## Contents

# RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

# Part P MOBILE OFFSHORE DRILLING UNITS AND SPECIAL PURPOSE BARGES

## Chapter 1 GENERAL

### 1.1 General

#### 1.1.1 Application

**1** The requirements in this Part apply to the materials, welding, stability, hull construction, equipment, positioning systems, machinery installations, electrical installations, computer-based systems, fire protection and detection system, fire extinguishing systems, means of escape and load lines of mobile offshore drilling units and special purpose barges, etc., notwithstanding the requirements in other Parts. The mobile offshore drilling units and special purpose barges, etc., (hereinafter referred to as "units" in this Part) are steel-made ships and floating structures, and those are generally positioned for a long period of time or semi-permanently at a specific sea area, or fixed at a specific sea area.

**2** FPSO, FPO and FSO defined in **1.2.1, Part PS** are to be according to **Part PS** notwithstanding the requirements given in this **Part**.

#### 1.1.2 Consideration for Special Units*

As for units of type or purpose different from those specified in this Part, the required hull construction, equipment, arrangement and scantlings are to be specified respectively basing upon the fundamental concept of the requirements in this Part and these specified requirements apply as substitutes of the requirements in this Part.

#### 1.1.3 Equivalency

Hull construction, equipment, machinery and their arrangements and scantlings to which the requirements of this part are not applicable will be accepted by the Society, provided that the Society is satisfied that such construction, equipment, machinery and their arrangements and scantlings are equivalent to those required in this Part.

#### 1.1.4 National Requirements*

**1** For the units which apply this Part, attention is to be paid to complying with the National Regulations of flag states and coastal states in addition to the requirements specified in this Part.

**2** The Society may make special requirements as instructed by the flag-government of units or the government of sovereign nation in which units navigate.

#### 1.1.5 Record of Design Criteria*

For the units classed with the Society, the design criteria such as water depth, wave height, etc. for which units are designed, are recorded in the Classification Register.

#### 1.1.6 Class Notations

**1** For units complying with the requirements in this Part, an appropriate notation corresponding to the type and purpose of units will be affixed to the Classification Characters.

**2** For units provided with positioning systems satisfied with the requirements in this Part, an appropriate notation corresponding to the type of the positioning systems of the units will be affixed to the Classification Characters.

## 1.2 Definitions

### 1.2.1 Application

The definitions of terms and symbols which appear in this Part, except for which are defined in **Chapter 2 of Part A**, **1.1.6 of Part D**, **1.1.5 of Part H** and **Chapter 3**, **Part R**, are to be specified in this **1.2**.

### 1.2.2 Type of Units

Units are classified into the following four groups depending upon their types:

(1) Self-elevating unit

Self-elevating unit is a unit having hulls with sufficient buoyancy to safely transport the unit to the desired location, after which the hull is raised to a predetermined elevation above the sea surface on its legs, which are supported by the seabed. Equipment and supplies may be transported on the unit, or may be added to the unit in its elevated position. The legs of such units may penetrate the seabed, may be fitted with enlarged sections or footings to reduce penetration, or may be attached to bottom pads or mats.

(2) Column-stabilized unit

Column-stabilized unit is a unit which depends upon the buoyancy of widely spaced columns for floatation and stability for all afloat modes of operation or in the raising or lowering of the unit, as may be applicable. The columns are connected at their top to an upper structure supporting the equipment. Lower hulls or footings may be provided at the bottom of the columns for additional buoyancy or to provide sufficient area to support the unit on the seabed. Bracing members of tubular or structural sections may be used to connect the columns, lower hulls or footings and to support the upper structure. Designated operations may be carried out in the floating condition, in which condition the unit is described as a semi-submersible, or when supported by the seabed, in which condition the unit is described as submersible. A semi-submersible unit may be designed to operate either floating or supported by the seabed, provided each type of operation has been found to be satisfactory.

(3) Ship-type unit

Ship-type unit is a seagoing ship-shaped unit having a displacement type hull or hulls, of the single, catamaran or trimaran type, which has been designed or converted for designated operations in the floating condition or seagoing condition. The unit of this type has propelling machinery.

(4) Barge-type unit

Barge-type unit is a seagoing unit having a displacement type hull or hulls, which has been designed or converted for operations in the floating condition. The unit of this type has no propelling machinery.

### 1.2.3 Purposes of Units*

Units are classified into the following eight groups depending upon their purposes:

(1) Mobile offshore drilling unit

Mobile offshore drilling unit is a unit which is provided with drilling equipment for the exploration for and exploitation of resourced beneath the seabed such as crude oil, natural gases, and so on.

(2) Storage units

Storage unit is a unit primarily for storage of inflammable liquids such as crude oil, and stationed for long periods of time or semi-permanent.

(3) Moored floating units

Moored floating unit is a unit used for the special purpose in which a number of passengers are on board, whose structure has two and more decks or whose spaces are enclosed of which are used for this purpose.

(4) Plant barges

Plant barge is a unit which is installed with equipment for the industrial factory, and fixed or stationed semi-permanent or for long periods of time under floating condition at its service area.

(5) Accommodation barges

Accommodation barge is a unit with no propelling machinery which has accommodation for particular personnel or passengers. This unit is to be stationed at smooth water areas or sea areas equivalent thereto. In addition, during moving of this unit, there is not to be anyone except operator for moving operation on board.

(6) Floating piers

Floating pier is a unit which has mooring equipment, loading apparatus, etc. for loading or unloading and has bridges for access from the shore. This unit is to be stationed semi-permanent or for long periods of time under floating condition at its service area.

(7) Other types of units

Other types of units are units other than those specified in **(1)** to **(6)**.

**1.2.4 Modes of Operation**

A mode of operation is a condition or manner in which a unit may operate or function while on location or in transit. In the requirements of this Part, the approved modes of operation of a unit are defined as follows:

(1) Operating condition

Operating condition is a condition wherein a unit is on location for purposes of operations, and combined environmental and operational loadings are within the appropriate design limits established for such operations. The unit may be either afloat or supported by the seabed, as applicable.

(2) Severe storm condition

Severe storm condition is a condition during which a unit may be subjected to the severest environmental loadings for which the unit is designed. Operations are assumed to have been discontinued due to the severity of the environmental loadings. The unit may be either afloat or supported by the seabed, as applicable.

(3) Transit condition

Transit condition is a condition wherein a unit is moving from one geographical location to another without any operation of its purpose.

(4) Temporary mooring condition

Temporary mooring condition is a condition wherein a unit is temporarily moored in the afloat condition.

**1.2.5 Length of Unit (*L*)**

**1** For self-elevating units and barge-type units, length is the distance in metres on the summer load line, between the insides of shell platings at the fore and after ends.

**2** For column-stabilized units, length is the maximum distance in metres between the fore and after ends of the primary hull structure which is projected to the centre line of the hull.

**3** For ship-type units, length is the distance in metres on the summer load line, from the fore side of the stem to the centre of the rudder stock, or 96% of the length on the summer load line, whichever is greater. Where a ship does not have a rudder, length is 96% of the length on the summer load line.

**1.2.6 Breadth of Unit (*B*)**

**1** For column-stabilized units, breadth is the horizontal distance in metres measured perpendicularly to the longitudinal centre line at the broadest part of the primary hull structure.

**2** For self-elevating units, ship-type units and barge-type units, breadth is the horizontal distance in metres between outsides of frames at the broadest part of the hull.

**1.2.7 Depth of Unit (*D*)**

**1** For column-stabilized units, depth is the vertical distance in metres from the top of bottom plating of the lower hull or footing to the top of beam of the uppermost continuous deck at side measured at the middle of *L*.

**2** For self-elevating units, ship-type units and barge-type units, depth is the vertical distance in metres from the top of bottom plating to the top of beam of the uppermost continuous deck at side measured at the middle of *L*.

**1.2.8 Load Line and Designed Maximum Load Line**

-1. Load line is the water line corresponding to each freeboard assigned in accordance with the provisions in **Chapter 8** of this Part.

-2. Designed maximum load line is the water line corresponding to the designed full load condition.

**1.2.9 Design Water Depth**

Design water depth is the vertical distance in metres from the seabed to the mean low water level plus the height of astronomical and storm tides.

**1.2.10 Light Ship Weight***

Light ship weight is the weight of the complete unit in tons with all its permanently installed machinery, equipment and

outfit, including permanent ballast, spare parts normally retained on board, and liquids in machinery and piping to their normal working levels, but does not include cargo, liquids in storage or reserve supply tanks, items of consumable or variable loads, any allowance for stores, or crew and their effects.

**1.2.11 Design Service Temperature of Materials for Unit**

Design service temperature of materials is the lowest of the average daily atmospheric temperatures, based on meteorological data, for any anticipated area of operation. If data giving the lowest daily average temperature are not available, the lowest monthly average temperature may be used.

**1.2.12 Weathertight**

Weathertight means that in any sea conditions water will not penetrate into the unit.

**1.2.13 Watertight**

Watertight means that the capability of preventing the passage of water through the structure in any direction under a head of water for which the surrounding structure is designed.

**1.2.14 Downflooding**

Downflooding means any flooding of the interior of any part of the buoyant structure of a unit through openings which cannot be closed watertight or weathertight, as appropriate, or which are required to be left open for operational reasons.

**1.2.15 Control Station**

Control station is a space where radio equipment, main navigational equipment or emergency source of power is located and control panels for posture or position control equipment, leg elevation control equipment, central fire detection or central fire alarm devices are installed.

**1.2.16 Hazardous Area**

**1** Hazardous areas are those areas or the spaces where flammable or explosive substances are placed and where it is likely that flammable or explosive gases or vapours will be given off by these substances.

**2** Hazardous areas of mobile offshore drilling units are all those areas where, due to the possible presence of a flammable atmosphere arising from the drilling operations, the use of machinery or electrical equipment without proper consideration may lead to fire hazard or explosion. In addition, the hazardous areas are subdivided into Zones 0, 1 and 2, the definitions of each category being as follows:

(1) Zone 0 is an area in which ignitable concentrations of flammable gases or vapours are continuously present or present for long periods.

(2) Zone 1 is an area in which ignitable concentrations of flammable gases or vapours are likely to occur in normal operation.

(3) Zone 2 is an area in which ignitable concentrations of flammable gases or vapours are not likely to occur, or in which such a mixture, if it does occur, will only exist for a short time.

**1.2.17 Safety Area**

Safety area is a non-hazardous areas which areas are other than hazardous areas.

**1.2.18 Enclosed Space**

An enclosed space is considered to be a space bounded by bulkheads and decks which may have doors, windows or other similar openings.

**1.2.19 Semi-enclosed Space**

A semi-enclosed location is considered to be a location where natural conditions of ventilation are notably different from those on open decks due to the presence of structures such as roofs, windbreaks and bulkheads and which are so arranged that the dispersion of gas may not occur.

**1.2.20 Provisions or Installations for Safety of the Unit**

The provisions or installations for the safety of the units are those listed in the following **(1)** to **(10)**:

(1) Auxiliary machinery classified into the manoeuvring and the safety which are specified in **1.1.6 of Part D**.

(2) Mooring systems

(3) Jacking systems

(4) Lighting systems

(5) Internal communication systems

(6) Fire extinguishing systems

(7) Radio installation

(8) Navigational systems

(9) Feed water systems and burning systems for boilers which supply steam to any one of the systems prescribed in **(1)** to **(8)**

(10) Other systems deemed necessary by the Society

**1.2.21 Unit Operating in Restricted Area**

The unit operating in restricted area is a unit whose navigation route or operating area is limited to the coastal waters, smooth waters or equivalent thereto, and unit is registered in the Register of Ships with the notation "*Coasting Service*" or "*Smooth Water Service*".

**1.2.22 Units for Self-propulsion System***

The unit for self-propulsion system is the unit which are to undertake self-propulsion passages without external assistance.

**1.2.23 Units Fixed on the Seabed or Positioned Semi-permanent**

Units fixed on the seabed or positioned semi-permanent mean that the units are fixed on the seabed or positioned at a specific sea area over 36 months which is the maximum interval of Docking Survey specified in **1.1.3, Part B**.

**1.2.24 Units Fixed on the Seabed or Positioned for Long Periods of Time**

Units fixed on the seabed or positioned for long periods of time mean that the units are fixed on the seabed or positioned at a specific sea area over 30 days. In general, units specified in **1.2.3(1)** to **(6)** are categorized into the units fixed on the seabed or positioned for long periods of time.

**1.2.25 Gas-tight Door**

A gas-tight door is a solid, close-fitting door designed to resist the passage of gas under normal atmospheric conditions.

**1.2.26 Normal Operational and Habitable Conditions**

Normal operational and habitable conditions are as follows:

(1) Conditions under which the unit as a whole, its machinery, services, means and aids ensuring safe navigation when underway, safety when in the industrial mode, fire and flooding safety, internal and external communications and signals, means of escape and winches for rescue boats, as well as the means of ensuring the minimum comfortable conditions of habitability, are in working order and functioning normally

(2) Conditions under drilling operations

**1.2.27 Working Spaces**

Working spaces are those open or enclosed spaces containing equipment and processes, associated with drilling operations, which are not included in hazardous areas and machinery spaces.

**1.2.28 Helideck**

Helideck is a purpose-built helicopter landing platform located on the unit.

**1.2.29 *D*-value**

*D*-value ($D_H$) means the largest dimension of the helicopter when rotor(s) are turning measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor path plane or helicopter structure.

**1.2.30 Final Approach and Take-off Area (*FATO*)**

Final approach and take-off area *(FATO)* is a defined area over which the final phase of the approach manoeuvre to hover or landing of the helicopter is intended to be completed and from which the take-off manoeuvre is intended to be commenced.

**1.2.31 Obstacle-free Sector**

Obstacle-free sector is a complex surface originating at, and extending from, a reference point on the edge of the *FATO* of a helideck, comprised of two components, one above and one below the helideck for the purpose of flight safety within which only specified obstacles are permitted.

**1.2.32 Limited Obstacle Sector (*LOS*)**

Limited obstacle sector *(LOS)* is a sector extending outward which is formed by that portion of the 360 degrees arc, excluding the obstacle-free sector, the centre of which is the reference point from which the obstacle-free sector is determined. Obstacles within the limited obstacle sector are limited to specified heights.

**1.2.33 Obstacle**

Obstacle is any object, or part thereof, that is located on an area intended for the movement of a helicopter on a helideck or that extends above a defined surface intended to protect a helicopter in flight.

**1.2.34 Touchdown and Lift-off Area (*TLOF*)**

Touchdown and lift-off area (*TLOF*) is a dynamic load-bearing area on which a helicopter may touch down or lift off. For a helideck it is presumed that the *FATO* and the *TLOF* will be coincidental.

**1.2.35 "*H*" Class Divisions***

"*H*" class divisions are those divisions which meet the same requirements as "*A*" class divisions, as defined in **3.2.2, Part R**, except that, when tested according to the Fire Test Procedures Code defined in **3.2.23, Part R**, the furnace control temperature curve is to be replaced with the furnace control temperature curve for hydrocarbon fires defined in national or international standards deemed appropriate by the Society.

**1.2.36 "*2009 MODU Code*"**

"*2009 MODU Code*" is the "*Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009*" adopted by the IMO as Resolution *A*.1023(26), as amended.

**1.2.37 SPS Code**

"*SPS Code*" is the "*Code of Safety for Special Purpose Ships*".

# Chapter 2 MATERIALS AND WELDINGS

## 2.1 General

### 2.1.1 General*

**1** Units are to be constructed from steel or other suitable material having properties, taking into consideration the temperature extremes in the areas in which the unit is intended to operate.

**2** Materials such as rolled steels, steel castings, steel forgings, etc. used for hull structures, equipment, etc. are to comply with the requirements of **Part K**.

**3** Equipment are to comply with the requirement of **Part L**.

**4** The requirements for weldings such as welding methods, welding materials, welding operators and their qualifications are to be in accordance with the requirements in **Part M**.

**5** Materials, welding method, etc. having characteristics differing from those specified in this Part, **Part K**, **Part L** and **Part M** may be used when the detailed design data of those and their use are approved by the Society. In this case, detailed data relating to the process of manufacture, the way of using, etc. of those are to be submitted for approval to the Society.

**6** Consideration is to be given to the minimization of hazardous substances used in the design and construction of the unit, and is to facilitate recycling and removal of hazardous materials.

## 2.2 Material

### 2.2.1 General

**1** The kinds of rolled steels are given in **Table P2.1**.

**2** In case of using rolled steels, material coefficients ($K$) due to kind of those corresponding to tensile strength are given in **Table P2.2**.

**3** Application of steels for structural members for hull are given in **Fig. P6.1** to **Fig. P6.4**, where the design service temperature of materials is lower than -50℃ and plate thickness is exceeding to 70*mm*, however, applied steels are satisfactory of the Society.

**4** Anchors, steel wire ropes, fibre ropes, etc. for permanent mooring for a long period of time are satisfactory to the Society.

## 2.3 Welding

### 2.3.1 Underwater Welding

Welders to be engaged in underwater welding are to be those who have been accepted through the qualification test approved by the Society.

Table P2.1 Category of Rolled Steels

| Kind of steels | Symbols specified in Part K | Symbols specified in this Part |
|---|---|---|
| Mild steel | *KA* | *KA* |
| | *KB* | *KB* |
| | *KD* | *KD* |
| | *KE* | *KE* |
| High tensile steel | *KA*32,*KA*36,*KA*40 | *KAH* |
| | *KD*32,*KD*36,*KD*40 | *KDH* |
| | *KE*32,*KE*36,*KE*40 | *KEH* |
| | *KF*32,*KF*36,*KF*40 | *KFH* |
| High strength rolled steels for offshore structures | *KA*420,*KA*460,*KA*500 | *AQ*1 |
| | *KA*550,*KA*620,*KA*690 | *AQ*2 |
| | *KA*890,*KA*960 | — |
| | *KD*420,*KD*460,*KD*500 | *DQ*1 |
| | *KD*550,*KD*620,*KD*690 | *DQ*2 |
| | *KD*890,*KD*960 | — |
| | *KE*420,*KE*460,*KE*500 | *EQ*1 |
| | *KE*550,*KE*620,*KE*690 | *EQ*2 |
| | *KE*890,*KE*960 | — |
| | *KF*420,*KF*460,*KF*500 | *FQ*1 |
| | *KF*550,*KF*620,*KF*690 | *FQ*2 |

Table P2.2 Material Coefficient (*K*) Corresponding to Tensile Strength

| Kind of steel | Symbols of materials | Coefficient(*K*)(1) |
|---|---|---|
| Mild Steel | *KA*,*KB*,*KD*,*KE* | 1.0 |
| High Tensile Steel | *KA*32,*KD*32,*KE*32,*KF*32 | 0.78 |
| | *KA*36,*KD*36,*KE*36,*KF*36 | 0.72 |
| | *KA*40,*KD*40,*KE*40,*KF*40 | 0.68(2) |
| High strength rolled Steels for offshore structures | *KA*420,*KD*420,*KE*420,*KF*420 | * |
| | *KA*460,*KD*460,*KE*460,*KF*460 | * |
| | *KA*500,*KD*500,*KE*500,*KF*500 | * |
| | *KA*550,*KD*550,*KE*550,*KF*550 | * |
| | *KA*620,*KD*620,*KE*620,*KF*620 | * |
| | *KA*690,*KD*690,*KE*690,*KF*690 | * |
| | *KA*890,*KD*890,*KE*890 | * |
| | *KA*960,*KD*960,*KE*960 | * |

Notes:

(1) * At the discretion of the Society.

(2) 0.66 may be taken where a fatigue assessment of the structure is performed to verify compliance with the requirements of the Society.

# Chapter 3 DESIGN LOADS

## 3.1 General

### 3.1.1 General*

**1** In regard to loads in determining scantlings of structural members and in calculating mooring forces for the units fixed on the seabed or positioned for long periods of time, unless otherwise specified elsewhere, the following **(1)** to **(18)** are to be taken into account, where applicable:

(1) Wind loads;
(2) Wave loads;
(3) Deck loads;
(4) Loads due to helicopter;
(5) Static loads such as water pressure in still water, buoyancy, dead load, etc.;
(6) Loads caused by tide and current;
(7) Loads caused by floating ice;
(8) Loads caused by snow and icing;
(9) Loads caused by earthquake in the case of bottoming-type units;
(10) Impact loads caused by touching seabed;
(11) Loads caused by mooring;
(12) Loads caused by mooring of tenders;
(13) Loads caused by towing;
(14) Loads caused by operation;
(15) Loads due to increase of resistance by marine growth;
(16) Secondary loads due to large deformation of legs for self-elevating units;
(17) Inertial loads due to dynamic response (e.g. DAF: Dynamic Amplification Factor);
(18) Other loads considered necessary.

**2** The design loads specified in **-1** are to be based upon statistical data and considerations are to be given to the severest condition anticipated in the period of at least 50 years. However, for large sized oil storage barges and those units considered necessary by the Society, the period is to be 100 years, and for units or towed barge-type units provided with self-propulsion system, the period may be 25 years.

**3** Notwithstanding the requirements of **-2**, in case where considering to the purpose of unit, employment period, etc. and those are approved by the Society, the design loads acting upon the unit in the most severe condition anticipated in the period which specified by the Owner may be used.

**4** Units except for units fixed on the seabed or positioned for long periods of time may be according to relevant requirements given in **Part C**, **Part CS** or **Part Q**. However, in cases where loads produced by designated operations cannot be ignored, such loads are to be considered in addition to the requirements.

## 3.2 Design Loads

### 3.2.1 General

The requirement of this **3.2** is specified the representative methods for calculation the design loads. In case where the calculation method of the design loads is not specified or even though they are specified, the design load may be determined from the appropriate model tests, wind tunnel tests, tank tests or theoretical methods approved by the Society may be used.

### 3.2.2 Wind Loads*

**1** The design wind velocity used in determining the wind loads may be specified by the Owner, but should not to be less than 25.8*m/sec*. However, the design wind velocity for the units intended for unrestricted services and operating sea areas is not to be

less than 36*m/sec*. for the operating condition and not to be less than 51.5*m/sec*. for the severe storm condition.

**2** The wind pressure $P$ is to be obtained from the following formula.

$P = 0.611 C_h C_s V^2 (N/m^2)$

$V$: Design wind velocity specified in **-1**. (*m/sec*.)

$C_h$: Height coefficient given by **Table P3.1** depending on the vertical height in metres at the location under consideration, where the vertical height is a vertical distance from sea surface to the geometric centre of the projected area $A$ specified in the following **-3**.

$C_s$: Shape coefficient given by **Table P3.2** depending on the shape of structural members.

**3** The wind load $F$ is not to be less than obtained from the following formula with regard to each structural member of the unit. In addition, the resultant force and its acting point are to be determined for each wind direction.

$F = PA\ (N)$

$P$: Wind pressure specified in **-2**. ($N/m^2$)

$A$: Projected area of all exposed structural members on a plane perpendicular to each wind direction in the upright condition or, if necessary, in the heeling condition ($m^2$). In determining the projected area, the requirements in the following **(1)** to **(5)** are to be applied:

(1) For self-elevating units, the projected areas of all legs are to be included. Where, however, the legs are of open truss work, the above-mentioned projected areas may be determined according to the requirements in **(5)**.

(2) For column-stabilized units, the projected areas of all columns are to be included.

(3) Notwithstanding the requirements of **(1)** or **(2)**, where legs or columns are closely located, the influence of screening effect, etc. may be considered. Where, however, this effect is to be obtained from an appropriate wind tunnel tests approved by the Society.

(4) The projected areas of deckhouses, other structural members, cranes, etc. are to be separately calculated. Where, however, two or more structures such as deckhouses and the like are closely located, they may be considered as one block and their projected areas may be considered as a projected block area perpendicular to each wind direction. In this case, the shape coefficient $C_s$ is to be taken as 1.1.

(5) The projected areas in case where drilling derrick towers, booms, masts, etc. are of open truss work may be taken as 60% of the projected block areas perpendicular to each wind direction assuming that they are not of open truss work.

**4** Where the lifting effect of the wind load is considered not negligible, this effect is determined from an appropriate method approved by the Society.

Table P3.1 Height Coefficient $C_h$

| Height ($m$) | | $C_h$ |
|---|---|---|
| Not less than | Less than | |
| | 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 | 259.0 | 1.79 |
| 259.0 | | 1.80 |

Table P3.2 Shape Coefficient $C_s$

| Structural members | $C_s$ |
|---|---|
| Spherical structures | 0.4 |
| Cylindrical structures | 0.5 |
| Main Hulls | 1.0 |
| Deckhouses | 1.0 |
| Clustered deckhouses or similar structures | 1.1 |
| Small parts | 1.4 |
| Independent structural members (cranes, shapes, beams, etc.) | 1.5 |
| Under-deck parts (smooth surface) | 1.0 |
| Under-deck parts (exposed beams, girders, etc.) | 1.3 |
| Drilling derricks (each surface) | 1.25 |
| Wires | 1.2 |

### 3.2.3 Wave Loads

**1** The design wave height to be used for wave load calculation may be specified by the Owner subject to the approval by the Society.

**2** The design wave period to be used for wave load calculation is to be the period which will give the maximum effect to the unit.

**3** For the wave load calculation, the following requirements are to be applied:

(1) The wave loads are to be calculated basing on acceptable wave theories appropriate to the design depth of water at the operation area subject to the approval by the Society.

(2) Waves from all directions are to be considered on the unit.

(3) The wave loads produced by shipping water on the deck, the loads acting directly on the immersed elements of the unit and the loads resulting from heeled positions or accelerations due to its motion are also to be considered.

(4) The vibration induced by waves is also to be considered.

(5) Where the low frequency motion is considered not negligible, low frequency components of wave such as swell, are to be considered.

**4** Notwithstanding the requirements of **-1** to **-3**, the wave loads may be determined from the simulation method in irregular wave using a suitable wave spectrum based upon the wave data at the service area.

### 3.2.4 Current and Tidal Current Loads

**1** Current and tidal current loads are to be obtained as follows.

(1) Drag force

Drag force ($F_D$) per unit length along the member due to the current and the tidal current is to be obtained from following formula.

$$F_D = 0.5\rho D C_D U_C \times |U_C| + 0.25\pi D^2 \rho C_M a_n (kN/m)$$

where

$\rho$: density of seawater 1.025 ($t/m^3$)

$D$: the projected width of the unit in the direction of the cross flow component of velocity. ($m$)

$C_D$: drag coefficient in steady flow (value is to be deemed appropriate by the Society)

$U_C$: current velocity ($m/sec.$)

$C_M$: inertia coefficient in steady flow (value is to be deemed appropriate by the Society)

$a_n$: acceleration ($m/s^2$)

(2) Lifting force

Lifting force ($F_L$) per unit length along the member due to the current and tidal current is to be obtained from following formula.

$$F_L = 0.5\rho D C_L U_C \times |U_C| \ (kN/m)$$

where

$C_L$: lifting force coefficient in steady flow (value is to be deemed appropriate by the Society)

$\rho$, $D$ and $U_C$ are specified in **(1)**.

**2** As necessary, the velocities of current and tide are to be added vectorially to the wave particle velocity.

### 3.2.5 Loads due to Vortex Shedding

The flutters of immersed structural members due to vortex shedding are also to be considered.

### 3.2.6 Deck Loads*

For deck loads, uniform and concentrated loads on the respective portions of the deck in each mode of operation and transit condition are to be taken into account. The values of the uniform loads, however, are not to be less than given in **Table P3.3**.

Table P3.3 Deck Loads

| Kind of deck | Minimum load($N/m^2$) |
|---|---|
| Accommodation spaces (including corridors and similar spaces) | 4,510 |
| Work areas and machinery spaces | 9,020 |
| Storage areas | 13,000 |

### 3.2.7 Helicopter Loads

**1** The design load in determining the scantlings of the members of helicopter deck is to be in accordance with the following **(1)** to **(3)**:

(1) Helicopter landing impact loading

(a) As for the deck loads in the range where a helicopter takes off or lands, a load of 75% of the helicopter maximum take-off weight is to be taken on each of two square areas, $0.3m \times 0.3m$.

(b) For girders, stanchions, etc., the structural weight of the helicopter deck is to be considered in addition to the helicopter impact loading specified in **(a)**.

(c) Where the upper deck of a superstructure or deckhouse is used as a helicopter deck and the spaces below are normally

manned, the impact loading specified in **(a)** is to be multiplied by a factor of 1.15.

(2) Stowed helicopter loading

(a) The deck loads in the space where a helicopter is stowed are to be taken as wheel loadings at maximum take-off weight. In this case, the dynamical effect due to the motion of the unit is also to be taken into consideration.

(b) In addition to **(a)**, a uniformly distributed loading of $490 N/m^2$, representing wet snow or ice is to be considered, if necessary.

(c) For girders, stanchions, etc., the structural weight of the helicopter deck is to be considered in addition to the loads specified in **(a)**.

(3) Minimum deck load

The minimum deck load for helicopter deck is to be taken as $2{,}010 N/m^2$.

**2** In case where a helicopter is provided with any other landing appliances than wheels, the design loads are to be at the discretion of the Society.

# Chapter 4 STABILITY

## 4.1 General

### 4.1.1 Application

**1** Stability of units is to be in accordance with the requirements given in this Chapter.

**2** Regarding damage stability and intact stability of units, notwithstanding the requirements of **-1**, ship-type and barge-type units, except for units fixed on the seabed or positioned for long periods of time, are to be according to **Part U** and **2.3, Part 1, Part C**. In addition, when deemed necessary by the Society, additional requirements may be requested.

### 4.1.2 General*

**1** All units are to meet the stability requirements in this Chapter for all applicable condition.

**2** For units embedded on the seabed, the stability of these are to satisfactory to the Society.

**3** For the purpose of stability calculation, it is to be assumed that the unit is floating free of mooring restraints. However, where there are the possible detrimental effects of mooring for stability of unit, these effects are to be considered.

**4** For the purpose of stability calculation, the free surface effect of liquids in tanks are to be taken account to.

**5** For the purpose of stability calculation, if available, the snowing and icing data based upon the service area of unit are to be included.

### 4.1.3 Intact Stability

**1** All units are to have positive stability in calm water equilibrium position.

**2** All units are to have sufficient stability to withstand the overturning effect of heeling moment induced to wind and motions induced to the wave.

**3** Each unit is to 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, are to be contained in the operating manual. It is to be possible to achieve the severe storm condition without the removal or relocation of solid consumables or other variable load. However, the Society may permit 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 KG 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 should be identified in the operating manual.

### 4.1.4 Damage Stability

**1** All units are to have sufficient freeboard and be subdivided by means of watertight decks and bulkheads to provide sufficient buoyancy and stability to withstand the flooding of any single compartment or any combination of compartments consistent with the damage assumption set out in **4.3** in any operating or transit condition.

**2** All units are to have sufficient stability in flooding any single compartment or any combination of compartments consistent with the damage assumption set out in **4.3** to withstand heeling moment induced to a wind based on a horizontal wind velocity superimposed from any direction and units' motions due to waves.

**3** The final waterline after flooding is to be below the lower edge of any downflooding opening.

**4** For the purpose of damage stability calculation, the abilities to compensate for heeling angle due to damage such as pumping out from the damaged compartment, ballasting or filling other compartments, or mooring force, etc. are not to be considered.

### 4.1.5 Wind Heeling Moment

**1** Wind loads are to be obtained from in accordance with the requirements in **3.2.2**. For damage stability calculation, however, wind loads are be obtained from wind velocity which may be 25.8*m/sec*.

**2** The lever for the heeling force is to be taken vertically from the centre of lateral resistance or, if available, the centre of hydrodynamic pressure, of the underwater body to the centre of pressure of the areas subject to wind loading.

**3** The wind heeling moment is to be calculated at several angles of inclination for each mode of operation.

**4** In calculating wind heeling moments for ship-shaped and barge-shaped hulls, the curve may be assumed to vary as the cosine function of the unit's heel.

**5** Wind heeling moments derived from authoritative wind tunnel tests on a representative model of the unit may be considered as alternatives to the method given in **-2** to **-4**. Such heeling moment determination is to include lift effects at various applicable heel angles, as well as drag effects.

## 4.2 Intact Stability Criteria

### 4.2.1 General

**1** For all units, consideration is to be paid to the cases of loading at the most critical positions applicable for intact stability, and curves of righting moments and of wind heeling moments similar to **Fig. P4.1** are to be prepared.

**2** The righting moment curves and wind heeling moment curves are to be calculated in relation to the most critical axes and sufficient numbers of floating condition.

**3** The righting moment curve are to be positive over the entire range of angle from upright to $\theta_3$ of the second intercept angle shown in **Fig. P4.1**.

**4** Where equipment is of such a nature that it can be lowered and stowed, additional wind heeling moment curves may be necessary and such data is to clearly indicate the position of such equipment.

### 4.2.2 Self-elevating Unit

In **Fig. P4.1**, units of this type are to meet the following stability criteria.

$$Area\ (A + B) \geq 1.4 \times Area\ (B + C)$$

However, the angle of heel is to be taken up to the down flooding angle, $\theta_2$ or the second intercept, $\theta_3$, whichever is less.

### 4.2.3 Column-stabilized Unit

In **Fig. P4.1**, units of this type are to meet the following stability criteria.

$$Area\ (A + B) \geq 1.3 \times Area\ (B + C)$$

However, the angle of heel is to be taken up to the down flooding angle, $\theta_2$,

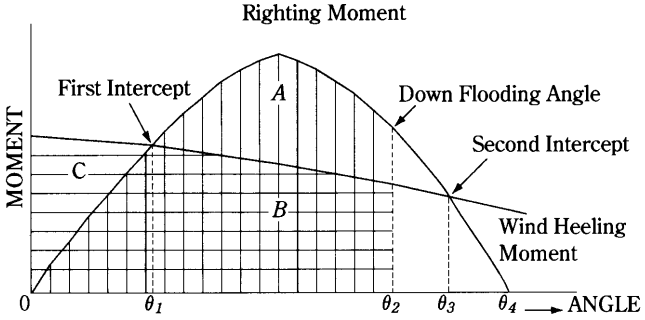
### 4.2.4 Ship-type and Barge-type Unit

In **Fig. P4.1**, units of this type are to meet the following stability criteria.

$$Area\ (A + B) \geq 1.4 \times Area\ (B + C)$$

However, the angle of heel is to be taken up to the down flooding angle, $\theta_2$ or the second intercept, $\theta_3$, whichever is less.

Fig. P4.1 Righting Moments and Heeling Moment Curves




## 4.3 Extent of Damage Depending On the Type of Units

### 4.3.1 General

**1** For the damage stability calculation, extent of damage is to be assumed in accordance with requirements of **4.3.2** to **4.3.4**

corresponding to unit's type, however, unless otherwise provided in case of considering the purpose of units, service area, service period, etc. and which are approved by the Society.

**2** Where damage of a lesser extent than the requirements of 4.3.2 to 4.3.4 in a more severe condition for units, such lesser extent of damage is to be assumed.

**3** All pipings, ventilation systems, trunks, etc., within the extent of damage are to be assumed to be damaged. Positive means of closure are to be provided at watertight boundaries to preclude the progressive flooding of other spaces which are intended to be intact. Where effective means of closure are not to be provided thereto, the compartments bounded by the bottom shell are to be considered flooded individually.

