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OFFSHORE STANDARD  
DNV-OS-C301

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STABILITY AND WATERTIGHT  
INTEGRITY

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JANUARY 2001

DET NORSKE VERITAS

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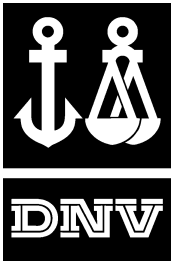
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## STABILITY AND WATERTIGHT INTEGRITY

### CHAPTER 1

## INTRODUCTION

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# SECTION 1

## INTRODUCTION

### A. General

#### A 100 Introduction

**101** This offshore standard provides principles, technical requirements and guidance related to stability, watertight integrity, freeboard and weathertight closing appliances for mobile offshore units and floating offshore installations.

The types of units and installations that are covered by this standard include:

- ship shaped units
- column stabilised units
- self elevating units
- deep draught units.

#### Guidance note:

For novel designs, not recognised by the typical features of a known type of design, the stability requirements have to be considered separately and based on an evaluation of risks reflecting the unit's design, the intended operational aspects and the environmental conditions.

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**102** The standard has been written for general worldwide application. Governmental regulations may include requirements in excess of the provisions by this standard depending on the size, type, location and intended service of the offshore unit or installation.

#### A 200 Objectives

**201** The objectives of this standard are to:

- provide an internationally acceptable standard of safety by defining minimum requirements for stability, watertight integrity, freeboard and weathertight closing appliances
- serve as a contractual reference document between suppliers and purchasers
- serve as a guideline for designers, suppliers, purchasers and regulators
- specify procedures and requirements for units or installations subject to DNV certification and classification.

### B. Normative References

#### B 100 General

**101** The standards given in 200 include provisions which, through reference in the text, constitute provisions of this offshore standard. The latest issue of the references shall be used unless otherwise agreed.

**102** Other recognised standards may be used provided it can be demonstrated that these meet or exceed the requirements of the standards given in 200.

**103** Any deviations, exceptions and modifications to the design codes and standards shall be documented and agreed between the contractor, purchaser and verifier, as applicable.

#### B 200 Reference documents

**201** Applicable DNV documents are given in Table B1.

Table B1 DNV Rules, Standards and Recommended Practices	
Reference	Title
DNV-OS-C201	Structural Design of Offshore Units (WSD method)
DNV-OS-D101	Marine and Machinery Systems and Equipment
DNV-RP-A201	Standard Documentation Types
DNV-RP-A202	Documentation of Offshore Projects
	Rules for Classification of Ships

**202** Other reference documents are given in Table B2.

Table B2 Normative references	
Reference	Title
ILLC 1966	International Convention on Load Lines, 1966
IMO MODU Code, 1989	Code for the Construction and Equipment of Mobile Offshore Drilling Units, 1989

### C. Informative References

#### C 100 General

**101** Informative references are not considered mandatory in the application of this offshore standard, but may be applied or used for background information.

**102** Informative references are given in Table C1.

Table C1 Informative references	
Reference	Title
ISO 1751	Shipbuilding and marine structures - Ships' side scuttles
ISO 3903	Shipbuilding and marine structures - Ships' ordinary rectangular windows
ISO 1095	Shipbuilding and marine structures - Toughened safety glass panes for side scuttles
ISO 614	Shipbuilding and marine structures - Toughened safety glass panes for rectangular windows and side scuttles - Punch method of non-destructive testing
SOLAS 1974	The International Convention for the Safety of Life at Sea, 1974, as amended

### D. Definitions

#### D 100 Verbal forms

**101** *Shall*: Indicates requirements strictly to be followed in order to conform to this standard and from which no deviation is permitted.

**102** *Should*: Indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required. Other possibilities may be applied subject to agreement.

**103** *May*: Verbal form used to indicate a course of action permissible within the limits of the standard.

## D 200 Definitions

**201 Column stabilised unit:** A unit with the main deck connected to the underwater hull or footings by columns.

**202 Damage penetration zone:** Defined as 1.5 m from the outer skin. The damage penetration zone is limited to exposed portions only.

**203 Damage waterline:** The final equilibrium waterline, including the wind heeling moment, after a damage.

**204 Downflooding:** Any flooding of the interior of any part of the buoyant structure of a unit through openings which cannot be closed watertight, as appropriate, in order to meet the intact or damage stability criteria, or which are required for operational reason to be left open.

**205 Dynamic angle:** The angle of heel where the area requirement according to the stability requirements of Ch.2 Sec.1 is achieved.

**206 Exposed portions:** Those portions of the structure that are exposed to collision from other units.

### Guidance note:

For a column stabilised unit, the exposed portions are the portions of the columns, pontoons and bracings which are located outboard of a line drawn through the centres of the periphery columns, see Fig. 1.

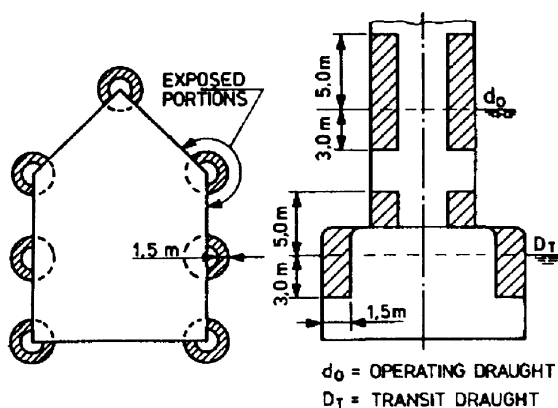


Figure 1  
Exposed portions of a column stabilised unit

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**207 Field move:** The transit voyage which can be completed within 12 hours (transit time) or within the limits of favourable reliable weather forecasts, whichever is less. However, for certain operating areas and seasons, a field move may exceed 12 hours if justified by independent reliable evidence.

### Guidance note:

Weather may be considered favourable up to Beaufort condition 6, i.e. average wind speed of 24 knots.

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**208 First intercept:** The angle of heel where the righting moment curve intercepts the heeling moment curve for the first time. The first intercept is also known as the static angle of heel.

**209 Floating offshore installation:** A buoyant construction engaged in offshore operations including drilling, production, storage or support functions, and which is designed and built for installation at a particular offshore location.

**210 Freeboard:** The distance measured vertically downwards amidship from the upper edge of the deck line to the upper edge in the related load line.

**211 Lightweight:** The unvariable weight of the unit; i.e. the basis for calculating the loading conditions. Anchors and cables are to be excluded from the lightweight and included in the loading conditions as variable loads.

**212 Maximum allowable vertical centre of gravity:** The maximum vertical centre of gravity (VCG) which complies with both intact and damage stability requirements at a given draught and service mode. All loading conditions are to have a VCG below the maximum allowable value for the given draught and service mode. The free surface effect of each slack tank should be calculated about the axis at which the moment of inertia is the greatest.

**213 Mobile offshore unit:** A buoyant construction engaged in offshore operations including drilling, production, storage or support functions, not intended for service at one particular offshore site and which can be relocated without major dismantling or modification.

**214 Offshore installation:** A collective term to cover any construction, buoyant or non-buoyant, designed and built for installation at a particular offshore location.

**215 Position 1 and 2:** In accordance with Regulation 13 of the International Convention on Load Line 1966 (ILLC 1966), adapted to mobile offshore units.

**216 Safe draught:** A draught which can be accepted under loading condition corresponding to damaged condition with respect to strength, and the requirement for minimum airgap is fulfilled.

**217 Second intercept:** The angle of heel where the righting moment curve intercepts the heeling moment curve for the second time.

