*Risk*	*MGW*	**Class**
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 PO Units

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

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 PO Unit and the support conditions for the PO Unit.

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

3.4.2 Load combinations

The PO Unit shall be calculated/analysed for all relevant load combinations. Guidance on relevant load combinations is included in the design load sections. See also 3.5.2.

3.4.3 Allowable stresses

Design loads defined in this section shall not produce Von Mises equivalent stresses, σ_e exceeding: $\sigma_e = 0.85$

$\times R_e$ (yield stress).

Guidance note:

$\sigma_e = 0.85 \times R_e$ is valid also for "accidental type" loads as the specified magnitude of these loads have been adjusted accordingly.

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For allowable stresses in aluminium, reference is made to Section 4.2.1 in DNV's Standard for Certification 2.7-1 Offshore Containers. Other materials may be approved after special consideration.

Guidance note:

The Von Mises equivalent stress design calculation method specified in Section 3 may be replaced by the principal stress method, defined in AISC Manual of Steel Construction ASD. If the principal stress method is chosen, all calculation in the sections noted below must be made by the principal stress method. The 1/3 increase is not allowed for any of the load conditions.

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3.4.4 Buckling resistance

All plates and members subject to compression stress should be verified for buckling. The allowable buckling stress/capacity should be calculated based on a recognized code applying elastic stress distribution.

The maximum allowable utilization factor shall be taken as 0.85.

3.4.5 Welding

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 as designated in 3.4.2 multiplied by the following reduction factors:

A) 0.5 for fillet weld.
B) 0.75 for partial penetration weld plus filet weld where the throat area of the filet weld is equal to or less than the stress area of the partial penetration weld.
C) 1.0 for full penetration welds.

3.4.6 Deflections

It should be documented (made plausible) that the deflections of PO Units and single members in PO Units for any load condition will not:

A) Be greater than specified (if applicable) by the owner/buyer of the PO Unit.
B) Complicate safe handling of the PO Units.
C) Introduce unacceptable loads in equipments due to relative deflection of their supports.
D) Members deflected due to impact loads will not "hit" (damage) 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 PO Units.

3.4.8 Stability against tipping

The sea transport design loads, see 3.7, should not cause uplift in any corner of the PO Unit. If required uplift could be prevented by lashings, see 3.7.3.

In order to ensure adequate stability before lift (and after removal of lashing) the PO Unit should normally be stable considering the following tilting angles:

— Operational Class R60: 30°
— Operational Class R45: 23°
— Operational Class R30: 15°

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

Guidance note:

It is also in these cases recommended that the maximum allowable tilting angle is indicated on the PO Unit.

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3.4.9 Maximum Gross Weight - MGW

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

— T is tare weight (mass) of the PO Unit. The weight should be found by weighing or documented by a reasonable conservative weight estimate.
— P is maximum allowable pay load for the PO Unit. 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 exactly as possible. I.e. the loading shall be distributed to members and joints according to the mass distribution in the PO Unit. Loads from equipments needs to be carefully evaluated, see 3.4.11 below.

3.4.11 Equipment and supports for equipment

Mounting of equipment or outfitting details installed in a PO Unit shall be designed to withstand maximum dynamic loadings during transport and lifting calculated according to the relevant equations in sections 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 to the equipment CoG in order to obtain 'correct' support reactions.

3.5 Design Loads – Lifting

3.5.1 Design load basis

The design loading on all elements in a lift with lifting slings shall be calculated based on F (in kN) where F is the greater of F_{Air} and F_{Sub} (if applicable). The following definitions apply:

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

Where the design factor, DF, is defined according to the Operational Class and MGW in Table 3-4:

Table 3-4 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

For subsea PO Units: $F_{Sub} = 2.5 \times MGW \times g$ is normally adequate, but see also section 3.11.

3.5.2 Design load application

For the normal lift condition the design loading for the PO UNIT global strength calculation/analysis shall be calculated based on F.

