STANDARD FOR CERTIFICATION
No. 2.7-3

PORTABLE OFFSHORE UNITS

JUNE 2006

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.

A list of Standards for Certification is found in the latest edition of Pt.0 Ch.1 of the ”Rules for Classification of Ships” and the ”Rules for Classification of High Speed, Light Craft and Naval Surface Craft”.

The list of Standards for Certification is also included in the current “Classification Services – Publications” issued by the Society, which is available on request. All publications may be ordered from the Society’s Web site http://exchange.dnv.com.

Comments may be sent by e-mail to *rules@dnv.com*
Comprehensive information about DNV and the Society's services is found at the Web site http://www.dnv.com

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Introduction

Experience has shown that Standard for Certification No 2.7-1 "Offshore Containers", is being used more and more in the industry today than ever before. As a consequence of this increased demand, DNV customers have voiced a strong requirement for a need to certify portable offshore Units that are not shaped like containers, according to Standard for Certification No 2.7-1.

As a result of this market demand, a new standard, Standard for Certification No 2.7-3 has been developed, which covers all other types of portable offshore Units, other than offshore containers. DNV firmly believes that this new standard will meet the customers need for these services and at the same time enable DNV to expand in this market segment.

This new Standard has been developed in close co-operation with the update of the Standard for Certification No 2.7-1.

1. General

1.1 Scope:

1.1.1 General

This Standard for Certification covers suitable requirements for Units for offshore transportation with respect to design, manufacturing, testing and certification. The Standard for Certification covers mainly the Unit's structure and the mounting of any permanent equipment.

The intention is that Units for offshore transportation 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
— ease of repair and maintenance.

When the word "Unit" is used throughout the Standard for Certification, it means a portable package for single or repeated shipment in an offshore environment.

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 the Society.

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 "Units" suitable for transportation offshore. Such considerations could be:

— single transportation event
— reoccurring transportation events
— value of product may vouch for special design and fabrication precautions
— predictability in behaviour during; road transportation, lifting, sea voyage, and landing on installations
— appropriate design criteria for dynamic load conditions
— specially planned transportation events due to size, shape, weight or other special features
— stability during handling, lifting and transportation
— durability of lifting arrangements in an offshore environment
— sensitivity against misalignment problems due to lack of stiffness and shock loads for e.g. machine arrangements
— symmetry problems and with Centre of Gravity location in a Unit or package.

1.1.2 Relationship with other DNV Rules and International regulations and standards.

This Standard for Certification does not apply for Units that are defined as offshore containers. Offshore containers shall be designed, manufactured and certified according to DNV's Standard for Certification 2.7-1, Offshore Containers, or 2.7-2, Offshore Service Containers.

Note:

Exceptions to this limitation may be given for Units with a MGW exceeding 25 000 kg. See also definition of general cargo.

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Portable offshore Units are not considered to be lifting appliances as defined by ILO, by the European Community's Machinery Directive or by DNV's Rules for Certification of Lifting Appliances. Instead they are considered to be cargo Units as defined in these codes and directives.

When handling and transporting Units or packages of the character "*Modules for permanent as well as temporary utilization offshore*", special consideration and careful planning are normally 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.

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.

For Units that are offshore containers or offshore tank containers, the IMDG code and the CSC refer to IMO's Guidelines for Certification of Offshore containers, MSC/Circ. 860.

This Standard for Certification does not apply for Units that are defined as freight containers by IMO's International Convention for Safe Containers, CSC.

1.1.3 Types of Units

This Standard for Certification has been organized in groups of four types of "Units", namely; *Type A, B, C, and D.*

The evaluation chart included in Section 3 "Design" is offered in attempt to organize the requirements for the different type of Units that normally falls outside of established definitions such as Offshore Containers, IMDG Tank Containers, Machine and Service Units for permanent installation purposes and Modules with a gross weight larger than 50 tonnes.

Note:

This Standard does not cover Units that are pressurized during transportation.

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Type A is by definition skids arranged with crash frames. It is a Unit with weight or other characteristics outside the limitation given in Standard for Certification 2.7-1. These Units will typically apply to service packages such as pumps, generation Units, coiled tubing Units, skid mounted manifolds, pressure vessels or process arrangements of portable nature.

Type B is by definition skid based installation where the end user will not require a crash frame protection. The packages could contain 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 Unit or other considerations.

Type C is Units or packages that lack a dedicated skid frame. These packages could be arranged with self supporting feet, skirts or support points integrated in the Units' own structure or utility structure. Example of this type of packages 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 packages do normally depend on the shell or skin to resist transportation generated loads. Examples of the type of Units would be control cabins or smaller modules for different services.

The flowchart in Fig. 1-1 and the sketch in Fig. 1-2 will assist in defining Unit types and also give reference to other relevant regulations and Standards for Certification that may apply for different packages intended to be transported.