**218 Self elevating unit:** A unit with movable legs capable of raising its hull above the surface of the sea.

**219 Service modes:**

- operation condition, i.e. normal working condition
- temporary conditions, i.e. transient conditions during change of draught to reach another service mode or installation mode
- survival condition, i.e. in case of severe storms
- transit condition.

**220 Ship shaped unit:** A unit with a ship or barge type displacement hull of single or multiple hull construction intended for operation in the floating condition.

**221 Variable load:** The load that varies with the operation of the unit such as deck cargo, fuel, lubricating oil, ballast water, fresh water, feedwater in tanks, consumable stores and crew and their effects.

**222 Watertight:** Capable of preventing the passage of water through the structure under a head of water for which the surrounding structure is designed.

**223 Weatertight:** Water will not penetrate into the unit in any sea conditions.

## D 300 Abbreviations and symbols

**301** Abbreviations used are given in Table C1.

Table C1 Abbreviations	
Abbreviation	Full text
CIBS	Classification Information Breakdown Structure
DNV	Det Norske Veritas
ILLC	International Convention on Load Lines
IMO	International Maritime Organization
ISO	International Organisation for Standardisation



Table C1 Abbreviations (Continued)	
Abbreviation	Full text
MODU	Mobile offshore drilling unit
OS	Offshore standard
RP	Recommended practice
VCG	Vertical centre of gravity

- lines plan or offset tables
- stability analysis
- external watertight integrity plan
- internal watertight integrity plan
- inclining test procedure
- inclining test report
- stability manual or stability part of the operations manual
- freeboard plan.

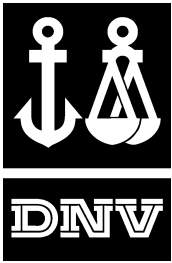
## E. Documentation

### E 100 General

**101** The following types of documentation are normally produced to document aspects covered by this standard:

**102** For documentation requirements related to certification and classification, see Ch.3.





## STABILITY AND WATERTIGHT INTEGRITY

### CHAPTER 2

## TECHNICAL PROVISIONS

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# SECTION 1

## STABILITY

### A. General

#### A 100 Scope

**101** This section gives requirements related to the following design parameters of mobile offshore units and floating offshore installations:

- 1) Buoyancy and floatability.
- 2) Wind exposed portions.
- 3) Draught range at various modes of service.
- 4) Watertight and weathertight closing of external openings.
- 5) Internal watertight integrity and watertight subdivision.
- 6) Lightweight and loading conditions.

**102** The combination of the design parameters under 101 (1-5) will determine the maximum allowable vertical centre of gravity (VCG) of the unit or installation at the applicable service draughts and modes.

**103** The loading of the unit or installation at various service draughts and modes shall be within the limits of maximum allowable VCG-curves.

**104** In order to determine VCG of the actual loading conditions, the lightweight and its centre of gravity must be known. This shall be obtained by an inclining test carried out in accordance with C.

**105** The requirements of this section are based on the IMO MODU Code, 1989. Text which has been taken directly from the code is written in *italics*.

**106** Deep draught floating installations (e.g. SPARs) are not directly covered by the IMO MODU Code. Criteria identical to those of a column stabilised unit or installations have been adopted.

### B. Determination of Wind Forces

#### B 100 Heeling moment curves

**101** The curves of wind heeling moments should be drawn for wind forces calculated by the following formula:

$$F = 0,5 C_s \cdot C_h \cdot P \cdot V^2 \cdot A$$

- F* = the wind force (Newton)
- C<sub>s</sub>* = the shape coefficient depending on the shape of the structural member exposed to the wind (see Table B1)
- C<sub>h</sub>* = the height coefficient depending on the height above sea level of the structural member exposed to wind (see Table B2)
- P* = the air mass density (1.222 kg/m<sup>3</sup>)
- V* = the wind velocity (metres per second)
- A* = the projected area of all exposed surfaces in either the upright or the heeled condition (square metres)

**102** Wind forces shall be considered from any direction relative to the unit and the value of the wind velocity shall be as follows:

- in general a minimum wind velocity of 36 m/s (70 knots) for offshore service shall be used for normal operating conditions and a minimum wind velocity of 51.5 m/s (100 knots) shall be used for the severe storm conditions

- where a unit is to be limited in operation to sheltered locations (protected inland waters such as lakes, bays, swamps, rivers, etc.) consideration shall be given to a reduced wind velocity of not less than 25.8 m/s (50 knots) for normal operating conditions.

**103** In calculating the projected areas to the vertical plane, the area of surfaces exposed to wind due to heel or trim, such as under-deck surfaces, etc., shall be included using the appropriate shape factor. Open truss work may be approximated by taking 30% of the projected block area of both the front and back section, i.e. 60% of the projected area of one side.

**104** In calculating the wind heeling moments, the lever of the wind overturning force shall be taken vertically from the centre of pressure of all surfaces exposed to the wind to the centre of lateral resistance of the underwater body of the unit. The unit is to be assumed floating free of mooring restraint.

**105** For units supported by dynamic positioning systems, the centre of the thruster force shall be applied as the centre of lateral resistance.

**Table B1** Values of the coefficient *C<sub>s</sub>*

Shape	<i>C<sub>s</sub></i>
Spherical	0.4
Cylindrical	0.5
Large flat surface (hull, deckhouse, smooth under-deck areas)	1.0
Drilling derrick	1.25
Wires	1.2
Exposed beams and girders under deck	1.3
Small parts	1.4
Isolated shapes (crane, beam, etc.)	1.5
Clustered deckhouses or similar structures	1.1

**Table B2** Values of the coefficient *C<sub>h</sub>*

Height above sea level (metres)	<i>C<sub>h</sub></i>
0 – 15.3	1.00
15.3 – 30.5	1.10
30.5 – 46.0	1.20
46.0 – 61.0	1.30
61.0 – 76.0	1.37
76.0 – 91.5	1.43
91.5 – 106.5	1.48
106.5 – 122.0	1.52
122.0 – 137.0	1.56
137.0 – 152.5	1.60
152.5 – 167.5	1.63
167.5 – 183.0	1.67
183.0 – 198.0	1.70
198.0 – 213.5	1.72
213.5 – 228.5	1.75
228.5 – 244.0	1.77
244.0 – 256.0	1.79
Above 256	1.80

**106** The wind heeling moment curve shall be calculated for a sufficient number of heel angles to define the curve. For ship-shaped hulls the curve may be assumed to vary as the cosine function of vessel heel.

**107** Wind heeling moments derived from wind tunnel tests on a representative model of the unit may be considered as alternatives to the methods given in 101.

## C. Determination of Lightweight

### C 100 Inclining test

**101** An inclining test shall be required for the first unit of a design, when the unit is as near to completion as possible, to determine accurately the light ship data (weight and position of centre of gravity).

**102** For successive units which are identical by design, the light ship data of the first unit of the series may be accepted in lieu of an inclining test, provided the difference in light ship displacement or position of centre of gravity due to weight changes for minor differences in machinery, outfitting or equipment, confirmed by the results of a deadweight survey, are less than 1% of the values of the light ship displacement and principal horizontal dimensions as determined for the first series.

Such dispensation cannot be granted for column stabilised units.