Guidance note:

Member forces/stresses combined with forces/stresses due to horizontal impact loads, should be calculated based on **MGW**. Stresses due to vertical impact loads do not need to be combined with stresses due to other load cases.

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Skew load effect shall be considered for the PO Unit for relevant cases and members, see 3.5.3 for details.

Design of lift points, their connections and any single element supporting a lift point shall be based on the **RSF**, see 3.5.4. Combined in-plane (3.5.4) and out-of plane (3.5.5) loads shall be considered for these elements.

3.5.3 Skew load effect

The PO UNIT should be verified for the effect of inaccuracies in sling lengths.

The structure of PO Units that are subject to 2 point lift test shall normally be checked by consider minimum one slack/inactive sling. The design load for this case should be taken equal to **0.6** × **F** for the structure.

Guidance note:

Lift point design (loads) could be based on the normal lift condition only, see 3.5.4 and 3.5.5.

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For PO Units that are not subject to 2 point lift test the normal lift condition could normally be considered to cover effect of inaccurate sling lengths. However, if adequate control with the applied sling lengths can not be expected throughout the PO Units lifetime the above check should always be included in the design calculations.

3.5.4 Padeyes – In plane loads

The in plane design load for a lifting point is equal to the resultant sling force (RSF) on the pad eye. Below listed design load covers both normal lift as well as the skew load cases mentioned in 3.5.3.

For a single lift point: $RSF = 1.4 \times F$

For 2-, 3- or 4 leg sling arrangements without spreader bars, the resultant sling force (RSF) on each padeye should be calculated based on the following equation:

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

Where:

ν = the angle between the sling leg and vertical. For 2-, 3- and 4 sling sets $\nu \leq 60$ degrees.

SKL = Skew load factor due to sling length deviations. Shall be taken as minimum 1.25 (assuming that sling lengths are adequately controlled) for a 4 slings set and 1.1 for 2- and 3 slings sets.

PL = Per cent Loading of F (quasi-static calculations) in the most loaded padeye. Any significant uncertainty in CoG should be included in the PL calculation by assuming 'extreme' positions of the CoG.

Guidance note:
For a 4 sling double symmetric sling set and no significant uncertainty in CoG, PL = 0.25 (25%).

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For sling sets with more than 4 slings, spreader bar(s) and/or $\nu > 60$ degrees, the resultant sling force (RSF) on each padeye should be calculated based on the following equation:

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

PL_{SKL} = Per cent Loading of F in the padeye considering all (skew) load effects due to:

A) CoG (extreme) position
B) Sling set geometry
C) Maximum sling length deviations
D) Maximum hoist line angle (at lift-off), see 3.5.5, item C).

3.5.5 Padeyes – Out of plane loads

Out of plane loads on padeyes are due to:

A) Design angle between sling- and padeye plate planes.
B) Inaccuracies in padeye fabrication and sling set design considered (e.g. due to hook size) causing an angle between sling and padeye plate planes.
C) Angle difference between crane hoist line and the line from the hook centre to the PO Unit CoG. This could be due to:
   a) Inclined transport vessel deck during lift-off.
   b) Not plumb hoist line during lift-off.
   c) Horizontal loads on PO Unit from e.g. tugger lines and impacts.
   d) If subsea PO Unit; horizontal loads from waves (and current).

The condition described in A) should normally be avoided. If not avoided out of plane loading due to A) shall be considered for all PO Unit Operational Classes and all sling set designs.

In order to take into account the effect of B) a 3% out of plane loading shall be applied in the shackle bow.

The following minimum hoist line angels should normally be considered in order to take into account effect C):

— Operational Class R60: 20 degrees
— Operational Class R45: 15 degrees
— Operational Class R30: 10 degrees

Out of plane load effects due to C) could be disregarded for 3 and 4 slings sets if not any of the slings became slack due to the considered angle.