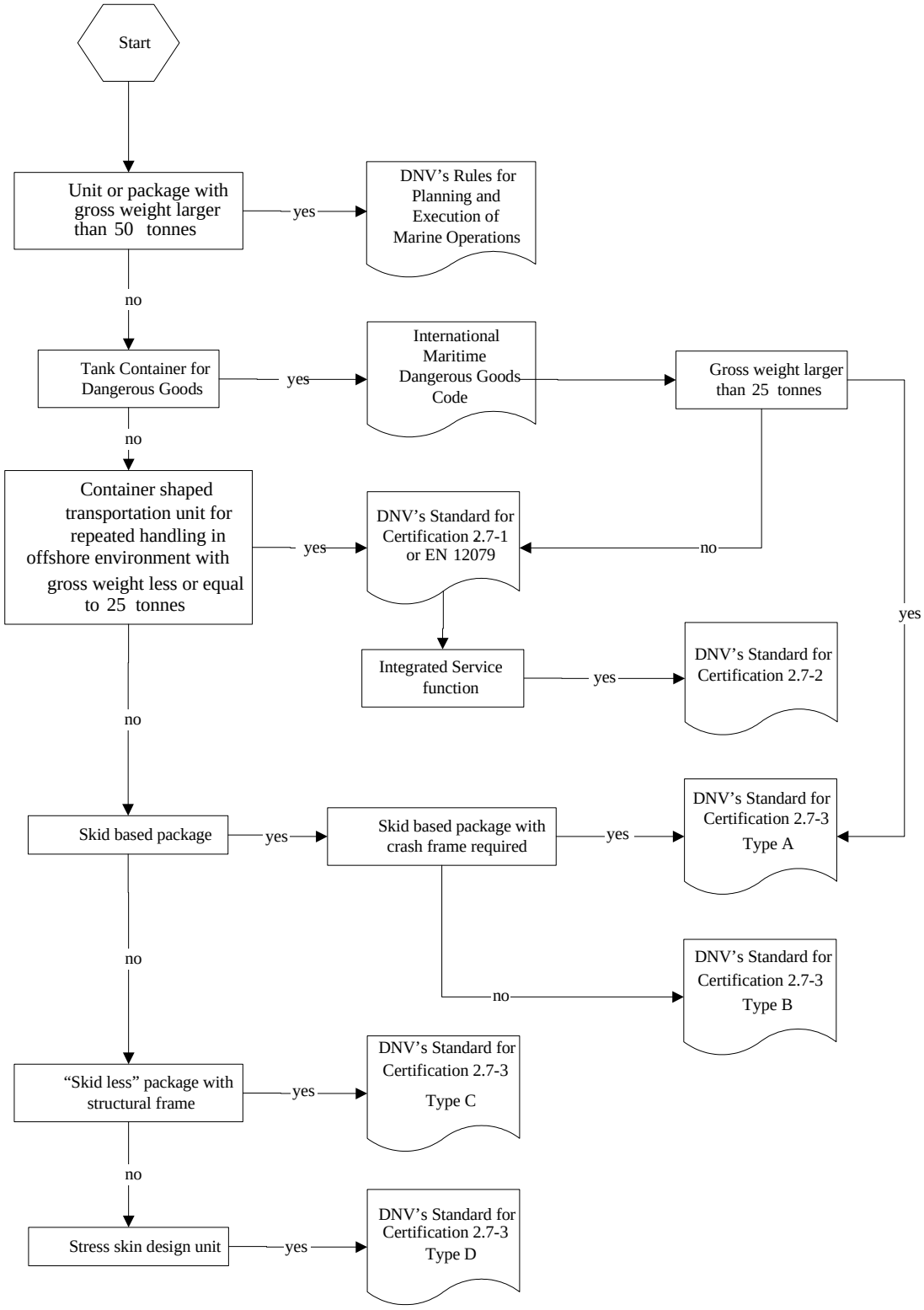

Figure 1-1
Unit types with references to relevant regulations and Standards for Certification

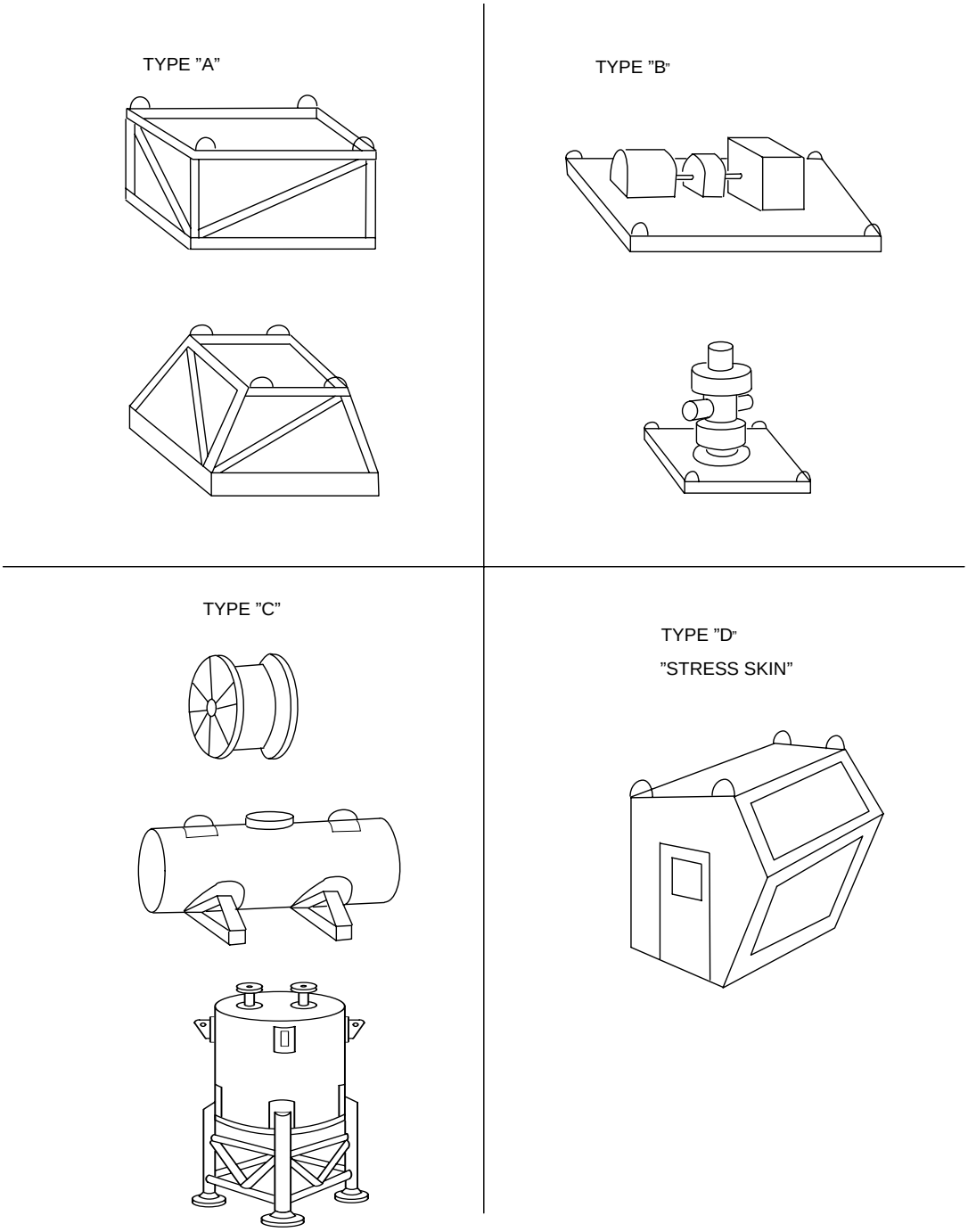

Figure 1-2
Example of Unit types

1.2 Definitions

1.2.1 Portable Offshore Units

Portable Unit or package with a maximum gross weight not exceeding 50 tonnes, for repeated or single use with a primary service function, handled in open seas, to, from or between fixed and/or floating offshore installations and ships.

1.2.2 Offshore Container

Portable Unit with a maximum gross weight not exceeding 25 tonnes, for repeated use in transport of goods or removable cargo, handled in open seas, to, from or between fixed and/ or floating offshore installations and ships.