## D. Intact Stability Requirements

### D 100 General

**101** Each unit shall be capable of attaining a severe storm condition in a period of time consistent with the meteorological conditions. The procedures recommended and the approximate length of time required, considering both operating conditions and transit conditions, shall be contained in the stability manual. It shall be possible to achieve the severe storm condition without the removal or relocation of solid consumables or other variable load. However, it may be acceptable loading a unit past the point at which solid consumables would have to be removed or relocated to go to severe storm condition under the following conditions, provided the allowable VCG requirement is not exceeded:

- 1) In a geographic location where weather conditions annually or seasonally do not become sufficiently severe to require a unit to go to severe storm condition, or
- 2) Where a unit is required to support extra deck load for a short period of time that falls well within a period for which the weather forecast is favourable.

The geographic locations, weather conditions and loading conditions in which this is permitted shall be identified in the stability manual.

**102** Alternative stability criteria may be acceptable, provided an equivalent level of safety is maintained and if it can demonstrate to afford adequate positive initial stability. In determining the acceptability of such criteria, the following will be considered and taken into account as appropriate:

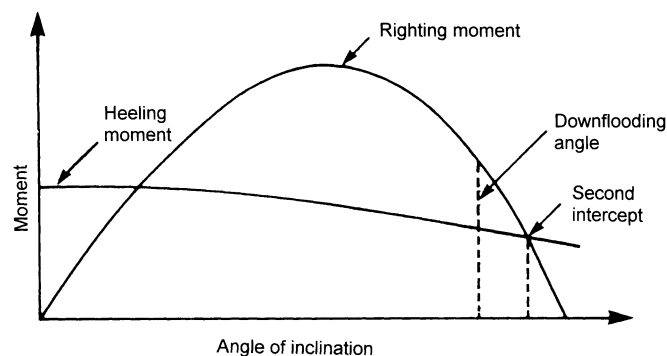
- 1) Environmental conditions representing realistic winds (including gusts) and waves appropriate for world-wide service in various modes of operation;
- 2) Dynamic response of a unit. Analysis should include the results of wind tunnel tests, wave tank model tests, and non-linear simulation, where appropriate. Any wind and wave spectra used shall cover sufficient frequency ranges to ensure that critical motion responses are obtained;
- 3) Potential for flooding taking into account dynamic responses in a seaway;
- 4) Susceptibility to capsizing considering the unit's restoration energy and the static inclination due to the mean wind speed and the maximum dynamic response;

5) An adequate safety margin to account for uncertainties.

### D 200 Ship shaped units or installations

**201** For units or installations having a ship shaped hull form, the intact stability requirements of the Rules for Classification of Ships, Pt.3 Ch.4 Sec.3 A100, shall be met.

**202** The area under the righting moment curve to the second intercept or downflooding angle, whichever is less, shall be not less than 40% in excess of the area under the wind heeling moment curve to the same limiting angle. See Figure 1.



**Figure 1**  
Righting moment and heeling moment curves

### D 300 Column stabilised units

**301** The area under the righting moment curve to the angle of downflooding shall be not less than 30% in excess of the area under the wind heeling moment curve to the same limiting angle.

**302** The righting moment curve shall be positive over the entire range of angles from upright to the second intercept.

### D 400 Self elevating units or installations

**401** The area under the righting moment curve to the second intercept or downflooding angle, whichever is less, shall be not less than 40% in excess of the area under the wind heeling moment curve to the same limiting angle.

**402** The righting moment curve shall be positive over the entire range of angles from upright to the second intercept.

### D 500 Deep draught floating installations

**501** The area under the righting moment curve to the second intercept or downflooding angle, whichever is less, shall be not less than 30% in excess of the area under the wind heeling moment curve to the same limiting angle.

**502** The righting moment curve shall be positive over the entire range of angles from upright to the second intercept.

## E. Damage Stability Requirements

### E 100 General

**101** It shall be demonstrated that the unit or installation complies with the requirements of 200 to 500 by calculations, which take into consideration the proportions and design characteristics of the unit or installation and the arrangements and configuration of the damaged compartments. In making these calculations it shall be assumed that the unit or installation is in the worst anticipated service condition as regards stability and is floating free of mooring restraints.

**102** The ability to reduce angles of inclination by pumping out or ballasting compartments or application of mooring forces,

etc., shall not be considered as justifying any relaxation of the requirements.

**103** The following permeability factors shall be assumed in the calculations:

- Store rooms: 0.60
- Engine room: 0.85
- Tanks, void spaces etc: 0.95

Other permeabilities may be accepted if documented by calculations.

**104** Alternative subdivision and damage stability criteria may be acceptable provided an equivalent level of safety is maintained. The alternative stability criteria, should consider at least the following and take into account:

- 1) Extent of damage as set out in 600 and 700;
- 2) On column stabilised units, the flooding of any compartment as set out in 402;
- 3) The provision of an adequate margin against capsizing.

## E 200 Ship shaped units or installations

**201** The unit shall have sufficient freeboard and be subdivided by means of watertight decks and bulkheads to provide sufficient buoyancy and stability to withstand in general the flooding of any one compartment in any operating or transit condition consistent with the damage assumptions set out in 600.

**202** The unit should have sufficient reserve stability in a damaged condition to withstand the wind heeling moment based on a wind velocity of 25.8 m/s (50 knots) superimposed from any direction. In this condition the final waterline, after flooding, should be below the lower edge of any downflooding opening.

## E 300 Self elevating units or installations

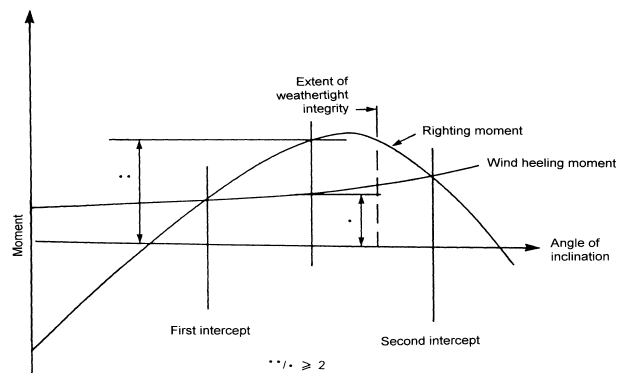
**301** The unit shall have sufficient freeboard and be subdivided by means of watertight decks and bulkheads to provide sufficient buoyancy and stability to withstand in general the flooding of any compartment in any operating or transit condition consistent with the damage assumptions set out in 600.

**302** The unit shall have sufficient reserve stability in a damaged condition to withstand the wind heeling moment based on a wind velocity of 25.8 m/s (50 knots) superimposed from any direction.

## E 400 Column stabilised units or installations

**401** The unit shall have sufficient freeboard and be subdivided by means of watertight decks and bulkheads to provide sufficient buoyancy and stability to withstand a wind heeling moment induced by a wind velocity of 25.8 m/s (50 knots) superimposed from any direction in any operating or transit condition, taking the following considerations into account:

- 1) The angle of inclination after the damage set out in 700 shall not be greater than 17°;
- 2) Any opening (through which progressive flooding may occur) below the final waterline shall be made watertight, and openings within 4 m above the final waterline shall be made weathertight;
- 3) The righting moment curve, after the damage set out above, shall have, from the first intercept to the lesser of the extent of weathertight integrity required by 401 2) and the second intercept, a range of at least 7°. Within this range, the righting moment curve shall reach a value of at least twice the wind heeling moment curve, both being measured at the same angle. See Figure 2.



**Figure 2**  
Righting moment and wind heeling moment curves

**402** The unit shall provide sufficient buoyancy and stability in any operating or transit condition to withstand the flooding of any watertight compartment wholly or partially below the waterline in question, which is a pump-room, a room containing machinery with a salt water cooling system or a compartment adjacent to the sea, taking the following considerations into account:

- 1) The angle of inclination after flooding shall not be greater than 25°;
- 2) Any opening below the final waterline shall be made watertight;
- 3) A range of positive stability shall be provided, beyond the calculated angle of inclination in these conditions, of at least 7°.