3.5.6 Lifting with fork lift truck

The design load in kN, F_F, on the primary structure shall for fork lift truck lifting be taken as:

$$F_F = 1.65 \times MGW \times g$$

Where fork pockets are only intended for empty handling of the PO Unit, the design load shall be taken as $F_F = 1.65 \times T \times g$. For marking of PO Units with such pockets see 6.2.

Guidance note:

Regarding the support condition it is recommended that conservative assumptions are made both for reaction load distribution between the two (fork) prongs and for the distribution along each prong.

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3.6 Design Loads - Impact

3.6.1 General

Impact loads may occur during lift off or set down of PO Units and they are a result of the relative velocities between transport vessel deck and the hanging load. Impacts loads occur randomly and are of very short duration. Due to the inherent uncertainties in the input parameters it is not considered feasible to calculate these loads accurately. Hence, in this standard impacts loads are considered adequately described by the requirements in 3.6.2 and 3.6.3.

3.6.2 Horizontal impact

The primary members 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 Maximum Gross Weight (MGW) of the PO Unit. Note that limiting stress and allowable deflections for these loads are given in 3.4.3.

The impact force may act in any horizontal direction on the corners of the PO Unit. On all sides of the PO Unit, 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: $F_{HI} = 0.05 \times$ the test load in Table 5-2

For end or side structure and upper rails/edge 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-Units) 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. This PO Unit type should be handled as a planned transportation event and due consideration should be given to lifting and stowage during the transport.

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For a PO Unit that will not be transported in conjunction with other units or is designated for a *single* transportation 50% of the above defined F_{HI} and F_{HIR} may be applied.

3.6.3 Vertical impact

Vertical impacts shall be calculated according to both point 1) and 2) below:

1) PO Units in Operational Class R45, R60 and R60-SE 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 section 5.3 or by calculation. Inertia forces acting on elevated part of the structure shall be addressed.
2) PO Units shall also be verified for an impact load acting on any other point on the bottom outer edge that could hit if the PO Unit is set down on a not flat surface: $F_{VI} = 0.08 \times F$. Note that limiting stress and allowable deflections for these loads are given in 3.4.

Guidance note:

Some designs of PO Units (e.g. Type C and probably most Type E) will not be structurally suitable for vertical impact resistance and the above design criteria may be voided for these units. The Operational Class should be selected accordingly and a proper handling procedure should be available.

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3.7 Sea Transport

3.7.1 General

The strength including equipment supports, and stability of all PO Units 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 (sloshing by sea), *see* 3.7.2 *GN*. If not known, realistic assumptions regarding support conditions and seafastening (reactions loads) should be made. See 3.4 for accept criteria.

3.7.2 Design forces

The accelerations could, if relevant, be based on motions calculations for the actual transport vessel(s), position (and direction) of PO Unit on vessel and maximum weather/wave conditions. Appropriate design factors considering the allowable stress given in 3.4.3, should be applied.

Guidance note:

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

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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/m^2 shall normally be considered.

Guidance note:

This standard does not include specific design forces for the PO Unit due to sloshing by sea. However, sea pressure (due to sloshing by sea) can induce great forces and if such design forces are not defined/applied it may be required to consider this in the positioning of the PO Unit on the transport vessels. See also 1.2.1 and 1.2.2. Design forces for sea pressure could be based on requirements to deck houses, see DNV Ship Rules, Pt.3 Ch.1 Sec.10 C.

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3.7.3 Seafastening and lashing

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

Guidance note:

DNV assume that the requirements to seafastening will be assessed for each transport considering vessel particulars, position of PO Unit, transport route and expected weather conditions.

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PO Units for multiple transports and especially PO Units that may become unstable during a sea voyage should normally have suitable strong points for lashing.

The design loads for lashing points should be based on:

A) PO Unit MGW and applicable design accelerations, see 3.7.2.
B) Number and position (relative to PO Unit CoG) of the lashing points.
C) Defined (range of) direction(s) of the lashings.
D) Zero friction between PO Unit 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 a indeterminate (redundant) system and/or additional safety if a determinate (not redundant) system.