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

Note:
Standard Freight containers are not suitable for offshore use.

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1.2.4 Primary Structure.

Primary structure includes the following structural components:

— load carrying and supporting structure

— load carrying panels (floor, tween decks etc.)
— fork lift pockets
— pad eyes
— supporting structures for tanks
— supports for heavy equipment.

Primary structures are divided into two sub-groups:

a) *Essential and non-redundant primary structure* are the main structural elements which transfer the resulting load to the crane hook (i.e. forming the " load path" from the load to the lifting sling), and will at least include:

   — top and bottom side elements
   — top and bottom end elements
   — corner elements
   — load distributing reinforcements
   — pad eyes.

   Other primary structure may also be considered to be essential/ non-redundant.

b) *Non-essential primary structure* are e.g. floor plates and other structural elements whose main function is not to transfer loads between the structure and pad eyes, but which are added for other purposes (e.g. protective frame members).

1.2.5 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 tank protection only.

1.2.6 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.

1.2.7 Owner

The legal owner of the Offshore Transportation Unit or his delegated nominee.

1.2.8 Lifting set

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

1.3 List of symbols

F	=	Design load, [N].
F_{HI}	=	Horizontal design impact load, [N].
F_{VI}	=	Vertical design impact load, [N].
L	=	Length of Unit, [m].
MGW	=	Maximum Gross Weight [tonnes], alternatively [kg]
Tonnes	=	Metric Ton, i.e. 1000 kilograms [kg] or 2 204.62 [Lbs]
P	=	Payload. The maximum permissible weight of cargo which may safely be transported by the Unit, [tonnes], P = R - T). This nomenclature is from C.N 2.7-1 and shall only be used in exceptional cases in this Standard for Certification as it is not primarily intended for use as standard for “containers”.
R	=	Rating. The weight of the offshore Unit and associated equipment involved in transport of the Unit, [tonnes], alternatively [kg]. (In this Standard for Certification “Rating” shall be understood to be the same as Maximum Gross Weight).
R_e	=	Specified minimum yield stress at room temperature, N/mm^2].
$R_{p\ 0.2}$	=	0.2% proof stress at room temperature, in [N/mm^2].
a	=	distance from the centroid to extreme the extreme vertical profile [m].
H	=	height of the Unit structure [m]
RSF	=	Resulting Sling Force on padeyes, in [N].
T	=	Tare weight. Mass of empty Units without cargo [tonnes], alternatively [kg], which includes all associated equipment and outfitting details involved in the transportation of the Unit.
T_D	=	Design temperature is a reference temperature used for the selection of steel or aluminium grades used in offshore Units and associated equipment [Deg. C].
g	=	Standard acceleration of gravity (~ 9.81 m/s^2).
L_n	=	Nominal length of structural member, [m].
n	=	Number of sling legs
t	=	Material thickness, [mm].
v	=	Angle of sling leg from vertical, [degrees].
y	=	Deflection of structural member, [m].
σ_e	=	Von Mises equivalent stress, [N/mm^2].
Ψ	=	Load factor can also be regarded as Dynamic Amplification Factor DAF
D	=	Design Factor
M	=	Material factor
SKL	=	Skew Load Factor
W	=	Weight factor
DAF	=	Dynamic Amplification Factor
V_R	=	Relative hoisting speed (e.g. considering lifting a load from a moving deck with a crane located on an installation that also moves) [m/s]
K_C	=	Stiffness of the Crane (predominantly the inverse of the elasticity the hoisting rope)
V_C	=	Velocity of the Cranes vertical movement [m/s].
V_H	=	Crane hook velocity [m/s].
V_B	=	Vertical velocity of the supply boat deck [m/s].

1.4 Documents for approval and information

For design review, the following documentation shall be submitted to DNV in ample time before manufacturing:

For approval, in triplicate:

— Plans showing arrangement, dimensions, max. gross weight, payload, scantlings of strength members, sling angle, pad eyes and design details as well as materials to be used.
— Particulars of joining methods (welding, bolted and riveted connections).

For information (1 off):

— information about intended use, as applicable:
— equipment to be installed
— service function
— special loads to be applied
— limitations in operation, Etc.
— particulars of corrosion protection and painting (type, application, dry film thickness)
— design calculations.

1.5 National authorities

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

1.6 References

1.6.1 Applicable rules and regulations:

— DNV Standard for Certification 2.7-1, Offshore Containers.
— DNV Standard for Certification 2.7-2, Offshore Service Containers.
— 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.
— EN 12079: Offshore Containers - Design, Fabrication, Testing, Inspection and Marking.

1.6.2 Applicable standards:

— 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.
— ISO 209: Wrought aluminium and aluminium alloys.
— ISO 630 pt. 13: Wrought Stainless Steel.
— 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.
— AISC Manual of Steel Construction, *Allowable Stress Design*.

Note:

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

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1.6.3 Other relevant documents:

— DNV Rules for Classification of Ships
— Rules for Certification of Freight Containers, Det Norske Veritas 1981.
— DNV's Rules for Planning and Execution of Marine Operations, January 1996.
— Rules for Certification of Lifting Appliances, Det Norske Veritas, 1994.
— Det Norske Veritas' Certification Note no. 1.1: "Certification Services - General Description".
— Det Norske Veritas' Certification Note no. 1.2: "Conformity Certification Services - Type Approval".
— Det Norske Veritas' Certification Note no. 1.3: "Conformity Certification Services - Quality System Certification".
— Det Norske Veritas' Certification Note no. 2.1: "Approval and Survey Programmes for Materials".
— 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.

2. Certification procedures

2.1 Introduction

2.1.1 General

Offshore Units designed, manufactured, tested and marked in compliance with the following requirements may be certified by Det Norske Veritas. Once a successful review process has been completed a product certificate is issued by the Society and the Unit's nameplate hard stamped with the allocated ID-number and the Society's scroll stamp.

Certification consists of the following steps:

— design review
— inspection and testing of prototype
— production inspection and testing
— issuance of certificates.

2.1.2 Approval Schemes

If a manufacturer plans to build only one Unit, or a single batch of Units, the Society may give an individual (case-by-case) approval valid for that batch only.

If series production is intended or if further orders for the same Unit design are expected in the future, a type approval certificate will normally be given. Type approval certificates can only be issued to the manufacturer of the product.