## E 500 Deep draught floating installations

**501** The installation shall have sufficient freeboard and be subdivided by means of watertight decks and bulkheads to provide sufficient buoyancy and stability to withstand a wind heeling moment induced by a wind velocity of 25.8 m/s (50 knots) superimposed from any direction in any operating or transit condition, taking the following considerations into account:

- 1) The angle of inclination after the damage set out in 700 shall not be greater than 17°;
- 2) Any opening through which progressive flooding may occur below the final waterline shall be made watertight, and openings within 4 m above the final waterline shall be made weathertight;
- 3) The righting moment curve, after the damage set out above, shall have, from the first intercept to the lesser of the extent of weathertight integrity required by 401 2) and the second intercept, a range of at least 7°. Within this range, the righting moment curve shall reach a value of at least twice the wind heeling moment curve, both being measured at the same angle. See Figure 2.

## E 600 Extent of damage – ship shaped and self elevating units or installations

**601** In assessing the damage stability of such units the following extent of damage is assumed to occur between effective watertight bulkheads:

- 1) Horizontal penetration: 1.5 m.
- 2) Vertical extent: from the base line upwards without limit.

The distance between effective watertight bulkheads or their nearest stepped portions which are positioned within the assumed extent of horizontal penetration shall be not less than

3.0 m; where there is a lesser distance one or more of the adjacent bulkheads shall be disregarded.

Where damage of a lesser extent than the above results in a more severe condition, such lesser extent shall be assumed.

Where a mat is fitted for self elevating units the above extent of damage shall be applied to both the platform and the mat but not simultaneously, unless deemed necessary due to their close proximity to each other.

All piping, ventilation systems, trunks, etc., within the extent of damage shall be assumed damaged. Positive means of closure shall be provided at watertight boundaries to preclude the progressive flooding of other spaces which are intended to be intact.

#### **E 700 Extent of damage – column stabilised units and deep draught floating installations**

**701** In assessing the damage stability of such units, the following extent of damage shall be assumed:

- 1) Only those columns, underwater hulls and braces on the periphery of the unit shall be assumed to be damaged, and the damage shall be assumed in the exposed portions of the columns, underwater hulls and braces.
- 2) Columns and braces shall be assumed flooded by damage having a vertical extent of 3.0 m occurring at any level between 5.0 m above and 3.0 m below the draughts specified in the stability manual. Where a watertight flat is located within this region, the damage shall be assumed to have occurred in both compartments above and below the watertight flat in question. Lesser distances above or below the draughts may be applied upon consideration, taking into account the actual operating conditions. However, the required damage region shall extend at least 1.5 m above and below the draught specified in the operating manual.
- 3) No vertical bulkhead shall be assumed damaged, except where bulkheads are spaced closer than a distance of one eighth of the column perimeter at the draught under consideration, measured at the periphery, in which case one or more of the bulkheads shall be disregarded.
- 4) Horizontal penetration of damage shall be assumed to be 1.5 m.
- 5) Underwater hull or footings shall be assumed damaged when operating in a transit condition in the same manner as indicated in 1), 2), 4) and either 3) or 6), having regard to their shape.
- 6) All piping, ventilation systems, trunks, etc., within the extent of damage shall be assumed damaged. Positive means of closure shall be provided at watertight boundaries to preclude the progressive flooding of other spaces that are intended to be intact.

#### **E 800 Chain lockers**

**801** Chain lockers, which are not provided with weathertight closing appliances, shall be provided with level alarm or

sounding and bilge arrangement or drainage system in accordance with DNV-OS-D101. In this case the chain pipes will be regarded as downflooding points.

**802** When chain lockers without weathertight closing appliances are used as ballast tanks, downflooding through chain pipes can be disregarded at a given draught provided that chain lockers are:

- equipped as ballast tanks according to DNV-OS-D101
- kept full at the given draught. This shall be stated in the stability manual.

Conditions during the cleaning of chain lockers shall be considered as temporary conditions.

#### **E 900 Load line and draught marks**

**901** The unit or installation shall have load line marks according to the maximum permissible draught in the afloat condition.

**902** The load line marks will be assigned on the basis of compliance with the requirements of this section as well as other applicable requirements.

**903** Draught marks shall be located in positions, which will ensure accurate determination of draughts, trim and heel and where they are clearly visible to personnel operating the unit or installation. The reference line shall be defined in the stability manual.

#### **E 1000 Extent of watertight and weathertight closing of external openings**

**1001** Watertight closing appliances are required for those external openings being submerged at least up to an angle of heel equal to the first intercept in intact or damage condition, whichever is greater.

**1002** Weathertight closing appliances are required for those external openings being submerged at least up to an angle of heel equal to the dynamic angle. This applies to any opening within 4.0 m above the final waterline as well.

#### **E 1100 Internal watertight integrity and subdivision**

**1101** The internal subdivision shall be adequate to enable the unit or installation to comply with the damage stability requirements of this section.

**1102** Ducts or piping, which may cause progressive flooding in case of damage, shall generally not be used in the damage penetration zone.

#### **E 1200 Loading computers**

**1201** Loading computers for stability calculation shall be considered as supplementary to the stability manual or the stability part of the operation manual.



## SECTION 2

# WATERTIGHT INTEGRITY, FREEBOARD AND WEATHERTIGHT CLOSING APPLIANCES

### A. General

#### A 100 Application

**101** This section provides requirements with regards to arrangement and design of watertight integrity and freeboard for self elevating and column stabilised units and installations.

**102** Watertight integrity, freeboard plan and weathertight closing appliances for ship shaped units or installations shall comply with the Rules for Classification of Ships Pt.3 Ch.1, Ch.4 and Ch.5 with the following additional requirements:

- a) Doors in unprotected fronts and sides shall be of steel.
- b) For doors located in exposed positions in sides and front bulkheads, the requirements to sill heights apply one deck higher than given by the Rules for Classification of Ships Pt.3 Ch.1 Sec.11 B.

**103** Piping and electrical systems for operation of watertight closing appliances shall be in accordance with relevant requirements given in DNV-OS-D101 unless otherwise specified in this section.

### B. Watertight Integrity

#### B 100 General

**101** The number of openings in watertight subdivisions shall be kept to a minimum compatible with the design and proper working of the unit or installation. Where penetrations of watertight decks and bulkheads are necessary for access, piping, ventilation, electrical cables etc., arrangements shall be made to maintain the watertight integrity of the enclosed compartments.

**102** Locations of openings where watertight integrity is required, are illustrated in I.

**103** The strength and arrangement of doors and hatch covers and their frames as well as the capacity of the closing systems shall be sufficient to ensure efficient closing of doors and hatch covers when water with a head of 2.0 m is flowing through the opening, and at an inclination of 17 ° in any direction.

#### B 200 Internal openings

**201** The means to ensure the watertight integrity of internal openings which are used during the operation of the unit or installation while afloat, shall comply with a) and b).

- a) Doors and hatch covers that are frequently used may normally be open if provided for remote closing from a central control room on a deck, which is above any final waterline after flooding and are also to be operable locally from each side of the bulkhead. Indicators shall be provided at the control room showing whether the doors or hatch covers are open or closed.
- b) The requirements regarding remote control in a) may be dispensed with for those doors or hatch covers, which are normally closed, provided an alarm system (e.g. light signals) is arranged, showing personnel in the control room whether the doors or hatch covers in question are open or closed. A notice shall be affixed to each such door or hatch cover to the effect that it is not to be left open.