**4.3.2 Self-elevating Unit**

In assessing the damage stability of self-elevating units, the following extent of damage is to be assumed to occur between effective watertight bulkheads:

(1) Horizontal penetration is 1.5*m*. However, the recessed ends and sides of the slot need not be subject to horizontal penetration if warning signs be posted on each side of the vessel stating that no boats be allowed inside the slot.

(2) Vertical extent is bottom shell upwards without limit.

(3) The compartments bounded by the bottom shell are to be assumed to be damaged. Where a bottom mat is fitted, assumed damage penetration simultaneous to both the mat and the upper hull need only be considered when the lightest draught allows any part of the mat to fall within 1.5*m* vertically of the waterline, and the difference in length or breadth of the upper hull and mat is less than 1.5*m* in any area under consideration. In case where other than above, only the compartments bounded by the bottom shell of the bottom mat are to be considered.

(4) The distance between effective watertight bulkheads or their nearest stepped portions which are positioned within the extent of horizontal penetration assumed by **(1)** is to be not less than 3.0*m*. Where there is a lesser distance, one or more of the adjacent bulkheads are to be disregarded.

**4.3.3 Column-stabilized Unit**

In assessing the damage stability of column-stabilized units, the following extent of damage is to be assumed to occur between effective watertight bulkheads:

(1) Only those columns, underwater hulls and braces on the periphery of the unit are to be assumed to be damaged and the damage will occur in the exposed outer portions of the columns, underwater hulls and braces.

(2) Columns and braces are to be assumed to be flooded by damage having vertical extent of 3.0*m* occurring at any level between 5.0*m* above and 3.0*m* below the draughts. Where a watertight flat is located within this region, the damage is to be assumed to have occurred in both compartments above and below the watertight flat in question.

(3) Lesser distances above or below the draughts may be applied to the satisfaction of the Society, taking into account the actual operating conditions. However, the extent of required damage region is to be at least 1.5*m* above **(2)** and below the draughts specified in the operating manual and where a watertight flat is located within this region, the damage is to be assumed to have occurred in both compartments above and below the watertight flat in question.

(4) No vertical bulkhead is assumed to be damaged except where bulkheads are spaced closer than a distance one-eighth the column perimeter at the draught under consideration, measured at the periphery, in which case one or more of the bulkheads will be disregarded.

(5) Horizontal penetration of damage is to be assumed not to exceed 1.5*m*.

(6) Footings are to be treated as damaged when operating at a light or transit condition in the same manner as indicated in **(1)** through **(5)**.

**4.3.4 Ship-type and Barge-type Unit**

In assessing the damage stability of ship-type and barge-type units, the following extent of damage is to be assumed to occur between effective watertight bulkheads:

(1) Horizontal penetration is 1.5*m*.

(2) Vertical extent is bottom shell upwards without limit.

(3) The compartments bounded by the bottom shell are to be considered flooded individually.

(4) The distance between effective watertight bulkheads or their nearest stepped portions which are positioned within the extent of horizontal damage assumed by **(1)** are to be not less than 3.0*m*. Where the distance of this is less than 3.0*m*, one or more of

the adjacent bulkheads are to be disregarded.

## 4.4 Damage Stability Criteria

### 4.4.1 Self-elevating Unit

**1** All units of this type, considering the extent of damage required in **4.3.1** and **4.3.2**, are to be meet the requirements in **4.1.4** at all floating conditions.

### 4.4.2 Column-stabilized Unit

**1** For all units of this type, curves of righting moments and of wind heeling moments in damage condition similar to **Fig. P4.3** are to be prepared.

**2** The righting moment curves and wind heeling moment curves are to be calculated in relation to the most critical axes and sufficient numbers of floating condition.

**3** The units are to have sufficient buoyancy and stability to withstand a wind heeling moment in any operating or transit condition, and are to be in accordance with following condition.

(1) The angle of inclination after the damage set out in **4.3.1** and **4.3.3** are not to be greater than 17 *degrees*.

(2) Any openings below the final waterline are to be made watertight, and openings within 4*m* above the final waterline are to be made weathertight.

(3) The righting moment curve, after the damage set out above, are to have a range of at least 7 *degrees* beyond its first intercept with the wind heeling moment curve to its second intercept or downflooding angle, whichever is less. Within this range, the righting moment are to reach a value of at least twice the wind heeling moment curve, both being measured at the same angle.

Fig. P4.2 Residual Stability for Self-elevating Units

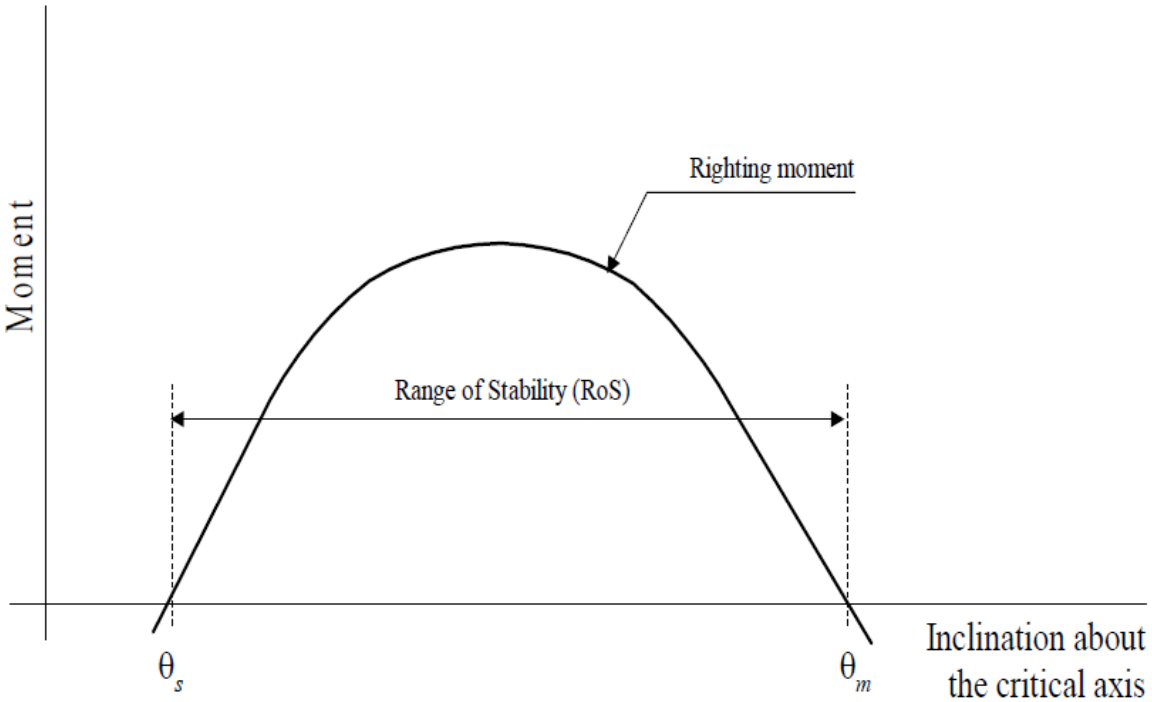
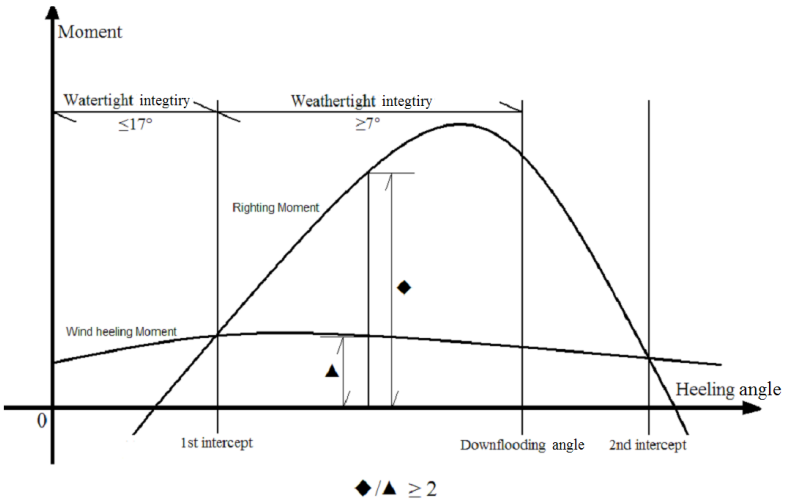



Fig. P4.3 Residual Damage Stability Requirements for Column-Stabilized Units




**2** In operating or transit condition, the flooding of any single compartment with the assumption of no wind while meeting the following criterion (see **Fig. P4.2**):

$$R_OS \geq 7° + (1.5\theta_s)$$

Where:

$R_OS \geq 10°$

$R_OS$: range of stability, in degrees, is to be given by the following formula

$$R_OS = \theta_m - \theta_S$$

Where:

$\theta_m$: Maximum angle of positive stability, in degrees

$\theta_S$: Static angle of inclination after damage, in degrees

The range of stability is determined without reference to the angle of downflooding.

**4** The units are to 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, and are to be in accordance with the following requirements.

(1) The angle of inclination after flooding is not to be greater than 25 *degrees*.

(2) Any opening below the final waterline is not to be made watertight.

(3) A range of positive stability of at least 7 *degrees* is to be provided, beyond the first intercept of the righting moment curve and horizontal coordinate axis of the static stability curve to the second intercept of the two curves or the downflooding angle, whichever is less.

#### 4.4.3 Ship-type or Barge-type Unit

All units of these type, considering the extent of damage required in **4.3.1** and **4.3.4**, are to be meet the requirements in **4.1.4** at all floating conditions.

### 4.5 Verification of Stability by Other Means

#### 4.5.1 Intact Stability*

Where deemed appropriate by the Society, intact stability may be verified by the model tests which take into consideration the effects of wind and waves or the verified direct calculation method in lieu of the requirements in **4.1.5** and **4.2**.

#### 4.5.2 Damage Stability*

Where deemed appropriate by the Society, damage stability under the provisions of the extent of damage specified in **4.3** may be verified by the model tests which take into consideration the effects of wind and waves or the verified direct calculation method in lieu of the requirements in **4.1.5** and **4.4**.

# Chapter 5 WATERTIGHT BULKHEADS

## 5.1 Watertight Bulkheads

### 5.1.1 General

**1** Watertight bulkheads of ship-type and barge-type units are to be in accordance with the requirements in **2.2.2**, **6.3** and **10.5, Part 1, Part C** or **Chapter 13, Part CS** and **Chapter 10, Part Q**. However, the arrangement of watertight bulkheads of the units to be provided in a specified sea area and in a restricted area for long periods of time or semi-permanent or in case where the arrangements of watertight bulkheads are approved by the Society is to be at the discretion of the Society.

**2** The arrangement of watertight bulkheads in self-elevating units and column-stabilized units is to be at the discretion of the Society.

**3** The arrangements and scantlings of watertight decks and bulkheads in column-stabilized unit are to be effective to that point necessary to meet the requirements of damage stability.

**4** Where openings are provided on watertight bulkheads, the requirements in **2.2.2, Part 1, Part C** and **13.2.5, Part D** are to be applied.

**5** Tanks for fresh water or fuel oil, or any other tanks which are not intended to be kept entirely filled in service, are to be in accordance with the requirements in **Chapter 6, Part 1, Part C** (assessment in maximum load condition) with necessary modifications or the requirements in **Chapter 14, Part CS**.

### 5.1.2 Boundary Penetrations

**1** Where watertight boundaries are required for damage stability, they are to be made watertight, including piping, ventilation, shafting, electrical penetrations, and so on. Piping systems and ventilation ducts within the extent of damage are to be provided with valves which are capable of being remotely operated from the weather deck, pump room, or other normally manned space, and are to be satisfactorily arranged to preclude the possibility of progressive flooding through the system to other spaces, in the event of damage. Valve position indicators are to be provided at the remotely operating positions.

**2** Notwithstanding the requirements in **-1**, non-watertight ventilation ducts are to be provided with watertight valves at the subdivision boundaries and the valves are to be capable of being operated from a remote location, with position indicators on the weather deck, or in a normally manned space.

**3** In the case of self-elevating units, ventilating systems which are not used during the transit condition may be secured by alternative methods approved by the Society. In this case, necessary ventilation for closed spaces and closing methods are to be arranged at the discretion of the Society.

**4** In the case of column-stabilized units, valve operating devices are to be in the central ballast control station. And valve position indicators are to be provided at the remote control station.

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

## 5.2 Closing Appliances

### 5.2.1 General

**1** The construction and closing appliances of openings through which the sea water is likely to flow in are to be in accordance with the requirements in this Section, in addition to the requirements given in **Part C** or **Part CS**.

**2** Notwithstanding the requirements given in **-1** above, the construction and closing appliances of the openings through of units, except for units fixed on the seabed or positioned for long periods of time, need not apply the requirements given in **5.2.2** to **5.2.4**.

**3** With respect to the provisions of **-1** above, **14.7.1** and **14.12.4.3, Part 1, Part C** and **21.6.8, Part CS** need not be applied to non self-propelled self-elevating units.

**4** Closing appliances provided in column stabilized units, which are not located within areas of calculated immersion and for

which special considerations are given, are to be at the discretion of the Society.

**5** Watertight doors are to be of ample strength and watertightness for water pressure to a head up to the bulkhead deck or freeboard deck respectively, moreover, door frames are to be effectively secured to the bulkheads. Where deemed necessary by the Society, watertight doors are to be tested by water pressure as follows before they are fitted.

(1) Prototype pressure test

(a) A prototype pressure test is to be conducted for each type and size of door to be installed on the unit at a test pressure corresponding to at least the head required for the intended location.

(b) The installation method and procedure for fitting the door on board are to correspond to those used for the prototype test.

(c) When fitted on board, each door is to be checked for proper seating between the bulkhead, the frame and the door.

(2) Notwithstanding the requirements of **(1)** above, large doors or hatches of a design and size that would make pressure testing impracticable may be exempted from the prototype pressure test, provided that it is demonstrated by calculations that the doors or hatches maintain watertightness at the design pressure, with a proper margin of resistance. After installation, all such doors, hatches or ramps are to be tested by means of a hose test or equivalent.

### 5.2.2 Internal Openings Used during Operation

Internal openings fitted with appliances to ensure watertight integrity are to comply with the following **(1)** to **(3)**:

(1) Internal openings which are used while the unit is afloat during operations are to comply with the following **(a)** and **(b)**:

(a) Doors and hatch covers are to be remotely controlled from the central ballast control station and also to be operable locally from each side. Open/shut indicators are to be provided at the control station.

(b) Doors are to comply with the following **i)** to **iv)** in addition to the requirements in **(a)** above.

i) Doors are to be sliding watertight doors.

ii) Doors are to be provided with an individual hand-operated mechanism. It is to be possible to open and close the door by hand at the door itself from both sides.

iii) An audible alarm is to be provided at the door closure

iv) The power, control and indicators are to be operable in the event of main power failure. Particular attention is to be paid to minimize the effect of control system failure.

(2) Doors or hatch covers in self-elevating units, or doors placed above the deepest load line draft in columun-stabilized, ship-type and barge-type units, which are normally closed while the unit is afloat may be of the quick acting type. However, they are to comply with the following **(a)** and **(b)**:

(a) Alarm systems (e.g., light signals) showing whether the doors or hatch covers in question are open or closed are to be provided locally and at central ballast control stations.

(b) Notices are to be affixed to each such door or hatch cover stating that it is not to be left open while the unit is afloat.

(3) The closing appliances are to have strength, packing and means for securing which are sufficient to maintain watertightness under the design water pressure of the watertight boundary under consideration.

### 5.2.3 External Openings

External openings are to comply with the following **(1)** to **(3)**:

(1) The waterline in the final condition of equilibrium after flooding, taking into account the effect of wind, is to be below the lower edge of any opening through which progressive flooding may take place.

(2) External openings which are used during operation of the units while afloat, are to comply with the following **(a)** to **(c)**.

(a) External openings, such as air pipes (regardless of closing appliances), ventilators, ventilation intakes and outlets, non-watertight hatches and weathertight doors are not to submerge when the unit is inclined to the first intercept of the righting moment and wind heeling moment curves in any intact or damaged condition.

(b) With regard to the requirements specified in **(a)**, openings, such as side scuttles of the non-opening type, manholes and small hatches, which are fitted with appliances to ensure watertight integrity, may be submerged. However, such openings are not to be regarded as the “means of escape” defined in **Chapter 14**.

(c) Where flooding of chain lockers or other buoyant volumes may occur, openings to these spaces are to be considered as downflooding points.

(3) External openings for column-stabilized unit are to be weathertight within the range necessary to comply with the requirement of damage stability criteria and within a zone measured 4.0*m* or 7 *degrees* perpendicularly above the final

waterline shown in Fig. P5.1.

**5.2.4 Internal and External Openings Kept permanently Closed while Afloat**

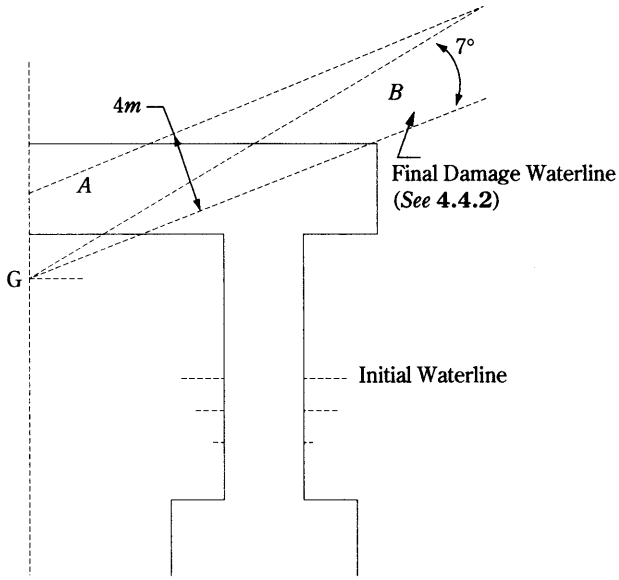
Internal and external openings fitted with appliances to ensure watertight integrity, which are to be kept permanently closed while afloat, are to comply with the following **(1)** to **(3)**:

(1) A signboard to the effect that the opening is always to be kept closed while afloat is to be fitted on the closing appliances in question.

(2) Manholes fitted with bolted covers need not e dealt with as under **(1)**.

(3) The closing appliances are to have strength, packing and means for securing which are sufficient to maintain watertightness under the design water pressure of the watertight boundary under consideration.

Fig. P5.1 Minimum Weathertight Integrity Requirements for Column-Stabilized Unit




*A* - 4*m* Zone of Weathertightness
*B* - 7° Zone of Weathertightness

# Chapter 6 HULL CONSTRUCTION

## 6.1 General

### 6.1.1 Application

**1** Hull construction of units fixed on the seabed or positioned for long periods of time are complied with the requirements of this Chapter. Where, however, the service area, operation area or operation season is restricted, the construction and equipment of the unit may be suitably modified basing on its condition subject to the approval by the Society.

**2** Unless otherwise specially specified in this Chapter, the relevant requirements in **Part C**, **Part CS** and **Part Q** correspondingly apply.

**3** The hull construction of units, except for units listed in **-1** above, is to be according to **6.5**, in addition to relevant requirements given in **Part C**, **Part CS** or **Part Q**.

## 6.2 Materials for Structural Members

### 6.2.1 Categories of Structural Members*

**1** Categories of structural members of self-elevating units and column-stabilized units are to be grouped the three categories, in general, the application categories are determined by the consequence of failure, stress and stress concentration, as following **(1)** to **(3)**.

(1) Primary structural members

Structural members essential to the overall integrity of the unit, such as columns, legs, bracings, lower hulls, footings, bottom mats, shell platings of leg tanks, decks, main deck girders, and so on.

(2) Secondary structural members

Structural members of minor importance failure of which is unlikely to affect the overall integrity of the unit, such as internal structural members of primary members specified in **(1)** and other members.

(3) Special portions of structural members

Special portions of the primary structural members specified in **(1)**, such as junctions which are specially important in structural viewpoint or in way of stress concentration and so on.

**2** Categories of structural members of ship-type units and barge-type units are to be grouped into the three categories of following **(1)** to **(3)**.

(1) Special portions of structural members:

Special members which are specially important in longitudinal strength viewpoint, such as sheer strake, deck stringer, bilge strake, hatch corner in way of stress concentration part which are within 0.4$L$ amidship.

(2) Primary structural members

Sheer strake, deck stringer, bilge strake, hatch corner in way of stress concentration part which are between 0.4$L$ and 0.6$L$ amidship and primary structural members except those specified in **(1)** such as bottom plating, side plating, deck plating, longitudinals on deck, etc. within 0.4$L$ amidship.

(3) Secondary structural members

Inner members of those specified in **(2)** and stern frame, rudder plate, etc., and sheer strake, deck stringer, bilge strake, hatch corner in way of stress concentration part which are outer 0.6$L$ amidship and primary structural members such as bottom plating, side plating, deck plating, longitudinals on deck, etc. which are outer 0.4$L$ amidship.

### 6.2.2 Application of Steels

**1** Application of rolled steels for units is to be **Fig. P6.1** to **Fig. P6.4** depending upon the category of structural members defined in **6.2.1**, thickness and service temperature defined in **1.2.11**. Application of rolled steeled for ship-type units and barge-type units, however, is to be accordance with **Table 3.2.2-1** and **Table 3.2.2-2, Part 1 Part C** when the service temperature is over -10℃.

**2** Application of the design service temperature specified in **-1**, this need not be lower than 0℃ for members which are satisfied with the following requirements.

(1) For all units except self-elevating units, their members which are below the light draught

(2) For self-elevating units, bottom mats and footings

(3) For column-stabilized units, lower hull or footings

**3** When major loads are applied in the direction across the plate thickness, the steel of which characteristics in the direction across the plate thickness are particularly taken into account is to be used.

## 6.3 Corrosion Control

### 6.3.1 General

**1** All steel works are to receive a paint of good quality or to be corrosion-controlled with an effect equivalent to or more than the paint. However, structural members of oil tanks need not to be painted.

**2** Where the in-water survey are carried out instead of Docking Survey at the Periodical Survey, special consideration are to be paid to the prevention of corrosion.

## 6.4 Welding

### 6.4.1 General

**1** Welded joints of crossing parts at the ends of columns and bracings are, as a rule, to be of full-penetration type.

**2** Size of fillet welds of Tee-joints applied to respective internal structural members of columns and bracings is to be $F_1$ specified in **Table 12.2.1-2, Part 1, Part C**.

**3** For other welded joints than specified in **-1** and **-2**, welding is to be in accordance with the requirements in **12.1** and **12.2, Part 1, Part C**.

### 6.4.2 Welded Joints of Special Design

In case of welded joints of special design, the Society may require tests to check the strength of the joints.

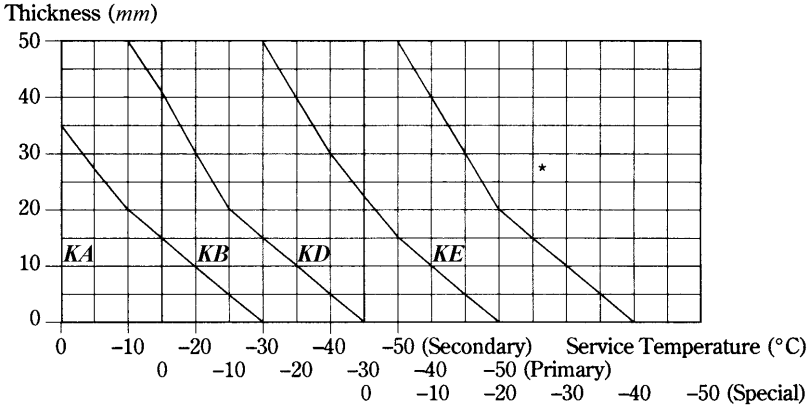
## 6.5 Ice Strengthening

### 6.5.1 General

**1** As for units which are to be engaged in operations in ice covered waters, special considerations is to be paid to ice strengthening.

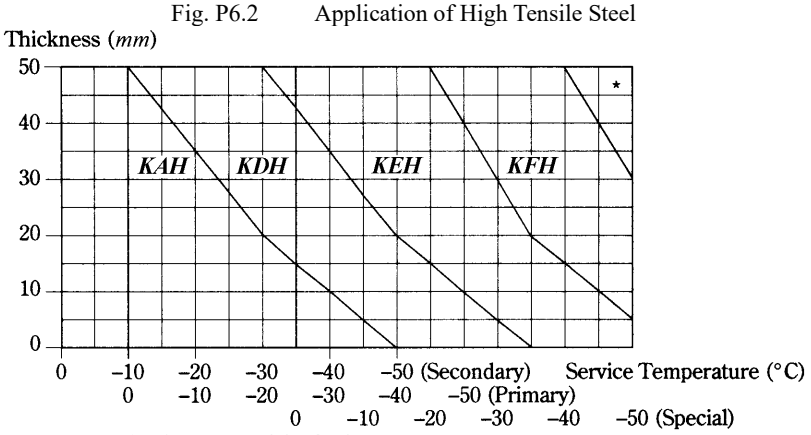
**2** Ships intended for navigation in ice covered waters are to be reinforced in accordance with the requirements of **Chapter 8, Part I**.

Fig. P6.1 Application of Mild Steel



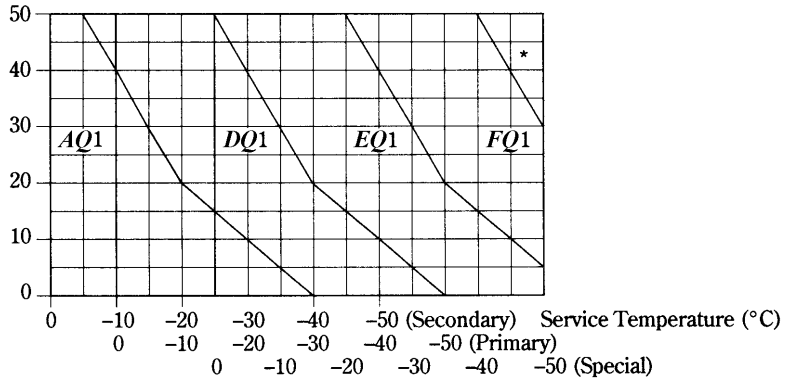

**Note**: *At the discretion of the Society.

Fig. P6.2 Application of High Tensile Steel



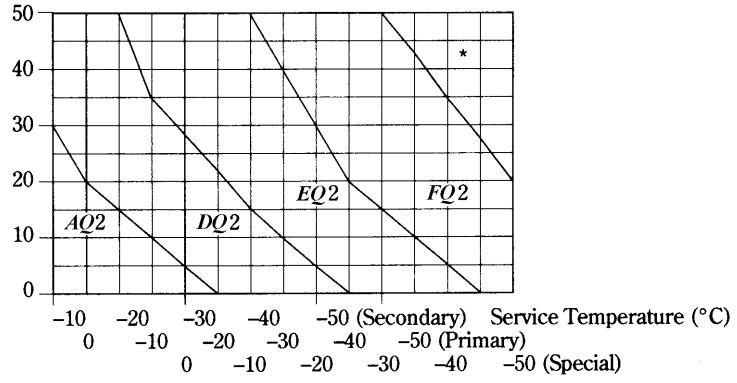

**Note:** *At the discretion of the Society.

Fig. P6.3 Application of High Strength Rolled Steels for Offshore Structures (*AQ*1,*DQ*1,*EQ*1 and *FQ*1)




**Note:** *At the discretion of the Society.

Fig. P6.4 Application of High Strength Rolled Steels for Offshore Structures (*AQ*2,*DQ*2,*EQ*2 and *FQ*2)




**Note:** *At the discretion of the Society.

# Chapter 7 HULL STRENGTH

## 7.1 General

### 7.1.1 Application

**1** The hull strength of units fixed on the seabed or positioned for long periods of time is to be according to this Part. However, in case where service areas or operation seasons are restricted, the hull construction of units may be suitably modified based on certain conditions subject to Society approval.

**2** The hull strength of units, except for units not listed in **-1** above, are to be according to relevant requirements given in **Part C**, **Part CS** or **Part Q**.

**3** The hull strength of units, except for units not listed in **-1** and **-2** above, is to be at the discretion of the Society.

### 7.1.2 Structural Analysis

The unit is to be analyzed by a method deemed appropriate by the Society for a sufficient number of conditions including all conditions

### 7.1.3 Analysis of Units Embedded on the Seabed

Units designed to be embedded on the seabed are to be analyzed assuming the over turning moment due to the combined environmental forces from any direction and the sufficient downward gravity loadings on the support footings or mat to withstand the moment.

### 7.1.4 Plastic Analysis

Scantlings of structural members designed basing upon plastic analysis are to be at the discretion of the Society.

### 7.1.5 Buckling Strength*

Structural members are to have sufficient strength against buckling in consideration of their shapes, scantlings, boundary conditions, etc.

### 7.1.6 Fatigue Strength

Structural members subject to repeated stress are to have sufficient fatigue strength, taking the value and number of cycles of the repeated stress, the shape of members, etc. into consideration.

### 7.1.7 Stress Concentration

The effect of local stress concentrations is to be considered for notches in members or discontinuous parts of structure.

### 7.1.8 Bending Stress

**1** The section moduli of members required by the Rules are those including the steel plates with the effective breadth of $0.1\,l$ on either side of members. However, the breadth of $0.1\,l$ is not exceed one-half of the spacing of member. $l$ is the length specified in the relevant members.

**2** Where subjected to eccentric loadings, an increase of bending stresses due to the deflections of the structural members is to be taken into account.

### 7.1.9 Shearing Stress

When calculating shearing stresses in bulkheads, plate girder webs, hull side plating, etc., only the effective shear area of web is to be considered as being effective. In this regard, the total depth of the girder may be considered as the web depth.

### 7.1.10 Combination of Stresses

**1** In obtaining respective local stresses of the structural members, all the stress components concerned are to be summed up. In this case, for tubular members, the effect of circumferential stress due to external pressure is to be considered.

**2** The scantlings are to be determined on the basis of criteria which combine, in a rational manner deemed appropriate by the Society, the individual stress components acting on the respective structural members.

### 7.1.11 Equivalent Stress

For plated structures, members may be designed according to the equivalent stress criterion, where the equivalent stress is obtained from the following formula:

$$\sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2}\ (N/mm^2)$$

$\sigma_x$ and $\sigma_y$: Stress in the *X*- and *Y*- directions at the centre of thickness of the plate, respectively ($N/mm^2$)

$\tau_{xy}$: Shearing stress in the *X*-*Y* plane($N/mm^2$)

**7.1.12 Corrosion Allowance**

**1** Where the unit is not fitted with a corrosion protection system deemed appropriate by the Society, the scantlings are to be those determined by the analyzing method specified above in conjunction with the allowable stresses specified by the Rule added by a proper corrosion allowance. In this case, the corrosion allowance is, as a rule, not to be less than 2.5*mm* and is to be determined considering the environmental condition, the means and degree of corrosion protection specified in **6.3** and the process of its maintenance. And further, where the requirements in **Part C**, **Part CS** or **Part Q** are applied, the scantlings are not to be less than those specified in the relevant requirements.

**2** In case where the unit is fitted with a corrosion protection system deemed appropriate by the Society, with regard to the corrosion allowance specified in **-1**, modification may be made as deemed adequate by the Society.

## 7.2 Analysis of Overall Strength

### 7.2.1 Loading Conditions

Analysis of overall strength is to be performed for the static loading and combined loading specified in the following **(1)** and **(2)** in the respective modes of operation:

(1) The static loading is a condition in which the unit is afloat or embedded on the seabed in calm sea and is loaded with static loads only such as loads taken in operating condition, dead load of the unit, etc. which affect the overall strength.

(2) The combined loading is a condition in which the unit is loaded with combined loads of the static loads specified in **(1)**, dynamic loads such as wind loads, wave loads, etc. which affect the overall strength and loads induced by the accelerate motion of the unit due to these loads and heeling.

### 7.2.2 Allowable Stresses

**1** Allowable stresses for static loading and combined loading specified in **7.2.1** are not to exceed the values in **Table P7.1** according to the kind of stress.

**2** The equivalent stress specified in **7.1.11** is not to exceed 0.7 and 0.9 *times* the yield strength of the material, for the static loading and combined loading specified in **-1**, respectively.

### 7.2.3 Combined Compressive Stress

In case where compressive stress is developed in combination of axial force and bending, the compressive stress is to satisfy the following relationship:

$$f_a/F_a + f_b/F_b \leq 1.0$$

$f_a$: Calculated compressive stress due to axial force ($N/mm^2$)

$f_b$: Calculated compressive stress due to bending ($N/mm^2$)

$F_a$: Allowable axial compressive stress obtained from the following formula, but is not to exceed $F_b$ ($N/mm^2$):

$$F_a = \eta \times \sigma_{cr,\,i} \times (1 - 0.13\lambda/\lambda_o) \quad where \quad \lambda < \lambda_o$$

$$F_a = \eta \times \sigma_{cr,\,e} \times 0.87 \quad where \quad \lambda \geq \lambda_o$$

$F_b$ : Allowable compressive stress due to bending prescribed in **Table P7.1** ($N/mm^2$)

$\lambda$ : Slenderness ratio of the member

$\lambda_o$ :$2{,}017\sqrt{\sigma_Y}$

$\sigma_Y$ : As specified in **7.2.2** ($N/mm^2$)

$\sigma_{cr,\,i}$: Inelastic column critical buckling stress ($N/mm^2$)

$\sigma_{cr,\,e}$: Elastic column critical buckling stress ($N/mm^2$)

$\eta$ : 0.6 for static loading

0.8 for combined loading

Table P7.1 Allowable Stresses for Static Loading and Combined Loading

| Kind of loads | Static loading | Combined loading |
|---|---|---|
| Tensile | $0.6 \times \sigma_Y$ | $0.8 \times \sigma_Y$ |
| Bending | $0.6 \times (\sigma_Y \ or \ \sigma_{cr})$ * | $0.8 \times (\sigma_Y \ or \ \sigma_{cr})$ * |
| Shearing | $0.4 \times \sigma_Y \ or \ 0.6 \times \tau_{cr}$ * | $0.53 \times \sigma_Y \ or \ 0.8 \times \tau_{cr}$ * |
| Compressive | $0.6 \times (\sigma_Y \ or \ \sigma_{cr})$ * | $0.8 \times (\sigma_Y \ or \ \sigma_{cr})$ * |

Note:

*Whichever is smaller.

$\sigma_Y$: Specified minimum tensile yield stress of the material ($N/mm^2$)

$\sigma_{cr}$: Critical compressive buckling stress ($N/mm^2$)

$\tau_{cr}$: Critical shear buckling stress ($N/mm^2$)

## 7.3 Scantlings of Structural Members

### 7.3.1 General

**1** For the primary structural members which contribute to the overall strength, the scantlings are to be determined in accordance with the requirements in 7.1 and 7.2. However, the requirements in 7.3.2 and 7.3.3 may be applied.

**2** For the structural members subjected to local loads only, the requirements in **Part C** or **Part CS** may be applied subject to the approval by the Society.