If a designer/design company wishes to obtain an approval for a Unit design which they do not manufacture themselves, or will build at a later date, the Society may issue a Design Assessment for type approval certificate. When the Unit design is built, it shall be type tested and a type approval certificate will 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 are to make Units of the same design type, type testing shall be carried out at each manufacturing plant.

Lifting sets for offshore Units may be certified separately in accordance with National requirements and recognised standards.

2.1.3 Survey and Certification

For each Unit produced, a product certificate with the title "Portable Offshore Unit", (Form No. 20.92a) will be issued. Units shall be constructed and tested under the supervision of a Surveyor, who issues the certificate.

Certification may be based on the Society'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 approved arrangement 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. The Society's Quality System Certification Service is described in DNV Certification Note 1.3: "Conformity Certification Services - Quality System Certification".

2.2 Design Review

The design review will include at least:

— strength of structure
— material specifications
— welding and other joining methods
— lifting set (if applicable)
— other permanent equipment.

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

2.3 Testing and Inspection

2.3.1 Prototype Testing

Whether a single Unit or a series of Units are to be built, prototype tests shall be carried out. As these tests shall not damage the Unit, no special prototype has to be built for testing. Test requirements are given in Section 3.7.

2.3.2 Production Testing

If a series of Units are to be built, strength tests shall be carried out on a percentage of these. Test requirements are given in Section 4.5.

2.3.3 Production Inspection

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

— dimensional control
— visual inspection of weld preparation, welding, alignment, material marking etc.
— review of material certificates
— review of WPS/WPQ, Welders Qualification Tests, welding consumables
— review of equipment documentation as necessary
— review of NDT documentation and report
— review of marking.

2.4 Certification of existing Units

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

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

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

2.5 Maintenance of certificate

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

Such periodic inspection may be carried out by the Society 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 the Society.

Inspection reports shall be attached to the Unit’s product 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 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 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.

2.6 Summary of procedures

The procedures for individual and type approval are outlined below.

2.6.1 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 offshore Unit manufactured under supervision of the Society's Surveyor.
5) Unit tested according to prototype test requirements, witnessed by the Society'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) Product Certificate for “Portable Offshore Unit”

2.6.2 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 offshore Units manufactured under supervision of the Society's Surveyor.
5) Units tested according to prototype test requirements, witnessed by the Society'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 Portable Offshore 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) Surveyor issues Product Certificate “Portable Offshore Unit” (form 20.29a).

2.6.3 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 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 General

Units intended for offshore transportation complying with this Standard for Certification 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 Units during it's exposure to dynamic conditions that are common for an offshore transportation event involving sea voyages, lifting and transfer to moving objects such as ships and floating offshore vessels.

Maximum allowable stresses, design loads and safety factors are defined in this section. Limitations on structural displacement and stiffness are also included to promote control of the Unit's behaviour during the transport event.

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 6m significant wave height, unless otherwise stated in operational limitations.

Units intended for repeated transportation events and to be mixed with other frequent handled goods shall be free from protruding parts outside the envelope of the Unit. Details and parts that may catch or damage other Units shall not be allowed. Door handles, hinges, hatch cleats and similar details shall be arranged in a recessed or protected fashion to avoid becoming catch points or contacting points that may complicate lifting and handling operations.

All Units in compliance with this Standard for Certification shall be evaluated with regard to the risk of uncontrolled skidding and overturning on a moving ship deck. This section contains design criteria's and circumstances affecting the design that shall be addressed to secure safe and controlled shipment and handling of the Units.

As mentioned in Section 1.0 this Standard for Certification is organized to address four major types of Units. The types of Units have been selected due to similarities in features. These main four types are defined in section 1.1.

3.1.1 Design Temperature

The design temperature shall not be taken higher than the (statistically) lowest daily temperature for the area where the package shall operate. In the absence of a design temperature designation, the design temperature shall be -20° C.

3.2 Structural Strength

When performing design analyses for verification of structural strength alternative approaches are acceptable. It is assumed that the calculation approach covers critical detail in an acceptable way and is representative for the through loading of the Unit.

3.2.1 Calculation Methods

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.

3.2.2 Allowable Stresses

Design loads defined in this section shall not produce Von Mises equivalent stresses, σ_e exceeding:

$$\sigma_e = 0.85 \times C$$

For the normally used materials C is defined below. Other materials may be approved after special consideration.

for steel: $C = R_e$

For allowable stresses in aluminium, reference is made to Section 4.2.1 in DNV's Standard for Certification 2.7-1 Offshore Containers.

Note:

An alternative approach based on principal stress is given in Appendix B.

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3.2.3 Lifting Loads

3.2.3.1 Lifting with lifting sling

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

Von Mises equivalent stress method:

$$F = 2.5 \times MGW \times g$$

The design load for a pad eye is equal to the resultant sling force (RSF) on the pad eye. For multiple leg slings, the resultant sling force (RSF) on each pad eye is:

$$RSF = \frac{1.2 \times F}{(n-1) \times Cos(v)}$$

where v is the angle between the sling leg and vertical and n is the number of pad eyes.

A Unit with a single pad eye may be approved after special consideration. The design load for such a pad eye shall be taken as:

$$RSF = 2 \times F$$

3.2.3.2 Lifting with fork lift truck

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

$$F_F = \frac{2}{3} \times F$$

3.2.4 Impact Loads

Dynamic loads occur as a result of vessel motion during the transportation handling event. Dynamic loads occur randomly. A part of dynamic loads are impact loads. Impact loads are of very short duration. In the following simplified calculations each impact load is considered separately.

Maximum calculated deflection for impact load conditions shall not exceed:

$$y = \frac{L_n}{250}$$

where y is the deflection and L_n = the total length of the corner post, side rail or the shortest edge of the wall being considered.

Guidance note:

L_n is the longest free spanned beam and/ or a complete side distance in a Unit frame.

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Calculated equivalent stress shall not exceed:

$$\sigma_e = C$$

3.2.4.1 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 Unit. The impact force may act in any horizontal direction on the corners of the Unit.

On all sides of the Unit, the load is considered to act perpendicular to the surface. The following values shall be used for the static equivalents of impact load:

Corner posts and bottom rails/ edge;

F_{HI} = 10 % of the proof load test factor calculated in Section 3.7.1.1

End or side structure and upper rails/ edge;

F_{HI} = 5 % of the proof load test factor calculated in Section 3.7.1.1

Note:

For exposed members in a skid frame with out crash frame (Type B-Units) only the first criteria will apply. Type C-Units are normally not structurally suitable for side impact resistance and these criteria shall not be evaluated in the design review. This Unit type should be handled as a planned transportation event and due consideration shall be given to lifting and stowage during the transport.