**202** To ensure the watertight integrity of internal openings which are kept permanently closed during the operation of the unit or installation, a notice shall be affixed to each such closing appliance to the effect that it is to be kept closed. Manholes fitted with closely bolted covers need not be so marked.

**203** Where valves are provided at watertight boundaries to maintain watertight integrity, these valves shall be capable of being operated from a control room. Valve position indicators shall be provided at the remote control station.

If the valves are remotely operated by means of mechanical devices, operation from a deck, which is above any final waterline after flooding will be accepted. Valve position indicators shall be provided at the remote control station.

#### B 300 External openings

**301** Where watertight integrity is dependent on external openings, which are used during the operation of the unit or installation while afloat, they shall comply with a), b) and c).

- a) The lower edge of openings of air pipes (regardless of their closing appliances) shall be above the damage waterline.
- b) The lower edge of ventilator openings, doors and hatch covers with manually operated means of weathertight closures shall be above damage waterline, unless 303 applies.
- c) Openings such as manholes fitted with closely bolted covers, and side scuttles or windows of the non-opening type with inside hinged deadlights may be submerged.

**302** The requirements of 301 b) apply where the watertight integrity is dependent on external openings, which are permanently closed during the operation of the unit or installation, while afloat.

**303** External doors and hatch covers of limited size may be accepted between the damage waterline and freeboard deck provided they are watertight closeable locally and by remote operation of the closing appliances from the control room, with indicators showing whether the openings are closed or open.

#### B 400 Strength of watertight doors and hatch covers

**401** Watertight doors and hatch covers for internal and external openings shall be designed with a strength equivalent to or better than required for the watertightness of the structure in which they are positioned.

**402** Provided flooding is a possible mode of failure based upon the damage assumptions as given in Sec.1, for compartments on both sides of a watertight door or hatch cover, the watertight door or hatch cover shall be designed to withstand the design pressure from both sides.

**403** The design pressure shall be taken as the waterhead corresponding to the vertical distance between the load point and the deepest waterline after damage.

#### 404 Plating

The thickness of plating subjected to lateral pressure shall not be less than:

$$t = \frac{16.5 k_a s \sqrt{p}}{\sqrt{\sigma_f k_p}} \quad (\text{mm})$$

$k_a$  = correction factor for aspect ratio of plate field

- $= (1.1 \text{ minus } 0.25 \text{ } s/l)^2$   
 $= \text{maximum } 1.0 \text{ for } s/l = 0.4$   
 $= \text{minimum } 0.72 \text{ for } s/l = 1.0$   
 $= \text{design pressure in kN/m}^2 \text{ corresponding to the head of water to damage waterline}$   
 $p = \text{design pressure in kN/m corresponding to the head of water to damage waterline}$   
 $k_p \text{ is dependent on support condition:}$   
 $k_p = 1.0 \text{ for clamped edges}$   
 $= 0.5 \text{ for simply supported edges}$   
 $\sigma_f = \text{minimum yield strength}$   
 $s = \text{stiffener spacing in m}$   
 $l = \text{stiffener span in m.}$

**Guidance note:**

The plating is normally assumed to be simply supported along the edges.

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**405 Stiffeners on doors and hatch covers**

The section modulus of panel stiffeners and edge stiffeners shall not be less than:

$$Z = \frac{l_{sp}^2}{m \sigma_f k_s} \quad (\text{mm}^3)$$

minimum  $15 \cdot 10^3 \text{ mm}^3$

- $l = \text{stiffener span in m. For doors with stiffeners in one direction only } l \text{ shall be taken as the span length between cleat support points in door}$   
 $m = 8 \text{ if simply supported}$   
 $= 12 \text{ if fixed at ends}$   
 $k_s \text{ is dependent on support condition:}$   
 $k_s = 1.0 \text{ if at least one end is clamped}$   
 $= 0.9 \text{ if both ends are simply supported.}$

**406 Minimum stiffness of door and hatch cover edge stiffeners**

Moment of inertia of the side element of the door shall generally not be less than the value given by the formula:

$$I = 8 \text{ pa}^4 10^4 \quad (\text{mm}^4)$$

- $p = \text{packing line pressure along edges in N/mm, minimum } 5 \text{ N/mm}$   
 $a = \text{spacing of bolts or other securing devices in m.}$

**407 Stiffness of door and hatch cover frames**

The frames shall have necessary stiffness to avoid deflections resulting in leakage in the damage condition.

The frame shall be continuous on all four sides and is to be designed to have a section moment of inertia on each side of not less than the value given by the formula:

$$I = 3.2 \text{ pbh}^3 10^4 \quad (\text{mm}^4)$$

- $b = \text{the shorter dimension of the opening in m}$

- $h = \text{the longer dimension of the opening in m.}$

**408 Stresses in door and hatch cover frames and their connections to the supporting structure**

The stresses shall not exceed the following values:

- $\text{— normal stresses} = 220 f_1 \text{ N/mm}^2$   
 $\text{— shear stresses} = 120 f_1 \text{ N/mm}^2.$

The material factor  $f_1$  for forgings and castings shall be taken as:

$$f_1 = \left( \frac{\sigma_F}{240} \right)^a$$

- $\sigma_f = \text{minimum upper yield stress in N/mm}^2, \text{ not to be taken greater than } 70\% \text{ of the ultimate tensile strength}$   
 $a = 0.75 \text{ for } \sigma_F > 240$   
 $= 1.0 \text{ for } \sigma_F < 240.$

**409** The end connections of the frames and the supporting structure shall be taken into consideration when calculating the stress levels in the frames.

**410** Cleatings (securing devices) shall be designed for sea pressure acting on the opposite side of which they are positioned.

**B 500 Operation and control of watertight doors and hatch covers**

**501** Frequently used watertight doors or hatch covers shall be arranged for emergency remote closing according to the principles given in 200.

**502** In addition to means for remote closing, it shall be possible to open and close the doors or hatch covers locally from both sides by use of e.g. a mechanical device or hydraulic system with stored energy. The stored energy may be a hydraulic accumulator connected to a centralised hydraulic system by a non-return valve. The capacity shall be sufficient for opening and closing the door or hatch cover three times.

**503** The device for local operation shall be designed with a neutral spring return position in which the doors or hatch covers shall stop closing. The device shall be located easily accessible for the personnel passing the door or hatchway.

**504** The movement of the local operating device shall be in the same direction as the movement of door or hatch cover.

**505** The arrangement shall be such that the door or hatch cover will close automatically only if opened by local control after being closed from the central control station. The total closing time shall not be less than 30 s or more than 60 s.

**506** Red lights shall be arranged for warning of personnel locally operating the doors or hatch covers that these have been remotely closed.

**507** An audible local alarm shall sound when the doors or hatch covers are moving to closed position.

**508** All watertight doors or hatch covers shall be provided with positive means of indication which will show at a central control station whether the doors or hatch covers are open or closed.

**509** Any failure of the remote control system shall not cause opening of closed doors or hatch covers. Failure on one door or hatch cover shall not put any other door or hatch cover out of function.

**510** Power supply shall be a separate independent source with stored energy for each door or hatch cover or a common redundant system with two independent sources capable of closing at least 50% of all doors or hatch covers in not more than 60 s.

**511** The electrical power required for operation, control and monitoring shall be supplied from the emergency switchboard either directly or by a dedicated distribution board situated above the area that may be flooded in a damage condition.