Guidance note:

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

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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 sub-sections 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 sling 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 3.5.4 and 3.5.5.

Distribution of the pad eye 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 PO Units.

Guidelines on how to calculate padeyes are given in Appendix A.

3.8.3 Position of padeyes

Padeyes should as far as practicable be located so that;

— they do not protrude outside the vertical boundaries of the PO Unit,
— the sling leg loads are equal,
— the risk of fouling the lifting sling by the PO Unit 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 pad eye thickness 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 Appendix A.

3.8.5 Forged pad eyes

Shoulder type machinery forged shoulder nut eye bolts may be accepted for single transportation events. The 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 PO Units 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

PO Units may be fitted with one or more sets of fork lift pockets in the bottom structure. In such cases the following will 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. PO Unit length, height, width and MGW (T if only empty handling) shall be taken into account.
C) Fork pockets shall pass through the base and have closed top and sides.
D) Pockets shall be located as far apart as practical considering PO Unit geometry and applicable fork lift dimensions.

Guidance note:

Table 3-5 indicates recommended minimum distances. For PO Units with well defined CoG in loaded condition the recommended minimum distances in empty condition could be considered in the loaded condition.

Table 3-5 Recommended fork pocket distances and operational limitations

PO Unit 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

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The bottom face of fork pockets may be fully closed or have partial openings. Such openings in the bottom of fork pockets are not allowed in way of the bottom side girders or less than 200 mm from the inside of these girders.

Guidance note:

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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Openings in the bottom may be damaged by fork lift trucks. This shall be taken into account in the design and when inspecting the containers.

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:

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” PO Units. 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 disengagement by impact. Doors shall be capable of being secured in the open position when PO Unit is unloaded. Doors may be outfitted with gaskets for weather tight PO Units. Hinges shall be protected against damage from impact loads.

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 PO Units with tanks

3.10.1 Application

This Standard for Certification does not apply to tanks to be used for transport of cargo. I.e. it applies normally only for transport of empty tanks with the following exemptions:

A) In special cases tanks with some residual content could be allowed.
B) Fuel (diesel) tanks that are an integrated part of the transported equipment package could be (partly) filled if they are properly protected against impacts.
C) For single transports (partly) filled tanks may be considered in the certification.

Maximum possible actual content in tanks shall be included in the MGW calculations. For cargo transport tanks reference is made to DNV Standard for Certification 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 for Certification, i.e. strength, impact resistance etc. unless specifically prohibited by the tank design code.

3.11 Subsea Application

3.11.1 General

The given design requirements in this DNV are based on the following main assumptions:

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

3.11.2 Design condition

The effective weight of a PO Unit 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 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 $0.9 \times$ MGW.
C) General design factor = 1.4.

The applied design condition always needs to be verified against the actual installation condition, see 3.11.5 item A).

3.11.3 Design considerations

The following main design considerations apply:

A) PO Unit geometry to weight relation. In order to avoid that the final check, see 3.11.5 item A), gives (too) low installation wave height limitations the following could be considered as a rough guidance:
   a) $A/MGW_{Sub} < 1.0$ where A is the PO Unit drag area in m^2.
   b) $V/MGW_{Sub} < 2.0$ where V is the volume of the PO Unit + added (water) mass/volume in m^3.
B) Structural strength requirements, see 3.11.1 and 3.11.4.
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/designed in such a way that the risk of damage and/or accidental release of sling set are neglectable.
H) Extended (more than a few days) subsea application of PO Units should be specially evaluated and shall not be considered covered by the given requirements in this standard.

3.11.4 Other design loads

In addition to the basic lift load case, see 3.5 and 3.11.1, the following need to be considered, if applicable:

A) Effect of horizontal wave loads. The tilt effect of this on the PO Unit could normally be considered covered by the requirements in 3.5.
B) Local design for hydrodynamic loads, e.g. slamming loads.
C) Tugger points for horizontal and rotational control.
D) Guiding system for final positioning.
E) Retrieval loads.
F) Hydrostatic pressure, see 3.11.3 D).