### 7.3.2 Thickness of Plating of Hull Structure

The thickness of plating of the primary hull structure such as shell plating which contributes to the overall strength, subjected to distributed loads, is not to be less than obtained from the following formulae, whichever is greater:

$$75.2S\sqrt{h_s/K_e} + C(mm)$$

$$60.8S\sqrt{h_c/K_p} + C(mm)$$

$S$: Spacing of transverse or longitudinal frames ($m$)

$h_s$: Head of water in static loading specified in 7.2.1(1) ($m$)

$h_c$: Head of water in combined loading specified in 7.2.1(2) ($m$)

$K_e$: As given by the following formulae, whichever is smaller:

$$K_e = (235 - K\sigma_{s1})/K$$

$$K_e = 1.45(235 - K\sigma_{s2})/K$$

$K_p$: As given by the following formulae:

- Where $\sigma_{c1}\sigma_{c2} > 0$, the value given by the following formulae, whichever is smaller:

$$K_p = (55{,}225 - K^2\sigma_{c1}^2)/235K$$

$$K_p = 2(235 - K|\sigma_{c2}|)/K$$

- Where $\sigma_{c1}\sigma_{c2} < 0$, the value given by the following formulae, whichever is smaller:

$$K_p = (55{,}225 - K^2\sigma_{c1}^2)/235K$$

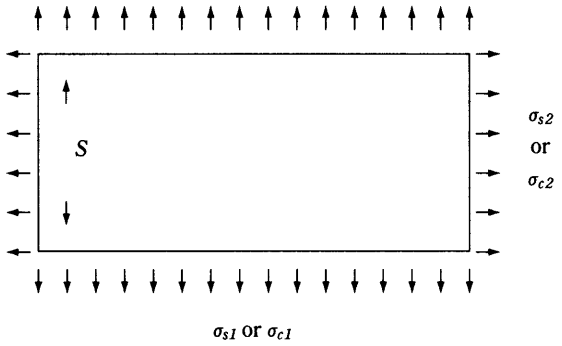
$$K_p = 2(235 - K|\sigma_{c1}| - K|\sigma_{c2}|)K$$

$\sigma_{s1}$, $\sigma_{s2}$ and $\sigma_{c1}$,$\sigma_{c2}$: Axial stresses acting on the plating in static loading and combined loading, respectively ($N/mm^2$), see **Fig. P7.1**

$K$: Material factor given in 2.2.

$C$: Corrosion allowance specified in 7.1.11 ($mm$)

Fig. P7.1 Axial Stresses, $\sigma_{s1}, \sigma_{s2}, \sigma_{c1}$ and $\sigma_{c2}$




### 7.3.3 Section Modulus of Transverse or Longitudinal Frames

The section modulus of transverse or longitudinal frames which support the panels prescribed in 7.3.2 is to be obtained from the following formula:

$$\frac{1{,}079CKSh_c l^2}{235 - K\sigma_{c0}} \quad (cm^3)$$

$C$: Coefficient given below:

1.0 for both ends fixed

1.5 for both ends supported

$l$: Span of frames ($m$)

$\sigma_{c0}$: Axial stress in combined loading ($N/mm^2$)

$S$, $h_c$ and $K$: As specified in 7.3.2

### 7.3.4 Local Buckling of Cylindrical Shells

Unstiffened or ring-stiffened cylindrical shells subjected to axial compression, or compression due to bending, and having proportions which do not satisfy the following relationship, are to be checked for local buckling in addition to the overall buckling as specified in 7.2.3.

$$t > 0.044D\sigma_Y (mm)$$

$t$: Thickness of shell plating ($mm$)

$D$: Diameter of cylindrical shell ($m$)

$\sigma_Y$: As specified in 7.2.2 ($N/mm^2$)

## 7.4 Self-elevating Units

### 7.4.1 Application

The Overall strength of the unit is to be in accordance with the requirements in 7.1 to 7.3. The unbalanced supported condition by the legs, if necessary, is to be considered.

### 7.4.2 Legs

Legs are to be in accordance with the requirements in the following **(1)** to **(8)**, in addition to the requirements in 7.4.1. However, with regard to the motions of the unit and legs, they may be determined by an analytical method or from a model experiment deemed appropriate by the Society.

(1) Legs are to be either shell type or truss type, and, as a rule, footings or bottom mats are to be fitted. Where footings or bottom mats are not fitted, proper consideration is to be given to the leg penetration of the seabed and the end fixity of the leg. In strength calculation of such a leg, the leg is to be assumed as pin-supported at a position at least 3 *metres* below the seabed.

(2) Legs in the field transit condition are to be in accordance with the following **(a)** and **(b)**. The field transit condition means the condition which does not exceed a 12-hour voyage between two areas in protected locations or locations where the unit may be safely elevated. However, during any portion of the move, the unit is to be capable of arriving at a protected location or a

location where the unit may be safely elevated within 6 *hours*.

(a) The legs are to have sufficient strength for the bending moment obtained from the following formula:

$M_1 + 1.2M_2$ (*N-m*)

$M_1$: Dynamic bending moment caused by a 6-*degree* single amplitude of roll or pitch at the natural period of the unit (*N-m*)

$M_2$: Static bending moment due to gravity caused by a 6 *degree* legs' angle of inclination (*N-m*)

(b) The legs are to be investigated for any proposed leg arrangement with respect to vertical position, and the approved positions are to be specified in the operating manual. Such investigation is to include strength and stability aspects.

(3) Legs in the ocean transit condition are to be designed in accordance with the following **(a)** to **(d)**:

(a) The legs are to be designed for acceleration and gravity moments resulting from the motions in the severest anticipated environmental transit condition, together with corresponding wind moments.

(b) The legs are to have sufficient strength for the bending moment obtained from the following formula:

$M_3 + 1.2M_4$ (*N-m*)

$M_3$: Dynamic bending moment caused by a 15-*degree* single amplitude of roll or pitch at a 10-second period (*N-m*)

$M_4$: Static bending moment due to gravity caused by a 15-*degree* legs' angle of inclination (*N-m*)

(c) For ocean transit condition, it may be necessary to reinforce or support the legs, or to remove sections of them.

(d) The approved condition is to be included in the operating manual.

(4) Legs are to be designed to withstand the dynamic loads which may be encountered by their unsupported length just prior to touching bottom, and also to withstand the shock of touching seabed while the unit is afloat and subject to wave motions.

(5) The maximum design motions, bottom conditions and sea state while lowering legs and the sea state while raising the legs are to be clearly indicated in the operating manual.

(6) When computing leg stresses, while in the elevated position, the maximum overturning load on the unit, using the most adverse combination of applicable variable loadings together with the loadings as specified in **Chapter 3**, is to be considered. Forces and moments due to lateral frame deflections of the legs are to be taken into account.

(7) Leg scantlings are to be determined in accordance with a method of rational analysis, to the satisfaction of the Society.

(8) Except for self-elevating units utilizing a bottom mat, the capability is to be provided to pre-load each leg to the maximum applicable combined load after initial positioning at a site. The pre-loading procedures are to be included in the operating manual.

### 7.4.3 Hull Structure

**1** The hull is to be considered as a complete structure having sufficient strength to resist all induced stresses while in the elevated position and supported by all legs.

**2** The scantlings of the respective hull structural members are to be in accordance with the requirements in **7.1** to **7.3** with reference to the loads prescribed in **Chapter 3** in addition to the requirements in **7.4.1**.

**3** The hull structure, including the parts of the well, etc., is to be good in the continuity of longitudinal strength and transverse strength.

### 7.4.4 Deckhouses

Deckhouses are to be in accordance with the requirements in **11.3, Part 1, Part C**. In applying the requirements in **4.9.2.2, Part 1, Part C**, deckhouses which are close to the side shell of the unit are to be treated as superstructure end bulkhead and other deckhouses are to be treated as boundary walls of deckhouse.

### 7.4.5 Bottom Mats

**1** The construction of bottom mats is to be designed so that loads transmitted from the legs may be evenly distributed to the respective parts of the mats.

**2** The thickness of shell plating of the bottom mats without opening to the sea and the scantlings of shell stiffeners are not to be less than determined by the requirements in **7.3.2** and **7.3.3**. In this case, the top of $h_s$ is at the water level at flood tide, and the top of $h_c$ is 0.6 times the design wave height in the severe storm condition above the water level at the design water depth.

**3** The scantlings of the watertight bulkheads and their stiffeners provided in the bottom mats are not to be less than the value determined by the requirements in **Chapter 6, Part 1, Part C** (assessment in flooded conditions) with necessary modifications or the

requirements in **Chapter 13, Part CS**. In the case of applying **Chapter 13, Part CS**, the top of $h_s$ to be substituted to the top of $h_c$ specified in **-2**.

**4** Where the unit is resting on the seabed, the effects of scouring are also to be considered.

**5** The effects of skirt plates, where provided, are to be specially considered.

**6** Mats are to be designed to withstand the shock of touching seabed while the unit is afloat and subject to wave motions.

#### 7.4.6 Deck Elevating Apparatus and Load Carrying Members

**1** Load carrying members which transmit loads from the legs to the hull are to have sufficient strength for the loads prescribed in **Chapter 3** and **7.4.2**.

**2** Load carrying members are to be so arranged that loads transmitted from the legs are properly diffused into the hull structure.

## 7.5 Column-stabilized Units

### 7.5.1 General

**1** The overall strength of the unit is to be in accordance with the requirements in **7.1** to **7.3**.

**2** For units of this type, the highest stresses, considering the arrangements of lower hull, distance between the lower hulls, etc., may be associated with less severe environmental conditions than the maxima specified by the Owner (designer). Particular attention is to be given to such a case.

**3** Local structures in way of fairleads, winches, etc., forming apart of the anchor mooring system, are to be designed to the breaking strength of the mooring line or chain.

**4** Where a bridge is provided for access from the shore, the jointed part of the hull with the bridge is to be sufficiently strengthened.

**5** For contact with other ships, the unit is to be equipped with sufficient fenders and particular attention is to be given to the reinforcement of shell plating, frames, girders, etc.

### 7.5.2 Upper Structure

**1** Where the upper structure is to be waterborne in any mode of operation specified in **1.2.4** or damaged condition, it is to be designed taking account of the loads induced under the condition.

**2** The construction and scantlings of deckhouses provided on the hull of the unit are to be determined taking account of their location and the environmental conditions in which the unit will operate.

**3** The upper structure, including the opening parts of the well, etc., is to be good in the continuity of longitudinal strength and transverse strength.

### 7.5.3 Columns, Lower Hulls and Footings

**1** Where columns, lower hulls or footings are of stiffened shell construction, the scantlings of plating, stiffeners, girders, etc. are not to be less than determined by the requirements in **7.3.2** and **7.3.3**. In this case, $h_s$ and $h_c$ are to be in accordance with the requirements in the following **(1)** to **(3)** :

(1) Where an internal space is loaded with liquid, $h_s$ is the vertical distance in metres from the load line to the tank top and $h_c$ is the vertical distance in metres from the tank top to the top of overflow pipes. Where, however, the specific gravity of the liquid is greater than that of sea water, $h_s$ and $h_c$ are to be modified taking account of specific gravity.

(2) Where an internal space is a void compartment, the top of $h_s$ is at the load line and the top of $h_c$ is 0.6 times the design wave height in the severe storm condition above the water level at the design water depth.

(3) The minimum values of $h_s$ and $h_c$ are not to be less than 6 *metres* for areas subject to wave immersion and 3.4 *metres* for other areas.

**2** Where columns, lower hulls or footings are designed as shells either unstiffened or ring stiffened, the scantlings of shell plating and ring stiffeners are to be determined to satisfy the strength requirements in **7.1** to **7.3** in response to the design heads, $h_s$ and $h_c$, specified in **-1**.

**3** The scantlings of deep tank bulkheads and their stiffeners provided in columns, lower hulls or footings are not to be less than the value determined by the requirements in **Chapter 6, Part 1, Part C** (assessment in maximum load condition) with necessary modifications or the requirements in **Chapter 14, Part CS**.

**4** Where the column, lower hull or footing is an effective member for the overall strength of the unit, the stress resulting from the overall strength added by the stress determined by the requirements in **-1** is not to exceed the allowable stress specified in **7.2**.

**5** Particular consideration is to be given to structural details, reinforcement, etc., in areas subject to high local loadings indicated in the following **(1)** to **(5)** :

(1) Areas subject to seabed bearing loads, where applicable,

(2) Bulkheads of partially filled tanks,

(3) Areas liable to sustain external damages,

(4) Jointed parts between columns and footings or lower hulls,

(5) Areas subject to wave impact.

**6** Where a unit is designed for operations while supported by the seabed, the effects of scouring are to be considered. The effects of skirt plates, where provided, are to be specially considered.

### 7.5.4 Bracing Members

**1** Bracing members are to be designed to transmit loadings and to make the structure effective against environmental forces, and when the unit is supported by the seabed, against the possibility of uneven bearing loads.

**2** Bracing members are to have sufficient strength for buoyancy, wave forces, current forces and wave impact.

**3** When bracing members are of tubular section, ring frames may be required to maintain stiffness and roundness of shape.

**4** Underwater bracing members are normally to be made watertight.

**5** When bracing members are watertight, they are to be suitably designed to prevent collapse from external hydrostatic pressure.

**6** The unit's structure are to able to withstand the loss of any slender bracing member without causing overall collapse.

**7** When any one slender bracing member are lost, overall strength of unit is complied with the following requirements where overall structure analysis are carried out based upon the design loads specified in **Chapter 3**.

(1) For determining the design loads, environmental loads such as wind force, wave force, etc., are to be obtained from not less than 1 *year* return period.

(2) Notwithstanding the kind of stress, the allowable stress at the combined loads condition is to be following formula.

$$\sigma_a = \sigma_Y$$

$\sigma_a$:allowable stress ($N/mm^2$)

$\sigma_Y$:specified yield stress of materials ($N/mm^2$)

(3) In case of taking into consideration of combined compression stress, $\eta$ specified in **7.2.3** may be 1.0.

(4) When taking into consideration of redistribution of forces due to yielding or buckling and overall strength is to be satisfied with the **-6**, the criteria of allowable stress may be exceed for local stress.

**8** Underwater bracing members are to be provided with a leak detection system make it possible to detect fatigue cracks at an early stage.

### 7.5.5 Mobile Offshore Drilling Units

**1** The upper hull structure of unit is to withstand to overall collapse after the assumed failure of any primary girder.

**2** Structural analysis after assumed failure of any primary girder is to be carried out in accordance with the requirements in **7.5.4-7**.

### 7.5.6 Storage Units

**1** As large sized storage units, the hull is to be of double hull construction and to be so constructed that in case where a fire, explosion, etc., might happen in one of the storage tanks, the effects could be confined to one compartment only.

**2** Hull arrangement is to be accordance with the requirement in **7.6.2-3**.

## 7.6 Ship-type Units and Barge-type Units

### 7.6.1 General

**1** The hull structure of units fixed on the seabed or positioned for long periods of time is to be in accordance with the requirements in this Section taking account of the following **(1)** to **(4)**. Where, however, approved by the Society, for the ship-type unit, the requirements in **Part C** or **Part CS** and for barge-type unit, the requirements in **Part Q** may apply, notwithstanding the requirements in **Chapter 3** and **7.1** to **7.3**.

(1) Where large deck openings such as wells, etc. are provided, the hull structure is to be suitably reinforced and to be good in the continuity of longitudinal strength and transverse strength.

(2) The plating of the well is to be suitably stiffened to prevent damage due to foreign objects which may become trapped in the well.

(3) The unit's structure in way of heavy concentrated loads is to be suitably reinforced.

(4) Local structures in way of fairleads, winches, etc., forming part of the position mooring system, are to be designed to the breaking strength of the mooring line or chain.

**2** In order to avoid occurrences of unacceptable stress in the hull structure with length $L$ which is $100m$ and over, the unit is to be provided with the loading manual indicated following items which is approved by the Society. However, the loading manual may not be provided with where deemed unnecessary by the Society.

(1) Loading conditions on the basis of which the barge is designed, and the allowable limits of longitudinal still water bending moment and still water shearing force.

(2) Results of calculation of longitudinal still water bending moment and still water shearing force.

**3** Where a bridge is provided for access from the shore, the jointed part of the hull with the bridge is to be sufficiently strengthened.

**4** For contact with other ships, the unit is to be equipped with sufficient fenders and consideration is to be given to the reinforcement of shell plating, frames, girders, etc.

**7.6.2 Storage Unit**

**1** Hull construction of the unit is to be accordance with the followings.

(1) As for hull construction, the requirements in **Chapter 3** and **7.1** to **7.3** or the requirements of **Part C** are to be applied, notwithstanding the requirements of **7.6.1**.

(2) In determining the scantlings of hull structural members, consideration is to be given to the increase of water head in the tank due to the inclination of storage unit.

**2** Hull construction of large sized storage unit is to be accordance with the followings.

(1) Where applying for the requirements of the **Table P7.1**, allowable stress against the compressive stress are to be obtained from following formulae corresponding to kinds of load conditions.

For static loading : $\sigma_a = 0.57\times(\sigma_Y \text{ or } \sigma_{cr}$,whichever is smaller.)

For combined loading : $\sigma_a = 0.77\times(\sigma_Y \text{ or } \sigma_{cr}$,whichever is smaller.)

$\sigma_a$: allowable stress ($N/mm^2$)

$\sigma_r$ or $\sigma_{cr}$:as specified in **7.2.2**

(2) Where considering the combined compressive stress, $\eta$ specified in **7.2.3** are to be obtained from following formulae corresponding to kinds of load conditions.

For static loading : $\eta = 0.57$

For combined loading : $\eta = 0.77$

(3) The hull is to be of double hull construction and is to be so constructed that in case where a fire, explosion and so on might happen in one of the storage tanks, the effects could be confined to one compartment only.

**3** Hull arrangement of unit is to be accordance with the followings.

(1) Where accommodation spaces are provided in storage units, they are, as a rule, not to be provided in the storage tank spaces and thereupon.

(2) Accommodation spaces, machinery spaces, operation spaces and so on are to be isolated from storage tanks and storage oil pump rooms. The method of isolation is to be determined correspondingly in accordance with the relevant requirements in **3.2, Part R** in consideration of the construction, arrangement, purpose and so on of the storage units.

(3) With regard to storage units used for storage of only oils having a flash point over 60℃, the requirements in the preceding **(1)** and **(2)** may be properly modified.

**4** In addition to the loading manual as required in **7.6.1-2**, it is strongly recommended that the barge is provided with a loading instrument approved by the Society together with its operation manual, by means of which longitudinal still water bending moment and still water shearing force can be easily and quickly ascertained.

# Chapter 8 LOAD LINES

## 8.1 General

### 8.1.1 Application

**1** The requirements given in **8.2** and **8.3** apply to the all units fixed on the seabed or positioned for long periods of time intended for international voyages or unrestricted services except units, *L* of which is less than 24 *metres*.

**2** In units fixed on the seabed or positioned for long periods of time, except for the units specified in **-1** above, marking of the load line is not necessary, however, designed maximum load line of these units are to be determined by the requirements in **Chapter 4**, **5**, **7** and **8.2**.

**3** A fixed unit on the seabed for semi-permanent is not to apply the requirements of **8.2**.

**4** The load lines of ship-type and barge-type units, except for the units listed in **-1** to **-3** above, are to be according to requirements given in **Part V**.

**5** The load lines of units, except for the units listed in **-1** to **-4** above, are to be at the discretion of the Society.

### 8.1.2 Terminology

*ILLC* means International Convention on Load Lines, 1966.

## 8.2 Load Lines

### 8.2.1 General

**1** With respect to weathertightness and watertightness of decks, superstructures, deck houses, doors, hatchway covers, other openings, ventilators, air pipes, scuppers, inlets and discharges, etc., these are to be complied with the requirements in **Chapter 5**.

**2** Heights of hatch and ventilator coamings, air pipes, doors sills, etc., in exposed positions and their means of closing are to be complied with the relevant requirements of **Part C** and **Part D**, in addition these are to be determined by consideration of the requirements in **Chapters 4** and **5**.

**3** All downflooding openings which may become submerged before the angle of inclination at which the required area under the intact righting moment curve specified in **Chapter 4** is achieved are to be fitted with weathertight closing appliances.

**4** The Society may give special considerations to the position of openings which cannot be closed in emergencies.

### 8.2.2 Self-elevating Units*

**1** Freeboard of this unit is to be assigned in accordance with *ILLC* after confirming that the hull structure has a sufficient strength for the draught corresponding to the freeboard assigned. Freeboard of units which cannot be assigned in accordance with *ILLC* due to special forms of units, however, is to be assigned in accordance with the requirements in **Chapters 4**, **5** and **7** at floating condition.

**2** Load lines corresponding to assigned freeboards are to be marked with in accordance with *ILLC*.

**3** When a unit may be manned while being towed, the bow height and reserve buoyancy requirements are to be as determined by the Society.

**4** For some units utilized a large mat or similar supporting structure which contributes to the buoyancy when the unit is floating, the mat or similar supporting structure is to be ignored in the calculation of freeboard. However, the mat or similar supporting structure is to always be taken into account in the evaluation of the stability of the unit when floating.

### 8.2.3 Column-stabilized Units

**1** The minimum freeboard of this unit are to be determined by the requirements of **Chapters 4**, **5**, **7** and **8.3.2**.

**2** The minimum freeboard are to be marked in appropriate location on the structure which is satisfactory to the Society.

**3** The enclosed deck structure of this unit is to be made weathertight.

**4** Windows, side scuttles and port lights, including those of the non-opening type, or other similar openings are not to be located below the deck structure of this unit.

### 8.2.4 Ship-type Units and Barge-type Units*

**1** Freeboard of this unit is to be assigned in accordance with *ILLC* after confirming that the hull structure has a sufficient strength

for the draught corresponding to the freeboards assigned.

**2** Load lines corresponding to assigned freeboards are to be marked with in accordance with *ILLC*.

## 8.3 Vertical Distance between the Wave Crests and Underside of Deck Structure

### 8.3.1 Self-elevating Units

The unit is to be designed for a crest clearance of either 1.2*m*, or 10% of the combined storm tide, astronomical tide and height of the maximum wave crest above the mean low water level, whichever is smaller, between the underside of the unit in the elevated position and the crest of the design wave. This crest elevation is to be measured above the level of the combined astronomical and storm tides.

### 8.3.2 Column-stabilized Units

**1** Unless deck structure are designed either in accordance with the requirement **7.5.2** or considering wave impact, to the satisfaction of the Society, reasonable clearance between the lower surface of deck structure and wave crest is to be ensured for all afloat modes of operation, taking into account the predicted motion of the unit relative to the surface of the sea.

**2** For on-seabed modes of operation, clearances are to be in accordance with those specified in **8.3.1**.

# Chapter 9 HULL EQUIPMENT

## 9.1 General

### 9.1.1 General

**1** Materials used for hull equipment are to be complied with the requirement in **Chapter 2**.

**2** Unless otherwise specially specified in this Chapter, the relevant requirements in **Part C**, **Part CS** and **Part Q** correspondingly apply.

## 9.2 Mooring Equipment for Temporary Mooring

### 9.2.1 General

**1** All units are to be provided with the mooring equipment for temporary mooring.

**2** Anchors, chain cables and ropes necessary for temporary mooring are to be provided on units in accordance with the requirements in **14.3** and **14.4, Part 1, Part C** or **Chapter 23, Part CS** according to their equipment number specified in **9.2.2**. Where, however, deemed appropriate by the Society, the requirements in **Chapter 19, Part Q** may be applied to the mooring equipment of units having no propelling machinery.

**3** Where units are provided with the anchor mooring system specified in **10.2.2(1)**, this system may be regarded as the mooring equipment for temporary mooring.

**4** Notwithstanding the requirements in **-1**, where units are provided with the mooring system excluding the anchor mooring system specified in **10.2.2(1)** and positioned or fixed at specific sea area for semi-permanent, mooring equipment for temporary mooring is to be as deemed appropriate by the Society.

### 9.2.2 Equipment Number

**1** The equipment number is to be determined according to the requirements in **14.5.1, Part 1, Part C** or **23.1.2, Part CS** for ship-type units and those in **19.1.3, Part Q** for barge-type units.

**2** The equipment number of self-elevating units and column-stabilized units is to be obtained from the following formula;

$$W^{2/3} + 2A_1 + 0.1A_2$$

$W$: Displacement of the unit in temporary mooring condition ($t$).

$A_1$ and $A_2$: Projected areas except that of legs of self-elevating units, above the water line on planes perpendicular and parallel to the centre line of the unit, respectively ($m^2$).

### 9.2.3 Equivalent Mooring Equipment

**1** If the Society recognizes that the effect of mooring equipment for operating condition is equivalent to that of the temporary mooring equipment specified in **9.2.2**, such mooring equipment for operating condition is regarded as the temporary mooring equipment specified in this Chapter.

**2** Where approved by the Society, wire ropes may be used in lieu of chain cables. In this case, however, the wire ropes are to satisfy the requirements in **Chapter 4, Part L** and their breaking load is not to be less than the breaking test load for Grade 1 chain cables specified according to the equipment number.

### 9.2.4 Anchor Handling Equipment

Units, except the mobile offshore drilling units and for those moored for a long period of time or semi-permanent, are to be provided with windlasses having a sufficient hoisting capacity.

## 9.3 Guardrails and Bulwarks

### 9.3.1 General

**1** In general, guardrails or bulwarks are to be provided on all exposed decks in order to prevent falling. The height and arrangement of the guardrails or bulwarks are to be in accordance with the requirements specified in **14.8, Part 1, Part C**.

**2** Regardless of the requirements in **-1**, suitable wirenets may be provided to the helicopter deck in nearly the same plane as the deck surface instead of the guardrails or bulwarks, if the guardrails or bulwarks will become hindrances to take-off and landing of helicopters.

**3** Regardless of the requirements in **-1**, guardrails or bulwarks which interfere with the operation may be eliminated subject to the approval by the Society at the request of the Owner.

**4** For contact with other ships and sea-based facilities, the unit is to be equipped with sufficient fenders.

## 9.4 Equipment for Special Purpose

### 9.4.1 General

**1** In cases where equipment and devices for the purposes of units are fitted, suitable measures are to be taken so that the safety of units is not impaired.

**2** Lifting appliances are to be in accordance with Chapter 12 of the *2009 MODU Code* as defined in **1.2.36**.

### 9.4.2 Mobile Offshore Drilling Units*

**1** Any opening is not to be provided at the part adjacent to the rotary table is so far as practicable in order to prevent gas or sea water due to drilling operation from entering into the hull structure. A quick closing device is to be equipped, if it is unavoidably provided in the above space.

**2** Drilling derricks

(1) The design and supporting structure of drilling derricks are to be to the satisfaction of the Society.

(2) The rated capacity for each reeving is to be included in the operating manual.

## 9.5 Towing Arrangements

**1** Towing arrangements are to be approved by the Society.

**2** Towing arrangements are to have regard to normal and emergency condition.

**3** Towing arrangements are to be clearly marked with any restrictions associated with its safe operation, taking into account the strength of its attachment to the unit's structure.

## 9.6 Means of Access

### 9.6.1 General*

**1** Each space within the unit is to be provided with at least one permanent means of access to enable, throughout the life of a unit, overall and close-up inspections and thickness measurements of the unit's structures to be carried out.

**2** Where a permanent means of access may be susceptible to damage during normal operations or where it is impracticable to fit permanent means of access, the Society may allow, in lieu thereof, the provision of movable or portable means of access, provided that the means of attaching, rigging, suspending or supporting the portable means of access forms a permanent part of the unit's structure. All portable equipments are to be capable of being readily erected or deployed by the unit's personnel.

**3** The construction and materials of all means of access and their attachment to the unit's structure are to be to the satisfaction of the Society.

### 9.6.2 Means of Access to Spaces*

**1** Safe access to holds, cofferdams, tanks and other spaces are to be direct from the open deck. Those accesses are to comply with the following requirements.

(1) Tanks, having a length of 35 *m* or more, are to be fitted with at least two access hatchways and ladders, as far apart as practicable.

(2) Tanks less than 35 *m* in length are to be served by at least one access hatchway and ladder.

(3) Each hold is to be provided with at least two means of access as far apart as practicable. In general, these accesses are to be arranged diagonally, e.g., one access near the forward bulkhead on the port side, the other one near the aft bulkhead on the starboard side.

(4) When a tank is subdivided by one or more swash bulkheads or similar obstructions which do not allow ready means of access to the other parts of the tank, at least two hatchways and ladders are to be fitted.

**2** Safe access to holds, cofferdams, tanks and other spaces are to be direct from the open deck and such as to ensure their complete inspection. Safe access may be from a machinery space, pump-room, deep cofferdam, pipe tunnel, hold, double hull space or similar compartment not intended for the carriage of oil or hazardous materials where it is impracticable to provide such access from an open deck.

**3** The uppermost entrance section of the ladder providing access from the deck to ballast tanks or other spaces is to be vertical for not less than 2.5 *m*, but not in excess of 3.0 *m* measured clear of the overhead obstructions in way of the tank entrance, and be connected to a ladder linking platform which is to be displaced to one side of the vertical ladder. However, where there is a longitudinal or athwartship permanent means of access fitted within 1.6 *m* and 3 *m* below the deck head, the uppermost section of the ladder may stop at this means of access.

**4** Access ladders to ballast tanks and other spaces are to be in accordance with the following.

(1) Where two access hatchways or manholes and ladders are required as in **-1(1)** above, at least one ladder is to be of the inclining type. However, the uppermost entrance section of the ladder is to be vertical in accordance with the provisions of **-3** above.

(2) Where ladders not required to be of the inclined type as specified in **(1)** above, maybe of a vertical type. Where the vertical distance is more than 6 *m*, vertical ladders are to be connected by one or more ladder linking platforms, generally spaced not more than 6 *m* apart vertically and displaced to one side of the ladder. The uppermost entrance section of the ladder is to be in accordance with the provisions of **-3** above.

(3) Where one access hatchway or manhole and ladder is required as in **-1(2)** above, an inclined ladder is to be used in accordance with the provisions of **(1)** above.

(4) In double hull spaces of less than 2.5 *m* width, access to the space may be made by means of vertical ladders that are connected to one or more ladder linking platforms generally spaced not more than 6 *m* apart vertically and displaced to one side of the ladder. Adjacent sections of ladder are to be laterally offset from each other by at least the width of the ladder. The uppermost entrance section of the ladder is to be in accordance with the provisions of **-3** above.

(5) Access from the deck to a double bottom space may be made by means of a vertical ladder through a trunk. The vertical distance from the deck to a resting platform, between resting platforms, or a resting platform and the tank bottom is generally not to be more than 6 *m* unless approved otherwise by the Society.

**5** Access ladders to large holds and other similar spaces are to be in accordance with the following.

(1) Either a vertical ladder or an inclined ladder may be used where the vertical distance between the upper surface of adjacent decks or between the deck and the bottom of the hold is not more than 6 *m*.

(2) An inclined ladder or a series of inclined ladders at one end of the hold is to be used where the vertical distance between the upper surface of adjacent decks or between the deck and the bottom of the hold is more than 6 *m*, except for the uppermost 2.5 *m* of the hold measured clear of overhead obstructions and the lowest 6 *m* may have vertical ladders, provided that the vertical extent of the inclined ladder or ladders connecting the vertical ladders is not less than 2.5 *m*.

(3) Means of access at the end of the hold other than those specified in **(2)** above, may be formed by a series of staggered vertical ladders, which is to be connected to one or more ladder linking platforms spaced not more than 6 *m* apart vertically and displaced to one side of the ladder. Adjacent sections of ladder are to be laterally offset from each other by at least the width of the ladder. The uppermost entrance section of the ladder directly exposed to a hold is to be vertical for a distance of 2.5 *m* measured clear of overhead obstructions and connected to a ladder-linking platform.

(4) A vertical ladder may be used as a means of access from a deck to a tank or space below, where the vertical distance between the deck and the longitudinal means of access in the tank, the stringer, or the bottom of the space immediately below the entrance is not more than 6 *m*. The uppermost entrance section of the ladder of the tank is to be vertical for a distance of 2.5 *m* measured clear of overhead obstructions and be connected to a ladder linking platform, unless the landing on the longitudinal means of access, the stringer, or the bottom is within 2.5 *m* and is displaced to one side of the vertical ladder.

(5) Unless specified in **(4)** above, an inclined ladder is to be used for access to a tank or space where the vertical distance is greater than 6 *m* between the deck and a stringer immediately below the entrance, between stringers, or between the deck or a stringer and the bottom of the space immediately below the entrance.

(6) In the case of **(5)** above, the uppermost entrance section of the ladder is to be vertical for a distance of 2.5 *m* clear of overhead

obstructions and connected to a landing platform. Another ladder is to continue down from the platform. Inclined ladders are not to be more than 9 *m* in actual length and the vertical height is not normally to be more than 6 *m*. The lowermost section of the ladder may be vertical for a distance of 2.5 *m*.

(7) In narrow spaces of less than 2.5 *m* width, access to the space may be made by means of vertical ladders that connects to one or more ladder linking platforms spaced not more than 6 *m* apart vertically and displaced to one side of the ladder. Adjacent sections of ladder are to be laterally offset from each other by at least the width of the ladder.

(8) A spiral ladder may be considered acceptable as an alternative for inclined ladders. In this regard, the uppermost 2.5 *m* can continue to be comprised of the spiral ladder and need not change over to vertical ladders.

**9.6.3 Means of Access within Spaces***

**1** Water ballast tanks except those specified in **-2** and other tanks are to be provided with means of access in accordance with the following **(1)** to **(6)**.

(1) For tanks of which the height is not less than 6 *m*, permanent means of access are to be provided in accordance with **(a)** to **(f)**.

(a) A continuous athwartship permanent means of access is to be arranged at each transverse bulkhead on the stiffened surface, at a minimum of 1.6 *m* to a maximum of 3 *m* below the deck head.

(b) At least one continuous longitudinal permanent means of access is to be provided at each side of the tank. One of these accesses is to be at a minimum of 1.6 *m* to a maximum of 6 *m* below the deck head and the other is to be at a minimum of 1.6 *m* to a maximum of 3 *m* below the deck head.

(c) Access between the arrangements specified in **(a)** and **(b)** and from the main deck to either **(a)** or **(b)** is to be provided.

(d) A continuous longitudinal permanent means of access integrated into the structural members on the stiffened surface of a longitudinal bulkhead, in alignment, where possible, with horizontal girders of transverse bulkheads is to be provided for access to transverse webs from the upper deck and tank bottom unless permanent fittings are installed at the uppermost platform for use as an alternative means deemed appropriate by the Society, for inspection at intermediate heights.

(e) A transverse permanent means of access on the cross-ties providing access to the tie flaring brackets at both sides of the tank, with access from one of the longitudinal permanent means of access in **(d)** for ships having cross-ties which are not less than 6 *m* above the tank bottom.

(f) An alternative means deemed appropriate by the Society may be provided for tanks other than ballast tanks less than 17 *m* in height as an alternative to **(d)**.

(2) For tanks less than 6 *m* in height, an alternative means deemed appropriate by the Society or portable means may be utilized in lieu of permanent means of access.

(3) Notwithstanding **(1)** and **(2)** above, tanks not containing internal structures need not to be provided with permanent means of access.

(4) Means of access deemed appropriate by the Society are to be provided for access to under deck structures, transverse webs and cross-ties outside the reach of permanent and/or portable means of access, as required in **(1)** and **(2)** above.

(5) For Pre-load tanks of less than 17 *m* in height in self-elevating units if it is not practicable to fit permanent means of access mentioned in **(1)** and **(2)** above due to their shape, the Society may permit the provision of alternative means.