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A Unit of sufficient size that it will not be transported in conjunction with Offshore Freight Containers or a Unit designated for a *single* transportation event may use the following static equivalent for impact load:

F_{HI} = 5 % of the proof test load factor calculated in Section 3.7.1.1

3.2.4.2 Vertical Impact

The structure must be capable of withstanding an impact from lowering on one corner of the structure. This may be simulated by the test described in Section 3.7.2 or by calculation. Inertia forces acting on elevated part of the structure shall be addressed.

In addition the static equivalent of impact load for any point on bottom side rails and bottom end rails is:

F_{VI} = 10 % of the proof load test factor calculated in Section 3.7.1.1

Note:

C-Units are normally not structurally suitable for vertical impact resistance and these criteria shall not be evaluated in the design review and operational limitation shall be stated accordingly (See Section 7).

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3.2.4.3 Minimum Material Thickness

Minimum material thicknesses are specified to ensure durability in the design of portable Units.

The following minimum material thicknesses will apply:

a) Those parts of the corners and bottom rails forming the outside of the Unit: t = 8 mm

b) All other parts of the primary structure: t = 5 mm

c) Secondary structure made of metal: t = 2 mm.

Note:

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

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3.3 Welding

Weld strength shall be based on the nominal weld area and the stress intensity produced by the design load, F. The allowable stress for the weld shall be as designated in Section 3.2 multiplied by the following reduction factors:

— 0.5 for fillet weld

— 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

— 1.0 for full penetration welds.

3.4 Design Details

3.4.1 Pad Eyes

Pad eyes should normally not protrude outside the vertical boundaries of the Unit and shall be located, as far as practicable, so that the sling leg loads are equal. Lifting points shall be positioned on the Unit to preclude the risk of fouling the lifting sling by the Unit or its contents. 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 Units.

3.4.1.1 Pad eyes made from plate

The outside radius of the pad eye shall be no less than the diameter of the pin hole. The dimensioning stress over the pad eyes minimum cross sectional area shall be taken as the vectorial sum of the shear stress plus the bending stress and 3.75 times the average tensile stress. All stresses shall be based on the RSF (Ref. 3.2.1.1). 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 pad eye. Full penetration welds are preferred for pad eyes on Type “A” and “B” Units.

If the lifting load is transferred through the plate thickness (z axis) plates with specified through thickness properties must be used. Reference for acceptance criteria’s are given in DNV’s Rules for Ships, Pt.2 Sec.2 E100 or to EN 10164 or to compatible ASTM specification.

3.4.1.2 Forged pad eyes

Shoulder type machinery eye bolts or forged shoulder nut eye bolts may be accepted for single transportation events. The ultimate strength of the pad eye shall be at least 5 times the working load limit. The working load limit of the eye bolt shall be equal to or greater than RSF. De-rating of eye bolts due to angular loads shall be done in accordance with the manufacturer’s recommendation. The pad eye and/ or nut must be positively secured to prevent accidental loosening of the threaded joint.

Note:

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

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3.4.2 ISO-corner Castings

This paragraph is not applicable to Type “B” or “C” Units. 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.

3.4.3 Drainage

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

3.4.4 Fork Lift Pockets

Portable Offshore Units may be fitted with one or more sets of fork lift pockets in the bottom structure. In such cases the following will apply.

The minimum opening of the fork lift pockets shall be 200 mm x 90 mm.

Fork lift pockets shall be located such that the container is stable during handling with fork lift truck. Unit length, height, width and rating shall be taken into account. Pockets shall be

located as far apart as practical. Centre distance shall be at least 900 mm (where possible), but need not be more than 2050 mm.

Note 1:

It is recommended that pockets are located and used according to Table 3-1

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Table 3-1 Recommended fork pocket distances and operational limitations

Unit length L (m)	*Min. distance between centres of pockets (mm)*	*Limitations*
L < 6	According to the above requirements.	If 3 < L < 6 m, the pockets for loaded handling shall be spaced at least 1500 mm apart.
6 ≤ L ≤ 12	2050	Pockets for loaded handling
	900	Pockets for empty handling
12 < L ≤ 18	2050	Empty handling only
L > 18	-	No pockets

Fork pockets shall pass through the base and have closed top and sides.

Note 2:

The bottom face of fork pockets may be fully closed or have partial openings.
Openings in bottom plates shall have such size and location so as to minimize the risk that the fork tines may penetrate or seize in the opening, or that they damage the free edges at the cut-out is minimized.
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.

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Note 3:

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.

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Such 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 4:

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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3.4.5 Walls

This paragraph is not applicable to Type "B" or "C" Units. Each Unit wall including the doors shall be designed to withstand an internal load of $F_W = 0.6 \times P \times g$ evenly distributed over the whole surface, without suffering any permanent deformation.

3.4.6 Equipment and Supports for equipment

Mounting of equipment or outfitting details installed in a Unit shall be designed to withstand dynamic loadings and other environmental forces to which it may be exposed. If these factors are not specified in the design documentation, the following minimum factors shall be used:

— Dynamic load factor; $\Psi = 1.66$
— Design factor against yield; $s = 1.5$

Alternatively: If the calculation approach recommended in paragraph 3.2.2.2 is made, the recommended multipliers may also be used for calculations of reaction loads on mounted equipment utilizing the specific equipment weight. In this approach it is acceptable to limit the allowable stress to Re.

3.4.7 Doors and hatches

This paragraph is not applicable to Type "C" 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 Unit is unloaded. Doors may be outfitted with gaskets for weather tight Units. Hinges shall be protected against damage from impact loads.

3.4.8 Lashing

Units that may become unstable when subjected to the dynamic conditions experienced during a sea voyage shall have suitable strong points for lashing. A dynamic factor of at least 1.33 shall be used for horizontal lashing.

3.4.9 Tugger points

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

— Designed for a load equal to the "MGW"
— Have a maximum stress limited to $0.67 \times C$
— Be placed as low on the structure as practical.

3.4.10 Coating and Corrosion Protection

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

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

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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3.5 Units with tanks

This Standard for Certification does not apply to tanks to be used for transport of cargo, or to tank containers for Dangerous Goods. See DNV Standard for Certification 2.7-1 and the IMDG code.

Tanks that are pressure vessels shall be designed in accordance with a recognized code, e.g. ASME or EN, and suitable for the intended service.

3.5.1 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.

3.6 Materials

Metals utilized in primary structures shall as a minimum be supplied with a "Works Certificate" equivalent to an Inspection Certificate of type 3.1B as defined in EN10204.