3.11.5 Operational aspects

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

A) Installation wave height/periods (if evaluated/applicable). The installation contractor needs to do a final assessment of the applicable operation limitations based on the actual installation vessel and –procedure.
B) Special considerations, e.g. the PO Unit 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).

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

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 (ref. Section 4.4) should also be presented for acceptance before start of production.

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 EN10204.

During production, and on the finished product, it shall be possible to identify the materials used for the primary structure with the corresponding documentation. If the marking is not visible on the finished product, a log shall be kept of the components to identify and ensure traceability of the materials.

4.3 Welding

Welders and welding procedures shall be approved by DNV and shall be according to a recognised standard, e.g. DNV-OS-C401, ASME section IX, ANSI/ AWS D1.1, EN 287 and EN288 or JIS.

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 reserves the right, however, to require verification of the approval when deemed necessary. Such verification may include additional NDT and/or welding tests.

Welding procedure specifications, welding procedure qualification tests and approval of welding procedures shall be in accordance with a recognised standard, e.g. ASME section IX, ANSI/ AWS D1.1, EN 287 and EN288 or JIS.

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 section IX or EN288 shall apply to these additional qualifications.

4.4 NDE

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 PO Units shall be examined as stipulated in columns I and II in Table 4-1 after production testing (if required). Inspections as stipulated in columns III and IV or other inspections will be decided by DNV's surveyor on a case by case basis.

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

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 in each case.

Frequent repairs shall result in increased extent of NDT.

4.4.3 NDT procedures and NDT operators

Procedure specifications for NDE-methods shall be established and followed. All NDE instructions shall be approved by an ASNT TC-1A level III examiner or an examiner qualified to an equivalent standard.

NDT operators shall be capable of performing a satisfactory operational test under production conditions using a qualified procedure appropriate for the NDT method and welded joints in question. Operators shall be certified according to a national certification scheme or have qualifications accepted by DNV to a similar level.

The NDT operators will issue reports describing the weld quality. The reports shall clearly distinguish between accepted and rejected welds, and state the type, quantity and location of repairs carried out to meet the specified acceptance standard. The inspection report shall specify the NDT methods and procedures used including all NDT-parameters necessary for a proper assessment. The report must be approved by an ASNT TC-1A level II or equivalent examiner.

4.4.4 Weld acceptance criteria

The soundness of welded joints shall comply with the specified standard, regulations or relevant rules for acceptability of weld defects.

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

Table 4-1 NDT of structural welds

Category of member, see 1.4.5	*Type of joint*	*Type of examination*			
		I Visual	II Magnetic[1)]	III Ultrasonic[2)]	IV Radiography
Primary - Essential	Butt welds T-joints – Full penetration welds T-joints – Fillet- & partial penetration welds	100% 100% 100%	20% 100% 100%	100% 100%	10%
Primary - Other	Butt welds T-joints – Full penetration welds T-joints – Fillet- & partial penetration welds	100% 100% 100%	Spot[3)] 20% 100%	20% 20% -	10% -
Secondary	All types	100%	Spot[3)]	Spot[3)]	Spot[3)]

1) Dye penetrant examination shall be used where magnetic particle examination is not possible.

2) Depending on material thickness and geometry.

3) Spot means random examination at the discretion of the surveyor, normally 2-5%.

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 PO Unit or prevent water from entering.

4.6 Coating and corrosion protection

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

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

Guidance note:

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: Surface treatment is normally not required for aluminium. Surfaces to be painted shall be blast cleaned to SA 2 ½. Primer should be vinyl or epoxy based.

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4.7 Production documentation

4.7.1 Basis for certification

The certification of each PO Unit 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 proof testing
N) report from final inspection.