(6) For ballast tanks in columns of column-stabilized units, longitudinal means the perimetral direction of the column and transversal means the radial direction of the column.

**2** For water ballast tanks of less than 5 *m* width are to be provided with means of access in accordance with the following **(1)** to **(5)**.

(1) For double side spaces above the upper knuckle point of the bilge hopper sections in surface units (ship-type or barge-type), permanent means of access are to be provided in accordance with **(a)** to **(c)**:

(a) Where the vertical distance between the uppermost horizontal stringer and the deck head is not less than 6 *m*, one continuous longitudinal permanent means of access is to be provided for the full length of the tank with a means to allow passing through transverse webs installed at a minimum of 1.6 *m* to a maximum of 3 *m* below the deck head with a vertical access ladder at each end of the tank.

(b) A continuous longitudinal permanent means of access integrated in the structure at a vertical distance not exceeding 6 *m* apart is to be provided.

(c) Plated stringers are, as far as possible, to be in alignment with horizontal girders of transverse bulkheads.

(2) For bilge hopper sections, of which the vertical distance from the tank bottom to the upper knuckle point is not less than 6 *m*, in surface units (ship-type or barge-type) and pontoons in column-stabilized units one longitudinal permanent means of access is to be provided for the full length of the tank in accordance with the following **(a)** and **(b)**. It is to be accessible by a vertical permanent means of access at each end of the tank.

(a) The longitudinal continuous permanent means of access may be installed at a minimum of 1.6 *m* to a maximum of 3 *m* from the top of the bilge hopper section. A platform extending from the longitudinal continuous permanent means of access in way of the web frame may be used to access the identified critical structural areas.

(b) Alternatively, the continuous longitudinal permanent means of access may be installed at a minimum of 1.2 *m* below the top of the clear opening of the web ring allowing the use of portable means of access to reach identified critical structural areas.

(3) Where the vertical distance referred to in **(2)** is less than 6 *m*, alternative means deemed appropriate by the Society or portable means of access may be utilized in lieu of permanent means of access. To facilitate the operation of the alternative means of access, in-line openings in horizontal stringers are to be provided. The openings are to be of an adequate diameter and are to have suitable protective railings.

(4) For pre-load tanks in self-elevating units, if it is not practicable to fit permanent means of access mentioned in **-1(1)** and **(2)** above due to their shape, the Society may permit the provision of alternative means.

(5) For ballast tanks in columns of column-stabilized units of which the vertical distance between each watertight flat or between horizontal stringers/non-tight flats is 6 *m* and over, one permanent means of access is to be provided for the full length of the tank required in **(1)** above.

**3** For holds, means of access to the overhead structure of the main deck are to be fitted in accordance with the following **(1)** to **(4)**.

(1) Permanent means of access are to be fitted to provide access to the overhead structure at both sides of the cross deck and in the vicinity of the centreline. Each means of access is to be accessible from the hold access or directly from the main deck and installed at a minimum of 1.6 *m* to a maximum of 3 *m* below the deck.

(2) An athwartship permanent means of access fitted on the transverse bulkhead at a minimum of 1.6 *m* to a maximum of 3 *m* below the cross deck head is deemed as equivalent to **(1)**.

(3) Access to the permanent means of access in **(1)** and **(2)** above may be via the uppermost stringer.

(4) Alternatively, in place of the requirement in **(1)** above, movable means of access may be utilized for access to the overhead structure of the cross deck if its vertical distance is not greater than 17 *m* above the bottom of the hold.

**4** For all holds, permanent means of vertical access are to be provided in all cargo holds and in no circumstances this arrangement is to be less than 3 permanent means of vertical access fitted to each side (fore and aft ends of hold and mid-span).

**5** For fore and aft peak tanks with a depth of not less than 6 *m* at the centreline of the collision and aft end bulkheads in surface units (ship-type or barge-type), a suitable means of access are to be provided for access to critical areas such as the underdeck structure, stringers, collision and aft end bulkheads and side shell structure in accordance with the following **(1)** and **(2)**.

(1) Stringers of less than 6 *m* in vertical distance from the deck head or a stringer immediately above are considered to provide suitable access in combination with portable means of access.

(2) Where the vertical distance between the deck head and stringers, stringers or the lowest stringer and the tank bottom is not less than 6 *m*, alternative means of access deemed appropriate by the Society is to be provided.

**6** When permanent means of access to critical structural areas located at a height of 6 *m* or more from the bottom of the space are not covered by sections **-1** to **-5** above, continuous permanent access arranged at the bulkhead on the stiffened surface is to be provided at a maximum of 3 *m* below the critical structural area, but not higher than 1.6 *m* below the deck throughout the extent of the critical structural area.

**7** For critical structural areas located at a height of less than 6 *m* from the bottom of the space, alternative means of access deemed appropriate by the Society is to be provided.

**8** Suitable means of access into the interior of the horizontal braces in column stabilized units deemed appropriate by the Society are to be provided. For access through vertical openings, the requirements of **9.6.4-6** are to be applied.

### 9.6.4 Specifications for Means of Access and Ladders*

**1** Permanent means of access are, in general, to be integral to the structure of the ship, thus ensuring that they are robust. Where

deemed necessary by the Society for facilitating that such means of access are of integral parts of the structure itself, reasonable deviations from the requirements of the position of means of access in 9.6.2 and 9.6.3 may be accepted.

**2** Elevated passageways forming sections of a permanent means of access, where fitted, are to have a minimum clear width of 600 *mm*, except for going around vertical webs where the minimum clear width may be reduced to 450 *mm*, and have guard rails over the open side of their entire length.

**3** Sloping parts of the access are to be of non-skid construction.

**4** Elevated passageways forming sections of a permanent means of access, are to be provided with guard rails of 1,000 *mm* in height and consist of a rail and an intermediate bar 500 *mm* in height and of substantial construction, with stanchions not more than 3 *m* apart, on the open side. Guardrail stanchions are to be attached to the permanent means of access.

**5** For access through horizontal openings, hatches or manholes, the dimensions are to be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also provide a clear opening to facilitate the hoisting of an injured person from the bottom of a confined space. The minimum clear opening is not to be less than 600 *mm* × 600 *mm*. When access to a hold is arranged through a flush manhole in the deck or a hatch, the top of the ladder is to be placed as close as possible to the deck or hatch coaming. Access hatch coamings having a height greater than 900 *mm* are to also have steps on the outside in conjunction with the ladder.

**6** For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the space, the minimum opening is to be not less than 600 *mm* × 800 *mm* at a height of not more than 600 *mm* from the bottom shell plating unless gratings or other footholds are provided.

**7** Smaller dimensions for the openings referred to in **-5** and **-6** may be approved by the Society in special circumstances, if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of the Society.

**8** Access to permanent means of access and vertical openings from the ship's bottom is to be provided by means of easily accessible passageways, ladders or treads. Treads are to be provided with lateral support for the foot. Where the rungs of ladders are fitted against a vertical surface, the distance from the centre of the rungs to the surface is to be at least 150 *mm*. Where vertical manholes are fitted higher than 600 *mm* above the walking level, access is to be facilitated by means of treads and hand grips with platform landings on both sides.

**9** For ladders or similar facilities forming sections of a permanent means of access, their specifications are to the satisfaction of the Society.

**9.6.5 Ship Structure Access Manual***

**1** Access manual is to be kept onboard. A unit's means of access to carry out overall and close-up inspections and thickness measurements are to be described in an access manual which may be incorporated in the unit's operating manual. The manual is to be updated as necessary and the updated manual maintained on board. The structure access manual is to include the following for each space:

(1) Plans showing the means of access to the space, with appropriate technical specifications and dimensions

(2) Plans showing the means of access within each space to enable an overall inspection to be carried out, with appropriate technical specifications and dimensions. The plans are to indicate from where each area in the space can be inspected

(3) Plans showing the means of access within the space to enable close-up inspections to be carried out, with appropriate technical specifications and dimensions. The plans are to indicate the positions of critical structural areas, whether the means of access is permanent or portable and from where each area can be inspected

(4) Instructions for inspecting and maintaining the structural strength of all means of access and means of attachment, taking into account any corrosive atmosphere that may be within the space

(5) Instructions for safety guidance when rafting is used for close-up inspections and thickness measurements

(6) Instructions for the rigging and use of any portable means of access in a safe manner

(7) An inventory of all portable means of access

(8) Records of periodical inspections and maintenance of the unit's means of access

**2** Where alternative means of access are adapted in accordance with the provisions of 9.6.3, in addition to the requirement in **-1** above, a means for safe operation and rigging of such alternative means to and from and within the spaces are to be clearly described in the Ship Structure Access Manual.

## 9.7 Protective Coatings of Dedicated Seawater Ballast Tanks

For dedicated seawater ballast tanks, including pre-load tanks on self-elevating units, the requirements of the *"PERFORMANCE STANDARD FOR PROTECTIVE COATINGS FOR DEDICATED SEAWATER BALLAST TANKS IN ALL TYPE OF SHIPS AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS"* (*IMO Performance Standard for Protective Coatings / IMO* resolution *MSC*.215(82)) are to be complied with. However, for mat tanks and spud cans on such units, the requirements need not be complied with.

# Chapter 10 POSITIONING SYSTEMS

## 10.1 General

### 10.1.1 Application

**1** The requirements in this Chapter apply to positioning systems to be provided with units. The positioning system referred to here includes a mooring system or a dynamic positioning system for positioning a unit a specific location for a long period or semi-permanent, or a mooring system or a dynamic positioning system for positioning a unit engaged in specific work at a specific location for a long period or semi-permanent.

### 10.1.2 General*

**1** The mobile offshore drilling units, whose type is a column-stabilized type, a ship-type or barge-type, are to be provided with the positioning system satisfied with the requirements in this Chapter. The units other than the mobile offshore drilling units, whose type is a column-stabilized type, a ship-type or barge-type, are to be provided with the positioning system satisfied with the requirements in this Chapter as a rule.

**2** The self-elevating units, notwithstanding the purpose of units, need not to be provided with the positioning system.

**3** Positioning systems are to be sufficiently capable of positioning the units safety at a specific position of all design condition for positioning.

**4** The surveys to be carried out and the plans and documents to be submitted, etc. for dynamic positioning systems are to be in accordance with relevant requirements specified in **Part B**.

## 10.2 Classification of Positioning Systems

### 10.2.1 General

Positioning system means a proper system provided on board and is to be classified into two types corresponding to its type.

(1) Mooring system

Mooring system means the positioning system excluding the dynamic positioning system and its system is defined in **10.2.2**

(2) Dynamic positioning system

Dynamic positioning system means the positioning system which the unit is kept a specific position by automatically control of thruster systems such as thruster or propeller provided with the unit and its system consists of the following systems specified in **(a)** to **(c)**.

(a) Power system

(b) Thruster systems such as thruster or propeller

(c) Dynamic positioning control system

### 10.2.2 Classification of Mooring Systems*

Mooring systems are to be classified into the following categories corresponding to the type.

(1) Anchor mooring systems

Anchor mooring systems are defined as those comprising anchors and sinkers laid to the seabed, fairleaders, windlasses, winches and other mooring equipment provided at several parts of the hull, and mooring lines connecting them, and obtaining a mooring force mainly from the net weight of the catenary mooring lines (for those provided with intermediate buoys or intermediate sinkers, their net weight or buoyancy). Here, the term “mooring line” means an integration of chains, wire ropes, fibre ropes or their combination, connecting means such as shackles, or intermediate buoys or intermediate sinkers.

(2) Tension mooring systems

Tension mooring systems are defined as those comprising supporting members such as piles and sinkers laid to the seabed, tension lines arranged upright direction, and connecting means to fix the tension mooring lines to the hull structure, and confining the unit’s heaves, rolls and pitches by the increased buoyancy created by pulling the unit downward and the tension

in the mooring line. Here, tension mooring lines include steel pipes, chains, steel wire ropes and fibre ropes, and they are arranged straight in a high tensile force which is mainly obtained from elastic elongation of these lines.

(3) Single-point mooring systems

In this system, mooring force is obtained only from a single point of a hull. The system comprises mooring equipment installed in the hull, connecting systems, one or more mooring lines, mooring construction instead of mooring lines, and supporting members laid to the seabed or provided in the fixtures in the vicinity.

(4) Dolphin mooring systems

Dolphin mooring systems are those comprising dolphins such as fixed piles or concrete caissons arranged adjacent to the unit, fenders and fender beams arranged between the unit and dolphins, or fenders provided in the unit as necessary. Positioning in this case is obtained from the reaction force of the fixed dolphins.

(5) Other mooring systems

Mooring systems are other than **(1)** through **(4)** above.

#### 10.2.3 Dynamic Positioning Systems*

**1** Dynamic positioning systems (hereinafter referred to as "DPS") are to be classified into the following three categories specified in **(1)** to **(3)**.

(1) Class 1 DPS

(2) Class 2 DPS

(3) Class 3 DPS

**2** Categories of the DPS is defined in the following assumptions specified in **(1)** to **(3)** of the worst failure conditions of the DPS. Where the worst failure condition includes a miss-operation (i.e. a single inadvertent act if such an act is reasonably probable) or a malfunction of the components or systems comprising the DPS. Where "failure" means an occurrence in a component or system that causes loss of component or system function or deterioration of functional capability to such an extent that the safety of the vessel or personnel, or of environment protection is significantly reduced.

(1) Class 1 DPS means a DPS for which a loss of position keeping capability (i.e. maintaining a desired position or heading) may occur in the event of a single failure.

(2) Class 2 DPS means a DPS for which a loss of position keeping capability is not to occur in the event of a single failure in any active component or system. Normally, common static components (e.g. ventilation and seawater systems not directly cooling running machinery), however, will not be considered to fail where adequate protection from damage is demonstrated to the satisfaction of the Society. This failure includes the following **(a)** and **(b)**.

(a) Any active component or system (generators, thrusters, switchboards, communication networks, remote-controlled valves, etc.).

(b) Any normally static component (cables, pipes, manual valves, etc.) that may immediately affect position keeping capabilities upon failure or is not properly documented with respect to protection.

(3) Class 3 DPS means a DPS for which a loss of position keeping capability is not to occur in the event of a single failure in all components or systems. This failure includes the following **(a)** to **(c)**.

(a) The components and systems specified in **(2)** above as well as any normally static component assumed to fail.

(b) All components in any one watertight compartment are to be assumed to fail due to fire or flooding.

(c) All components in any one fire sub-division are to be assumed to fail due to fire or flooding (Cables are to comply with 10.7.9-2).

**3** Considering the requirements in -2(2) and **(3)** above, failure mode and effects analysis (*FMEA*) deemed appropriately by the Society is to be carried out in order to demonstrate not to lose a position keeping capability in the assumed worst failure conditions of each component and is to be updated where considered necessary.

### 10.3 Anchor Mooring System

#### 10.3.1 General*

**1** The requirements in 10.3 apply to the units having the anchor mooring system as its sole positioning means.

**2** In the case where chains are used as the mooring line, these chains are to comply with the requirements of Part L. Where

chains of *Grade R4* specified in 3.2, Part L are used, special attention is to be paid that repair works for any defects, loosen stud and corrosion by welding is in principle, prohibited for such chains.

**3** The individual system components consisting on anchor mooring systems are to be designed using a design procedure capable of verifying the most severe loading conditions, having a safety factor coefficients deemed appropriate by the Society.

**4** It is desirable that the maximum value of motions of the unit in waves is determined by model experiments. However, its value may be calculated by an analytical method verified through model experiments which are deemed appropriate by the Society.

**5** For assessing motions of the unit in waves at shallow waters, the shallow water effects are to be taken into account. Where changes in tidal levels in shallow waters are relatively large, the tidal difference affecting unit motions is to be considered.

**6** Corrosion control and fatigue strength of mooring lines are to be considered.

**7** The mooring lines with anchor are to have a sufficient length so that undue pulling up of anchors can be prevented.

**8** When multiple mooring system is adopted as mooring systems, all mooring lines, in principle, are to be of the same elastic coefficient.

**9** The parts of hull structure where windlasses are installed are to be capable of withstanding the break load of the mooring lines.

**10** Fairleads and sheaves are to be so designed that excessive bending and wearing of mooring lines can be prevented. Their fixtures connecting the hull structure are to be capable of withstanding the breaking load of the mooring lines.

**11** Suitable anchor storage arrangements are to be provided to prevent from moving the anchors in a seaway. For units moored semi-permanent at a specific location, however, storage arrangements may be dispensed with.

**12** The design of anchor mooring systems, where anchor mooring systems are used in combination with propulsion system, such as thrusters, for positioning, is to be as deemed appropriate by the Society.

### 10.3.2 Calculating the Tension of Mooring Line*

**1** For calculating the maximum tension acting on the mooring lines, the most severe combination of wind, waves and current (generally, this condition corresponds to a case when all the directions of wind, wave and current are consistent) is to be considered together with a sufficient number of angle of incidence. For specific sea areas, combinations of wind, wave and current in different directions, which are likely to create a higher tension are to taken into account as necessary.

**2** In calculating the tension acting on the mooring lines, at least its items **(1)** to **(3)** mentioned below are to be considered. Item **(4)** may be assessed as necessary. This analytical procedure is called the quasi-static analytical procedure, the calculating procedure of tension acting on the mooring lines are adopted as standard. The maximum tension of mooring lines calculated by the quasi-static analytical procedure has to have a suitable safety factor deemed appropriate by Society against their breaking tension.

(1) Static tension of mooring lines due to its net weight and buoyancy

(2) Steady tension of mooring lines due to steady horizontal displacements of the unit induced to wind, waves and current.

(3) Quasi-static varying tension of mooring lines due to the unit's motions induced to waves.

(4) Tension of mooring lines considering their elastic elongation when they are used with a moderate taut condition (generally in shallow waters), or when mooring lines with a low rigidity such as fibre ropes are used.

**3** For the mobile offshore drilling units, the anchor mooring system is to be so designed that a failure of any one mooring line does not cause progressive failure of the remaining mooring lines. For units other than the mobile offshore units, the anchor mooring systems are to be as deemed appropriate by the Society. In this case, a calculating procedure of tension acting to mooring lines may also be adopted to the quasi-static analytical procedure specified in -2. The period of recurrence of the environmental loads such as wind and wave loads, however, may be taken as one year. The maximum tension of mooring lines calculated by the quasi-static analytical method is to have a suitable safety factor deemed appropriate by the Society against their breaking tension.

**4** In addition to -2 above, when the following items **(1)** and **(2)** are taken into account, the safety factor required where the quasi-static analytical procedure is adopted may be reduced to a value deemed appropriate by the Society.

(1) Dynamic tension in mooring lines due to the damping force and the inertial force action on each mooring line when they are generally used in deep waters.

(2) Quasi-static low-frequency varying tension of mooring lines due to low-frequency motions of the unit in irregular waves when they are used in a sufficiently slack condition. (when the natural period of the motions of the unit in a horizontal plane is sufficiently longer than the period of ordinary waves)

### 10.3.3 Equipment for Anchor Mooring System

**1** Individual equipment for anchor mooring system is to be approved by the Society, in principle.

**2** Windlasses used for anchor mooring system of unit are to comply with the following requirements specified in **(1)** to **(3)**.

(1) Each windlass is to be provided with two independent power-operated breaks. Each brake is to be capable of holding against a static load in the anchor cable of at least 50% of its breaking strength. When deemed appropriate by the Society, one of the breaks may be replaced by manually operated break.

(2) The windlass is to have a sufficient dynamic braking capacity to control normal combination of loads from anchor, mooring cable and anchor handling vessel during the deployment of the anchors at the maximum design pay-out speed of the windlass.

(3) When a source of power for windlasses is lost, the power-operated breaking system is to be automatically applied to and be capable of holding against 50% of the total static braking capacity of the windlass.

**3** The means specified in **(1)** through **(4)** below are to be provided for controlling anchor mooring systems:

(1) Each windlass is to be capable of being controlled from a position which provides a good view of the operation.

(2) Means are to be provided at the windlass control position to monitor the mooring line tension and windlass power load and to indicate the amount of mooring line paid out.

(3) Systems which indicate and automatically record mooring line tension, wind velocity and wind direction at each windlass are to be provided at the manned control position.

(4) Means of communication are to be provided between essential place for mooring operations (for example: operating position, wheel house, control room, etc.)

**4** Means are to be so provided that mooring lines can be released from the unit after the loss of the main power supply.

## 10.4 Tension Mooring System

### 10.4.1 General

**1** Tension mooring systems are to have a safety equivalent to the anchor mooring systems approved by the Society.

**2** The tension mooring systems may be designed in accordance with the requirements of **10.3** for anchor mooring systems. However, the items specified in **10.4.2** are to be taken into account.

### 10.4.2 Tension Mooring System

**1** It is to designed so that no slackening is caused in any tension mooring line due to changes in line tension.

**2** For mobile offshore drilling units, tension mooring lines are to be designed so that a failure of any one tension mooring line does not cause a progressive failure of the remaining tension mooring lines. For units other than mobile offshore drilling units, it is to be designed as deemed appropriate by the Society.

**3** The possible effects of a partial loss of buoyancy due to damage of the extent specified in **4.3** upon the mooring system are also to be assessed.

**4** For mobile offshore drilling units, where the tension mooring system of the buoyancy type such a steel pipe having a large-bore and thin-thickness is used, the possible effects of a partial loss of buoyancy due to damage to any one tension mooring line upon the mooring system are to be assessed.

**5** In the case of tension mooring systems which are connected upright, the effects of sinkage of the unit due to its motions in a horizontal plane are to be assessed.

**6** The difference in tension of the tension mooring line due to tidal difference including astronomical tide and meteorological tide is to be considered.

**7** The effects of changes in the weight and the displacements of heavy items carried on board upon tension of tension mooring lines are to be sufficiently taken into account.

**8** Special consideration is to be given to the fatigue strength of the connections between the tension mooring lines and the hull. Where steel pipe joints are used for tension mooring lines, the fatigue strength at the stress concentrated areas is to be thoroughly assessed.

**9** Consideration is to be given to wear of the connections between tension mooring lines and the hull.

**10** Where the effects of the non-linear behavior of tension mooring lines upon their tension are not negligible, tension due to non-linear behavior is to be considered.

**11** The effects of the high order vibrations of tension mooring lines upon fatigue strength, in particular, are to be carefully assessed. In this case, the safety factor against the breaking load may be reduced to be value deemed appropriate by the Society.

**12** When mooring lines of the thin-thickness cylinder type are used, special consideration is to be given to buckling due to combined axial and hoop stresses.

**13** The permissible stress when steel pipes are used for mooring lines is to be accordance with 7.2.2.

**14** When used in sea areas where currents are significant, means are to be provided to suppress vibrations of tension mooring lines due to vortex shedding as necessary.

#### 10.4.3 Equipment for Tension Mooring Systems

**1** For laying tension mooring lines, the initial tension in all mooring lines is to be coordinated to achieve approximate uniformity. Power equipment capable of adjusting the tension mooring lines is to be provided as necessary.

**2** A tension monitoring system is to be provided for each tension mooring line.

**3** Plans and documents showing that the supporting members laid to the seabed are designed so that they cannot be pulled up under any design load condition are to be submitted to the Society for reference.

### 10.5 Single-point Mooring Systems

#### 10.5.1 General

**1** Single-point mooring systems are to have a safety equivalent to the anchor mooring systems approved by the Society.

**2** Single-point mooring systems may be designed in accordance with the requirements of 10.3, for anchor mooring systems. However, the specified in 10.5.2 are to be taken into account.

#### 10.5.2 Single-point Mooring Systems

**1** Predictions of unit motions in waves and tension of mooring lines are, as a rule, to be based upon the results of model experiments and non-linear time history domained calculations. However, if non-linear time history domained calculations are carried out using the analytical method and analysis programs that have been sufficiently validated by model experiments, model experiments may be omitted subject to approval by the Society.

**2** Irregularities of waves and variances of wind are to be considered.

**3** In calculating motions, the low frequency varying wave drifting forces of waves due to irregular waves are to be considered.

### 10.6 Dolphin Mooring Systems

#### 10.6.1 General

The mooring lines directly connecting units with dolphins among the dolphin mooring systems and their connections to a unit's hull are to have a safety equivalent to the anchor mooring systems approved by the Society.

#### 10.6.2 Dolphin Mooring System

**1** If dolphins such as fender beams having non-linear reaction characteristics are used in combination, mooring lines are, as a rule, to be taken into account the requirements of 10.5.2.

**2** The pressure bearing parts of unit's hull relating to fenders are to be capable of sufficiently withstanding the maximum reaction of the dolphin system. In this case, the scope of the pressure bearing parts is to be the widest predictable considering the changes in draught, tidal levels and ship motions.

### 10.7 Dynamic Positioning System

#### 10.7.1 General*

**1** The requirements in 10.7 apply to the units which are provided with the DPS as a solely positioning system.

**2** The DPS consists of the following systems specified in **(1)** to **(3)**.

(1) Power Systems

"Power system" means all components and systems necessary to supply the DPS with power. The power system includes the following **(a)** to **(f)**.

(a) Prime movers with necessary auxiliary systems including piping, fuel, cooling, pre-lubrication and lubrication, hydraulic, pre-heating, and pneumatic systems.

(b) Generators
(c) Switchboards
(d) Distributing system (cabling and cable routing)
(e) Power supplies, including uninterruptible power supplies (UPS)
(f) Power management systems (as appropriate)

(2) Thruster Systems

"Thruster system" means all components and systems necessary to supply the DPS with thrust force and direction. The thruster system includes the following **(a)** to **(e)**.

(a) Thrusters with drive units and necessary auxiliary systems including piping, cooling, hydraulic, and lubrication systems, etc.
(b) Main propellers and rudders if these are under the control of the DPS
(c) Thruster control electronics
(d) Manual thruster controls
(e) Associated cabling specified in **(a)** to **(d)** above and cable routing

(3) Dynamic Positioning Control Systems

"Dynamic positioning control system" (hereinafter referred to as "DP-control system".) means all control components and systems, hardware and software necessary to dynamically position the vessel. The DP-control system consists of the following **(a)** to **(f)**.

(a) Operating systems such as computer systems and joystick systems. In this context, "computer system" means a system consisting of one or more computers and associated hardware, software and their interfaces, and "joystick system" means a system with centralized manual position control and manual or automatic heading control.
(b) Position reference system
(c) Sensor systems
(d) Display systems (including operator panels) which indicate position and operating mode
(e) The associated cabling and cable routing for **(a)** to **(d)** above
(f) Networks

**3** Redundancy of components or systems required in **10.7** means ability of a component or system to maintain or restore its function, when a single failure has occurred. Redundancy can be achieved, in general, by installation of multiple components, systems or alternative means of performing a function in a timely manner.

**4** Installations comprising dynamic positioning system are to be designed, manufactured, and tested in accordance with the standard deemed appropriate by the Society.

**10.7.2 Installations Comprising the DPS**

**1** Redundant components and systems comprising the DPS are to be immediately available without needing manual intervention from operators and with such capacity that the dynamic positioning operation (hereinafter referred to as "DP-operation") can be continued for such a period that the work in progress can be terminated safely. The transfer of control is to be smooth and within acceptable limitations of the DP-operation for which the vessel is designed.

**2** If external forces from mission-related systems (cable laying, pipe laying, mooring, etc.) have a direct impact on DP performance, the influence of such systems is to be considered and factored into DP system design. Where data for such influences are available from the DP system or equipment manufacturer, such data inputs are to be provided automatically to the DP-control system. Additionally, provisions are to be made to provide such data inputs into the DP-control system manually.

**3** For Class 1 DPS, each component need not be redundant according to **10.2.3-2(1)**.

**4** For Class 2 DPS, all active components are to be redundant according to **10.2.3-2(2)**.

**5** For Class 2 DPS, when a component or system not related to the DPS and which will cause a failure of the DPS due to failure of this component or system is provided, the component or system is to comply with the relevant requirements in **10.7**.

**6** For Class 3 DPS, all components are to be redundant according to **10.2.3-2(3)**, and each component is to be arranged in the compartment physically separately by watertight and "*A-60*" class division. In cases where full redundancy of the control systems may not be possible (i.e. there may be a need for a single changeover system from the main computer system to the backup computer system), such connections between otherwise redundant and separated systems may be accepted when these are operated so that they

do not represent a possible failure propagation path during DP-operations.

**7** For Class 2 DPS and Class 3 DPS, connections between otherwise redundant and separated systems are to be kept to a minimum and made to fail to the safest condition. Failure in one system is to in no case be transferred to the other redundant system.

**8** For Class 2 DPS and Class 3 DPS, hidden failure monitoring is to be provided on all devices where the FMEA shows that a hidden failure will result in a loss of redundancy. In this context, "hidden failure" means a failure that is not immediately evident to operations or maintenance personnel and has the potential for failure of equipment to perform an on-demand function, such as protective functions in power plants and switchboards, standby equipment, backup power supplies or lack of capacity or performance.

### 10.7.3 Power System

**1** The power system for the DPS is to comply with the requirements of **Chapter 12** and is to have an adequate response time to power demand. Additionally, sudden load changes resulting from single faults or equipment failures are not to cause blackouts.

**2** For Class 1 DPS, the power system need not be redundant.

**3** For Class 2 DPS, the power system is to be divisible into two or more systems such that in the event of failure of one system at least one other system will remain in operation and provide sufficient power for position keeping. The power system may be run as one system during DP-operation, but is to be arranged by bus-tie breakers to separate automatically upon failures which could be transferred from one system to another, including overloading and short-circuits.

**4** For Class 3 DPS, the power system and arrangements of this system are to comply with the following.

(1) Each power system is to comply with **10.7.3-3**.

(2) Bus-tie breakers are to be open during Class 3 DPS operations unless equivalent integrity of power operation can be accepted according to **10.7.2-7**.

(3) Each power system is to be located in different spaces separated by an "*A-60*" class division.

(4) Where the power systems are located below the load waterline as required by **Chapter 8**, each power system is to be located in different spaces separated by an watertight compartment.

**5** For Class 2 DPS and Class 3 DPS, the power available for position keeping is to be sufficient to maintain the vessel in position after the worst failure according to **10.2.3**.

**6** For Class 2 DPS and Class 3 DPS, at least one automatic power management system is to be provided and is to have redundancy according to the DPS class and a blackout prevention function.

**7** Alternative energy storage (e.g. batteries and fly-wheels) may be used as sources of power to thrusters as long as all relevant redundancy, independency and separation requirements for the relevant notation are complied with. For Class 2 DPS and Class 3 DPS, the available energy from such sources may be included in the consequence analysis function required in **10.7.6** when reliable energy measurements can be provided for the calculations.

### 10.7.4 Thruster System

**1** Each thruster on a DP system is to be capable of being remote-controlled individually and independently of the DP-control system.

**2** The thruster system is to provide thrust in longitudinal and lateral directions, and provide yawing moment for heading control.

**3** Failure of a thruster system including pitch, azimuth or speed control, is not to cause an increase in thrust magnitude or change in thrust direction.

**4** The values of thruster force used in the consequence analysis specified in **10.7.6** are to be corrected for interference between thrusters and other effects which would reduce the effective force.

**5** Individual thruster emergency stop systems are to be arranged in the DP-control station. For Class 2 DPS and Class 3 DPS, the thruster emergency stop system is to have loop monitoring (i.e. functions to monitor disconnections and short-circuits). For Class 3 DPS, the effects of fire and flooding are to be considered.

**6** The thruster system for Class 1 DPS need not comply with the requirements specified in **-2** after failure of one of the constituent power systems or the thrusters connected to that system.

**7** The thruster system for Class 2 DPS and Class 3 DPS is to be connected to the power system in such a way that the requirements in **-2** can be complied with even after failure of one of the constituent power systems and the thrusters connected to that system.

### 10.7.5 DP-control System

**1** The design and arrangement of the DP-control system is to comply with the following requirements specified in **(1)** to **(10)**.

(1) The DP-control system is to be arranged in a DP-control station where the operator has a good view of the vessel's exterior

limits and the surrounding area. Equipment that is to be located in the DP-control station includes, but is not limited to, the following:

(a) DP-control and independent joystick control operator stations
(b) Manual thruster levers
(c) Mode change systems
(d) Thruster emergency stop systems
(e) Internal communication systems
(f) Position reference system HMIs (Human Machine Interface), when considered necessary

(2) The DP-control station is to display information from the power systems, thruster systems, and DP-control systems to ensure that these systems are functioning correctly. Information necessary to operate the DPS safely is to be visible at all times. Other information is to be available upon operator request.

(3) Display systems and the DP-control station in particular, are to be based on sound ergonometric principles which promote proper operation of the system. The DP-control system is to provide for easy accessibility of control mode (i.e. manual, joystick, or automatic DP control of thrusters, propellers, and rudders, if part of the thruster system) and the active mode is to be clearly displayed.

(4) Alarms and warnings for failures in all systems interfaced to and/or controlled by the DP-control system are to be audible and visual. A record of their occurrence and of status changes is to be provided together with any necessary explanations.

(5) The DP-control system is to prevent failures being transferred from one system to another. The redundant components are to be so arranged that any failed component may be easily isolated so that the other components can take over smoothly with no loss of position or heading.

(6) It is to be possible to control the thrusters manually, by individual levers and by independent joysticks, in the event of the failure of the DP-control system. If an independent joystick is provided with sensor inputs, failure of the main DP-control system is to not affect the integrity of the inputs to the independent joystick.

(7) A dedicated UPS is to be provided for each DP-control system (i.e. minimum one UPS for Class 1 DPS, two UPSs for Class 2 DPS and three UPSs for Class 3 UPS) to ensure that any power failure will not affect more than one computer system and its associated components.

(8) The reference systems and sensors are to be distributed on the UPSs in the same manner as the control systems they serve so that any power failure will not cause loss of position keeping ability.

(9) An alarm is to be initiated in case of loss of charge power. UPS battery capacity is to provide a minimum of 30 *minutes* operation following a main supply failure. For Class 2 DPS and Class 3 DPS, the charge power for the UPSs supplying the main control system is originate from different power systems.

(10) The software is to be produced in accordance with an appropriate international quality standard recognized by the Society.

**2** For the DP-control systems for Class 2 DPS and Class 3 DPS, operator controls are to be so designed that no single inadvertent act on the operator panel can lead to a loss of position or heading in addition to complying with the requirements in **-1**.

### 10.7.6 Computer System*

**1** Computer systems used as the DP-control systems for Class 1 DPS need not be redundant.

**2** Computer systems used as the DP-control systems for Class 2 DPS are to comply with the following **(1)** to **(5)**.

(1) The DP-control system is to consist of at least two computer systems so that automatic position keeping ability is ensured in case of any single failure.

(2) Redundant computer systems are to be arranged with automatic transfer of control after a detected failure in one of the computer systems. The automatic transfer of control from one computer system to another is to be smooth with no loss of position or heading.

(3) Software is to be provided with a "consequence analysis" type of functionality, for continuously verifying that the vessel remains in position even if the worst failure occurs is to be provided. The analysis is to verify that the thrusters, propellers and rudders (if included under DP-control) remaining in operation after the worst failure (as specified in **10.2.3-2**) can generate the same resultant thruster force and moment as required before the failure. The analysis is to provide an alarm if the occurrence of a worst failure were to lead to a loss of position or heading due to insufficient thrust for the prevailing environmental conditions (e.g. wind, waves, current). For operations which will take a long time to safely terminate, the analysis is to include a function

which simulates the remaining thrust and power after the worst failure based on the input of environmental conditions.