3.6.1 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 should be Charpy (V-notch) impact tested in accordance to a recognized code, e.g. 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.

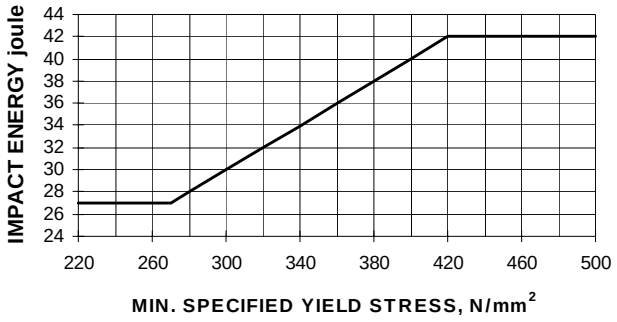

Figure 3-1
Charpy V-notch requirements for steel

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 temperature 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 yield strength above 500 N/mm^2 (70 000 psi) should not be used.

3.6.2 Forged or Rolled 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 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.

3.6.3 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 special evaluation.

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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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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3.6.4 Non-metallic Material

Due regard shall be given to strength, durability, suitability and possible hazards caused by the use of non-metallic materials. Timber, plywood, reinforced plastics, paper and other non-metallic materials may be used as secondary structures. These materials will be given similar consideration as load bearing structures.

3.7 Prototype Testing

The prototype testing specified in Sections 3.7.1.1 and 3.7.1.2 is required for Units intended for multiple lifts throughout the life of the Unit. A Unit intended for a single transportation event is exempted from prototype testing if built in accordance with section 3.7.1.3.

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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If the Unit is a special purpose Unit with large localized loads, the test load shall mimic this distribution as reasonably possible. If the Unit will contain delicate equipment, i.e. gauges or instruments, the tests should occur before these items are installed.

3.7.1 Lift Tests

All certified Units shall pass a production proof load test (ref. Table 4-2). The 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. All major welds in the main load path shall be thoroughly visually examined after the testing is complete. All essential and or non redundant welds shall be examined through NDT.

3.7.1.1 All Point Lifting

Units equal or less then 25 tonnes shall be load tested with an overload factor of 2.5 x MGW. For Units from 25 tonnes through 50 tonnes the overload factor shall be chosen from table 3-3.

Table 3-3 Proof Load Test factors for all point lifts:

Maximum Gross Weight	*Proof Load Test Factor*
Less or equal to 25 tonnes	2.5 x MGW
25 tonnes to 30 tonnes	[2.5-0.2(MGW-25)] x MGW
30 tonnes to 50 tonnes	[1.5-0.01(MGW-30)] x MGW

The maximum deflection of any member of the suspended Unit shall not exceed 1/300 of the span of the member. Following the lift there shall be no permanent deformation.

3.7.1.2 2-point Lifting (Diagonal Lift Test)

Units of particular shape or slenderness that may show erratic reactions or unacceptable displacements shall be subject to a 2-point lift test. Units with four pad eyes that require a 2-point test shall be lifted from two diagonally located pad eyes with a load test factor as specified in Table 3-4.

The interpretation of the necessity of performing the two point test will be at the discretion of the Society.

Table 3-4 Proof Load Test factors for two point lifts

Maximum Gross Weight	*Proof Load Test Factor*
Less or equal to 25 tonnes	1.5 x MGW
25 tonnes to 30 tonnes	[1.5-0.06(MGW-25)] x MGW
30 tonnes to 50 tonnes	[1.2-0.01(MGW-30)] x MGW

Following the lift there shall be no permanent deformation.

Note:

Units without roof may have insufficient strength and stiffness to pass the 2 point lifting test. In order to avoid building prototypes that will not pass the test, the rigidity should be checked by a suitable calculation method. In these calculations, the nominal yield stress of the material, R_e, shall not be exceeded. These calculations do not replace the prototype testing.

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3.7.1.3 Exceptions for Single Transportation Event Units

Units intended for a single installation or decommissioning lift do not require lifting tests if the rating, R, is increased by a factor of 1.5 in the strength calculations. Should a situation arise that necessitates a second transportation event for a Unit, the related lifting may be accepted at the discretion of a DNV surveyor after a thorough visual and NDE inspection.

3.7.2 Vertical Impact Test

This test is performed if the testing method is chosen in paragraph *3.2.4.2*. The Unit, with an internal test weight corresponding to payload *P*, should 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 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 5° with the floor. However, the greatest height difference between the highest and lowest point of the underside of the offshore 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.

Alternative 1: Drop test

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

Alternative 2: Lowering test

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

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.

4.2 Welding

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

4.2.1 Welding Qualification

Welders and welding procedures shall be approved by the Society and shall be according to a recognised standard, e.g. 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. The Society reserves the right, however, to require verification of the approval when deemed necessary. Such verification may include additional NDT and/ or welding tests.

4.2.1.1 Welding Procedures

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.

4.2.2 Inspection of Welds

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

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 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 the Society'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.

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 the Society in each case.

Table 4-1 NDT of structural welds

Category of member	*Type of joint*	*Type of examination* I Visual examination	II Magnetic particle examination[1)]	III Ultrasonic examination[2)]	IV Radiographic examination
1.Primary					
A:Essential/	Butt welds	100%	20%	100%	10%
Non-redundant	T-joints	100%	100%	100%	
---	---	---	---	---	---
B:Other	Butt welds	100%		20%	10%
	T-joints/fillet welds	100%	20%	20%	
2.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.

4.2.2.1 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 the Society 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.

4.2.2.2 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 the Society's discretion, dependent on the local stress conditions and the limitations of the NDT-methods to determine location and size of defects.

4.3 Secondary structure

Secondary structure shall be installed to perform the designated function, i.e. to prevent cargo from falling out of the Unit or prevent water from entering. Manufacturing procedures should reflect this.

4.4 Production documentation

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

— drawings, including a general arrangement drawing
— unit and member strength calculations
— design approval certificate (DVR or TAC)
— material documentation
— welding procedure qualifications (WPQ)
— specifications for welding procedures (WPS)
— welders certificates
— report on traceability of materials
— report from manufacturing inspection
— report from dimensional control
— report from non-destructive testing (NDT)
— report from prototype testing
— report from proof testing
— report from final inspection.

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

The "As Built" dossier should at least include:

— general arrangement drawing
— material documentation
— specifications for welding procedures (WPS)
— report on traceability of materials
— report from manufacturing inspection
— report from dimensional control
— report from non-destructive testing (NDT)
— report from proof testing
— report from final inspection
— DNV's certificate for the Unit namely "Portable Offshore Unit" Ref. form 20.92a.