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

4.7.2 As built dossier

The "As Built" dossier should at least include:

A) general arrangement drawing
B) material documentation
C) specifications for welding procedures (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 proof testing
I) report from final inspection
J) DNV's certificate namely "Certificate for Portable Offshore Unit" Ref. form 40.01a.

The various reports may be combined as practical.

5. Testing

5.1 Extent of Testing

A test program shall be agreed with DNV for each PO Unit or series of units. The program shall include prototype testing, see 5.2 and 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
R60-SE	Yes [1)]	Yes [1)]	See 3.6.3
R45-SE	Yes [1)]	No	No
R30-SE	Yes [1)]	No	No

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

Guidance note:
Prototype tests shall not damage the PO Unit. 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 PO Unit mass (MGW) distribution as reasonably possible. See DNV 2.7-1 for further information.

Guidance note:
It is advised that the Maximum Gross Weight be verified by weighing before a lift test is performed to avoid repeated load tests.

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The PO Unit 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 Accept criteria

All welds joining essential members, see 1.4.5, 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) Accept criteria for deflections shall be established.
B) Deflections shall be monitored during the test lifts.

5.2.3 All point lifting

PO Units shall be load tested with a test load according to Table 5-2. For PO Units 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 and be subject to that design calculations indicate 2 point testing as sufficient.

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

MGW	*Test Load*
Less or equal to 25 tonnes	Minimum of F and $2.5 \times MGW \times g$
25 tonnes to 50 tonnes	$[1 - 0.01 \times (MGW^{1)} - 25)] \times F$
Above 50 tonnes	$0.75 \times F$

[1)] Numerical value of MGW in tonnes to be used.

5.2.4 2-point lifting (diagonal lift test)

PO Units with four pad eyes that require a 2-point test shall be lifted from two diagonally located pad eyes. For none symmetric 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 × g for all MGW.

Following the lift there shall be no permanent deformation.

5.2.5 Exceptions for single transportation

PO Units intended for a single installation 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 transportation event for a PO Unit, the related lifting may be accepted at the discretion of a DNV surveyor after a thorough visual and NDE inspection.

5.3 Prototype Test – Impact

5.3.1 General

Impact testing is optional, see Table 5-1and 3.6.3.

5.3.2 Test alternatives, procedures and precautions

The PO Unit, 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 PO Unit 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 5º 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 PO Unit 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 PO Unit's final maximum gross weight. Internal loads equal to payload (*P*) or omitted equipment shall be sufficiently secured and the PO Unit should be inclined as noted above. The PO Unit should be suspended from a quick release hook. When released, the PO Unit 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 PO Unit should be inclined as detailed above. The PO Unit 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 PO Units should be strength tested during production. An all point lifting test shall be carried out. The number of PO Units to be tested shall be agreed in advance and will depend on the total number in the production series. PO Units 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 PO Units to be tested.

Table 5-3 Production testing

Total number in series	*Number to be tested* [1)]
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 PO Unit is specified to be weather tight, the following weather tightness tests shall be carried out:

For the prototype and 10% of the PO Units 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 PO Units, the water test may be replaced by simple light tests, using the following procedure:

An inspector will enter the PO Unit. The doors are then closed, and the inspector shall accustom him/her self 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.

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 PO Unit.

For single event PO Units the requirements to marking could be relaxed in agreements with DNV.

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.
C) If the PO Unit needs handling according to a specific operation procedure this should also be indicated by also writing: 'Operational restrictions'.
D) When a PO Unit is fitted with fork pockets designed for handling the PO Unit when empty only (e.g. on some tanks and long baskets) 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.

If relevant (see 3.4.8), the maximum allowable tilting angle should be marked on the PO Unit with e.g. a simple pictogram.

6.3 Identification Markings

Each approved PO Unit will be identified through a DNV Certificate number that will be found on the name plate. For multiple Units the PO Unit Certificate number may be complemented with a serial number as a suffix.