**512** The power sources for operation, control and monitoring shall be monitored by alarm.

## C. Freeboard

### C 100 General

**101** The requirements of the ILLC 1966 with respect to weathertightness and watertightness of decks, superstructures, deckhouses, doors, hatchway covers, other openings, ventilators, air pipes, scuppers, inlets and discharges, etc. are taken as a basis for all units or installations in the afloat condition.

**102** The requirements for hatchways, doors and ventilators are depending upon the position as defined in the ILLC 1966, Reg. 13.

**103** The minimum freeboard of units or installations, which cannot be computed by the normal methods laid down by the ILLC 1966 shall be determined on the basis of meeting the applicable intact stability, damage stability and structural requirements for transit and operational conditions while afloat. The freeboard shall not be less than that calculated in accordance with the ILLC 1966, where applicable.

### C 200 Self elevating units or installations

**201** Load lines for self elevating units are calculated under the terms of the ILLC 1966. When floating or when in transit from one operational area to another, the units shall be subject to all the conditions of assignment of the ILLC 1966 unless specifically excepted. The regulations of relevant national authorities shall also be observed.

**202** Self elevating units or installations shall not be subject to the terms of the ILLC 1966 while they are supported by the seabed or are in the process of lowering or raising their legs.

**203** In general, heights of hatch and ventilator coamings, air pipes, door sills, etc. in exposed positions and their means of closing are determined by consideration of both intact and damage stability requirements.

**204** Side scuttles below freeboard deck shall be of the non-opening type with inside hinged deadlight.

### C 300 Column stabilised units or installations

**301** Load lines for column stabilised units or installations shall be based on:

- the strength of the structure
- the air gap between waterline and deck structure
- the intact and damage stability requirements.

**302** The conditions of assignment shall be based on the requirements of the ILLC 1966. The regulations of relevant national authorities shall also be observed.

**303** In general, heights of hatch and ventilator coamings, air pipes, door sills, etc., in exposed positions and their means of closing are determined by consideration of both intact and damage stability requirements.

**304** The freeboard deck (reference deck) is defined as the lowest continuous deck exposed to weather and sea, which has permanent means of closing and below which all openings are watertight closed at sea.

**305** Side scuttles and windows, including those of non-opening type, or other similar openings, shall not be fitted below the freeboard deck.

**306** For the first tier on the freeboard deck, the requirements as for position 2 in the ILLC 1966 apply with respect to openings, sill heights, coaming heights and weathertight closing appliances. Side scuttles and windows on first tier need not be fitted with inside hinged deadlights if they are not below damage waterline.

For the second tier, weathertight closing appliances are required, but sill or coaming heights may be omitted.

Above the second tier, weathertight closing appliances are required if openings give access to a space below the freeboard deck or a space included in the buoyant volume.

**307** Deckhouses and wells on the first and second tiers, which are not weathertight closed as described in 306, shall be provided with satisfactory drainage. The total drainage cross sectional area shall not be less than 0,30% of the deck area for the deckhouse or well. The drainage shall be arranged so that it will prevent accumulation of water in any part of the space.

## D. Weathertight Closing Appliances

### D 100 General

**101** This sub-section gives requirements for the arrangement of weathertight openings and their closing appliances. The closing appliances shall in general have a strength at least corresponding to the required strength of the part of the hull in which they are fitted.

For side scuttles and windows, however, the pressure head shall not be taken less than 2.5 m water column.

#### Guidance note:

Some requirements are also governed by the regulations in the «International Convention of Load Lines 1966»:

- doors in reg.12
- definition of positions in reg.13
- hatchways in reg.14 to reg.16
- machinery space openings in reg.17
- miscellaneous openings in reg.18
- ventilators in reg.19
- air pipes in reg.20
- scuppers, inlets and discharges in reg.22
- side scuttles in reg.23
- freeing ports in reg.24
- special requirements in reg.25 to reg.27.

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Regarding location of openings where weathertight integrity is required, see I.

### D 200 Weathertight doors

**201** Weathertight doors shall be of steel or equivalent material.

The doors shall be designed for a strength equivalent to or better than that required for the weathertightness of the structure in which they are positioned.

Doors should generally open outwards to provide additional security against impact of the sea.

#### 202 Sill heights

Openings as mentioned in 201 shall in general have a sill height of not less than 380 mm.

The following openings in position 1 shall have sill heights not less than 600 mm:

- companionways
- openings in superstructures and in bulkheads at ends and sides of deckhouses where access is not provided from the deck above
- openings in engine casings.

## D 300 Weathertight hatch coamings and covers

**301** The minimum height of coamings for hatch covers with weathertight covers shall normally not be less than:

- 600 mm in position 1
- 450 mm in position 2.

**302** Manholes and small scuttles with coaming height less than given in 301 and flush scuttles may be allowed when they are closed by watertight covers. Unless secured by closely spaced bolts, the covers shall be permanently attached.

**303** Coamings with height less than given in 301 may be accepted for column stabilised units or installations upon special consideration.

**304** Hatch covers shall be mechanically lockable in the open position.

**305** Materials for steel hatch covers shall satisfy the requirements given for structural materials.

Other material than steel may be used, provided the strength and stiffness of the covers are equivalent to the strength and stiffness of steel covers.

**306** The design sea pressure on weathertight deck hatch covers is given in the section for design loads in the offshore standard relevant for type of unit or installation considered.

**307** The plating thickness depending on lateral pressure is given in DNV-OS-C201. The thickness of the top plating shall not be less than 6 mm.

**308** The section modulus requirement of stiffeners is given in DNV-OS-C201. The requirements for section modulus and moment of inertia of hatch girders are given in DNV-OS-C201.

## D 400 Gaskets and closing devices

**401** The requirements in 402 to 410 apply to steel hatch covers on weather decks with ordinary gasket arrangement between hatch cover and coaming and gaskets arranged for vertical gasket pressure in joints between hatch cover elements.

Other gasket arrangements shall be specially considered.

**402** The gasket material shall be of satisfactory air- and sea-water-, and if necessary, oil-resistant quality, effectively secured along the edges of the hatch cover.

The hatchway coamings or steel parts on adjacent covers in contact with the gaskets shall be well rounded where necessary.

Where necessitated by the type and design of the unit or installation, mass forces from heavy covers or cargo stowed on the hatch covers as well as forces due to sea pressure should be transferred to the coaming or the deck by direct contact, obtained by suitable devices, while sealing is achieved by means of relatively soft gaskets.

**403** The gaskets and securing arrangements shall either be designed for the expected relative movement between cover and coaming, or special devices shall be fitted to restrict such movement.

**404** Panel hatch covers on weather decks shall be secured by bolts, wedges or similar arrangement, suitably spaced alongside the coamings and between the hatch cover sections.

**405** Where hydraulic cleating is applied, the system shall remain mechanically locked in closed position in the event of failure of the hydraulic system or power supply.

**406** Ordinary gasketed hatch covers shall be secured to the coaming by a net bolt area for each bolt not less than:

$$A = 1.4 a \text{ (cm}^2\text{)}$$

A = spacing of bolts in m.

The bolt diameter shall not be less than 16 mm.

**407** The bolt diameter shall not be less than 22 mm for hatchways exceeding 5 m<sup>2</sup> in area.

**408** Between cover elements the gasket line pressure shall be maintained by a bolt area as given in 406.

**409** For gasket line pressures exceeding 5 N/mm, the net bolt area shall be increased accordingly. The gasket line pressure shall be specified.