The various reports may be combined as practical.

When the surveyor has carried out manufacturing inspection, witnessed testing and reviewed the production documentation:

— a "Product Certificate" will be issued.
— "NV" and the certificate number will be hard stamped into the name plate and into the Unit primary member immediately below the name plate.

4.5 Production testing

4.5.1 Lifting test

Provided that the exempt rule given in 3.7.1.3 does not apply, some Units should be strength tested during production. An all point lifting test shall be carried out. The number of Units to be tested shall be agreed in advance and will depend on the total number in the production series. Units for testing shall be chosen at random after the production of a batch is finished.

Table 4-2 may be used as a guide to decide the number of Units to be tested.

Table 4-2 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.

4.5.2 Weatherproof testing

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

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

An inspector will enter the Unit or container. 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.

5. Marking

5.1 Safety marking

The maximum gross weight, the tare mass, and the payload shall be displayed in characters of a contrasting colour not less than 50 mm high. This information shall be located in a prominent place. The location and elevation shall allow the plates to be easily read by a person standing beside the Unit.

When a Unit is fitted with fork pockets designed for handling the Unit when empty only (e.g. on some tanks and long baskets) then the words "Empty Lift Only" shall be clearly displayed near each set of fork pockets in characters not less than 50 mm high.

5.2 Identification Markings

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

5.3 Additional Information Markings (Optional)

On each Unit a matt black square not less than 400 x 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 Unit without doors or the end of the tank of a tank Unit.

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.

5.4 Other Marking

The user of the 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 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.

6. Information Plates

6.1 General

Units shall be fitted with an information plate (ref. sections 6.2). Unit that is intended for multiple transportation events over a period exceeding one year shall be fitted with an inspection plate (ref. sections 6.3).

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 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 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.

6.2 Operational limitations

If the Unit is imposed with operational limitations the sides of the Units shall be clearly marked with letters 100 mm high stating "Operational limitations", and the limitations shall be stated on the information plate.

6.3 Information Plate

The plate shall be headed

"PORTABLE OFFSHORE UNIT"

The plate shall contain the following information:

a) Name of manufacturer.
b) Month/year of manufacture.
c) Manufacturer's serial number.
d) Maximum gross weight (kg) at design sling angle.
e) Design temperature.
f) DNV’s Inspector Stamp (Ref. 4.4).
g) Operational restrictions (if any).

A recommended format for the plate is shown in Figure 6-1.

PORTABLE OFFSHORE UNIT – DNV CN 2.7-3 Type A/ B/ C/ D –for Single/ Multiple transportation

Name of manufacturer:
Month/ year of manufacture:
Manufacturer’s serial no:
Maximum Gross Weight: Tonnes/ Kg @ ° maximum sling angle

DNV’s Product Certificate no:
Design Temperature: °C

“DNV Hard Stamp”

Operational Restrictions: (if any)

…..e.g Limited to transport in Sea State less or equal to “2”

Figure 6-1
Information plate

6.4 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 (tonnes/ kg) @ ° design sling angle.
c) Tare mass (tonnes/ kg) if relevant.
d) Payload (tonnes/ kg) and intermediate deck payload (if applicable).
e) Owner's name and international telephone number(s).
f) 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 facil-

itate permanent marking to record a minimum of 9 inspections.

A recommended format for the plate is shown in Figure 6-2:

INSPECTION DATA – PORTABLE OFFSHORE UNITS

Product Certificate No.:
Maximum Gross Weight: Kg @ ° design sling angle.

Owner:
Tel : +
: +
...: +
...: +

Inspection dates:

Figure 6-2
Inspection plate

At each periodic or other inspection, this plate should be marked as described in clause 7.2.2.

Note:

Users of Units should regard the data plate as prima facie evidence of certification status. 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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7. Operational restrictions

All Units will require special consideration or attention that may affect the design as well as arrangement and procedures for the transportation event. These considerations will entail limitations of sea state for the transport event, specially arranged procedure or arrangements for handling or sea fastening, or reasonable other necessary compromises on requirements stipulated in this Standard for Certification. Examples of special considerations are listed in Section 1.1.

For such Units it is advised that an agreement with the Society is established in an early stage of the enterprise. The main objective for this pre-design agreement will be to establish reasonable compromises to achieve a consensus of suitable actions and precaution to ensure a product suitable for handling and transportation in a predictable and safe manner.

The operational restrictions shall be agreed on. They shall be documented in the Societies reports and certificates. When necessary and relevant, they shall also be noted on the information plate.

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 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 Units

8.2.1 Schedule of examination and tests

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.

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.

Table 8-1 Schedule of examination and tests

Time or interval	*Test/Examination*			
	Lifting test as described in clause 3.7.1.2	*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 the primary elements of the offshore Unit, or elements which contribute directly to its structural integrity.

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

After renewal or substantial repair of damaged parts of the primary structure or after modification of a 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.

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 Inspection report

When, in the opinion of the inspector, a 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) 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 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 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
Alternate design approach for transportation and lifting of Units involving dynamic amplification of load reactions during operations.

A.1 Introduction

Transportation and lifting operations in offshore environments involving partly or fully developed sea state are dynamic events. The reaction forces during these events are generally greater than the reaction forces of a similar static event.

These dynamic effects are encountered due to variation of hoisting speed, crane characteristics, vessel motion, etc. They will also be significantly influenced by conditions such as:

— environmental conditions such as wind, waves, current etc.
— type of crane carrier such as fixed platforms or different types of floating vessels
— stiffness of crane structure such as gantry arrangement, boom arrangement etc.
— performance characteristics of hoists
— rigging arrangement
— interaction and influences of the cargo carrying vessel
— lifting procedures and.
— weight of the lifted objects.

These global effects of a transportation event or lift scenario can be accounted for by introduction of a Dynamic Amplification Factor (DAF).

A thorough analysis of the influencing effects should conclude a suitable seizing of the DAF. This factor will affect the reaction forced in the sling or grommet arrangement involved in the lift.

A commonly accepted, simplified approach is to derive the DAF from studies of relative motions of the lifting appliance and the object being lifted. The following formula is given in DNV's Rules for Certification of Lifting Appliances.

$$DAF = 1 + V_R \times \sqrt{\frac{K_C}{Mg}}$$

Where:

V_R = the relative hoisting speed (e.g. considering lifting a load from a moving deck with a crane located on an installation that also moves) [m/s]
g = the gravitational acceleration coefficient [9.81 m/s^2]
MGW = Maximum gross weight subjected to the lift [Kg]
K_C = stiffness of the crane (predominantly the inverse of the elasticity in the hoisting rope) [N/m].