(4) Common facilities such as self-checking routines, alignment facilities, data transfer arrangements, and plant interfaces which are provided with the computer system, are not to be capable of causing the failure of more than one computer system.

(5) An alarm is to be initiated if any computer fails or is not ready to take control.

**3** Computer systems used as the DP-control systems for Class 3 DPS are to comply with the following **(1)** to **(5)**, in addition that they are to comply with the requirements in **-2**.

(1) A back-up computer system is to be provided in addition to the computer systems specified in **-2**.

(2) The back-up computer system is to be in a room separated by an "*A-60*" class division from the main DP-control station where the main computer system is installed.

(3) During the DP-operation, the back-up computer system is to be continuously updated by input from at least one of the required sets of sensors, position reference system, thruster feedback, etc., and be ready to take over control.

(4) The switch-over of control to the back-up computer system from the main computer system is to be manual, situated on the back-up computer system, and is not to be affected by failure of the main computer system.

(5) Main and back-up computer systems are to be so arranged to ensure that at least one system will be able to perform automatic position keeping after any single failure.

**4** Each computer system is to be isolated from other on-board computer systems and communications systems to ensure the integrity of the DP system and command interfaces. This isolation may be effected via hardware or software systems as well as the physical separation of cabling and communication lines. Robustness of the isolation is to be verified by analysis and testing. Specific safeguards are to be implemented to ensure the integrity of the computer systems and prevent the connection of unauthorized or unapproved devices or systems.

### 10.7.7 Position Reference Systems

**1** For all classes of the DPS, position reference systems which are selected with due consideration to operating requirements, both with regard to restrictions caused by the manner of deployment and expected performance in working situation are to be provided with.

**2** Two or more position reference systems required to be installed. Such systems are not to all be of the same type but based on different principles and suitable for the operating conditions.

**3** The position reference systems are to produce data with adequate accuracy and repeatability for the intended DP-operation.

**4** The performance of position reference systems is to be monitored and warnings are to be provided when the signals from the position reference systems are either incorrect or substantially degraded.

**5** For Class 1 DPS, at least two independent position reference systems are to be installed and simultaneously available to the DP-control system during operation.

**6** For Class 2 DPS, at least three independent position reference systems are to be installed and simultaneously available to the DP-control system during operation.

**7** For Class 3 DPS, the position reference systems required by **-6** above are to be installed and at least one are to be connected directly to the back-up computer systems and separated by an "*A-60*" class division from the other position reference systems. However, position reference systems, antennas, cables, etc. installed in exposed areas may be separated by physical distance as well as by some other practical method of separation instead of an "*A-60*" class division.

### 10.7.8 Vessel Sensors

**1** Vessel sensors that measure at least vessel heading, vessel motions, and wind speed and direction are to be installed to all classes of DPS.

**2** Sensors for the same purpose, connected to redundant systems are to be arranged independently so that failure of one will not affect the others.

**3** For Class 2 DPS, signals from vessel sensors are to be based on three systems serving the same purpose when the DP-control system is fully dependent upon the correctness of such signals. This will result in at least three heading reference sensors being installed.

**4** For Class 3 DPS, vessel sensors which comply with the requirements in **-3** are to be installed. One of each type of sensors is to be connected directly to the back-up computer system and is to be separated by an "*A-60*" class division from the other sensors. However, vessel sensors, antennas, cables, etc. installed in exposed areas may be separated by physical distance as well as by some other practical method of separation instead of an "*A-60*" class division. If the data from these sensors is passed to the main computer system for use, this system is to be arranged so that a failure in the main computer system cannot affect the integrity of the signals to

the back-up computer system.

**10.7.9 Cables and Piping Systems**

**1** Cables and piping systems such as fuel oil pipes, lubricating oil pipes, hydraulic oil pipes, cooling water pipes, etc., for Class 2 DPS, are to be located with due regard to fire hazards and mechanical damage.

**2** Cables and piping systems such as fuel oil pipes, lubricating oil pipes, hydraulic oil pipes, cooling water pipes, etc., for Class 3 DPS are to comply with the following requirements specified in **(1)** and **(2)**.

(1) Cables and piping systems for redundant equipment or systems are not to be routed together through the same compartments.

(2) Where the requirement in **(1)** is not complied with or is unavoidable, such cables are to run together in cable ducts of "*A-60*" class division, the termination of the ducts included, which are effectively protected from all fire hazards, except that represented by the cables and piping systems themselves. Cable connection boxes are not allowed in such ducts.

**10.7.10 Systems other than DPS**

For Class 2 DPS and Class 3 DPS, systems not directly part of the DP system, but which in the event of failure could cause failure of the DP system (e.g. common fire suppression systems, engine ventilation, heating, ventilation and air conditioning (HVAC) systems, shutdown systems) are to also comply with relevant requirements systems specified in this **10.7**.

**10.7.11 Independent Joystick Systems**

**1** A joystick system independent of the automatic DP-control system is to be arranged. The power supply for the independent joystick system is to be independent of the UPS for the DP-control system. An alarm should be initiated upon failure of the independent joystick system.

**2** The independent joystick system is to have automatic heading control.

# Chapter 11 MACHINERY INSTALLATIONS

## 11.1 General

### 11.1.1 Scope

**1** For main propulsion machinery, power transmission systems, shafting systems, propellers, prime movers other than main propulsion machinery, boilers, etc., incinerators, pressure vessels, auxiliaries, piping systems, jacking systems and their control systems (hereinafter referred to as "machinery installations" in this Part) for mobile offshore drilling units, storage units, plant barges, accommodation barges and units which have accommodation for particular personnel or passengers, requirements in this **11.1** are to be applied.

**2** Machinery installations for units not listed in **-1** are to be deemed appropriate by the Society.

### 11.1.2 General

**1** For machinery installations other than those used for solely for the operation which is the purpose of the unit, relevant requirements in **Part D** listed in the following **(1)** to **(40)** as well as the requirements in this Chapter are to be applied.

(1) **1.1.2, Part D** General - General - Equivalency
(2) **1.1.3, Part D** General - General - Machinery Installations with Novel Design Features
(3) **1.1.4, Part D** General - General - Modification of Requirements
(4) **1.1.6, Part D** General - General - Terminology
(5) **1.2, Part D** General - Materials
(6) **1.3.4, Part D** General - General Requirements for Machinery Installations - Fire Protections
(7) **1.3.5, Part D** General - General Requirements for Machinery Installations - Ventilating Systems for Machinery Spaces
(8) **1.3.6, Part D** General - General Requirements for Machinery Installations - Protection against Noise
(9) **Chapter 2, Part D** Reciprocating Internal Combustion Engines
(10) **Chapter 3, Part D** Steam Turbines
(11) **Chapter 4, Part D** Gas Turbines
(12) **Chapter 5, Part D** Power Transmission Systems
(13) **Chapter 6, Part D** Shaftings
(14) **Chapter 8, Part D** Torsional Vibration of Shaftings
(15) **Chapter 9, Part D** Boilers, etc. and Incinerators
(16) **Chapter 10, Part D** Pressure Vessels
(17) **Chapter 11, Part D** Welding for Machinery Installations
(18) **Chapter 12, Part D** Pipes, Valves, Pipe Fittings and Auxiliaries
(19) **13.1, Part D** Piping Systems - General
(20) **13.2, Part D** Piping Systems - Piping
(21) **13.3, Part D** Piping Systems - Sea Suction Valves and Overboard Discharge Valves
(22) **13.4, Part D** Piping Systems - Scuppers and Sanitary Discharges
(23) **13.6, Part D** Piping Systems - Air Pipes
(24) **13.7, Part D** Piping Systems - Overflow Pipes
(25) **13.8, Part D** Piping Systems - Sounding Pipes
(26) **13.9.1, Part D** Piping Systems - Fuel Oil Systems - General
(27) **13.9.2, Part D** Piping Systems - Fuel Oil Systems - Fuel Oil Filling Pipes
(28) **13.9.4, Part D** Piping Systems - Fuel Oil Systems - Drip Trays and Drainage System
(29) **13.9.5, Part D** Piping Systems - Fuel Oil Systems - Fuel Oil Heaters
(30) **13.10.1, Part D** Piping Systems - Lubricating Oil Systems and Hydraulic Oil Systems -General
(31) **13.11, Part D** Piping Systems - Thermal Oil Systems
(32) **13.13, Part D** Piping Systems - Pneumatic Piping System

(33) **13.14, Part D** Piping Systems - Steam Piping Systems and Condensate Systems

(34) **13.15.3, Part D** Piping Systems - Feed Water Systems for Boilers - Distilling Plant

(35) **13.15.4, Part D** Piping Systems - Feed Water Systems for Boilers - Pipes passing through Tanks

(36) **13.16, Part D** Piping Systems - Exhaust Gas Piping Arrangement

(37) **13.17, Part D** Piping Systems - Tests

(38) **Chapter 17, Part D** Refrigerating Machinery

(39) **Chapter 18, Part D** Automatic and Remote Control

(40) **Chapter 24, Part D** Spare Parts, Tools and Instruments

**2** For machinery installations used solely for the operation which is the purpose of the unit, relevant requirements in **Part D** listed in the following **(1)** to **(25)** as well as the requirements in **11.1.3** and **11.1.4** are to be applied.

(1) **1.1.2, Part D** General - General - Equivalency

(2) **1.1.3, Part D** General - General - Machinery Installations with Novel Design Features

(3) **1.1.4, Part D** General - General - Modification of Requirements

(4) **1.1.6, Part D** General - General - Terminology

(5) **1.2, Part D** General - Materials

(6) **1.3.4, Part D** General - General Requirements for Machinery Installations - Fire Protections

(7) **1.3.5, Part D** General - General Requirements for Machinery Installations - Ventilating Systems for Machinery Spaces

(8) **1.3.6, Part D** General - General Requirements for Machinery Installations - Protection against Noise

(9) **2.2.2-4, Part D** Reciprocating Internal Combustion Engines - Materials, Construction and Strength - Construction, Installation and General

(10) **2.2.2-5, Part D** Reciprocating Internal Combustion Engines - Materials, Construction and Strength - Construction, Installation and General

(11) **2.2.2-6, Part D** Reciprocating Internal Combustion Engines - Materials, Construction and Strength - Construction, Installation and General

(12) **2.4, Part D** Reciprocating Internal Combustion Engines - Safety Devices

(13) **2.5.4, Part D** Reciprocating Internal Combustion Engines - Associated Installations - Fuel Oil Arrangements

(14) **3.3, Part D** Steam Turbines - Safety Devices

(15) **4.3, Part D** Gas Turbines - Safety Devices

(16) **5.2.5, Part D** Power Transmission Systems - Materials and Construction - Lubricating Oil arrangements

(17) **Chapter 9, Part D** Boilers, etc. and Incinerators

(18) **Chapter 10, Part D** Pressure Vessels

(19) **Chapter 11, Part D** Welding for Machinery Installations

(20) **13.9.1, Part D** Piping Systems - Fuel Oil Systems - General

(21) **13.9.2, Part D** Piping Systems - Fuel Oil Systems - Fuel Oil Filling Pipes

(22) **13.9.4, Part D** Piping Systems - Fuel Oil Systems - Drip Trays and Drainage System

(23) **13.9.5, Part D** Piping Systems - Fuel Oil Systems - Fuel Oil Heaters

(24) **13.10.1, Part D** Piping Systems - Lubricating Oil Systems and Hydraulic Oil Systems - General

(25) **13.11, Part D** Piping Systems - Thermal Oil Systems

**3** In addition to **-1** and **-2**, machinery installations other than those used for solely for the operation are to comply with the requirements in **4.2.1 and 4.2.2(3)(d)**, **Part R**.

**11.1.3 Tests**

**1** Before installation on board, equipment and components constituting the machinery installations are to be tested at the plants provided with installations and equipment necessary for the tests (hereinafter referred to as "manufacturers, etc." in this Part) in accordance with relevant requirements in **Part D**.

**2** Notwithstanding in **-1** above, for machinery installations (other than boilers, pressure vessels belonging to Group I or II and piping systems which contain inflammable or toxic liquids) used solely for operations which are the intended purpose of the unit, tests may be as deemed appropriate by the Society.

**3** Notwithstanding **-1** and **-2** above, for equipment manufactured by mass-production systems deemed appropriate by the Society,

test procedures suited to the production method may be accepted upon the request of the manufacturer.

**4** Systems or the equipment essential for the safety of the unit or for the propulsion of the unit (only applicable to units which have main propulsion machinery) are to be subjected to performance tests after installation on board.

**5** Remote control devices and automatic control devices attached to boilers are to be subjected to performance tests after installation on board.

**6** The safety devices required by this chapter are, as a rule, to be subjected to performance tests after installation on board.

**7** The Society may require other tests than those specified in **11.1.3** when deemed necessary.

**8** Mechanical components used for load carrying components, torque transmitting components, components for fixation systems and hydraulic components of jacking systems are to be subjected to the hardness tests and non-destructive tests specified in **5.5.1, Part D**.

**9** Rack and pinion jacking systems are to be tested in accordance with the following. However, in cases where such systems are of equivalent design, the Society may allow such tests to be omitted in consideration of established service histories.

(1) A load equivalent to 150 % of the maximum normal holding capacity rating of the unit is to be applied, and the climbing pinion is to make at least one complete revolution.

(2) The unit is to be disassembled and it is to be confirmed that all pinions and gears are free from abnormal defects by non-destructive tests deemed appropriate by the Society.

### 11.1.4 General Requirements for Machinery Installations*

**1** Machinery installations are to be of a design and construction adequate for the service for which they are intended and are to be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards. The design is to have regard to the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.

**2** Main propulsion machinery, prime movers for generators, and auxiliary machinery and the prime movers for it are to be designed to operate under the static conditions given below, as fitted in the unit. The Society may permit deviation from the angles given below taking into consideration the type, size and service conditions of the unit.

(1) For self-elevating units:
static inclination up to 10 *degrees* in any direction

(2) For column-stabilized units:
static inclination up to 15 *degrees* in any direction

(3) For ship-type units and barge-type units:
list static inclination up to15 *degrees* either way and simultaneously trim up to 5 *degrees* by the bow or stern

**3** Prime movers for emergency generators are to be designed to function at full rated power when inclined up to the maximum angle of heel in the intact and damaged conditions as determined in accordance with **Chapter 4**. In no case need the equipment be designed to operate when inclined more than an angle listed below.

(1) For self-elevating units:
static inclination of 15 *degrees* in any direction

(2) For column-stabilized units:
static inclination of 25 *degrees* in any direction

(3) For ship-type units and barge-type units:
list static inclination of 22.5 *degrees* either way and simultaneously trim of 10 *degrees* by the bow or stern

**4** Where valves of piping systems are arranged for remote control and are power operated, a secondary means of operating the valves which may be manual or other control is to be provided.

**5** Means are to be provided to ensure that machinery installations can be brought into operation from the dead unit condition without external aids. However, machinery installations of the unit for restricted areas, this requirement may be dispensed with, but special consideration is to be paid if the unit has a large embarking capacity.

**6** Machinery installations are to be designed to operate smoothly under the temperature conditions given in **Table P11.1**.

**7** As for machinery installations of the unit which is to work or navigate in icy sea areas, special considerations are to be paid to ice strengthening.

**8** Provision is to be made to the design, construction and installation of machinery installations facilitate cleaning, inspection,

maintenance and operation.

**9** Where fuel oils with a flash point (to be determined by a closed cup method) of less than 60℃ are used, the flashpoint of the fuel oils is to be clearly indicated on the drawings submitted to the Society for approval.

**10** The unit provided with fuel oil arrangements for helicopters is to be in accordance with the following **(1)** to **(5)**.

(1) Areas where fuel oil tanks are situated and fuelling operations conducted are to be suitably isolated from enclosed spaces or other areas which contain a source of vapour ignition. These areas are to be properly marked.

(2) Vent heads with suitable flame arresters are to be fitted to vent pipes of tanks.

(3) Fuel oil tanks are to be of metallic construction which is acceptable to the Society.

(4) Special attention is to be given to the design, mounting and securing arrangements and electrical bonding of the tanks and fuel oil transfer systems.

(5) Coamings or other arrangements are to be provided to contain fuel oil spills.

Table P11.1 Temperature

| | Installed location | Temperature(℃) |
|---|---|---|
| Air | In enclosed spaces | 0 to 45(*) |
| | In spaces subject to temperatures exceeding 45℃, and below 0℃ | According to specific local conditions |
| | On the open deck | -25 to 45(*) |
| Sea Water | - | 32(*) |

Note:

*Other temperatures deemed appropriate by the Society may be accepted in units for restricted areas.

### 11.1.5 Sea Suction Valves and Overboard Discharge Valves

For units listed in the following **(1)** or **(2)**, each sea water inlet and discharge in spaces below the assigned load line or the designed maximum load line is to be provided with a valve operable from an accessible position outside the space. Where remote operation is provided by power actuated valves for sea water inlets and discharges for operation of the main propulsion machinery and the machinery for generators, power supply failure of the control system is not to result in “closing” of “open” valves nor “opening” of “closed” valves.

(1) Column-stabilized units

(2) Other units where the space containing the valve is normally unattended and is not provided with a high bilge water level alarm

### 11.1.6 Bilge Pipings*

**1** An efficient bilge pumping system is to be provided, capable of pumping from and draining any watertight compartment other than a space permanently appropriate for the carriage of liquid and for which other efficient means of pumping are provided, under all practical conditions. A means is to be provided to detect the presence of water in such compartments which are adjacent to the sea or adjacent to tanks containing liquids and in void compartments through which pipes conveying liquids pass. If the Society is satisfied that the safety of the unit is not impaired, the bilge pumping arrangements and the means to detect the presence of water may be dispensed with in particular compartments.

**2** Suitable measures are to be taken to the bilge pumping system to prevent the possibility of water passing from the sea to the watertight compartment and of bilge inadvertently passing from one compartment to another. To achieve this requirement, all bilge distribution boxes and manually operated valves in connection with the bilge pumping system are to be in positions which are accessible under ordinary circumstances. All valves in the bilge distribution boxes are to be of non-return type. Where such valves are located in normally unattended spaces below the assigned load line or the designed maximum load line, a high bilge water level alarm of the space is to be provided or such valves are to be operable from outside the space.

**3** A means to indicate whether a valve is open or closed is to be provided at each location from which the valve can be controlled. The indicator is to rely on movement of the valve spindle.

**4** Hazardous and non-hazardous areas are to be provided with separate bilge suction arrangements.

**5** At least two independent power bilge pumps of self-priming type or equivalent thereto are to be provided and are to be connected respectively to the main bilge suction pipes. Ballast pumps, sanitary pumps, general service pumps, etc. driven by independent power may be accepted as independent power bilge pumps provided that they are connected properly to the main bilge line. As for the unit for restricted areas (except for a unit which has a large embarking capacity), however, one bilge pump may be accepted.

**6** The internal sectional area of the main bilge suction pipes is not to be less than the combined internal sectional areas of the two largest branch bilge suction pipes.

**7** Branch bilge suction pipes from each compartment are to be of the internal diameter obtained from the following formula or the standard pipes of internal diameter nearest to the calculated diameter. In case where the internal diameter of such standard pipes is short of the calculated value by 5*mm* or more, standard pipes of one grade higher diameter are to be used.

$d' = 2.15\sqrt{A} + 25$ $(mm)$ minimum 50 $(mm)$

$d'$: Internal diameter of branch bilge suction pipes $(mm)$

$A$: Wetted surface area of the compartment, excluding stiffening members when the compartment is half filled with water $(m^2)$

**8** Capacity of each bilge pump is to be capable of discharging bilge of not less than that obtained from the following formula through the main bilge line specified in **-6**.

$Q=5.66d^2\times10^{-3}$

$Q$: Required quantity $(m^3/hour)$

$d$: Internal diameter of main bilge line specified in -6 $(mm)$

**9** Bilge pipes passing through deep tanks are to be led through an oiltight or watertight pipe tunnel or, alternatively, are to be of sufficient thicknesses complying with the requirements in **Table D12.6(1)** to **Table D12.6(2), Part D of the Rules** and all joints of them are to be welded.

**10** Bilge pipes passing through double bottom tanks are to be led through oiltight or watertight pipe tunnel or, alternatively, are to be of sufficient thicknesses complying with the requirements in **Table D12.6(1)** to **Table D12.6(2), Part D of the Rules**.

**11** Bilge pipes passing through double bottoms, side tanks, bilge hopper tanks or void spaces, where there is a possibility of damage of these pipes due to grounding or collision, are to be provided with non-return valves near the bilge suctions or stop valves capable of being closed from readily accessible positions.

**12** Bilge of chain lockers may be drained by eductors, hand pumps or portable means. A means is to be provided for removal of mud and debris from the bilge system.

### 11.1.7 Bilge Pipings of Column-stabilized Units

Bilge pipings of the column-stabilized unit are to comply with the requirements in the following **(1)** to **(3)** as well as the requirements in **11.1.6**.

(1) Chain lockers which, if flooded, could substantially affect the unit's stability are to be provided with a remote means to detect flooding and to provide an audible and visual alarm at the central ballast control station.

(2) At least one of the pumps specified in **11.1.6-5** and pump room bilge suction valves are to be capable of both remote and local operation.

(3) Machinery spaces and pump rooms in lower hulls are to be provided with two independent high bilge water level alarms providing an audible and visual alarm at the central ballast control station.

### 11.1.8 Ballast Pipings*

**1** An efficient ballast piping system is to be provided, capable of pumping ballast water into and from any tanks for carriage of ballast water under all practical conditions.

**2** Ballast piping system is to be provided with a suitable provision such as a non-return valve or a stop valve which can be kept closed any time excluding the time of ballasting and deballasting, and which is provided with an indicator to show whether it is open or closed, in order to prevent the possibility of water inadvertently passing from the sea to the ballast tanks or of ballast passing from one ballast tank to another.

**3** Ballast pipes passing through deep tanks other than ballast tanks are to be led through an oiltight or watertight pipe tunnel or, alternatively, are to be of sufficient thickness complying with the requirements in **Table D12.6(1)** to **Table D12.6(2), Part D of the Rules** and all joints of them are to be welded.

### 11.1.9 Ballast Piping of Column-stabilized Units

**1** Ballast pipings of the column-stabilized unit are to comply with the following requirements as well as the requirements in **11.1.8**.

**2** The ballast system is to provide the capability to bring the unit, while in an intact condition, from the maximum normal operating draught to a severe storm draught, or to a greater distance, as may be specified by the Society, within 3 *hours*.

**3** The ballast system is to be arranged to provide at least two independent power pumps of self-priming type or equivalent thereto so that the system remains operational in the event of failure of any one such pump. The pumps provided need not be dedicated ballast pumps, but are to be readily available for such use at all times.

**4** The ballast system is to be capable of operating after the damage specified in **4.3.3** and have the capability of restoring the unit to a level trim and safe draught condition without taking on additional ballast, with any one pump inoperable. The Society may permit counter-flooding as an operational procedure.

**5** The ballast system is to be arranged and operated so as to prevent inadvertent transfer of ballast water from one tank or hull to another, which could result in moment shifts leading to excessive angles of heel or trim. The system is also to be arranged so that the transfer of ballast water from one tank to any other tank through a single valve is not possible except where such a transfer could not adversely affect the stability of the unit.

**6** It is to be possible to supply each ballast pump required by **-3** from the emergency source of electrical power. The arrangements are to be such that the system is capable of restoring the unit from an inclination specified in **11.1.4-2** to a level trim and safe draught condition after loss of any single component in the power supply system.

**7** All valves and operating controls are to be clearly marked to identify the function they serve. A means is to be provided locally to indicate whether a valve is open or closed.

**8** A central ballast control station equipped with the following **(1)** to **(7)** control systems, indicating systems and indicators which activate audible and visual alarms if an abnormal condition is detected, is to be provided. It is to be located above the worst damage waterline and in a space not within the assumed extent of damage referred to in **Chapter 4** and adequately protected from weather.

(1) A ballast pump control system (including a ballast pump status-indicating system)

(2) A ballast valve control system for ballasting and deballasting (including a ballast valve position-indicating system)

(3) A ballast tank level indicating system

(4) A draught indicating system

(5) A heel and trim indicator

(6) A power availability indicating system (main and emergency)

(7) A ballast system hydraulic or pneumatic pressure-indicating system

**9** The control and indicating systems listed in **-8** are to function independently of one another, or have sufficient redundancy, such that a failure in one system does not jeopardize the operation of any of the other systems.

**10** The ballast tank level indicating system required by **-8** is to provide means specified in **(1)** and **(2)** below.

(1) A means to indicate liquid levels in all ballast tanks. A secondary means of determining levels in ballast tanks, which may be a sounding pipe is to be provided. Tank level sensors are not to be situated in the tank suction lines.

(2) A means to indicate liquid levels in other tanks, such as fuel oil, fresh water, drilling water or liquid storage tanks, the filling or emptying of which, in the view of the Society, could affect the stability of the unit. Tank level sensors are not to be situated in the tank suction lines.

**11** The draught indicating system is to indicate the draught at each corner of the unit or at representative positions as deemed appropriate by the Society.

**12** In addition to remote control of the ballast pumps and valves from the central ballast control station, all ballast pumps and valves are to be fitted with independent local control operable in the event of remote control failure. The independent local control of each ballast pump and of its associated ballast tank valves are to be in the same location.

**13** Each power-actuated ballast valve is to fail to the closed position upon loss of control power. Upon reactivation of control power, each such valve is to remain closed until the reactivation of the system is assumed. The Society may accept ballast valve arrangements that do not fail to the closed position upon loss of power provided the Society is satisfied that the safety of the unit is not impaired.

**14** A means to indicate whether a valve is open or closed is to provided at each location from which the valve can be controlled. The indicators are to rely on movement of the valve spindle.

**15** A means is to be provided at the central ballast control station to isolate or disconnect the ballast pump control and ballast valve control systems from their sources of electrical, pneumatic or hydraulic power.

**11.1.10 Air Pipes and Overflow Pipes**

Air pipe openings and discharge openings of overflow pipes are to be located above the final calculated immersion line in the assumed damage condition specified in **Chapter 4** and are to be positioned outside the extent of damage, as defined in **Chapter 4**.

**11.1.11 Sounding Pipes**

**1** The internal diameter of sounding pipes of 20*m* or more in length is not to be less than 50*mm*.

**2** Where a remote level indicator is used for tanks which are not always accessible, an additional sounding system is to be provided.

**11.1.12 Burning Systems for Boilers**

Where the removal of residual fuel oil in burners is conducted by means of steam or air, a means is to be taken to prevent the mixing of oil into steam or air.

**11.1.13 Feed Water Systems for Boilers**

**1** Every boiler which could be rendered dangerous by the failure of its feed water supply is to be provided with two separate feed water systems from and including the feed pumps so that these systems are capable of supplying feed water to the boiler with any one system being out of use. However, a single penetration of the steam drum is acceptable.

**2** For boilers intended to supply steam for other than the systems or the equipment for the safety of the unit and for the propulsion of the unit (only applicable to the unit which has the main propulsion machinery), only one feed water system may be acceptable notwithstanding the requirement in **-1**.

**11.1.14 Jacking Systems**

**1** The following plans and documents are to be submitted to the Society in addition to those specified in **Chapter 15, Part B**.

(1) Plans and documents for approval

(a) A description of the jacking system and plans for its arrangement

(b) Rack and pinion jacking systems

i) Detailed plans for rack and pinions (including details of tooth geometry in cases where it is not an involute gear)

ii) Plans for power transmitting components, shafts, bearings, couplings, casings and brakes

iii) Detailed plans for gear elements

iv) Diagrams for electric and hydraulic control systems

v) Detailed plans for hydraulic power packs

iv) Detailed plans for electric motors (including specifications and operating characteristics)

vii) Detailed plans for fixation systems (if provided)

viii) Prototype test procedures (if applicable)

(c) Ram and pin jacking systems

i) Detailed plans for hydraulic cylinders and control valves

ii) Details for pins and activating mechanisms

iii) Detailed plans and arrangements for pin holes

iv) Diagrams for electric and hydraulic control systems

v) Detailed plans for hydraulic power packs

vi) Detailed plans for electric motors (including specifications and operating characteristics)

vii) Detailed plans for the casings and supporting structures of the system (including fixed and movable crossheads)

(d) Detailed plans for monitoring and alarm systems

(e) Material specifications for load carrying components (racks and jackcases for rack and pinion units, jacking pins and yokes for hydraulically actuated units, etc.), torque transmitting components (climbing pinions, gears, pinions, planet carriers, pins, shafts, torque supports, couplings, coupling bolts, torque flanges, brakes, etc.), fixation system components and hydraulic components (hydraulic cylinders and actuators, etc.) of **(b)** and **(c)** above

(f) Design calculations (including strength, fatigue, buckling, rigidity, critical speed (resonance) analysis) of **(b)** and **(c)** above

(2) Plans and documents for reference

(a) Documents for Failure Modes and Effects Analysis (*FMEA*)

(b) Details and procedures for non-destructive tests for components subject to direct loads (including inspection locations, inspection types, and acceptance criteria)

(c) Details for operating temperature and heating arrangements for low-temperature service

(d) Limits for alignment and misalignment between rack and pinions

**2** The material of load carrying components and torque transmitting components, fixation system components and hydraulic components of jacking systems are to be suitable for the temperature conditions of operating areas of intended use and are to comply with **Part K**.

**3** Jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are to be such as to maintain the safety of the unit in the event of failure of part of the system or the control device or loss of source of power for driving gear. A suitable monitoring device is to be provided at a permanently attended control station to indicate such failure.

**4** With respect to **-3** above, Failure Modes and Effects Analysis (*FMEA*) is to be used to confirm that the safety of the unit will not be compromised by the jacking system.

**5** Where electrical motors, hydraulic or pneumatic systems are used as a source of power for jacking systems (including fixation systems in cases where separately equipped as holding mechanisms), two or more sets of sources of power are to be provided so as to be capable of operating the jacking system even when one of the sets fail. However, one set may be acceptable for units designated for use in restricted areas (except for units which have large embarking capacities).

**6** Jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are be designed and constructed for the maximum lowering and lifting loads of the unit as specified in the unit's operation manual for at least the following loading conditions. In addition, friction loss from leg guiding and the effect of variation in location of the centre of gravity of the hull are to be included in the maximum lowering and lifting loads.

(1) Normal lifting, lowering, holding of hull (static loading)

(2) Pre-load lifting, lowering, holding of hull (static loading in cases where lifting and lowering, and combined loading in cases where holding)

(3) Normal lifting, lowering, holding of legs (static loading)

(4) Severe storm holding under the elevated condition and the afloat condition (combined loading)

**7** Allowable stresses of mechanical components used in jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are to comply with the values specified in **7.2.2** under all loading conditions specified in **-6** above. In addition, buckling strength and fatigue strength are to be in accordance with the requirements of **7.1.5** and **7.1.6** respectively. In the case of gears, tooth surface contact and tooth root bending are to be in accordance with requirements specified otherwise by the Society.

**8** Jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are to be able to withstand the forces imposed on the unit from the maximum environmental criteria for the unit.

**9** All lifting and lowering operations as well as applicable repeated loads are to be considered for fatigue strength. In the case of gears, the following safety factors are to be applied for cumulative fatigue in the fatigue design life.

Tooth surface contact: 1.0

Tooth root bending: 1.5

**10** In cases where hydraulic cylinders are used as power sources for ram and pin jacking systems, the requirements of **Chapter 10, Part D** are to be applied mutatis mutandis. For piping attached to such cylinders, the requirements of **Chapter 12** and **Chapter 13, Part D** are to be applied mutatis mutandis.

**11** Jacking systems are to be operable from central jacking control stations.

**12** Jacking control stations are to be provided for the following safety devices:

(1) Audible and visual alarms for jacking system overload and out-of-level. For rack and pinion jacking systems, visible and audible alarms for rack phase differential are to be provided in cases where required for design reasons.

(2) Indicators for the following:

(a) The inclination of the unit on two horizontal perpendicular axes

(b) Power consumption or other indicators for lifting or lowering the legs (as applicable)

(c) Brake release status

**13** Communication systems are to be provided between central jacking controls and locations at each leg.

### 11.1.15 Additional Requirements for the Unit which has the Main Propulsion Machinery*

**1** Machinery installations of the unit which has the main propulsion machinery are to comply with the requirements in this **11.1.15** as well as the requirements in **11.1.2** to **11.1.14** and the relevant requirements in **Part D** listed in the following **(1)** to **(8)**.

(1) **1.3.2, Part D** General - General Requirements for Machinery Installations - Astern Power

(2) **1.3.7, Part D** General - General Requirements for Machinery Installations - Communication between navigation bridge and control stations for main propulsion machinery

(3) **1.3.8, Part D** General - General Requirements for Machinery Installations - Engineers' Alarm

(4) **Chapter 7, Part D** Propellers

(5) **13.9, Part D** Piping Systems - Fuel Oil Systems (except **13.9.1**, **13.9.2**, **13.9.4** and **13.9.5**)

(6) **13.10, Part D** Piping Systems - Lubricating Oil Systems and Hydraulic Oil Systems (except **13.10.1**)

(7) **13.12, Part D** Piping Systems - Cooling Systems

(8) **Chapter 15, Part D** Steering Gears

**2** Units are to be tested at sea trial in accordance with the following **(1)** to **(5)**.

(1) No abnormalities in the operating conditions of machinery or the behaviour of ships during sea trial are to be confirmed in accordance with **2.1.7-7, Part B**.

(2) Astern tests are to be carried out in accordance with **2.1.7-7, Part B**. The astern test results are to be recorded and are to be made available on board.

(3) In units having multiple propellers, the unit navigating and manoeuvring performance with one or more propellers inoperative is to be verified, as well as the test results recorded are to be available on board for the use as a guidance for unit manoeuvres.

(4) When the unit is provided with supplementary means for manoeuvring or stopping, performance test of such means is to be carried out, and the test records are to be available on board for the use as a guidance for unit manoeuvres.

(5) The Society may require, when deemed necessary, other tests than those specified in **11.1.15**

**3** When the machinery listed in the following **(1)** to **(4)** is singly fitted on board, special consideration is to be given to the reliability of the machinery and its components. For units in which unconventional machinery is used as the main propulsion machinery and propulsion shafting system, provision of additional machinery capable of ensuring the unit to proceed at a navigable speed in the possible event of failure of the machinery may be requested by the Society.

(1) For units in which reciprocating internal combustion engines are used as main propulsion machinery (excluding electric propulsion ships):
Reciprocating internal combustion engines, high elastic couplings, reduction gears and propulsion shafting systems

(2) For units in which steam turbine engines are used as main propulsion machinery (excluding electric propulsion ships):
Steam turbine engines, main boilers, main condenser, reduction gears and propulsion shafting systems

(3) For units in which gas turbine engines are used as main propulsion machinery (excluding electric propulsion ships):
Gas turbine engines, compressors, combusters, reduction gears and propulsion shafting systems

(4) For electric propulsion units (as specified in **5.1.1-1, Part H**, hereinafter the same in this Part):
Propulsion motors, reduction gears and propulsion shafting systems

**4** For electric propulsion units two or more propulsion generators are to be provided.

**5** Means are to be provided whereby normal operations of main propulsion machinery can be sustained or restored even though one of the essential auxiliaries becomes inoperative. Special consideration is to be given to the malfunctioning of systems or equipment listed in the following **(1)** to **(10)**. However, having regard to overall safety consideration, a partial reduction in propulsion capability from normal operation may be accepted.