6.4 Information Plates

6.4.1 General

PO Units shall be fitted with an information plate. PO Unit that is intended for multiple transportation 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.

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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 PO Units 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 PO Unit.

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

The plate shall be headed

"PORTABLE OFFSHORE UNIT"

The plate shall contain the following information:

A) Type of PO Unit and Operational Class
B) Name of manufacturer.
C) Month/year of manufacture.
D) Manufacturer's serial number.
E) Maximum gross weight (kg)
F) Tare mass (tonnes/kg) if relevant.
G) Payload (tonnes/kg) and intermediate deck payload (if applicable).
H) Design sling angle(s), and/or any other relevant design assumptions regarding the sling set.
I) Design temperature.
J) Operational restrictions and/or reference to operational procedure.

K) DNV's inspector stamp

6.4.3 Inspection Plate

The plate shall be headed

"INSPECTION DATA - PORTABLE OFFSHORE UNIT"

The plate shall contain the following information:

A) Certificate number.
B) Maximum Gross Weight
C) Owner's name and international telephone number(s).
D) Date of last inspection.

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 should be marked as described in 8.2.2.

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

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6.5 Additional Information Markings (Optional)

On each PO Unit 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 PO Unit without doors or the end of the tank of a tank PO Unit.

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.

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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 PO Unit may add additional information marking such as owners name etc. However, to avoid misinterpretation additional marking should be kept to a minimum.

If the PO Unit 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.

7. Lifting Sets

7.1 General Requirements

The lifting set (chain or wire rope slings and shackles) shall be specially designed for use on PO Units 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.

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

Guidance note:
When a PO Unit is installed for an extended period on an offshore installation, the lifting set may be removed for the duration of the installation period.

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When a lifting set on a PO Unit 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 PO Unit by shackles in padeyes. Shackle bolts shall be secured to

prevent unwanted opening of the shackle. Other attachment details shall be accepted by DNV 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 Annex 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. In order to retain the type approval, manufacturers will be audited regularly by DNV.

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.

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

In special cases DNV 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 product certificates may be issued for individual products or batches of products.

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

Guidance note 2:

Lifting sets for offshore PO Units 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.

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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 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:

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

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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 PO Unit bottom when the sling hangs over the long side of the PO Unit.

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:

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

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7.3.2 Sling minimum dimensions & MBL

The MBL for wire rope- and chain slings connected to the PO Units 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 3.5.4. For extra top leg slings (forerunners)

the RSF for a single padeye is used in the equation.

For offshore handling of PO Units 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
R30	D ≥ 10 mm	D ≥ 12 mm	D ≥ 7 mm	D ≥ 8 mm
R45	D ≥ 12 mm	D ≥ 15 mm	D ≥ 8 mm	D ≥ 10 mm
R60	D ≥ 14 mm	D ≥ 18 mm	D ≥ 8 mm	D ≥ 10 mm

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

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7.3.3 Shackles

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

$WLL \geq 0.45 \times RSF$ Where,

WLL is the documented Working Load Limit of the shackle and RSF is defined in 3.5.4. 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 3.5.5, 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

$$WLL \geq (0.43 + 0.01 \times ang) \times RSF$$

should be fulfilled for out-of-plane angels greater than 2 degrees, where "ang" is the out-of-plane angle in degrees.

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The documented minimum breaking force for shackles shall not be less than 5 times the WLL.

7.3.4 Spreader Bars

Spreader bars are normally not considered adequate for offshore lifting under adverse weather conditions. However, for lifts with detailed operational procedures including weather limitations, spreader bars may be applied.

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

Spreader bars shall be included in the PO Unit 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 Section 4 apply.

7.3.5 Master links

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

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 42J. 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 EN10204,

Other items such as thimbles and ferrules shall be supplied with material certificates according to EN10204, test report type 2.2.