**410** Hatch covers on exposed decks with reduced coaming height shall be especially considered.

## E. Ventilators and Air Pipes

### E 100 General

**101** Ventilators to spaces below freeboard deck or to deck-houses closed weathertight shall have a coaming height of at least:

- 900 mm in position 1
- 760 mm in position 2.

**102** The thickness of ventilator coamings, air pipes, and exhaust pipes shall not be less than given in the Tables E1 and E2.

Table E1 Thickness for self elevating units	
External diameter mm	Wall thickness mm
≤ 80	6
≥ 165	8.5

Table E2 Thickness for column stabilised units or installations	
External diameter mm	Wall thickness Above freeboard deck mm
≤ 80	5
≥ 165	7.0

For intermediate external diameters the wall thickness shall be obtained by linear interpolation. Coamings with height exceeding 900 mm shall be supported by stays or equivalent arrangements.

**103** The deck plating in way of deck openings for ventilator coamings shall be of sufficient thickness and efficiently stiffened.

**104** The openings shall be provided with permanently attached weathertight efficient means of closing.

**105** Ventilators with coaming height of more than 4.5 m in position 1, or more than 2.3 m in position 2, need not be fitted with closing arrangement.

**106** Stability requirements may necessitate closing appliances.

#### Guidance note:

Special closing arrangement may be required by national maritime administrations.

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**107** The height of air pipes, measured from the deck to the point where water may have access below, shall not be less than 760 mm on freeboard deck and 450 mm on superstructure deck.

**108** Where air pipes of heights as required in 106 will cause difficulties in operation of the unit or installation, a lower height may be accepted, provided that relevant regulatory bodies are satisfied that the closing arrangement and other circumstances justify a lower height.

**109** Openings of air pipes shall be provided with permanently attached efficient means of closing. The closing appliances shall be so constructed that damage to the tanks by overpumping or occasionally possible vacuum by discharging is prevented.

**110** All air pipes shall be well protected.

## F. Inlets, Discharges and Scuppers

### F 100 Sea inlets and discharges in closed systems

**101** Valves for sea inlets and discharges shall be arranged for direct manual operation by means of a mechanical device or permanently installed hand pump. Any valve serving a sea inlet or a discharge below the load waterline shall be remotely operated from above the damage waterline.

Discharges between load waterline and damage waterline may be fitted with one locally closable non-return valve. The valves shall be fitted as close to the inlet or discharge as possible.

The controls shall be readily accessible and are to be provided with indicators showing whether the valves are open or closed. All connections to sea shall be marked:

SEA DIRECT.

**102** The wall thickness of the pipes shall be as required in 204 and DNV-OS-D101.

### F 200 Discharges

**201** Discharges leading through the shell either from spaces below the freeboard deck or from spaces required to be watertight above the freeboard deck, shall be fitted with one automatic non-return valve at the outboard end with positive means of closing located at a suitable position above the damage waterline.

**202** If a septic tank is arranged in the system, a discharge with inboard opening located lower than the uppermost load line may be accepted when a loop of the pipe is arranged, extended not less than 0.02 L above the summer load waterline, where L is the length of the unit or installation.

**203** Discharges from spaces above the freeboard deck shall be of steel or material especially resistant to corrosion.

**204** The wall thickness of steel piping between the hull plating and a closable or non-return valve below freeboard deck shall not be less than given in the Table F1.

Table F1 Wall thickness of steel piping	
External diameter mm	Wall thickness mm
≤ 80	7.0
= 180	10.0
≥ 220	12.5

For intermediate external diameters the wall thickness shall be obtained by linear interpolation.

**205** General requirements for pipes are given in DNV-OS-D101.

**206** Adequate arrangement shall be provided to protect valves or pipes from being damaged.

**207** The piping shall be of steel or equivalent material. Valves and shell fittings shall be of steel, bronze or other ductile material. Valves of ordinary cast iron are not acceptable.

**208** Where plastic piping is used, the connection between plastic and steel shall be considered as the inboard opening.

### F 300 Scuppers

**301** A sufficient number of scuppers, arranged to provide effective drainage, shall be fitted to all decks.

**302** Scuppers on weather portions of decks and scuppers leading from superstructures or deckhouses not provided with weathertight closing appliances shall be led overboard.

**303** Scuppers through the deck or shell shall comply with requirements for material and thickness as given for discharges.

**304** Scupper pipes shall be well stayed to prevent any vibrations. However, sufficient possibility for expansion of the pipes shall be provided where necessary.

**305** Scuppers from spaces below the freeboard deck or spaces within closed superstructures, may be led to bilges.

**306** Scuppers leading overboard from spaces mentioned in 305 shall comply with the requirements given for discharges. Scuppers and drains from compartments of exposed superstructure decks led through the unit or installation's side below the freeboard deck and not having closable valves, shall have additional wall thickness as required in 204.

## G. Side Scuttles and Windows

### G 100 General

**101** Acceptable standards for side scuttles and windows are ISO 1751 and ISO 3903 with glass according to ISO 1095 and testing according to ISO 614. National standards equivalent to the ISO standards are also acceptable.

**102** Side scuttles and windows in the first tier and second tier with direct access below the freeboard deck, shall have hinged inside deadlights arranged so that they can be effectively closed and secured watertight.

**103** Deadlights as required in 102 may be hinged on the outside, provided there is easy access for closing.

**104** No side scuttle shall be fitted in a position with its sill below a line drawn parallel to the freeboard deck. The lowest point shall be minimum 0.025 B above the summer load waterline, or 500 mm, whichever is the greater distance. B is the breadth of the unit or installation.

## H. Testing of Doors and Hatch Covers

### H 100 Pressure testing of watertight doors and hatch covers

**101** Before installation (i.e. normally at the manufacturer) the watertight doors or hatch covers shall be hydraulically tested with exposure to the side most prone to leakage.

**102** The test pressure shall correspond to the pressure height + 0,05 N/mm<sup>2</sup> (5 m water), and the acceptance criteria shall be:

- no leakage for doors or hatch covers with gaskets
- maximum water leakage 1 litre per minute for doors or hatch covers with metallic sealing.

### H 200 Hose testing of watertight and weathertight doors and hatch covers

**201** After installation onboard all watertight and weathertight doors or hatch covers shall be hose tested. The water pressure shall be at least 0.2 mm<sup>2</sup> (2 bar), and the nozzle shall be held at a distance of maximum 1.5 m from the door or hatch cover. No leakage shall be accepted.

As an alternative to hose testing, chalk testing may be applied under special circumstances upon acceptance by all parties involved.

### H 300 Function testing of watertight doors and hatch covers

**301** After installation onboard the operation, control and alarm functions for all watertight doors and hatch covers shall be tested.

The following shall be verified:

- It shall be possible to close all doors or hatch covers in one group simultaneously within 60 s from the control room.
- It shall be possible to open and close the doors or hatch covers three times by means of a local device and stored energy.
- It shall be possible for a person to pass through the doorway or hatchway and at the same time hold both handles in the «open position».
- It shall be possible to open the door or hatch cover locally from both sides, after being closed centrally, and the door or hatch cover shall close automatically after such opening.
- The door or hatch cover shall be mechanically locked in closed position.
- The light and sound signals shall give warning when the door or hatch cover is closed centrally.
- The remote position indicator for doors or hatch covers shall function properly.
- The alarms for the following conditions shall function properly:
  - start of standby pump
  - loss of power to control, alarm and indicating system
  - low pressure (below lowest permissible).

## I. Closing Arrangements for Doors and Hatch Covers

### I 100 Description of waterlines

**101** The following waterlines are defined:

- *Waterline A*; waterline showing equilibrium position at first intercept between righting and wind heeling moment curves in damage condition
- *Waterline B*; waterline according to area requirement of righting and wind heeling moment curves, either in intact or damage condition, whichever is the most severe.