(1) A generating set which serves as a main source of electrical power

(2) The sources of steam supply

(3) The boiler feed water system

(4) The fuel oil supply systems for boilers or engines

(5) The sources of lubricating oil pressure

(6) The sources of water pressure

(7) A condensate pump and the arrangements to maintain vacuum in condensers

(8) The mechanical air supply for boilers

(9) An air compressor and a receiver for starting or control purposes

(10) The hydraulic, pneumatic or electrical means for control in main propulsion machinery including controllable pitch propellers

**6** Means are to be provided to ensure that machinery installations can be brought into operation from the dead ship condition without external aids. In addition, the starting systems in conjunction with other machinery are to be so arranged as to restore propulsion from dead ship condition within 30 *minutes* after blackout.

**7** Main propulsion machinery, prime movers for generators, and auxiliary machinery and the prime movers for it are to be designed to operate under the following dynamic conditions as well as the static conditions specified in **11.1.4-2** and **-3**. The Society may permit deviation from the angles given in the following taking into consideration the type, size and service conditions of the unit.

(1) For self-elevating units:
dynamic inclination up to 15 *degrees* in any direction

(2) For column-stabilized units:
dynamic inclination up to 22.5 *degrees* in any direction

(3) For ship-type units and barge-type units:
rolling up to 22.5 *degrees* and simultaneously pitching up to 7.5 *degrees* by bow or stern

**8** Special consideration is to be given to the design, construction and installation of the machinery installations so that any mode of vibrations shall not cause undue stresses in normal operating ranges.

**11.1.16 Additional Requirements for the Unit which has the Periodically Unattended Machinery Spaces**

Machinery Installations of the unit which has the periodically unattended machinery spaces are to comply with the relevant requirements in Rules for Automatic and Remote Control Systems as well as the requirements in **11.1.2** to **11.1.14** and **11.1.15** (only applicable to the unit which has the main propulsion machinery).

## 11.2 Mobile Offshore Drilling Units

### 11.2.1 Scope

Machinery installations of the mobile offshore drilling unit are to comply with the requirements in this **11.2** as well as the requirements in **11.1**.

### 11.2.2 Auxiliaries and Piping Systems

**1** Piping Systems used for the safe operation of the unit are, as a rule, to be separate from systems used for drilling operations. Where necessarily inter-connected, such piping systems are to be acceptable to the Society.

**2** Where air or steam is used to atomize well bore fluids prior to flaring, a non-return valve is to be fitted in the air or steam line. This valve is to be part of the permanently installed piping, readily accessible and as close as possible to the burner boom. Alternative arrangements shown to provide an equivalent level of safety may be accepted by the Society.

**3** Non-metallic expansion joints in piping systems, if located in a system which penetrates the unit's side and both the penetration and the non-metallic expansion joint are located below the deepest load waterline, are to be inspected as part of the dry-dock survey in **12.6, Part B** and replaced as necessary, or at an interval recommended by the manufacturer.

### 11.2.3 Safety Devices

**1** In view of exceptional conditions in which the explosion hazard may extend outside the hazardous areas, special arrangements are to be provided to facilitate the selective disconnection or shut-down of the facilities listed in the following **(1)** to **(5)**.

(1) Ventilation systems (excluding fans necessary for supplying combustion air to prime movers for generators)

(2) All electrical equipment (excluding that of a certified safe type for hazardous areas zone 1) installed in hazardous areas zone 2 and in non-hazardous areas

(3) Prime movers for main generators and their ventilating systems

(4) Emergency electrical equipment except that which is necessary to operate after an emergency shut-down according to the requirement in **-5**

(5) Prime movers for emergency generators

**2** In the case of units using dynamic positioning systems, disconnection or shut-down of machinery and equipment necessary for maintaining the operability of the dynamic positioning system is to be based on a shut-down logic system designed to preserve the

capability to maintain operational control over the integrity of the well and station keeping capability. Shut-down of generators and related power supply equipment needed for the operation of the dynamic positioning system are to be divided into independent groups to allow response to gas detection alarms while maintaining position keeping.

**3** Emergency shut-down facilities stipulated in **-1** are to be provided near the drilling console and at a suitable attended location outside the hazardous areas.

**4** Shut-down systems provided to comply with **-1** are to be so designed that the risk of unintentional stoppages caused by malfunction in a shut-down system and the risk of inadvertent operation of a shut-down are minimized.

**5** At least the facilities listed in the following **(1)** to **(5)** are to be operable after an emergency shut-down specified in **-1**. Equipment which is located in spaces other than enclosed spaces is to be suitable for installation in hazardous areas zone 2. Such equipment, when located in enclosed spaces, is to be suitable for its intended application to the satisfaction of the Society.

(1) Emergency lighting required by **12.2.3-3(1)** to **(4)** for 30 *minutes*

(2) Blow-out preventer control system

(3) General alarm system

(4) Public address system

(5) Battery supplied radio communication installations

**6** Alarm systems

(1) A suitable audible and visual alarm to indicate significant increase or decrease in the level of the contents of the mud pit is to be provided at the control station for drilling operations and at the mud pit. Where deemed appropriate by the Society, any other means may be substituted.

(2) Ventilation system alarms are to be in accordance with the requirements in **13.1.4**.

## 11.3 Storage Units

### 11.3.1 Scope

Machinery installations of the storage unit are to comply with the requirements in this **11.3** as well as the requirements in **11.1**.

### 11.3.2 General Requirements for Machinery Installations

Driving machinery for a storage oil pump other than a deep well pump or a submerged pump is to comply with the requirements in the following **(1)** to **(3)**.

(1) Where the driving machinery for a storage oil pump is a steam engine, it may be installed in the same compartment as the storage oil pump.

(2) Where the storage oil pump is driven by other prime mover than that stipulated in **(1)**, the prime mover is to be installed in a separate compartment partitioned from the pump room by a gas tight bulkhead or deck and the part where a shaft penetrates the bulkhead or deck is to be made to maintain gas tightness, providing with a suitable stuffing box. However, as for units which store oils having a flashpoint over 60℃ only, this requirement does not apply.

(3) The driving prime mover for a storage oil pump is to be so arranged as to be stopped from an accessible suitable position as well in the event of fire at the place where the prime mover is installed or its neighbourhood.

### 11.3.3 Auxiliaries and Piping Systems

**1** Auxiliaries and piping systems

With regard to auxiliaries and piping systems, the requirements in the following **(1)** to **(14)** are to be applied. However, in the case of units which store oils having a flashpoint over 60℃ only, the requirements may be properly modified.

(1) Pipes for the storage oil system are to be arranged separately from pipes for other purposes.

(2) Pipes for the storage oil system are not to pass through fuel oil tanks and other compartments where sources of ignition might exist.

(3) Piping for storage oil on the main deck is to be safely led well apart from the areas other than hazardous areas.

(4) Storage oil pumps are, as a rule, not to be used for other purposes than transfer of storage oil, transfer of storage oil tank cleaning water, transfer of ballast in case where storage oil tanks are used as ballast tanks and bilge suction.

(5) Where deep well pumps, submerged pumps, etc. are installed, construction of the pumps and driving systems are to be submitted for approval of the Society.

(6) Pumps used for ballasting of compartments adjoining to the storage oil tank or for bilge suction are not to be installed at the spaces other than hazardous areas specified in **13.1.3-2**.

(7) All storage oil tanks are to be provided with suitable sounding devices. The sounding devices are to be so constructed and arranged that hazardous gases will not flow into the spaces where sources of ignition might exist.

(8) The storage oil tanks are to be provided with suitable devices to prevent positive pressure and negative pressure in the tanks during storage and cargo handling. Where air pipes are provided for this purpose in the storage oil tanks, the air pipes are to be in accordance with the requirements in **4.5.3**, **Part R**.

(9) Transfer arrangements for storage oil such as pumps, valves, etc. for cargo handling are to be as far safe as practicable for trouble or mishandling and to be capable of shutting-off in case of emergency.

(10) Pouring-into-type oil-filling pipes provided in storage oil tanks are to be led to the bottom of tanks.

(11) Where communication pipes are provided to connect each one of storage oil tanks, the communication pipes are to be so arranged as to be closed in case of emergency.

(12) Storage oil tanks are to be provided with suitable measures to prevent freezing of oil in case of necessity according to the nature of oil stored. Where steam pipes for heating are provided for this purpose, the requirements in **14.2.9, Part D** are to be correspondingly applied.

(13) Piping arrangements for storage oil are to be earthed to the hull as necessary.

(14) Openings of storage oil tanks such as ullage holes are to be so arranged as can be fitted with flame screens.

**2** Inert gas systems

Where the inert gas system is provided, the requirements in **Chapter 35**, **Part R** are to be correspondingly applied.

### 11.3.4 Safety Measures

**1** General

The safety measures for the unit are to comply with the requirements in this **11.3.4**. Where, however, deemed unnecessary by the Society, their installation may be dispensed with.

**2** Detecting and indicating devices

The unit is to be provided with devices to automatically detect and indicate the matters listed in the following **(1)** to **(3)**. The devices stipulated, in general, are to be of centralized control system.

(1) Oil level and temperature of oil in the storage oil tanks, and oxygen concentration and oil vapour concentration in the tanks. However, the detection of oil level is to be of duplicate system or to be similarly arranged.

(2) Pressure and speed of flow in the storage oil transfer pipes.

(3) State of opening and closing of primary valves.

**3** Alarm systems

(1) The unit is to be provided with devices which automatically detect the matters listed in the following **(a)** to **(e)** and issue alarms at the space suitable to take necessary measures.

(a) Abnormality in the difference of oil levels in storage oil tanks

(b) Fire in the machinery spaces

(c) Abnormality in the concentration of combustible gases in the pump rooms

(d) Oil leakage

(e) Abnormality in the state of water filling in the cofferdams

(2) Detecting and alarming devices for oil leakage are to comply with the requirements listed in the following **(a)** to **(d)**.

(a) To detect the leakage instantly and to issue in case where oils leak into cofferdams.

(b) Devices for detection of leakage are to be installed at places where examination can be readily carried out.

(c) The material for metallic part of probe is to be corrosion resisting or to be sufficiently protected against corrosion.

(d) The alarming devices are to be as follows:

i) To be provided with trouble signals which continuously issue a sound signal until restored from trouble when something is wrong with the source of electrical power or electrical circuits.

ii) Manual stopping of each alarm system is to be clearly indicated.

(3) Monitoring and alarming devices for water filling are to comply with the requirements listed in the following **(a)** to **(d)**.

(a) To detect automatically the state of water filling in the cofferdams and, where any abnormality in the state might happen,

to issue alarm instantly.

(b) The devices to monitor the abnormality of the state of water filling are to be installed at the place where examination can be readily carried out.

(c) The material of metallic part of probe is to be corrosion resisting or to be sufficiently protected against corrosion.

(d) The alarming devices are to be in accordance with **(2)(d)**.

(4) Monitoring and alarming devices for combustible gases are to comply with the requirements listed in the following **(a)** to **(e)**.

(a) To monitor the concentration of combustible gases leaked into the compartment for which the concentration of combustible gases is intended to be monitored by the relevant devices and to issue an alarm automatically when the concentration gets to at least 1/4 of the lower explosion limit value.

(b) To be capable of predetermining a set valve for an alarm according to the kind of combustible gas to be detected.

(c) To be of construction to be safely used for combustible gases intended to be detected.

(d) The material of metallic part of probe is to be corrosion resisting or to be sufficiently protected against corrosion.

(e) To be provided with alarming devices to indicate the trouble of the devices.

# Chapter 12 ELECTRICAL INSTALLATIONS

## 12.1 General

### 12.1.1 Scope

**1** For electrical equipment, wirings and their control systems (hereinafter referred to as “electrical installations” in this Part), for mobile offshore units, storage units, plant barges, accommodation barges and units which have accommodation for particular personnel or passengers requirements in this **12.1** are to be applied.

**2** Electrical installations for units not listed in **-1** are to be deemed appropriate by the Society.

### 12.1.2 General

**1** For electrical installations other than those used for solely for the operation which is the purpose of the unit, relevant requirements in **Part H** listed in the following **(1)** to **(9)** as well as the requirements in this Chapter are to be applied.

(1) **1.1.2, Part H** General - General - Equivalency

(2) **1.1.3, Part H** General - General - Electrical Installations with Novel Design Features

(3) **1.1.5, Part H** General - General – Definitions

(4) **1.1.6, Part H** General - General - Drawings and Data

(5) **Chapter 2, Part H** Electrical Equipment and System Design

(6) **3.4, Part H** Design of Installations - Starting Arrangement for Emergency Generating Sets

(7) **3.7, Part H** Design of Installations - Lightning Conductors

(8) **3.8, Part H** Design of Installations - Spare Parts, tools and Instruments

(9) **Chapter 6, Part H** Special Requirements for Ships with Restricted Service and Small Ships

**2** For electrical installations used solely for the operation which is the purpose of the unit, as a rule, the relevant requirements in **Part H** listed in the following **(1)** to **(6)** as well as the requirements in **12.1.4-1** are to be applied. However, electrical installations which do not comply with the requirements in **Part H** may be in accordance with the standards deemed appropriate by the Society.

(1) **1.1.2, Part H** General - General - Equivalency

(2) **1.1.3, Part H** General - General - Electrical Installations with Novel Design Features

(3) **1.1.5, Part H** General - General – Definitions

(4) **1.1.6, Part H** General - General - Drawings and Data

(5) **Chapter 2, Part H** Electrical Equipment and System Design

(6) **Chapter 6, Part H** Special Requirements for Ships with Restricted Service and Small Ships

### 12.1.3 Tests*

**1** Electrical installations used for the systems or the equipment essential for the safety of the unit or for the propulsion of the unit (only applicable to the unit which has the main propulsion machinery) or dynamic positioning system specified in **Chapter 10**, and listed in the following **(1)** to **(5)** are to be tested in accordance with the respective requirements in **Part H** at the manufacturer’s works or at other works which provide with the adequate apparatus for testing and inspections. However, tests for any equipment with small capacities as specified in **(2)** and **(3)** are to be conducted as deemed appropriate by the Society.

(1) Generators

(2) Motors

(3) Control gears for motors

(4) Main and emergency switchboards

(5) Transformers for power and lighting of single phase 1*kVA* or more and three phase 5*kVA* or more

**2** For the electrical installations manufactured by mass- production system, test procedures suited to their production methods, despite of the requirements in **-1**, may be applied subject to the approval of the Society.

**3** Electrical installations used for the systems or the equipment essential for the safety of the unit or for the propulsion of the unit (only applicable to the unit which has the main propulsion machinery) and listed in the following **(1)** to **(6)** are to be subjected to type tests for each of product. However, in cases where it is inadequate to deal with them under the requirements for type tests (e.g.

those used only for specific ships or purposes with little possibility of continued use, or items for which the acquisition of individual test/inspection certificates is desired), tests and inspections of individual products may be accepted in place of type tests when requested by application.

(1) Fuses

(2) Circuit breakers

(3) Electromagnetic contactors

(4) Explosion-protected electrical equipment

(5) Cables for power, lighting and internal communications

(6) Semiconductor converters for power of not less than 5 *kW* that are used for supplying power to the electrical equipment specified in **-1(1)** to **(5)** above

**4** Electrical equipment and cables having a certificate considered acceptable to the Society may be exempted partially or wholly from the tests and inspections.

**5** Among electrical equipment used solely for the operation which is the purpose of the unit, fuses, circuit breakers, explosion-protected electrical equipment and cables are to be subjected to be in accordance with the requirement in **-3**. However, electrical installations which do not comply with this requirement may be accepted provided that the submission of documents such as specifications, sectional assembly drawings, test reports, certificates issued by public bodies for the examination by the Society.

**6** Electrical equipment used solely for the operation which is the purpose of the unit and not listed in **-5** may be in accordance with the standards deemed appropriate by the Society.

**7** For electrical installations used for the systems or the equipment essential for the safety of the unit or for the propulsion of the unit (only applicable to the unit which has the main propulsion machinery), performance tests specified in **2.18, Part H** are to be carried out after installed on board

**8** For electrical installations used solely for the operation which is the purpose of the unit, an insulation resistance test specified in **2.18.1, Part H** and performance tests of safety devices for generators and transformers are to be carried out after installed on board.

**9** The sources of electrical power regarded as the electrical installations used solely for the operation which is the purpose of the unit in accordance with the requirements in **12.1.5-4** are, after installed on board, to be subjected to running test, where deemed necessary by the Society, to ascertain that they will not affect the main source of electrical power.

**10** The Society may require, when deemed necessary, other tests than those specified in **12.1.3**.

### 12.1.4 General Requirements for Electrical Installations

**1** Electrical installations are, where practicable, to be excluded from any compartment in which explosives are stored. Where lighting is required, the light is to come from outside through the boundaries of the compartment. If electrical installations cannot be excluded from such a compartment, they are to be so designed and used as to minimize the risk of fire or explosion.

**2** Electrical installations are to be so designed to operate under the static conditions specified in **11.1.4-2**. The Society may permit deviation from the angles given in **11.1.4-2** taking into consideration the type, size and service conditions of the unit.

**3** Emergency electrical installations are to be so designed to operate at full rated power under the static conditions specified in **11.1.4-3**.

**4** Electrical installations are to be so designed to operate smoothly under the temperature conditions given in **Table P11.1**.

### 12.1.5 Main Source of Electrical Power and Lighting Systems*

**1** Every unit is to be provided with a main source of electrical power of sufficient capacity. This main source of electrical power is to consist of at least two generating sets.

**2** The capacity of these generating sets required by **-1** is to be such that in the event of any one generating set being stopped it will still be possible to supply electrical installations listed in the following **(1)** and **(2)**.

(1) Electrical installations necessary for maintaining the safety of the unit and the propulsion of the unit (only applicable to the unit which has the main propulsion machinery) in normal operational conditions. Electrical installations listed in the following **(a)** to **(f)** are to be included at the least.

(a) Navigation lights, other lights and sound signals required by national regulations or international regulations.

(b) Radio installations

(c) Fire detecting and extinguishing systems

(d) Ventilation of hazardous areas and those areas maintained at an overpressure to exclude the ingress of dangerous gases

(e) Bilge pumps

(f) Ballast pumps for column-stabilized units

(2) Electrical installations necessary to ensure minimum comfortable conditions of habitability which include at least adequate services for cooking, heating, domestic refrigeration, mechanical ventilation, sanitary and fresh water.

**3** Where transformers or converters constitute an essential part of the electrical supply system required by this **12.1.5**, the system is to be so arranged as to ensure the same continuity of the supply as is stated in **-1** and **-2**.

**4** For the unit for restricted areas, one set of main source of electrical power may be acceptable, but special consideration is to be paid if the unit has a large embarking capacity. Where, however, the navigation lights, signaling devices, etc. specified in **-2(1)(a)** are solely operated by electrical power, the unit is to be provided with an independent source of electrical power capable of operating these lights and devices in the event of failure of the main source of electrical power. Further, generators and prime movers as sources of electrical power provided from the necessity of the operation which is the purpose of the unit in addition to the main source of electrical power are regarded as equipment used solely for the operation, even when they are arranged to be used as a main source of electrical power.

**5** The requirements in **-1** to **-4** do not apply to the unit which is so designed that electrical power is supplied from other units or from the shore. However, the unit provided with navigation lights, signaling devices, etc. specified in **-2(1)(a)** is to be so designed as to be capable of operating these lights and devices without supply of electrical power from other units or from the shore.

**6** The main switchboard and one main generating station are to be located in a same space. However, main switchboard may be separated from the generators by an environmental enclosure, such as may be provided by a machinery control room situated within the main boundary of the space.

**7** A main lighting system supplied from the main source of electrical power is to be provided in spaces or compartments where crew and personnel use and normally work on duty.

**8** The main lighting system is to be so arranged as not to be impaired in the event of a fire or other casualty in spaces containing the emergency source of electrical power, associated transforming equipment (including converters, hereinafter the same), the emergency switchboard and the emergency lighting switchboard.

**9** The emergency lighting system required by **12.1.8-3(3)** and **12.2.3-3**, **12.3.3**, **12.4.2** or **12.5.2** and the navigation lights, signaling devices, etc. required by **12.2.4(2)** and **(3)**, **12.3.4(2)**, **12.4.3(2)** and **(3)** or **12.5.3(2)** and **(3)** are to be so arranged as not to be impaired in the event of a fire or other casualty in spaces containing the main source of electrical power, associated transforming equipment, the main switchboard and the main lighting switchboard.

### 12.1.6 Emergency Source of Electrical Power*

**1** Every unit is to be provided with a self-contained emergency source of electrical power.

**2** The emergency source of electrical power, the associated transforming equipment, the transitional source of emergency electrical power, the emergency switchboard and the emergency lighting switchboard are to be located above the worst damage waterline and in a space not within the assumed extent of damage referred to in **Chapter 4**, and are to be readily accessible from the open deck. They are not to be located forward of the collision bulkhead, if any.

**3** The location of the emergency source of electrical power, the associated transforming equipment, the transitional source of emergency electrical power, the emergency switchboard and the emergency lighting switchboard are to be such as to ensure to the satisfaction of the Society that a fire or other casualty in the space containing the main source of electrical power, the associated transforming equipment and the main switchboard, or in any machinery space of category A will not interfere with the supply, control and distribution of emergency electrical power. As far as practicable, the space containing the emergency source of electrical power, the associated transforming equipment, the transitional source of emergency electrical power and the emergency switchboard is not to be contiguous to the boundaries of machinery spaces of category A or to those spaces containing the main source of electrical power, the associated transforming equipment and the main switchboard, or to hazardous areas. Where the space could not be avoided to be contiguous to the boundaries, the contiguous boundaries are to comply with the requirements in **Chapter 14**.

**4** For the unit where the main source of electrical power is located in two or more spaces which have their own systems, including power distribution and control systems, completely independent of the systems in the other spaces and such that a fire or other casualty in any one of the spaces will not affect the power distribution from the others, or to the emergency services required by **12.1.8-4**, and **12.2.4**, **12.3.4**, **12.4.3** or **12.5.3**, the requirements of **-1** to **-3** may be considered satisfied without an additional emergency source of

electrical power, provided that the Society is satisfied with the following **(1)** to **(3)**.

(1) At least two generating sets meeting the requirements in **11.1.4-3** and each of sufficient capacity to meet the requirements in **12.1.8-4**, and **12.2.4**, **12.3.4**, **12.4.3** or **12.5.3**, in each of at least two spaces are provided.

(2) The arrangements required by **(1)** in each such space are equivalent to those required by **-7(1)**, **-8** to **-12** and **3.4, Part H** so that a source of electrical power is available at all times to the services required by **12.1.8-4**, and **12.2.4**, **12.3.4**, **12.4.3** or **12.5.3**.

(3) The location of each of the spaces referred to in **(1)** is in compliance with **-2** and the boundaries meet the requirements of **-3** except that contiguous boundaries are to consist of a steel bulkhead insulated to class "*A-60*" on both sides.

**5** Provided that suitable measures are taken for safeguarding independent emergency operation under all circumstances, the emergency generator may be used exceptionally and for short periods to supply non-emergency circuits.

**6** The emergency electrical power available is to be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously. The emergency source of electrical power is to be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the services required by **12.1.8-4**, and **12.2.4**, **12.3.4**, **12.4.3** or **12.5.3** for the periods specified hereinafter, if they depend upon an electrical source for their operation.

**7** The emergency source of electrical power is to be either a generator or an accumulator battery, which is to comply with the following.

(1) Where the emergency source of electrical power is a generator, it is to comply with the following **(a)** to **(c)**.

(a) The emergency generator is to be driven by a suitable prime mover with an independent supply of fuel, having a flashpoint (closed cup test) of not less than 43℃.

(b) The emergency generator is to be started automatically upon failure of the main source of electrical power supply unless a transitional source of emergency electrical power in accordance with **(c)** is provided. Where the emergency generator is automatically started, it is to be automatically connected to the emergency switchboard and those services referred to the requirements in **-8** are then to be connected automatically to the emergency generator.

(c) A transitional source of emergency electrical power as specified in **-8** is to be provided unless an emergency generator is provided capable both of supplying the services mentioned in **-8** and of being automatically started and supplying the required loads as quickly as is safe and practicable subject to a maximum of 45 *seconds*.

(2) Where the emergency source of electrical power is an accumulator battery, it is to be capable of:

(a) carrying the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage;

(b) automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power; and

(c) immediately supplying at least those services specified in **-8**.

**8** The transitional source of emergency electrical power where required by **-7(1)(c)** is to consist of an accumulator battery suitably located for use in an emergency which is to:

(1) operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage; and

(2) be of sufficient capacity and be so arranged as to supply automatically in the event of failure of either the main or the emergency source of electrical power for 30 *minutes* at least the following services if they depend upon an electrical source for their operation.

(a) The emergency lighting required by **12.1.8-4(1)**, and **12.2.4(1)**, **12.3.4(1)**, **12.4.3(1)** or **12.5.3(1)**. For this transitional phase, the required emergency electrical lighting, in respect of the machinery space, accommodation and service spaces may be provided by permanently fixed, individual, automatically charged, relay operated accumulator lamps.

(b) The navigation lights and signaling devices required by **12.2.4(2)**, **12.3.4(2)**, **12.4.3(2)** or **12.5.3(2)**.

(c) All services required by **12.1.8-4(2)(b)**, and **12.2.4(4)(a)**, **(c)** to **(e)** and **12.2.4(5)**, **12.3.4(3)**, **(6)** and **(7)**, **12.4.3(4)(a)**, **(c)** and **(d)** or **12.5.3(4)(a)**, **(c)** and **(d)** unless such services have an independent supply for the period specified from an accumulator battery suitably located for use in an emergency.

**9** The emergency switchboard is to be installed as near as is practicable to the emergency source of electrical power. Where the emergency source of electrical power is a generator, the emergency switchboard is to be located in the same space unless the

operation of the emergency switchboard would thereby be impaired.

**10** No accumulator battery fitted in accordance with this **12.1.6** is to be installed in the same space as the emergency switchboard, unless appropriate measures to the satisfaction of the Society are taken to extract the gases discharged from the said battery. An indicator is to be mounted in a suitable place on the main switchboard or in the machinery control room to indicate when the batteries constituting either the emergency source of electrical power specified in **-7(2)** or the transitional source of electrical power specified in **-8** are being discharged.

**11** An interconnector feeder connecting the emergency switchboard and the main switchboard is to be:

(1) adequately protected at the switchboard against overload and short circuit;

(2) disconnected automatically at the emergency switchboard upon failure of the main source of electrical power; and

(3) protected at the emergency switchboard at least against short circuit where the system is arranged for feedback operation.

In addition, the emergency switchboard is to be supplied during normal operation from the main switchboard.

**12** Arrangements are to be made where necessary to disconnect automatically non-emergency circuits from the emergency switchboard to ensure that electrical power shall be available automatically to the emergency circuits.

**13** Emergency electrical system is to be provided with measures for periodic testing. The periodic testing is to include the testing of automatic starting arrangements.

**14** For the unit for restricted areas, the Society may modify the application of the requirements in this **12.1.6**.

**15** With respect to the provisions of **-14** above, special consideration is to be paid to unit which has a large embarking capacity.

### 12.1.7 Internal Means of Communication

**1** An internal means of communication available for transfer of information between all spaces where action may be necessary in case of an emergency is to be provided.

**2** For column-stabilized units, a permanently installed internal means of communication, independent of the unit's main source of electrical power, is to be provided between the central ballast control station and spaces that contain ballast pumps or valves, or other spaces deemed necessary by the Society for the operation of the ballast system.

### 12.1.8 Additional Requirements for the Unit which has the Main Propulsion Machinery*

**1** Electrical installations of the unit which has the main propulsion machinery are to comply with the requirements in this **12.1.8** as well as the requirements in **12.1.2** to **12.1.7** and the relevant requirements in **Chapter 5, Part H**.

**2** Electrical installations are to be so designed to operate under static conditions specified in **11.1.4-2** and **-3** and under dynamic conditions specified in **11.1.15-7**. The Society may permit deviation from the angles specified taking into consideration the type, size and service conditions of the unit.

**3** Main source of electrical power and lighting systems

(1) The arrangements of the unit's main source of electrical power are to be such that the services referred to in **12.1.5-2** can be maintained regardless of the speed and direction of the propulsion machinery or shafting.

(2) The generating sets are to be such as to ensure that with any one generator or its primary source of power out of operation, the remaining generating sets are to be capable of providing the electrical services necessary to start the main propulsion plant from a dead ship condition. The emergency source of electrical power may be used for the purpose of starting from a dead ship condition if its capability either alone or combined with that of any other source of electrical power is sufficient to provide at the same time those services required to be supplied by the requirements in **12.2.4**, **12.3.4**, **12.4.3** or **12.5.3**.

(3) At the steering gear, emergency lighting providing sufficient illumination necessary for the safety is to be provided.

**4** Emergency source of electrical power

In addition to complying with **12.1.6**, the emergency source of electrical power is to be capable of supplying simultaneously the following services for the period specified hereinafter.

(1) For a period of 18 *hours*, emergency lighting specified in **-3(3)**.

(2) For a period of 18 *hours*, services listed in the following unless such services have an independent supply for the period of 18 *hours* from an accumulator battery suitably located for use in an emergency.

(a) Navigational aids as required by Regulations 19 and 20, Chapter V, the Annex to *SOLAS* Convention unless the flag Government exempts the unit from application of said regulation

(b) Intermittent operation of the daylight signalling lamp and the unit's whistle

(3) For a period of 10 *minutes*, a steering gear where it is required to be so supplied by **15.2.6, Part D**.

## 12.2 Mobile Offshore Drilling Units

### 12.2.1 Scope

Electrical installations of the mobile offshore drilling unit are to comply with the requirements in this 12.2 as well as the requirements in 12.1.

### 12.2.2 General Requirements for Electrical Installations

All machinery, metal structures of drilling towers, masts and helicopter platforms, in case where effective earthing can not be expected structurally, are to be effectively earthed.

### 12.2.3 Main Source of Electrical Power and Lighting Systems*

**1** In cases where main sources of electrical power are necessary for the propulsion and steering of ships, systems are to be arranged so that electrical supplies to equipment necessary for propulsion and steering and to ensure ship safety will be maintained or immediately restored in cases where there is the loss of any one of the generators in service.

**2** In cases where electrical sources are necessary to restore propulsion, capacities of emergency sources of power is to be sufficient to restore propulsion to ships from dead ship conditions within a period of 30 *minutes* after a blackout.

**3** Emergency lighting providing sufficient illumination necessary for the safety is to be provided:

(1) at every muster and embarkation station, and over sides;

(2) in all service and accommodation alleyways, stairways and exits, personnel lift cars, and personnel lift trunks;

(3) in the machinery spaces and main generating stations including their control positions;

(4) in all control stations, machinery control rooms, and at each main and emergency switchboard;

(5) at all stowage positions for firemen's outfit;

(6) at the fire pumps, at the sprinkler pumps and at the emergency bilge pumps, and at the starting positions of their motors;

(7) in all spaces from which control of the drilling process is performed and where controls of machinery essential for the performance of this process, or devices for emergency switching-off of the power plant are located; and

(8) on helicopter landing decks.

### 12.2.4 Emergency Source of Electrical Power*

The emergency source of electrical power is to be capable of supplying simultaneously the services listed in the following **(1)** to **(10)** for the period specified hereinafter if they depend upon an electrical source for their operation.

(1) For a period of 18 *hours*, emergency lighting specified in 12.2.3.

(2) For a period of 18 *hours*, navigation lights, other lights and sound signals required by national regulations or international regulations.

(3) For a period of 4 *days*, any signalling lights or sound signals which may be required for marking of offshore structures.

(4) For a period of 18 *hours*, the services listed in the following unless such services have an independent supply for the period of 18 *hours* from an accumulator battery suitably located for use in an emergency.

(a) All internal communication equipment as required in an emergency.

(b) Installations listed in the following **i)** to **iv)** as required by Chapter IV, the Annex to *SOLAS* Convention and installed in the unit. Where, however, those radio installations are installed in duplicate, it is not necessary to consider duplicated installations are operated simultaneously in determining capacity of the emergency source of electrical power.

i) *VHF* radio installations

ii) *MF* radio installations

iii) Recognized mobile satellite service ship earth stations

iv) *MF/HF* radio installations

(c) Fire and gas detection and their alarm systems.

(d) Manual fire alarms and all internal signals that are required in an emergency.

(e) Devices of closing the blow-out preventer and of disconnecting the unit from the well head arrangement, if electrically controlled.

(5) For a period of 30 *minutes*, safety devices required by 11.2.3.

(6) For a period of 18 *hours*, one of the fire pumps if dependent upon the emergency generator for its source of power.

(7) For a period of 18 *hours*, permanently installed diving equipment.

(8) On column-stabilized units, for a period of 18 *hours*, the services listed in the following **(a)** and **(b)**.
  (a) Any of the ballast pumps required by **11.1.9-3**. Only one of the connected pumps need be considered to be in operation at any time.
  (b) Ballast control and indicating systems required by **11.1.9-8**.

(9) For a period of 30 *minutes*, the services listed in the following **(a)** and **(b)**.
  (a) Devices to operate the watertight doors required by **5.2.2**, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided.
  (b) Control devices and indicators required by **5.2.2**.

(10) In every ship of 10,000 gross tonnage or above for at least 30 minutes and in any other ship for at least 10 minutes, steering gear designed to receive emergency generators according to the requirements in **15.2.6, Part D**.

## 12.3 Storage Units

### 12.3.1 Scope

Electrical installations of the storage unit are to comply with the requirements in this **12.3** as well as the requirements in **12.1**.

### 12.3.2 General Requirements for Electrical Installations

**1** High voltage electrical installations

(1) The high voltage electrical equipment and high voltage cables to be connected to the high voltage distribution system on shore, and their tests are, notwithstanding the requirements in **2.17, Part H**, to be at the discretion of the Society.

(2) In case where distribution system with neutral earthed is adopted in relation to the electrical installations on shore, in the case specified in **(1)**, the requirements in the following **(a)** to **(c)** are also to be applied.
  (a) The earthing of neutral is to be made on shore, and the hull of the unit and the shore are to be electrically effectively connected.
  (b) Electrical equipment is to be arranged so that the earth current would not flow in the hazardous areas.
  (c) Where a transformer is provided for low voltage circuits, the transformer is to be of such type as an isolator being inserted between the primary winding and the secondary winding and the isolator is to be effectively earthed.

**2** Electrical installations in the spaces other than hazardous areas

It must be considered that the range of hazardous areas on the storage unit will be expanded than that specified in **13.1.3-2** in the event of transferring oils into storage oil tanks and conducting gas-freeing operations in tanks. For this reason, as for the electrical equipment among that installed in the unit which is not necessary to be used during these operations, it is to be arranged so that power supply can be stopped during operations providing disconnecting switches in the spaces outside the hazardous areas. And, electrical equipment which is necessary to be used during these operations, even it is installed outside the hazardous areas, is to be constructed not to be the source of ignition in a normal condition.