For the purpose of assessing the K_C-value, the modulus of the elasticity of steel wire ropes may be equal to $0.75 \cdot 10^5$ N/ mm^2, based on the metallic area of the wire rope.

When the load is picked up the relative hoisting velocity of the load can be expressed as the arithmetic sum of the vertical velocities of the crane, the hook and the supply boat deck, i.e. .

$$V_R = V_C + V_H + V_B$$

V_C = velocity of the cranes vertical movement
V_H = the crane hook velocity
V_B = vertical velocity of the supply boat deck

A more reasonable approach is to use the “root-mean-square” to calculate the relative speed, i.e. .

$$V_R = \sqrt{V_C^2 + V_H^2 + V_B^2}$$

For example, the DAF for a fixed platform lift from a specific supply boat, involving a typical offshore crane, in a sea state with a significant wave height of about 3 meters is shown in Fig. A-1.

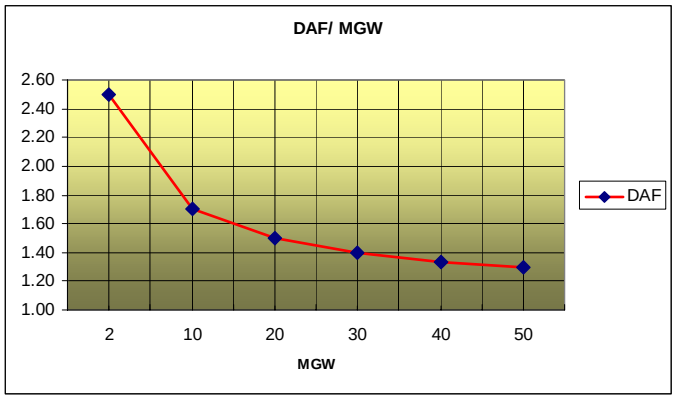

Figure A-1

Note:
the validity of the curve is somewhat inaccurate for loads in the extremes of the curve.

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A.2 Partial Coefficient Method

The partial coefficient method is commonly accepted for establishing safety margins for dynamic offshore lifts.

This method consists of assigning load or consequence factors and combines them with the anticipated dynamic amplification related to the analysed lift scenario.

Several characteristics must be known to establish the dynamic amplification factor. The behaviour of the supply vessel in the chosen sea state has to be known. The stiffness characteristic and hoisting speed information related to the utilized crane should also be known. If the crane is installed on a floating carrier the vertical motions of the crane (i.e. crane carrier) should also be known. With this information available the dynamic amplification factor can be calculated as described through the earlier presented formula.

Once the DAF has been resolved, the following approach is recommended as an alternative to the standard method described in this Standard for Certification. This approach is mainly intended for Units with maximum gross weight exceeding 25 tonnes.

Note:
The approach of the Partial Coefficient Method is further in detail described in DNV’s Rules for Planning and Execution of Marine Operations, January 1996.

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A.2.1 Amplification of Loads

As can be seen in the example chart A-1, the DAF varies from about 2.5 for a load of 2 tonnes down to about 1.3 for a load of 50 tonnes. It is also noted that the most dramatic variation occurs in the range between 0 to 25 tonnes. After 25 tonnes the graph can more or less be approximated to be a straight line and not a curve.

The consequences of the distribution of the DAF as demonstrated in the example (Fig. A-1) suggest that there is reason to

expect more sever inertia loads being involved in dynamic lifts the lesser the gross weight is.

Based on this approximation it is reasonable to apply different load factors over the load range. These factors will accommodate for the reaction load in the lifted structure and associated gears such as shackles, padeyes and sling arrangements.

Note:

It is also worth mentioning that a well designed sling arrangement with appropriate thimble reinforcement, master link arranged and a possible fore runner will contribute to dampening the result of shock loads generated by undesired dynamic motions occurring in the lifting sequence.

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A.3 Load Factors (Ultimate Limit State and Consequence Factors)

A number of load or consequence factors can be established as influences on the planned lifting. The following may serve as guidance for choosing load factors when designing Units suitable for offshore lifts and applying the partial coefficient method.

A.3.1 Design Factor [D]

The first factor to consider relates to inaccuracies in design and potential consequences of a failure. This could relate to a series of approximation and assumption the designer has performed in the design process. One could also refer to a degree of unknown influences participating in the actual load once the Unit is involved in the transportation or the lift. For fairly complex Units with a maximum gross weight above 25 tonnes it is recommended to use a factor of 1.3.

A.3.2 Skew Load Factor (or shift of Centre of Gravity). [SKL]

It may be difficult to predict or calculate the centre of gravity to a desired degree of accuracy when dealing with Units or structures of a certain complexity. This is especially valid when not involving a rigorous control activity to establish the true centre of gravity. This type of inaccuracy may also originate from differences in sling length and load sharing in sling legs. To accommodate for such inaccuracies it is advised to use a factor of no less then 1.05 as a contributor in the conclusion of the total determination of the design load.

A.3.3 Weight Inaccuracy Factor. [W]

A weight inaccuracy factor of at least 1.05 is recommended, if not weighing the Unit after final assembly. This should account for differences from e.g. installation tolerances, weld deposits, tolerances and paint etc.

A.3.4 Material Factor. [M]

It is advisable to encounter inaccuracies in material. This could represent deviation in weld quality, material flaws such as undesired deposits, or similar consequences. A material factor of at least 1.05 is recommended.

A.3.5 Dynamic Amplification Factor [DAF]

As explained in paragraph A.2.1, to account for dynamic amplification of the loads acting on a lifted Unit a DAF derived from the equation in A.1 should be used for the “Total Load Factor” as described below.

Total Load Factor [F_{tot}]

The total load factor to use for calculating acceptable design stresses with reference to paragraph 3.2.1 is now:

$$F_{tot} = D \times SKL \times W \times M \times DAF$$

Appendix B
Alternate Design Method

B.1 General

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.

B.2 Allowable Stresses

The following shall replace the calculation in paragraph 3.2.2.

Tensile stress, $\sigma_t = 0.6 \times C$

Shear stress, $\tau = 0.4 \times C$

B.3 Lifting Loads

The following shall replace the calculation in paragraph 3.2.3.

The design load on the primary stress shall be taken as:

$$F = 2.68 \times MGW \times g$$