### I 200 Description of location of openings

**201** The location of openings in relation to the waterlines are defined as (see Figure 1):

- Internal openings in watertight bulkheads, i.e. internal bulkheads assumed watertight in stability calculations.
- External openings below deepest draught according to ILLC 1966.
- External openings between deepest draught and freeboard deck.

IV External openings above freeboard deck, submerged before equilibrium position at first intercept (line A) between righting and wind heeling moment curves in damage condition.

V External openings:

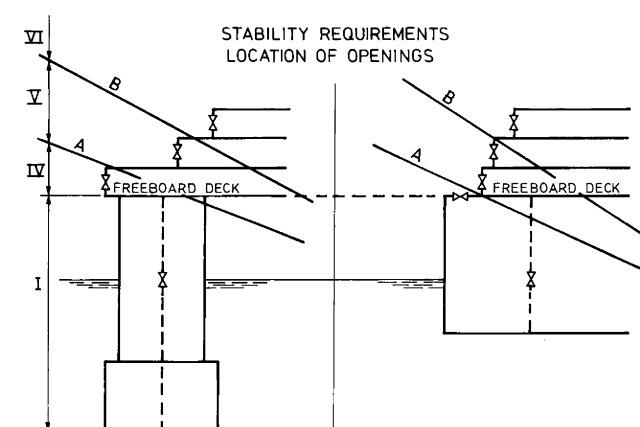
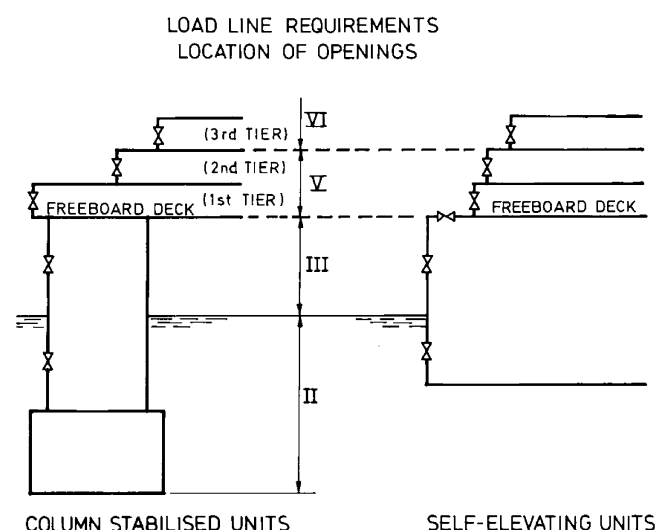
- on first and second tier
- submerged between equilibrium position at first intercept (line A) and compliance with area requirement (line B).

VI External openings:

- on and above third tier
- above waterline B.

### I 300 Operation and locking

**301** The requirements for operation and locking of doors and hatch covers are given in Table I1, in relation to the locations defined in 200.



**Figure 1**  
Location of openings

**Table I1 Requirements regarding operation and locking of doors and hatch covers**

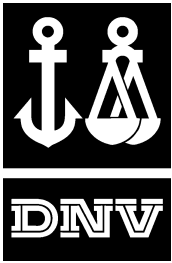
Location of opening	Pressure side		Type of door or hatch cover				Operation of door or hatch cover		Locking in closed position
	One side	Both sides	Sliding <sup>1)</sup>	Rolling <sup>2)</sup>	Hinged	Bolted	Local	Remote	Mechanical <sup>3)</sup>
I	X		X				X	X	X
				X			X	X	X
					X		X	X	X
						X	X	NA	X
		X	X				X	X	X
				X			X	X	X
					X		X	X	X
						X	X	NA	X
II	X					X	X	NA	X
		X				X	X	NA	X
III	X		NA				NA	NA	NA
				NA			NA	NA	NA
					NA		NA	NA	NA
						X	X <sup>4)</sup>	NA	X
IV	X		X				X	X	
				X			X	X	
					X		X	X	
						X	X	NA	
V	X		X				X		
				X			X		
					X		X		
VI	X		X				X		
				X			X		
					X		X		
						X	X		

NA means «not applicable»

- 1) Sliding door: moving along and supported by trackway grooves, with built-in «mechanical» locking due to the tapered form and friction, and a positive force is required to re-open the door.
- 2) Rolling door: guided and supported by steel rollers with hydraulic cleating.
- 3) Mechanical locking: by means of wedges, bars or similar devices, which are self-locking.
- 4) The door or hatch cover shall be fitted with a notice board stating that the door or hatch cover is to be kept closed while the unit or installation is afloat at sea (for self elevating units) and at sea (for column stabilised units or installations). The door or hatch cover may be only locally operable.







## STABILITY AND WATERTIGHT INTEGRITY

### CHAPTER 3

## CERTIFICATION AND CLASSIFICATION

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# SECTION 1 GENERAL

## A. Introduction

### A 100 Application

**101** As well as representing DNV's recommendations on safe engineering practice for general use by the offshore industry, the offshore standards also provide the technical basis for DNV classification, certification and verification services.

**102** A complete description of principles, procedures, applicable class notations and technical basis for offshore classification is given by the offshore service specifications for classification, see Table A1.

Table A1 DNV Offshore Service Specifications	
No.	Title
DNV-OSS-101	Rules for Classification of Offshore Drilling and Support Units
DNV OSS-102	Rules for Classification of Floating Production and Storage Units

## B. Design Review

### B 100 Documentation requirements

**101** Documentation for classification shall be in accordance with DNV-RP-A201 and DNV-RP-A202. DNV-RP-A201 describes applicable standard document types, while DNV-RP-A202 lists document requirements for classification projects.

**102** Documents listed in DNV-RP-A202 under the following CIBS codes shall be submitted for review:

- 26. Openings and closing appliances
- 28. Stability and loadline.

### B 200 Specific classification requirements

**201** *Freeboard*, see Ch.2 Sec.2 C

The computation of freeboard is not subject to classification. However, the requirements, including those relating to certification, of the International Convention on Load Lines 1966 (ILLC 1966) apply to all units and installations.

## C. Certification of Materials and Components

### C 100 General

**101** The product certification is a conformity assessment normally including both design and production assessment.

The production assessment includes inspection and testing during production and/or of the final product.

**102** Components shall be certified consistent with its functions and importance for safety. The principles of categorisation of component certification are given in the relevant offshore service specifications, see Table A1.

**103** Product certification shall be documented by the following types of documents:

a) Det Norske Veritas Product Certificate (NV):

A document signed by a DNV surveyor stating:

- conformity with rules and standard requirements
- that tests are carried out on the certified product itself
- that tests are made on samples taken from the certified product itself
- that tests are performed in presence of the surveyor or in accordance with special agreements.

b) Works Certificate (W):

A document signed by the manufacturer stating:

- conformity with rules and standard requirements
- that tests are carried out on the certified product itself
- that tests are made on samples taken from the certified product itself
- that tests are witnessed and signed by a qualified department of the manufacturers.

c) Test Report (TR):

- conformity with rules and standard requirements
- that tests are carried out on samples from the current production.

### C 200 Certification requirements under DNV-OS-C301

**201** Certification requirements for components are given in Table C1.

Table C1 Certification of components	
Item	Certificate
Watertight doors and hatch covers	NV
Weather-tight doors	W
Side scuttles and windows	W
Ventilator closing devices	NV
Valves for sea inlet or discharge	NV