### 12.3.3 Main Source of Electrical Power and Lighting Systems

Emergency lighting providing sufficient illumination necessary for the safety is to be provided:

(1) at a central control room;

(2) at machinery spaces including pump rooms;

(3) at spaces where emergency sources of electrical power are installed; and

(4) at any other spaces deemed essential for security.

### 12.3.4 Emergency Source of Electrical Power

The emergency source of electrical power is to be capable of supplying simultaneously the services listed in the following **(1)** to **(10)** for a period of 24 *hours* (30 *minutes* in case of **(9)** ) if they depend upon an electrical source for their operation.

(1) Emergency lighting specified in **12.3.3**.

(2) Navigation lights, other lights and sound signals required by national regulations or international regulations.

(3) Emergency shut-off devices for storage oil transfer systems.

(4) Closing and opening devices for primary valves.

(5) Fire detecting and extinguishing systems

(6) Safety devices stipulated in **11.3.4**.

(7) Communication systems.

(8) On column-stabilized units, for a period of 18 *hours*, the services listed in the following **(a)** and **(b)**.

(a) Any of the ballast pumps required by **11.1.9-3**. Only one of the connected pumps need be considered to be in operation at any time.

(b) Ballast control and indicating systems required by **11.1.9-8**.

(9) For a period of 30 *minutes*, the services listed in the following **(a)** and **(b)**.

(a) Devices to operate the watertight doors required by **5.2.2**, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided.

(b) Control devices and indicators required by **5.2.2**.

(10) Any other devices deemed essential for security.

## 12.4 Units which are Engaged In a Special Work and are Stationed for a Long Period of Time

### 12.4.1 Scope

**1** Electrical installations for the unit, such as a plant barge, which is engaged in a special work and is stationed for a long period of time are to comply with the requirements in this **12.4** as well as the requirements in **12.1**.

**2** For electrical installations for the unit which is engaged in works with danger of a fire or an explosion, the requirements in **12.2** and **12.3** are to be correspondingly applied.

**3** For electrical installations for the unit of which electrical power is intended to be supplied from the shore, the Society may modify the application for the requirements in **12.1** and in this **12.4**.

**4** For electrical installations for the unit which has a large embarking capacity, the Society requires additional requirements in addition to the requirements in this **12.4**.

### 12.4.2 Main Source of Electrical Power and Lighting Systems

**1** Where the source of electrical power for the facilities for the factory is utilized as the main source of electrical power specified in **12.1.5**, this source of electrical power is to be capable of supplying electrical power to the systems or equipment essential for the safety of the unit even while necessary electrical power is supplied to the facilities for the factory.

**2** For the unit for which it is deemed impracticable to utilize the main source of electrical power while being towed and the unit to which electrical power is intended to be supplied from the shore, a suitable source of electrical power is to be provided to supply electrical power necessary during being towed. However, this source of electrical power may be a temporary equipment.

**3** Emergency lighting providing sufficient illumination necessary for the safety is to be provided:

(1) at every muster and embarkation station;

(2) in all service and accommodation alleyways, stairways and exits, personnel lift cars, and personnel lift trunks;

(3) in the machinery spaces and main generating stations including their control positions;

(4) in all control stations, machinery control rooms, and at each main and emergency switchboard;

(5) at all stowage positions for firemen's outfit;

(6) at the fire pumps, at the sprinkler pumps and at the emergency bilge pumps, and at the starting positions of their motors; and

(7) on helicopter landing decks.

### 12.4.3 Emergency Source of Electrical Power*

The emergency source of electrical power is to be capable of supplying simultaneously the services listed in the following **(1)** to **(7)** for the period specified hereinafter if they depend upon an electrical source for their operation.

(1) For a period of 18 *hours*, emergency lighting specified in **12.4.2-3**.

(2) For a period of 18 *hours*, navigation lights, other lights and sound signals required by national regulations or international regulations.

(3) For a period of 4 *days*, any signalling lights or sound signals which may be required for marking of offshore structures.

(4) For a period of 18 *hours*, the services listed in the following unless such services have an independent supply for the period of 18 *hours* from an accumulator battery suitably located for use in an emergency.

(a) All internal communication equipment as required in an emergency.

(b) Installations listed in the following **i)** to **iv)** as required by Chapter *IV*, the Annex to *SOLAS* Convention and installed in

the unit. Where, however, those radio installations are installed in duplicate, it is not necessary to consider duplicated installations are operated simultaneously in determining capacity of the emergency source of electrical power.

i) *VHF* radio installations

ii) *MF* radio installations

iii) Recognized mobile satellite service ship earth stations

iv) *MF/HF* radio installations

(c) Fire and gas detection and their alarm systems.

(d) Manual fire alarms and all internal signals that are required in an emergency.

(5) For a period of 18 *hours*, one of the fire pumps if dependent upon the emergency generator for its source of power.

(6) On column-stabilized units, for a period of 18 *hours*, the services listed in the following.

(a) Any of the ballast pumps required by **11.1.9-3**. Only one of the connected pumps need be considered to be in operation at any time.

(b) Ballast control and indicating systems required by **11.1.9-8**.

(7) For a period of 30 *minutes*, the services listed in the following.

(a) Devices to operate the watertight doors required by **5.2.2**, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided.

(b) Control devices and indicators required by **5.2.2**.

## 12.5 Units which have Accommodation for Particular Personnel or Passengers

### 12.5.1 Scope

**1** Electrical installations for the unit which has an accommodation for particular personnel or passengers, such as an accommodation barge, are to comply with the requirements in this **12.5** as well as the requirements in **12.1**.

**2** For electrical installations for the unit of which electrical power is intended to be supplied from the shore, the Society may modify the application for the requirements in **12.1** and in this **12.5**.

**3** For electrical installations for the unit which has a small embarking capacity, the Society may modify the application for the requirements in **12.5.2** and **12.5.3**.

### 12.5.2 Main Source of Electrical Power and Lighting Systems

Emergency lighting providing sufficient illumination necessary for the safety is to be provided:

(1) at every muster and embarkation station;

(2) in all service and accommodation alleyways, stairways and exits, personnel lift cars, and personnel lift trunks;

(3) in the machinery spaces and main generating stations including their control positions;

(4) in all control stations, machinery control rooms, and at each main and emergency switchboard;

(5) at all stowage positions for firemen's outfit;

(6) at the fire pumps, at the sprinkler pumps and at the emergency bilge pumps, and at the starting positions of their motors; and

(7) on helicopter landing decks.

### 12.5.3 Emergency Source of Electrical Power*

The emergency source of electrical power is to be capable of supplying simultaneously the services listed in the following **(1)** to **(7)** for the period specified hereinafter if they depend upon an electrical source for their operation.

(1) For a period of 36 *hours*, emergency lighting specified in **12.5.2**.

(2) For a period of 36 *hours*, navigation lights, other lights and sound signals required by national regulations or international regulations.

(3) For a period of 4 *days*, any signalling lights or sound signals which may be required for marking of offshore structures.

(4) For a period of 36 *hours*, the services listed in the following unless such services have an independent supply for the period of 36 *hours* from an accumulator battery suitably located for use in an emergency.

(a) All internal communication equipment as required in an emergency.

(b) Installations listed in the following **i)** to **iv)** as required by Chapter *IV*, the Annex to *SOLAS* Convention and installed in the unit. Where, however, those radio installations are installed in duplicate, it is not necessary to consider duplicated

installations are operated simultaneously in determining capacity of the emergency source of electrical power.

i) *VHF* radio installations

ii) *MF* radio installations

iii) Recognized mobile satellite service ship earth stations

iv) *MF/HF* radio installations

(c) Fire and gas detection and their alarm systems.

(d) Manual fire alarms and all internal signals that are required in an emergency.

(5) For a period of 36 *hours*, one of the fire pumps if dependent upon the emergency generator for its source of power.

(6) On column-stabilized units, for a period of 36 *hours*, the services listed in the following.

(a) Any of the ballast pumps required by **11.1.9-3**. Only one of the connected pumps need be considered to be in operation at any time.

(b) Ballast control and indicating systems required by **11.1.9-8**.

(7) For a period of 30 *minutes*, the services listed in the following.

(a) Devices to operate the watertight doors required by **5.2.2**, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided.

(b) Control devices and indicators required by **5.2.2**.

# Chapter 13 MACHINERY INSTALLATIONS, ELECTRICAL INSTALLATIONS, AND SO ON IN HAZARDOUS AREAS

## 13.1 General

### 13.1.1 Scope

For machinery installations, electrical installations, and so on installed in hazardous areas, requirements in this Chapter are to be applied.

### 13.1.2 General

Hazardous areas as specified in 13.1.3 may be extended or reduced depending on the actual arrangements in each case, by use of windshields, special ventilation arrangements, structural arrangements, etc.

### 13.1.3 Hazardous Areas

**1** Mobile offshore drilling units

Hazardous areas for the mobile offshore drilling unit are, at least, to be as listed in the following **(1)** to **(3)**. In addition, hazardous areas not covered in following **(1)** to **(3)**(such as, but not limited to, well test equipment areas, helicopter fuel storage areas, acetylene cylinder storage areas, battery rooms, paint lockers, flammable gas or vapour vents and diverter line outlets) are to be classified in accordance with 1.2.16.

(1) Hazardous areas zone 0

The internal spaces of closed tanks and pipes in which active non-degassed drilling mud, oil that has a closed-cup flashpoint below 60°*C* or flammable gas and vapour, as well as produced oil and gas in which an oil/gas/air mixture is continuously present or present for long periods.

(2) Hazardous areas zone 1

(a) Enclosed spaces containing any part of the mud circulating system that has an opening into the spaces and is between the well and the final degassing discharge.

(b) In outdoor or semi-enclosed locations, except as provided for in **(d)**, the area within 1.5*m* from the boundaries of any openings to equipment which is part of the mud system as specified in **(a)**, any ventilation outlets of hazardous areas zone 1, or any access to hazardous areas zone 1.

(c) Pits, ducts or similar structures in locations which would otherwise be hazardous areas zone 2 but which are so arranged that the dispersion of gas may not occur.

(d) Enclosed spaces or semi-enclosed locations that are below the drill floor and contain a possible source of release such as the top of a drilling nipple.

(e) Enclosed spaces that are on the drill floor and which are not separated by a solid floor from the spaces in **(d)**.

(f) Outdoor locations below the drill floor and within a radius of 1.5 *m* from a possible source of release such as the top of a drilling nipple.

(3) Hazardous areas zone 2

(a) Enclosed spaces which contain open sections of the mud circulating system from the final degassing discharge to the mud pump suction connection at the mud pit.

(b) Outdoor locations within the boundaries of the drilling derrick up to a height of 3*m* above the drill floor.

(c) Semi-enclosed towers to the extent of their enclosures above the drill floor or to a height of 3*m* above the drill floor, whichever is greater.

(d) Semi-enclosed locations below and contiguous to the drill floor and to the boundaries of the tower or to the extent of any enclosure which is liable to trap gases.

(e) Outdoor locations below the drill floor and within a radius of 1.5 *m* beyond the zone 1 area specified in **(2)(f)**.

(f) The areas 1.5*m* beyond the hazardous areas zone 1 specified in **(2)(b)** and beyond the semi-enclosed locations specified in **(2)(d)**.

(g) Outdoor areas within 1.5*m* of the boundaries of any ventilation outlet from or access to hazardous areas zone 2.

(h) Air locks between a zone 1 and a non-hazardous area.

**2** Storage units

(1) Hazardous areas for the storage unit which stores oils having a flashpoint of 60℃ and under are, at least, to be as listed in the following **(a)** to **(j)**.

(a) Storage oil tanks.

(b) Enclosed spaces and semi-enclosed spaces adjacent to storage oil tanks. The spaces which adjoin to the storage oil tanks by point-contact or line-contact are to be included.

(c) Storage oil pump rooms.

(d) Enclosed spaces and semi-enclosed spaces to which cargo pipes are fitted.

(e) Compartments in which cargo hoses are housed.

(f) Open areas and semi-enclosed spaces within 3*m* away from the openings of storage oil tanks.

(g) Areas from 9*m* above the openings of vapour pipes to the deck.

(h) Open areas 2.4*m* high above the exposed deck (the outer surface of the storage oil tank in case where the surface is above the exposed deck) and to 3*m* outside the outer surface of the storage oil tank.

(i) Open areas and semi-enclosed spaces within 3*m* apart from entrances and ventilation outlets of the spaces specified in **(b)** to **(e)**.

(j) Enclosed spaces and semi-enclosed spaces which have direct openings to the spaces or are as specified in **(a)** to **(i)**.

(2) Hazardous areas for the storage unit which stores oils having a flashpoint exceeding 60℃ are to be deemed appropriate by the Society.

**3** Units which are engaged in works with danger of a fire or an explosion

For hazardous areas for the unit which is engaged in works with danger of a fire or an explosion, requirements in **-1** or **-2** or requirements for tankers are to be correspondingly applied.

### 13.1.4 Openings, Access and Ventilation Conditions Affecting the Extent of Hazardous Areas for the Mobile Offshore Drilling Units

**1** Except where necessary for the safety and operation of the unit, access doors or other openings are not to be provided in the locations specified in the following **(1)** and **(2)**.

(1) Between a hazardous area zone 2 and a hazardous area zone 1

(2) Between a non-hazardous area and a hazardous area.

**2** Where access doors or other openings having a direct access to any hazardous area zone 1 or zone 2 are provided in enclosed spaces other than hazardous areas zone 1 and zone 2, the areas are regarded as the areas of the same hazard as that of the area with direct access through the access doors or other openings, except those indicated in the following **(1)** to **(3)**.

(1) An enclosed space with a direct access to any hazardous area zone 1 can be considered as a hazardous area zone 2 if:

(a) the access is fitted with a gas tight door opening into the hazardous area zone 2;

(b) ventilation is such that the air flow with the door open is from the hazardous area zone 2 into the hazardous area zone 1; and

(c) loss of ventilation is alarmed at an attended station.

(2) An enclosed space with a direct access to any hazardous area zone 1 is not considered hazardous if:

(a) the access doors of self-closing gas tight type are provided in duplicate to form an air lock. Where, however, the Society recognizes that the ventilation system for the space is sufficient to prevent the inflow of gases from the hazardous area zone 1, single access door of self-closing gas tight type may be provided with. The door is to be opened into the space only and no holding device to keep the door open is to be provided;

(b) the space has ventilation overpressure in relation to the hazardous area; and

(c) loss of ventilation overpressure is alarmed at an attended station.

(3) An enclosed space with a direct access to any hazardous area zone 2 is not considered hazardous if:

(a) the access is fitted with a self-closing gas tight door that opens into the non-hazardous area;

(b) ventilation is such that the air flow with the door open is from the non-hazardous area into the hazardous areas zone 2; and

(c) loss of ventilation is alarmed at an attended station.

**3** Hold-back devices are not to be used on self-closing gastight doors forming hazardous area boundaries.

## 13.2 Ventilation Systems

### 13.2.1 Mobile Offshore Drilling Units*

**1** Attention is to be given to ventilation inlet and outlet locations and airflow in order to minimize the possibility of cross contamination.

**2** Inlets are to be located in non-hazardous areas as high and far away from any hazardous area as practicable.

**3** Each air outlet is to be located in an outdoor area which, in the absence of the considered outlet, is of the same or lesser hazard than the ventilated space.

**4** Where the inlet duct passes through a more hazardous area, the inlet duct is to have overpressure in relation to this area; where the inlet duct passes through a less hazardous area, the inlet duct is to have underpressure in relation to this area.

**5** Ventilation for hazardous areas is also to be in accordance with the requirements in the following **(1)** to **(7)**.

(1) Ventilation for hazardous areas is to be completely separate from that used for non-hazardous areas.

(2) The enclosed hazardous areas are to be adequately ventilated so that the areas are maintained with underpressure in relation to the less hazardous areas.

(3) The arrangement of ventilation inlet and outlet openings in the space is to be such that the entire space is efficiently ventilated, giving special consideration to location of equipment which may release gases, and to spaces where gases may accumulate.

(4) The outlet air from hazardous areas zone 1 and zone 2 is to be led in separate ducts to the outdoor locations. The internal spaces of such ducts are to be regarded as the spaces of the same hazard as the ventilated spaces.

(5) Air inlet ducts designed for constant relative underpressure are to be rigidly constructed to avoid air leaks.

(6) Fans are to be designed so as to reduce the risk that sparks may occur.

(7) Hazardous enclosed mud processing spaces are to be ventilated at a minimum rate of 12 air changes per hour.

### 13.2.2 Storage Units*

**1** Large sized storage units

(1) Except for compartments used as tanks, the compartments adjacent to a storage oil tank are to be provided with effective ventilation systems.

(2) Storage oil pump rooms are to be provided with exhaust-type mechanical ventilation systems in accordance with the requirements in the following **(a)** to **(d)**.

(a) To have ventilating capacity of 20 *times* or more per *hour* for the total volume of the pump room.

(b) To arrange openings of exhaust ducts considering not to keep gases stay in part of the pump room.

(c) Fans are to be constructed so as not to emit sparks.

(d) Driving motors for fans are to be installed outside the ventilation ducts. Where, however, it is unavoidable from arrangement, motors installed in the ventilation ducts may be used. In this case, the motors are to be flame-proof and sufficient consideration is to be given to the construction and arrangement of housing of fans so that maintenance and examination are readily made.

(3) Storage oil tanks are to be provided with ventilation systems necessary for gas-freeing operation in the tanks.

(4) As for a storage unit which stores oils having a flashpoint exceeding 60℃ only, the requirements, in **(2)** with regard to the ventilating capacity, the construction of fans and arrangement of motors may be properly modified.

(5) The mechanical ventilating system is to be arranged so as to be stopped from any other accessible suitable position in the event of fire at the place where the system is installed or its neighbourhood.

**2** Other storage units

Ventilation systems for storage units other than large sized storage units are to comply with requirements in **Chapter 14, Part D**.

### 13.2.3 Units Engaged In Works with Danger of a Fire or an Explosion

For ventilation systems of the unit engaged in works with danger of a fire or an explosion, requirements in **13.2.1** or **13.2.2** or requirements for tankers are to be correspondingly applied.

## 13.3 Machinery Installations in Hazardous Areas

**13.3.1 General**

**1** Machinery installations in hazardous areas are to be limited to those essential for operational purposes.

**2** Machinery installations in hazardous areas are to be so constructed and installed as to reduce the risk of ignition from sparking due to the formation of static electricity or friction between moving parts and from high temperatures of exposed parts due to exhausts or other emissions.

**13.3.2 Mobile Offshore Drilling Units**

**1** Combustion engines, as a rule, are not to be installed in hazardous areas. Where this cannot be avoided, internal combustion engines may be installed in hazardous areas provided that the Society approves and sufficient precautions listed in the following **(1)** to **(3)** have been taken against the risk of dangerous ignitions.

(1) Exhaust outlets are to be fitted with suitable spark arresting devices and to be located outside hazardous areas.

(2) Where exhaust pipes are insulated, the insulation is to be protected against possible oil absorption.

(3) Air intakes are not to be less than 3*m* apart from any hazardous area.

**2** Fired boilers, as a rule, are not to be installed in hazardous areas. Where this cannot be avoided, fired boilers may be installed in hazardous areas zone 2 provided that the Society approves and sufficient precautions listed in the following **(1)** and **(2)** have been taken against the risk of dangerous ignitions.

(1) Exhaust outlets are to be located outside hazardous areas.

(2) Where exhaust pipes are insulated, the insulation is to be protected against possible oil absorption.

**13.3.3 Storage Units**

Fired boilers or combustion engines are not to be installed in hazardous areas. As for air intakes and exhaust pipes for them, they are to be in accordance with the requirements in the following **(1)** to **(4)**.

(1) Exhaust outlets are to be fitted with suitable spark arresting devices.

(2) The outer surface of the exhaust pipe is to be cooled by water, etc. or to be properly insulated.

(3) Exhaust outlets are to be located outside hazardous areas and as far away from outlets of air pipes of storage oil tanks as practicable.

(4) Air intakes for the internal combustion engine are not to be hazardous areas.

**13.3.4 Units which are Engaged In Works with Danger of a Fire or an Explosion**

For machinery installations of the unit which is engaged in works with danger of a fire or an explosion, requirements in 13.3.2 or 13.3.3 or requirements for tankers are to be correspondingly applied.

## 13.4 Electrical Installations in Hazardous Areas

**13.4.1 General**

**1** Electrical installations are not to be installed in hazardous areas unless essential for operational purposes. Where installation of electrical installations is unavoidable, it is to comply with requirements in this 13.4.

**2** Distribution system

(1) Notwithstanding the requirement in 2.2.1-1, Part H, the system of power supply is to be one of the following.

(a) Two-wire insulated for *d. c.* system

(b) Single-phase two-wire insulated for *a. c.* system

(c) Three-phase three-wire insulated for *a. c.* system

(2) Notwithstanding the requirement in **(1)**, a hull return distribution system may be used for the systems listed in 2.2.1-2(1) to **(3), Part H**.

(3) Notwithstanding the requirement in **(1)**, an earthed distribution system may be used for the following systems.

(a) Intrinsically safe circuits

(b) Power supplies, control circuits and instrumentation circuits where technical or safety reasons preclude the use of a system with no connection to earth, provided the current in the hull is limited to not more than 5*A* in both normal and fault conditions

(c) Limited and locally earthed systems, provided that any possible resulting current does not flow directly through any dangerous spaces

(d) *A. C.* power networks of 1,000*V* root mean square (line to line) and over, provided that any possible resulting current does not flow directly through any dangerous spaces

**3** Explosion-protected electrical equipment is to comply with the requirements in **2.16, Part H** and to be certified that it is safety usable in the explosive gas atmosphere concerned.

**4** Electrical measuring, monitoring, control and communication apparatuses are to be of intrinsically safe type. Where it is, however, technically impracticable to meet this requirement, electrical equipment of other explosion-protected construction as deemed appropriate by the Society may be used as an alternative to category '*ib*' intrinsically safe type electrical equipment.

**5** Portable lamps are to be of intrinsically safe type, flameproof type or increased safety type with self contained battery or of air-driven type with pressurized enclosure.

**6** Switch gears installed in feeder circuits for explosion protected electrical equipment in hazardous areas are to be provided with effective means for preventing dangers arising from miss operation, except for the intrinsically safe circuits, in addition to the compliance with the requirements in **2.2.12-2, Part H**.

**7** Aerials and associated riggings are to be sited well clear of gas or vapour outlets.

**8** As a rule, no portable electrical equipment is to be located in hazardous areas. Where it is unavoidable to locate, it is subjected to the approval of the Society.

**9** Wiring in hazardous areas

(1) Cables are to be one of the following. Where corrosion may be expected, a *PVC* or chloroprene sheath is to be applied over armour or metallic sheath of cables for corrosion protection.
  (a) Mineral insulated and copper sheathed
  (b) Lead alloy sheathed and metal armoured
  (c) Non-metallic sheathed and metal armoured

(2) Installation of cables is to comply with the following.
  (a) Cables are to be installed as close to the hull centre line as practicable.
  (b) Cables are to be installed sufficiently distant from decks, bulkheads, tanks and various kinds of pipes.
  (c) Cables are, as a rule, to be protected against mechanical damage. Further, the cables and their supports are to be fitted in such a manner as to withstand expansion and construction and other effects of the hull structure.
  (d) The penetration part of the cables or cable pipes through decks and bulkheads of the dangerous spaces is to be constructed so as to maintain gas-tightness and liquid-tightness as the case may require.
  (e) When mineral insulated cables are used, special precautions are to be taken to ensure sound terminations.

(3) Power and lighting cables are to be in accordance with the requirements specified in **4.2.4-7, Part H**.

### 13.4.2 Mobile Offshore Drilling Units

**1** Electrical installations permitted in hazardous areas are as follows.

(1) Hazardous areas zone 0
  (a) Category 'ia' intrinsically safe type electrical equipment and associated cables

(2) Hazardous areas zone 1
  (a) Intrinsically safe type electrical equipment and associated cables
  (b) Flame-proof type electrical equipment and associated cables
  (c) Pressurized type electrical equipment and associated cables
  (d) Increased safety type electrical equipment and associated cables. For increased safety type motors, due consideration is to be given to the protection against overcurrent.
  (e) Through run cables
  (f) Encapsulation type electrical equipment and associated cables
  (g) Oil immersion type electrical equipment and associated cables. For transportable apparatus, is not to be use.
  (h) Powder filling type electrical equipment and associated cables

(3) Hazardous areas zone 2
  (a) Intrinsically safe type circuits or equipment and associated cables
  (b) Flame-proof type electrical equipment and associated cables
  (c) Pressurized type electrical equipment and associated cables

(d) Increased safety type electrical equipment and associated cables. For increased safety type motors, due consideration is to be given to the protection against overcurrent.

(e) Any electrical equipment of the type which ensures the absence of sparks or arcs and no part of such equipment has an operating temperature which can cause the ignition of gases or vapours liable to exist, and associated cables

(f) Through run cables

(g) Encapsulation type electrical equipment and associated cables

(h) Oil immersion type electrical equipment and associated cables. For transportable apparatus, is not to be use.

(i) Powder filling type electrical equipment and associated cables

(j) Equipment specially approved for use in this zone by the Society

**2** Electrical apparatus are to be so selected that its maximum surface temperature will not reach ignition temperature of any gas/vapour possibly presenting in the hazardous areas in which the electrical apparatus is located. The relationship among equipment temperature class, equipment maximum surface temperature, gas/vapour ignition temperature is shown in **Table P13.1**.

**3** Electrical cables are to meet the following;

(1) Thermoplastic sheathed cables, thermosetting sheathed cables or elastomeric sheathed cables are to be used for fixed wiring in zone 2 areas.

(2) Permanently installed, fixed cable passing through zone 1 hazardous areas are to be fitted with conductive covering, braiding or sheathed for earth detection.

**4** Group selection for electrical equipment is to be as follows:

(1) Group *II* in accordance with *IEC* 60079 is to be selected for increased safety type, encapsulation type, type "n" protection, oil immersion type, pressurized type, powder filling type and equipment specially approved for use in this zone by the Society.

(2) Group *IIA*, *IIB* or *IIC* in accordance with *IEC* 60079 is to be selected for intrinsically safe type, flame-proof type, and certain types of "n" protection.

(3) Electrical apparatus located in hazardous drilling well and mud processing areas are to meet at least Group *IIA* in accordance with *IEC* 60079 and temperature class *T*3.

Table P13.1 Relationship among Temperature Class, Maximum Surface Temperature and Ignition Temperature

| Electrical apparatus Temperature class | Electrical apparatus maximum surface temperature | Gas/vapour ignition temperature |
|---|---|---|
| *T*1 | 450℃ | above 450℃ |
| *T*2 | 300℃ | above 300℃ |
| *T*3 | 200℃ | above 200℃ |
| *T*4 | 135℃ | above 135℃ |
| *T*5 | 100℃ | above 100℃ |
| *T*6 | 85℃ | above 85℃ |

Table P13.2 Relationship between Gas/Vapour Group and Permitted Equipment Group

| Gas/vapour group | Electrical equipment group |
|---|---|
| *IIC* | *IIC* |
| *IIB* | *IIB* or *IIC* |
| *IIA* | *IIA*, *IIB* or *IIC* |

### 13.4.3 Storage Units

**1** Electrical installations of the storage unit which stores oils having a flashpoint of 60℃ and under are to comply with requirements in the following **(1)** to **(4)**.

(1) Intrinsically safe type electrical equipment and associated cables may be installed in any hazardous areas specified in **13.1.3-2(1)**.

(2) Electrical installations in hazardous areas specified in **13.1.3-2(1)(b)** and **(c)** are to be in accordance with the following **(a)** to **(d)**.

(a) Transducers of navigation instruments such as electric depth sounding devices and associated cables may be installed. The transducers are to be of totally enclosed type and to be housed in a gas tight enclosure clear of the storage oil tank. Cables to the transducers are to be installed in heavy gauge galvanized steel pipes with gas tight joints up to the main deck.

(b) Anodes or electrodes of an impressed current cathode protection system (for external hull protection only) and associated cables may be installed. In this case, as for the anodes or electrodes and cables, the requirements in **(a)** are to apply.

(c) Lighting fittings of flameproof type or air-driven type with pressurized enclosure and associated cables may be installed in the areas where apparatus which necessitate operation and monitoring are installed. The lighting fittings are to be arranged on at least two independent circuits.

(d) Cables may be run through these areas. The through run cables are to be installed in heavy gauge galvanized steel pipes with gas tight joints.

(3) Electrical installations in hazardous areas specified in **13.1.3-2(1)(d)** and **(e)** are to be in accordance with the following **(a)** and **(b)**.

(a) Lighting fittings of flame-proof type or air-driven type with pressurized enclosure and associated cables may be installed.

(b) Cables may be run through these areas. The through run cables are to be installed in heavy gauge galvanized steel pipes with gas tight joints.

(4) Electrical installations in hazardous areas specified in **13.1.3-2(2)(f)** to **(i)** are to be in accordance with the following **(a)** to **(d)**.

(a) Flameproof type electrical equipment and associated cables may be installed.

(b) Pressurized type electrical equipment and associated cables may be installed.

(c) Increased safety type electrical equipment and associated cables may be installed. For increased safety type motors, due consideration is to be given to the protection against overcurrent.

(d) Cables may be run through these areas. However, no cable expansion bends are to be provided in these areas as far as practicable.

(5) For electrical installations installed in hazardous areas specified in **13.1.3-2(1)(j)**, these areas are to be considered as equivalent to the adjacent hazardous area having direct openings, and the electrical installations are to be in compliance with the relevant requirements in **(1)** to **(4)**.

### 13.4.4 Units which are Engaged In Works with Danger of a Fire or an Explosion

For electrical installations of the unit which is engaged in works with danger of a fire or an explosion, requirements in **13.4.2** or **13.4.3** or requirements for tankers are to be correspondingly applied.

# Chapter 14 FIRE PROTECTION AND MEANS OF ESCAPE

## 14.1 General

### 14.1.1 Application

**1** The structural fire protection and means of escape provided for units fixed on the seabed or positioned for long periods of time are to be in accordance with the requirements given in this Chapter.

**2** The structural fire protection and means of escape provided for ship-type or barge-type units, except for units fixed on the seabed or positioned for long periods of time, are to be according to the requirements given in **Part R**.

**3** The structural fire protection and means of escape provided for units, except for units listed in **-1** and **-2** above, are to be at the discretion of the Society.

**4** The structural fire protection and means of escape provided for units are to be according to this **Part**. In addition, attention is to be paid to complying with the National Regulations of the flag state.

### 14.1.2 General

**1** The hull, superstructures, structural bulkheads, decks, deckhouses and walls of control station are to be constructed of steel or other equivalent materials.

**2** The insulation of aluminum alloy components of "*A*" or "*B*" class divisions is to be such that the temperature at the structural core does not rise more than 200℃ above the ambient temperature at any time during the applicable exposure to the standard fire test, except where these insulations are as deemed appropriate by the Society.

**3** In working areas, paints, varnishes and similar preparations having nitro-cellulose or other highly inflammable bases are not to be used.

**4** Helicopter decks, if they are provided, are to be of a steel or other equivalent fire resistant materials. If the spaces below the helicopter deck are fire risk spaces, the insulation standard is to be satisfaction of the Society.

## 14.2 Mobile Offshore Drilling Units

### 14.2.1 General

**1** The Construction of fire protection for this unit is to be in accordance with the requirements of **14.1.2** and **14.2** of this Chapter and the requirements of **5.3, Part R** and **Chapter 6, Part R**. In addition, it is to be tested and approved in accordance with the Fire Test Procedures Code. The means of escape for this unit is to be in accordance with the requirements of **14.2**, in addition to the requirements of **14.1.2**.

**2** Unless otherwise specially specified in this Part, the definitions for fire protection systems are in accordance with **Chapter 3, Part R**.

**3** When fire safety design or arrangements deviate from the requirements of this Chapter, engineering analysis, evaluation and approval of the alternative design and arrangements are to be carried out in accordance with **Chapter 17, Part R**.

**4** Fire safety systems are to be in accordance with the requirements specified in **Chapters 22** to **Chapter 35, Part R**, as applicable.

### 14.2.2 Construction of Fire Protection*

**1** Bulkheads and decks are to be the divisions respectively specified in **Table P14.1** and **Table P14.2** according to the spaces adjoining to the relevant bulkheads or decks. Exterior boundaries of superstructures and deckhouses enclosing accommodation, are to be constructed to "*H-60*" standard for the whole of the portion which faces and is within 30 *m* of the centre of the rotary table. For units that have a movable substructure the 30 *m* is to be measured with the substructure at its closest drilling position to the accommodation.

**2** For determining the appropriate fire integrity standards to be applied to the **Tables P14.1** and **Table P14.2** required divisions between adjacent spaces, such spaces are classified according to their fire risk, as shown in following categories **(1)** to **(11)**.

(1) Control stations

Control stations are spaces as defined in **1.2.15**, excluding the spaces where emergency sources of power are located.

(2) Corridors

Corridors mean corridors and lobbies.

(3) Accommodation spaces

Accommodation spaces are spaces, excluding corridors, lavatories and pantries containing no cooking appliances, which are used for public spaces, cabins, offices, hospitals, cinemas, games and similar spaces. Public spaces are those portions of the accommodation spaces which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

(4) Stairways

Stairways are enclosed interior stairways, lifts and escalators (other than those wholly contained within the machinery spaces) and enclosures thereto. In this connection, a stairway which is enclosed only at one level is to be regarded as part of the space from which it is not separated by a fire door.

(5) Service spaces with low risk of fire

Service spaces with low risk of fire are locker rooms and store rooms not having the storage of flammable liquids and having areas less than $4m^2$, drying rooms and laundries.

(6) Machinery spaces of Category *A*

Machinery spaces of Category *A* are the spaces which fall under any one of the following **(a)** to **(c)**, including trunks to such spaces:

(a) Spaces where internal combustion engines for main propulsion are installed.

(b) Spaces where internal combustion engines used for other purposes than main propulsion, having aggregate power of not less than $375kW$ are installed,

(c) Spaces which contain oil-fired boilers or oil fuel units.

(7) Other machinery spaces

Other machinery spaces are all other machinery spaces than machinery spaces of Category *A*, containing propelling machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilating and air-conditioning machinery and similar spaces, including trunks to such spaces.

(8) Hazardous areas

Hazardous areas are as defined in **1.2.16**.

(9) Service spaces with high risk of fire

Service spaces with high risk of fire are galleys, pantries containing cooking appliances, paint and lamp rooms, locker rooms and store rooms having areas of $4m^2$ or more, spaces for the storage of flammable liquids, and workshops which are not intended in the machinery spaces.

(10) Open decks

Open decks are open deck spaces, excluding hazardous areas.

(11) Sanitary and similar spaces

Sanitary and similar spaces are communal sanitary facilities such as showers, baths, lavatories, etc., and isolated pantries containing no cooking appliances. Sanitary facilities which serve a space and with access only from that space are to be considered a portion of space in which they are located.

**3** Continuous "*B*" Class ceilings or linings in association with the relevant decks or bulkheads may be accepted as contributing wholly or in part to the required insulation and integrity of a division.