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 PO Unit certificate and the lifting set certificates attached to the PO Unit certificate. However, if the owner or operator has a system for keeping track of each PO Unit 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 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 Standard for Certification 2.7-3
J) signature of the DNV inspector, or the manufacturer when they have an MSA agreement with DNV.

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 guarantied ratio MBL/WLL
F) reference to DNV 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 Standard for Certification
K) record of the unique identification number or mark carried by the component
L) signature of the DNV inspector, or the manufacturer when they have an MSA agreement with DNV.

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.

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Slings should be marked with an identification tag permanently attached to the top assembly of the sling. More details requirements to marking details 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 Standard for Certification[1)]
C) the certificate number and, if applicable, the unique identification number of the sling[2)]
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 PO Unit 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"

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.

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 PO Unit, 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 inspector 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 on PO Units

8.2.1 Schedule of examination and tests

PO Units should be periodically examined and tested in accordance with the schedule listed in Table 8-1. The inspector may require other or additional tests and examinations, and dismantling if found necessary.

Guidance note:

National authorities may have stricter requirements for periodical inspections.

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When a lifting test is required, the non-destructive examination and thorough visual examination should 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 PO Unit, 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*	*Thorough visual examination*	*Suffix (to be marked on plate)*
At intervals not exceeding 12 months	At the discretion of the inspector	At the discretion of the inspector	Yes	T or VN or V
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 PO Unit.

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 inspectors 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 inspector, a PO Unit 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) PO Unit 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 NDE carried out (where relevant)
G) a statement that the PO Unit 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 for Certification shall be recorded. The report may refer to the reasons for failure and any recommended corrective action, or note that the PO Unit 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 subsection the below listed definitions are applied. Nominal dimensions could be considered.

RSF	Padeye in line design load, see 3.5.4. 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)
R_{pad}	Radius of padeye, taken as: $R_{pad} = \dfrac{R_{pl} \times t_{pl} + 2 \times R_{ch} \times t_{ch}}{t}$

Where:
R_{pl} is minimum distance form 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 $D_{\text{pin}} \geq 0.94 \times D_{\text{H}}$ 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. $D_{\text{pin}} < 0.94 \times D_{\text{H}}$) 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 (i.e. in the load direction) the hole. The following criterion shall be fulfilled:

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

A.5 Cheek plate welds

The cheek plate welds should fulfil the following criterion:

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

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 ≈ 2.0 (i.e. $\pi \times 0.6$).

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 should (could) be calculated based on the following assumptions:

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

Appendix B
Example Certificate (form 49.01a)

DET NORSKE VERITAS

Certificate No.:

CERTIFICATE FOR PORTABLE OFFSHORE UNIT

Part 1

Portable Offshore Unit Type:		
Max. Gross Mass (Rating):	Tare Mass:	Payload:
External Dimensions (LxWxH):	Design Temperature:	
Det Norske Veritas Type Approval No./ Design Approval Reference:	Assembly Drawing No.:	
Manufacturer:		
Type Designation:	Manufacturer's serial No:	Date of manufacture:

Production testing
This portable offshore unit, or another portable offshore unit from the same fabrication series, has been subjected to the following proof test:

Manufacturer's serial No. of the portable offshore unit(s) tested:	Total test load :	Test date:
Lifting set (optional) (When the lifting set is approved by DNV, certificates for lifting set / components of lifting set, or reference to owner's record, to be listed in Part 2)	Lifting set approved by DNV: Yes / No:	

Operational restrictions:

Min. shackle bolt diameter:	Max. angle of legs (from vertical):	Type of unit:

This Unit has been designed, approved, manufactured and tested in accordance with Det Norske Veritas Standard for Certification no. 2.7-3 Portable offshore units.

The Unit also complies with the following requirements and regulations:

-

-

Remarks

This field needs only be filled in when the certificate is prepared by a manufacturer with an MSA agreement with DNV.

Date:

Place:

(Name)
Manufacturer

Date:

Place:

(Name)
Surveyor

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