**4** In approving structural fire protection details, the risk of heat transmission at intersections and terminal points of required thermal barriers is to be considered. The insulation of a deck or bulkhead is to be carried past the penetration, intersection or terminal point for a distance of at least 450 *mm* in the case of steel and aluminium structures. If a space is divided with a deck or a bulkhead of "*A*" class standard having insulation of different values, the insulation with the higher value is to continue on the deck or bulkhead with the insulation of the lesser value for a distance of at least 450 *mm*.

**5** Windows and side scuttles, with the exception of navigating bridge windows, are to be of the non-operating type. Navigating bridge windows may be of the opening type provided the design of such windows would permit rapid closure.

**6** The fire resistance of doors are, as far as practicable, to be equivalent to that the division in which they are fitted. External doors in superstructures and deckhouses are to be constructed to "*A-0*" Class divisions and, where applicable, be self-closing.

**7** Self-closing doors in fire rated bulkheads are not to be fitted with hold-back hooks. However, hold-back arrangements

incorporating remote release fittings of the fail-safe type may be utilized.

**8** Protection of accommodation spaces, service spaces, control stations specified in **1.2.15** (except the space where the emergency source of electric power is installed, the same being applied hereinafter in **14.2.**) and spaces containing vital machinery and equipment, is to be in accordance with the requirements in the following **(1)** to **(13)**:

(1) In general, accommodation spaces, service spaces, control stations and spaces containing vital machinery and equipment are not to be located adjacent to hazardous areas. However, where this is not practicable, an engineering evaluation is to be performed in accordance with national or international standards deemed appropriate by the Society to ensure that the level of fire protection and blast resistance of the bulkheads and decks separating these spaces from the hazardous areas are adequate for the likely hazard. Where it is shown that these spaces may be exposed to a radiant heat flux in excess of 100 $kW/m^2$, the bulkhead or deck is to be constructed to at least an "*H-60*" standard.

(2) All bulkheads that are to be "*A*" class divisions are to extend from deck to deck and to the deckhouse side or other boundaries.

(3) All bulkheads required to be "*B*" Class divisions are to be extend from deck to deck and to the deckhouse side or other boundaries, unless continuous "*B*" Class ceilings or linings are fitted on both sides of the bulkhead, in which case the bulkhead may terminate at the continuous ceiling or linings.

(4) In corridor bulkheads, ventilation openings may be permitted only in and under the doors of cabins, public spaces, offices and sanitary spaces. The openings are to be provided only in the lower half of the door. Where such an opening is in or under a door, the total net area of any such opening or openings are not to exceed $0.05m^2$. When such an opening is cut in a door it is to be fitted with a grille made of non-combustible material. Such openings are not to be provided in a door in a division forming a stairway enclosure.

(5) Stairs are to be constructed of steel or other material equivalent thereto.

(6) Stairways which penetrate only a single deck are to be protected at least at one level by "*A*" or "*B*" Class divisions and self-closing doors so as to limit the rapid spread of fire from one deck to another. Personnel lift trucks are to be protected by "*A*" Class divisions. Stairways and lift trunks which penetrate more than a single deck are to be surrounded by "*A*" Class divisions and protected by self-closing doors at all levels. Self-closing doors are not to be fitted with hold-back hooks.

(7) Air spaces enclosed behind ceilings, panellings or linings are to be divided by close fitting draught stops spaced not more than 14*m* apart. In the vertical direction, such enclosed air spaces, including those behind linings of stairways, trunks, etc., are to be closed at each deck.

(8) Except for insulation in refrigerated compartments, insulation material, pipe and vent duct lagging, ceiling, lining and bulkheads are to be of non-combustible material. Insulation of pipe fittings for cold service systems and vapour barriers and adhesives used in conjunction with insulation need not be non-combustible but they are to be kept to a minimum and their exposed surfaces are to have low-flame spread characteristics. In spaces where penetration of oil products is possible, the surfaces of the insulation are to be impervious to oil or oil vapours.

(9) The framing, including grounds and the joint pieces of bulkheads, linings, ceilings and draught stops are to be of non-combustible material.

(10) All exposed surfaces in corridors and stairway enclosures and surfaces in concealed or inaccessible spaces in accommodation and service spaces and control stations are to have low flame-spread characteristics. Exposed surfaces of ceilings in accommodation and service spaces and control stations are to have low-flame-spread characteristics.

(11) Bulkheads, linings and ceilings may have combustible veneers provided that the thickness of such veneers are not to exceed 2*mm* within any space other than corridors, stairway enclosures and control stations where the thickness is not to exceed 1.5*mm*. Combustible materials used on these surfaces are to have a calorific value not exceeding $45MJ/m^2$ of the area for the thickness used.

(12) Primary deck coverings, if applied within accommodation and service spaces and control stations, are to be of approved material by the Society or organizations deemed appropriate by the Society, which will not readily ignite, this being determined in accordance with the Fire Test Procedures Code.

(13) Paints, varnishes and other finishes used on exposed interior surfaces are not to be capable of producing excessive quantities of smoke and toxic products; this being approved by the Society or organizations deemed appropriate by the Society in accordance with the Fire Test Procedures Code.

**9** Ventilation provided with units except those provided in hazardous area are to be in accordance with following **(1)** to **(10)**.

(1) The ventilation of the accommodation spaces and control stations are to be arranged in such a way as to prevent the ingress of flammable, toxic or noxious gasses, or smoke from the surrounding area.

(2) Ventilation ducts are to be of non-combustible material. Short ducts, however, not generally exceeding 2*m* in length and with a cross-sectional area not exceeding $0.02m^2$ need not be non-combustible, subject to the following conditions:

(a) These ducts are to be of a material which, in the opinion of the Society, has a low fire risk;

(b) They may only be used at the end of the ventilation devices; and

(c) They are not to be situated less than 600*mm*, measured along the duct, from where it penetrates any "*A*" or "*B*" Class division including continuous "*B*" Class division.

(3) Where a thin plated duct with a free cross-sectional area equal to, or less than, 0.02 $m^2$ passes through "*A*" class bulkhead or decks, the opening is to be lined with a steel sheet sleeve having a thickness of at least 3 *mm* and a length of at least 200 *mm*, divided preferably into 100 *mm* on each side of the bulkhead or, in the case of the deck, wholly laid on the lower side of the deck pierced. Where ventilation ducts with a cross-sectional area exceeding $0.02m^2$ pass through class "*A*" bulkheads or decks, the opening is to be lined with a steel sheet sleeve unless the ducts passing through the bulkheads or decks are of steel in the vicinity of penetrations through the deck or bulkhead. The ducts and sleeves at such places are to comply with the followings.

(a) The ducts or sleeves are to have a thickness of at least 3*mm* and a length of at least 900*mm*. When passing through bulkheads, this length is to be divided preferably into 450*mm* on each side of the bulkhead. These ducts, or sleeves lining such ducts, are to be provided with fire insulation. The insulation is to have at least the same fire integrity as the bulkhead or deck through which the duct passes. Equivalent penetration protection may be provided to the satisfaction of the Society.

(b) Ducts with a cross-sectional area exceeding $0.075m^2$, except those serving hazardous areas, are to be fitted with fire dampers in addition to meeting the requirement of **(a)**. The fire damper is to operate automatically but is also to be capable of being closed manually from both sides of the bulkhead or deck. The damper is to be provided with an indicator which shows whether the damper is open or closed. Fire dampers are not required, however, where ducts pass through spaces surrounded by "*A*" Class divisions, without serving these spaces, provided those ducts have the same fire integrity as the divisions which they pierce. The Society may, given special considerations, permit operation from one side of a division only.

(4) In general, ventilation systems for machinery spaces of category *A*, galleys and hazardous areas are to be separated from each other and from the ventilation systems serving other spaces. Ducts serving hazardous areas are not to pass through accommodation spaces, service spaces, or control spaces. Ducts provided for ventilation of machinery spaces of category *A* and galleys are not to pass through accommodation and service spaces or control stations, except in cases where any of the following requirements of **(a)** or **(b)** are complied with:

(a)

i) The ducts are constructed of steel having a thickness of at least 3*mm* for ducts of 300*mm* in width or less and at least 5*mm* for ducts of 760*mm* in width and over. In case of ducts the width or diameter of which is between 300*mm* and 760*mm*, the thickness are to be obtained by interpolation;

ii) The ducts are suitably supported and stiffened;

iii) The ducts are to be fitted with automatic fire dampers close to the boundaries penetrated; and

iv) The ducts are to be insulated to "*A-60*" standard from the machinery or galleys to a point at least 5*m* beyond each fire damper.

(b)

i) The ducts are constructed of steel in accordance with the preceding **(a)i)** and **ii)**;

ii) The ducts are to be insulated to "*A-60*" standard throughout the accommodation spaces, service spaces or control stations.

(5) Ducts provided for ventilation of accommodation and service spaces or control stations are not to pass through machinery spaces of category *A*, galleys or hazardous areas, except for the following requirements **(a)** or **(b)** may be complied with:

(a)

i) The ducts where they pass through a machinery space of category A or galley are constructed of steel in accordance with the requirement in preceding **(4)(a)i)** and **ii)**;

ii) Automatic fire dampers are fitted close to the boundaries penetrated; and

iii) The integrity of the machinery space or galley boundaries is maintained at the penetrations.

(b)

i) The ducts where they pass through a machinery space of category *A* or a galley are constructed of steel in accordance with the preceding requirements **(4)(a)i)** and **ii)**;

ii) The ducts are insulated to "*A-60*" standard within the machinery space or galley.

(6) Ventilation ducts with a cross-sectional area exceeding $0.02m^2$ passing through "*B*" Class bulkheads are to be lined with steel sleeves of 900*mm* in length divided preferably into 450*mm* on each side of the bulkhead unless the duct is of steel for this length.

(7) Where they pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges are to be of equivalent fire integrity to "*A*" class divisions.

(8) Each galley exhaust duct is to be fitted with the following **(a)** to **(d)**:

(a) a grease trap readily removable for cleaning

(b) both of the dampers specified in the following **i)** and **ii)**

i) a fire damper located in the galley end of the duct which is automatically and remotely operated

ii) a remotely operated fire damper located in the exhaust end of the duct

(c) arrangements, operable from within the galley, for shutting off the exhaust fans

(d) fixed means for extinguishing a fire within the duct

(9) The main inlets and outlets of all ventilation systems are to be capable of being closed from outside the spaces being ventilated.

(10) Power ventilation of accommodation spaces, service spaces, control stations, machinery spaces and hazardous areas are to be capable of being stopped from an easily accessible position outside the space being served. The means provided for stopping the power ventilation serving machinery spaces or hazardous areas are to be entirely separate from the means provided for stopping ventilation of other spaces.

**10** Windows and side scuttles in boundaries which are required to meet an "*A-60*" standard which face the drill floor areas are to be in accordance with one of the following requirements.

(1) They are to be constructed to an "*A-60*" standard.

(2) They are protected by a water curtain.

(3) They are fitted with shutters of steel or equivalent material.

**11** The construction of the helidecks is to be of steel or other equivalent materials. If the helideck forms the deckhead of a deckhouse or superstructure, it is to be insulated to "*A-60*" class standard. For use of aluminium or other low melting point metal construction that is not made equivalent to steel, the following requirements are to be satisfied:

(1) if the helideck is cantilevered over the side of the unit, after each fire on the unit or on the helideck, the helideck is to undergo a structural analysis to determine its suitability for further use; and

(2) if the helideck is located above the unit's deckhouse or similar structure, the following conditions are to be satisfied:

(a) the deckhouse top and bulkheads under the helideck are to have no openings;

(b) windows under the helideck are to be provided with steel shutters; and

(c) after each fire on the helideck or supporting structure, the helideck is to undergo a structural analysis to determine its suitability for further use.

**12** Where more than 1 cylinder of oxygen and acetylene are carried simultaneously on the unit, such cylinders are to be arranged in accordance with the requirements of following **(1)** to **(7)**.

(1) Permanent piping systems for oxyacetylene systems are to be to the satisfaction of the Society.

(2) Where two or more cylinders of each gas are intended to be carried in enclosed spaces, separate dedicated storage rooms are to be provided for each gas.

(3) Storage rooms are to be constructed of steel, and be well ventilated and accessible from the open deck.

(4) Provisions are to be made for the expeditious removal of cylinders in the event of fire.

(5) "NO SMOKING" signs are to be displayed at the gas cylinder storage rooms.

(6) Where cylinders are stowed in open locations means are to be provided:

(a) to protect cylinders and associated piping from physical damage;

(b) to minimize exposure to hydrocarbons; and

(c) to ensure suitable drainage.

(7) Fire-extinguishing arrangements for the protection of areas or spaces where such cylinders are stored are to be to the satisfaction of the Society.

Table P14.1 Fire Integrity of Bulkheads Separating Adjacent Spaces

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Control Stations (1) | *A*-0[d] | *A*-0 | *A*-60 | *A*-0 | *A*-15 | *A*-60 | *A*-15 | *A*-60[e] | *A*-60 | * | *A*-0 |
| Corridors (2) | | *C* | *B*-0 | *B*-0<br>*A*-0[b] | *B*-0 | *A*-60 | *A*-0 | *A*-0[e] | *A*-0 | * | *B*-0 |
| Accommodation spaces (3) | | | *C* | *B*-0<br>*A*-0[b] | *B*-0 | *A*-60 | *A*-0 | *A*-0[e] | *A*-0 | * | *C* |
| Stairways (4) | | | | *B*-0<br>*A*-0[b] | *B*-0<br>*A*-0[b] | *A*-60 | *A*-0 | *A*-0[e] | *A*-0 | *<br>* | *B*-0<br>*A*-0[b] |
| Service spaces with low risk of fire (5) | | | | | *C* | *A*-60 | *A*-0 | *A*-0 | *A*-0 | * | *B*-0 |
| Machinery spaces of category *A* (6) | | | | | | *[a] | *A*-0[a] | *A*-60 | *A*-60 | * | *A*-0 |
| Other machinery spaces (7) | | | | | | | *A*-0[a,c] | *A*-0 | *A*-0 | * | *A*-0 |
| Hazardous area (8) | | | | | | | | - | *A*-0 | - | *A*-0 |
| Service spaces with high risk of fire (9) | | | | | | | | | *A*-0[c] | * | *A*-0 |
| Open decks (10) | | | | | | | | | | - | * |
| Sanitary and similar spaces (11) | | | | | | | | | | | *C* |

Notes:

1 *C* in the Table means that divisions are made non-combustible materials.

2 a to e,* and - in the Table means as follows:

a : Where the space contains an emergency power source or components of an emergency power source that adjoins a space containing a unit's service generator or the components of unit's generator, the boundary bulkhead or deck between those spaces is to be an "*A-60*" Class division.

b : Either of the divisions indicated above or below is to be provided in consideration of **14.2.2-8(3)** and **(6)**.

c : Where spaces are of the same numerical category and superscript c appears, a bulkhead or deck of the rating shown in the Table is only required when the adjacent spaces are for a different purpose, e.g. in category(9). A galley next to a galley does not require a bulkhead but a galley next to a paint room requires an "*A-0*" bulkhead.

d : Bulkhead separating the navigating bridge chartroom and radio room from each other may be "*B-0*" rating.

e : Additional provisions for fire boundaries are to be assessed in accordance with paragraph **14.2.2-8(1)**.

* : Where an asterisk appears in the Table, the division is required to be of steel or equivalent material but is not required to be of "*A*" Class standard. However, where a deck is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke.

- :Where a dash appears in the Table, the division need not be of "*A*", "*B*" nor "*C*" Class standard.

Table P14.2 Fire Integrity of Decks Separating Adjacent Spaces

| Space Below ↓ / Space→ Above | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control Stations | (1) | *A*-0 | *A*-0 | *A*-0 | *A*-0 | *A*-0 | *A*-60 | *A*-0 | *A*-0 | *A*-0 | * | *A*-0 |
| Corridors | (2) | *A*-0 | * | * | *A*-0 | * | *A*-60 | *A*-0 | *A*-0 | *A*-0 | * | * |
| Accommodation spaces | (3) | *A*-60 | *A*-0 | * | *A*-0 | * | *A*-60 | *A*-0 | *A*-0 | *A*-0 | * | * |
| Stairways | (4) | *A*-0 | *A*-0 | *A*-0 | * | *A*-0 | *A*-60 | *A*-0 | *A*-0 | *A*-0 | * | *A*-0 |
| Service spaces with low risk of fire | (5) | *A*-15 | *A*-0 | *A*-0 | *A*-0 | * | *A*-60 | *A*-0 | *A*-0 | *A*-0 | * | *A*-0 |
| Machinery spaces of category *A* | (6) | *A*-60 | *A*-60 | *A*-60 | *A*-60 | *A*-60 | *[a] | *A*-60 | *A*-60 | *A*-60 | * | *A*-0 |
| Other machinery spaces | (7) | *A*-15 | *A*-0 | *A*-0 | *A*-0 | *A*-0 | *A*-0[a] | *[a] | *A*-0 | *A*-0 | * | *A*-0 |
| Hazardous area | (8) | *A*-60[e] | *A*-0[e] | *A*-0[e] | *A*-0[e] | *A*-0 | *A*-60 | *A*-0 | - | *A*-0 | - | *A*-0 |
| Service spaces with high risk of fire | (9) | *A*-60 | *A*-0 | *A*-0 | *A*-0 | *A*-0 | *A*-0 | *A*-0 | *A*-0 | *A*-0[c] | * | *A*-0 |
| Open decks | (10) | * | * | * | * | * | * | * | - | * | - | * |
| Sanitary and similar spaces | (11) | *A*-0 | *A*-0 | * | *A*-0 | * | *A*-0 | *A*-0 | *A*-0 | *A*-0 | * | * |

Note:

See Notes under **Table P14.1**.

### 14.2.3 Means of Escape

**1** Within the accommodation spaces, service spaces and control stations, the means of escape specified in the following **(1)** to **(4)** are to be provided:

(1) In every general area which is likely to be regularly manned or in which personnel are accommodated, at least two separate escape routs are to be provided, situated as far apart as practicable, to allow ready means of escape to the open decks and embarkation stations. Where, however, deemed appropriate by the Society in consideration of the nature, location of spaces and the number of persons who might normally be accommodated or employed there, one of these means of escape may be dispensed with.

(2) Stairways are normally to be used for means of vertical escape. Where, however, the installation of a stairway is shown to be impracticable, a vertical ladder may be used for one of the means of escape.

(3) Every escape route is to be readily accessible and unobstructed. All exit doors along the route are to be readily operable. Dead-end corridors exceeding 7*m* in length are not to be provided.

(4) The means of escape in accommodation areas, including stairways and exits, are to comply with the following requirements **(a)** to **(d)**:

(a) In addition to the emergency lighting, the means of escape are to be marked in the following locations **i)** and **ii)** by lighting or photoluminescent strip indicators complying with **Chapter 31, Part R**:

i) places not more than 300 *mm* above the deck at all points of the escape route, including angles and intersections; and

ii) escape route signs and fire equipment location markings.

(b) The marking specified in the preceding **(a)** is to enable personnel to identify the routes of escape and readily identify the escape exits.

(c) Electric illumination is to be supplied by the emergency source of power.

(d) The failure of any single light or cut in a lighting strip indicators is not to result in the marking being ineffective.

**2** Two means of escape are to be provided from every machinery space of category *A* by either one of the following **(1)** or **(2)**. Ladders are to be of steel or other equivalent material.

(1) two sets of ladders, as widely separated as possible, leading to doors in the upper part of the machinery space of category *A*, similarly separated and from which access is provided to the open deck. One of these ladders is to comply with the following requirements:

(a) The ladder is to be located within a protected enclosure that satisfies **Tables P14.1** and **P14.2**, category **(4)**, from the lower part of the space it serves to a safe position outside the space. Self-closing fire doors of the same fire integrity standards are to be fitted in the enclosure; and

(b) The ladder is to be fixed in such a way that heat is not transferred into the fire shelter through non-insulated fixing points. The enclosure is to have minimum internal dimensions of at least 800 *mm* x 800 *mm*, and is to have emergency lighting provisions.

(2) the means of escape specified in the following **(a)** and **(b)**;

(a) one ladder leading to a door in the upper part of the machinery space of category *A* from which accesses to the open deck; and

(b) a steel door capable of being operated from each side, in the lower part of the machinery space of category *A*, in a position well separated from the ladder. The steel door is to be provided with access to a safe escape route from the lower part of the machinery space of category *A* to the open deck.

**3** From machinery spaces other than those of category *A*, escape routes are to be provided to the satisfaction of the Society, having regard to the nature and location of the space and whether persons are normally employed in that space.

**4** Lifts are not to be considered as forming one of the required means of escape.

**5** Superstructures and deckhouses are to be sited such that, in the event of fire at the drill floor, at least one escape route to the embarkation position and survival craft is protected against radiant heat flux levels in excess of 2.5 $kW/m^2$ emanating from the drill floor.

**6** Stairways and corridors used as a means of escape are to meet the requirements of **Chapter 33, Part R**.

**7** For emergency escape breathing devices (hereinafter, referred to as "*EEBD*s"), the following requirements are to be complied with:

(1) *EEBD*s are to comply with the requirements of **Chapter 23, Part R**. Spare *EEBD*s are to be kept on board;

(2) In machinery spaces of category *A* containing internal combustion machinery used for main propulsion, *EEBD*s are to be positioned as specified in the following **(a)** to **(d)**:

(a) one *EEBD* in the engine control room, if located within the machinery space;

(b) one *EEBD* in workshop areas. If there is, however, a direct access to an escape way from the workshop, an *EEBD* is not required; and

(c) one *EEBD* on each deck or platform level near the escape ladder constituting the second means of escape from the machinery space (the other means being an enclosed escape trunk or watertight door at the lower level of the space).

(d) Alternatively, a different number or location than as specified in **(a)** to **(c)** may be required by the Society taking into consideration the layout and dimensions or the normal manning of the space.

(3) For machinery spaces of category *A* other than those containing internal combustion machinery used for main propulsion, one *EEBD* is, as a minimum, to be provided on each deck or platform level near the escape ladder constituting the second means of escape from the space (the other means being an enclosed escape trunk or watertight door at the lower level of the space).

(4) For other machinery spaces, the number and location of *EEBD*s are to be to the satisfaction of the Society.

**8** A helideck is to be provided with both a main and an emergency means of escape and access for fire fighting and rescue personnel. These are to be located as far apart from each other as is practicable and preferably on opposite sides of the helideck.

### 14.2.4 Operational Readiness and Maintenance

Operational readiness and maintenance are to be in accordance with **15.2.16**.

## 14.3 Storage Units

### 14.3.1 Application

**1** Construction of fire protection and means of escape for the units are to be applied in **14.3**, in addition to comply with the requirements in **14.1.2**.

**2** For construction of fire protection and means of escape for the units which have a large embarking capacity, the Society requires additional requirements in addition to the requirements in **14.3**.

### 14.3.2 Construction of Fire Protection

**1** Fire protection for storage units which store liquids having a flashpoint of 60℃ and under, are to correspondingly comply with the requirements in **4.5.1** (except **-8**), **4.5.2** and **Chapter 9, Part R**.

**2** Fire protection for storage units which store liquids having a flashpoint over 60℃, are to be correspondingly complied with the requirements **Chapter 13, Part R**, otherwise are to be of the discretion of the Society.

### 14.3.3 Means of Escape

Means of escape provided in units are to be in accordance with the requirements in **Chapter 13, Part R**, considering the size of units, their construction, type of structure, arrangements of persons or none, etc.

## 14.4 Work-ships which are Engaged In Works with Danger of a Fire or an Explosion

### 14.4.1 Application

**1** Construction of fire protection and means of escape for the units which are engaged in works with danger of a fire or an explosion are to be applied in **14.4**, in addition to comply with the requirements in **14.1.2**.

**2** For construction of fire protection and means of escape for the units which have a large embarking capacity, the Society requires additional requirements in addition to the requirements in **14.4**.

### 14.4.2 Construction of Fire Protection

The construction of fire protection for the units is to correspondingly comply with the requirements in **14.2.2** or **14.3.2** or the requirements in **4.5.1** (except **-8**), **4.5.2** and **Chapter 9, Part R**.

### 14.4.3 Means of Escape

Means of escape for the units are to be correspondingly complied with the requirements in **14.2.2** or **14.3.2** or the requirements in **Chapter 13, Part R**.

## 14.5 Work-ships which are Engaged In Works without Danger of a Fire or an Explosion

### 14.5.1 Application

**1** Construction of fire protection and means of escape for the units which are engaged in works without danger of a fire or an explosion are to be applied in **14.5**, in addition to comply with the requirements in **14.1.2**.

**2** For construction of fire protection and means of escape for the units which have a large embarking capacity, the Society requires additional requirements in addition to the requirements in **14.5**.

### 14.5.2 Construction of Fire Protection

The construction of fire protection for the units is to be correspondingly complied with the requirements in **5.3**, **Chapter 6**, **Chapter 8**, **Chapter 9** and **Chapter 11, Part R**.

### 14.5.3 Means of Escape

Means of escape for the units are to be correspondingly complied with the requirements in **Chapter 13, Part R**.

## 14.6 Units which have Accommodation for Particular Personnel or Passengers

### 14.6.1 Application

The construction of fire protection and means of escape for unit which has accommodation for particular personnel or passengers, such as an Accommodation barge are to be applied in the requirements in this **14.6** as well as the requirements in **14.1.2**.

### 14.6.2 Construction of Fire Protection

**1** The construction of fire protection for the unit is to be of appropriate by the Society, considering the structural arrangements, unit type, embarking capacity, etc.

**2** The construction of fire protection for the unit which has a small embarking capacity, are to be correspondingly complied with the requirements in **5.3**, **Chapter 6**, **Chapter 8**, **Chapter 9** and **Chapter 11, Part R**.

### 14.6.3 Means of Escape

**1** The means of escape for the unit is to be of appropriate by the Society, considering the structural arrangements, unit type, embarking capacity, etc.,

**2** The means of escape for the unit which has a small embarking capacity, are to be correspondingly complied with the requirements in **Chapter 13, Part R**.

# Chapter 15 FIRE EXTINGUISHING SYSTEMS

## 15.1 General

### 15.1.1 Application

**1** The fire detection and extinguishing systems provided for units fixed on the seabed or positioned for long periods of time are to apply the requirements given in this Chapter.

**2** The fire detection and extinguishing systems of ship-type or barge-type units, except for units fixed on the seabed or positioned for long periods of time, are to be according to **Part R**. In addition, when deemed necessary by the Society, additional requirements may be applied to work-ships depending on their purposes of operation.

**3** The fire detection and extinguishing systems of units, except for units listed in **-1** and **-2** above, are to be at the discretion of the Society.

**4** The fire detection and extinguishing systems of units are to be according to this **Part**. In addition, attention is to be paid to complying with the National Regulations of the flag state.

### 15.1.2 General

**1** Unless otherwise specially required in this Chapter, fire extinguishing systems, fire extinguishers, fire detection systems, etc., and associated pipings are to be complied with the requirements in **Part D** and **Part R**.

**2** All fire extinguishing systems and fire extinguishers are to be being available for immediate use at all time.

**3** Where helicopter facilities are provided in the units except mobile offshore drilling units, fire extinguishing systems on helicopter decks are to be in accordance with the requirements in **Chapter 18, Part R**.

**4** Where the intermediate tanks to serve water for fire extinguishing systems are provided in the units except mobile offshore drilling units, the intermediate tanks are to be satisfactory of the Society.

## 15.2 Mobile Offshore Drilling Units

### 15.2.1 General

**1** As for the fire extinguishing systems and fire extinguishers, etc., in addition to the requirements in **15.1.2**, the requirements of **15.2** are to be applied.

**2** Unless otherwise specially specified in this Part, the definitions for fire protection systems are in accordance with **Chapter 3, Part R**.

**3** When fire safety design or arrangements deviate from the prescriptive requirements of this Chapter, engineering analysis, evaluation and approval of the alternative design and arrangements are to be carried out in accordance with **Chapter 17, Part R**.

**4** Fire safety systems are to be in accordance with **Chapters 22** to **36, Part R**, as applicable.

### 15.2.2 Fire Pumps and Water Supply

**1** At least two independently driven power pumps are to be provided, each arranged to draw directly from the sea and discharge into a fixed fire main. However, in units with high suction lifts, booster pumps and storage tanks may be installed.

**2** At least one of the pumps required in **-1** is to be dedicated from fire-fighting duties and be available for such duties at all times.

**3** The arrangements of the pumps, sea suctions and sources of power are to be such as to ensure that a fire in any one space would not put both the pumps required in **-1** out of action.

**4** The capacity of the pumps required in **-1** is to be appropriate to the fire-fighting services supplied from the main. Where more pumps than required are installed, their capacity is to be to the satisfaction of the Society.

**5** Each pump is to be capable of delivering at least one jet simultaneously from each of any two fire hydrants, hoses and 19 *mm* nozzles while maintaining a minimum pressure of 0.35 *MPa* at any hydrant. In addition, where a foam system is provided for protection of the helicopter deck, the water consumption used for foam system is to be added to the pump capacity and the pumps are to be capable of maintaining a pressure of 0.7 *MPa* at the foam installation. If the water consumption for any other fire protection or

fire-fighting purpose are to exceed the rate of the helicopter deck foam installation, this consumption is to be the determining factor in calculating the required capacity of the fire pump.

**6** Where either of the pumps required in **-1** is located in a space not normally manned and is relatively far removed from working areas, suitable provision is to be made far remote start-up of that pump and remote operation of associated suction and discharge valves.

**7** Except as provided in **-2**, sanitary, ballast, bilge or general service pumps may be accepted as fire pumps, provided that they are not normally used for pumping oil.

**8** Every centrifugal pump which is connected to the fire main is to be fitted with a non-return valve.

**9** Relief valves are to be provided in conjunction with all pumps connected to the fire main if the pumps are capable of developing a pressure exceeding the design pressure of the fire main, hydrants and hoses. Such valves are to be so placed and adjusted as to prevent excessive pressure in the fire main system.

**10** At least two water supply sources (sea chests, valves, strainers and pipes) are to be provided and so arranged that one supply source failure will not put all supply sources out of action.

**11** For self-elevating units, the following additional fire water supply measures are to be provided:

(1) water is to be supplied from sea water mains filled by at least two submersible pumping systems. One system failure will not put the other system(s) out of function; and

(2) water is to be supplied from drill water systems while unit lifting or lowering. Water stored in the drill water tank(s) is not be less than 40 $m^3$ plus engine cooling water consumption before unit lifting or lowering. Alternatively, water may be supplied from buffer tank(s) in which sea water stored is not less the quantity as the above mentioned.

### 15.2.3 Fire Main, Hydrants and Hoses

**1** The diameter of the fire main and water service pipes are to sufficient for the effective distribution of the maximum required discharge from the required fire pumps operating simultaneously.

**2** With the required fire pumps operating simultaneously, the pressure maintained in the fire mains is to be adequate for the safe and efficient operation of all equipment supplied therefrom.

**3** The fire main is, where practicable, to be routed clear of hazardous areas and be arranged in such a manner as to make maximum use of any thermal shielding or physical protection afforded by the structure of the unit.

**4** The fire main is to be provided with isolating valves located so as to permit optimum utilization in the event of physical damage to any part of the main.

**5** The fire main is not to have connections other than those necessary for fire-fighting purposes.

**6** All practical precautions consistent with having water readily available are to be taken to protect the fire main against freezing.

**7** Materials readily rendered ineffective by heat are not to be used for fire mains and hydrants unless adequately protected. The pipes and hydrants are to be so placed that the fire hoses may be easily coupled to them.

**8** A cock or valve is to be fitted to serve each fire hose so that any fire hose may be removed while the fire pumps are operating.

**9** The number and position of the hydrants are to be such that at least two jets of water, not emanating from the same hydrant, one of which is to be from a single length of fire hose, may reach any part of the unit normally accessible to those on board while the unit is being navigated or is engaged in drilling operations. A hose is to be provided for every hydrant.

**10** Fire hoses are to be of material approved by the Society and be sufficient in length to project a jet of water to any of the spaces in which they may be required to be used. Their maximum length is to be to the satisfaction of the Society. Every fire hose is to be provided with a dual purpose nozzle and the necessary couplings. Fire hoses, together with any necessary fittings and tools, are to be kept ready for use in conspicuous positions near the water service hydrants or connections.

**11** Fire hoses are to have a length of at least 10 *m*, but not more than:

(1) 15 *m* in machinery spaces;

(2) 20 *m* in other spaces and open decks; and

(3) 25 *m* for open decks with a maximum breadth in excess of 30 *m*.

### 15.2.4 Nozzles

Nozzles are to comply with the following requirements:

(1) Standard nozzle sizes are to be 12 *mm*, 16 *mm* and 19 *mm* or as near thereto as possible. Larger diameter nozzles may be permitted at the discretion of the Society.

(2) For accommodation and service spaces, a nozzle size greater than 12 *mm* need not be used.

(3) For machinery spaces and exterior locations, the nozzle size is to be such as to obtain the maximum discharge possible from two jets at the pressure specified in **15.2.2-5** from the smallest pump, provided that a nozzle size greater than 19 *mm* need not be used.

**15.2.5 Fire Extinguishing Systems in Machinery Spaces and in Spaces Containing Fired Processes**

**1** In spaces where main or auxiliary oil-fired boilers and other fired processes of equivalent thermal rating are situated, or in spaces containing oil fuel units or settling tanks, the unit is to be provided with the following:

(1) One of the following fixed fire extinguishing systems complying with **10.4, Part R**:

(a) a fixed pressure water-spraying system complying with **Chapter 27, Part R**;

(b) a fixed gas fire-extinguishing system complying with **Chapter 25, Part R**;

(c) a fixed high-expansion foam installation complying with **Chapter 26, Part R**.

Where the machinery space and spaces containing fired processes are not entirely separate, or if fuel oil can drain from the latter spaces into the machinery space, the combined machinery space and fired process space are to be considered as one compartment.

(2) At least two approved portable foam extinguishers or equivalent in each space containing a fired process and each space in which a part of the oil fuel installation is situated. In addition, at least one extinguisher of the same description with a capacity of 9*l* for each burner, provided that the total capacity of the additional extinguisher or extinguishers need not exceed 45*l* for any one space.

(3) A receptacle containing sand, sawdust impregnated with soda, or other approved dry material in such quantity as may be required by the Society. Alternatively, an approved portable extinguisher may be substituted.

**2** The following arrangements are to be provided in the spaces containing internal combustion machinery used either for main propulsion or for other purposes when such machinery has a total power output of not less than 750 *kW*.

(1) One of the fixed arrangements required in **-1(1)**:

(2) One approved foam-type extinguisher of not less than 45 *l* capacity or equivalent in every engine space and one approved portable foam extinguisher for each 750 *kW* of engine power output or part thereof. The total number of portable extinguishers so supplied is to be not less than two and need not exceed six.

**3** Fire extinguishing arrangements provided in spaces not fitted with fixed fire-extinguishing installations are to be to the satisfaction of the Society.

**4** Where a fire hazard exists in any machinery space for which no specific requirements for fire-extinguishing appliances are prescribed in **-1** to **-3**, there are to be provided in, or adjacent to, that space a number of approved portable fire extinguishers of other means of fire extinction to the satisfaction of the Society.

**15.2.6 Fire Extinguishing Systems in Accommodation, Service and Working Spaces**

**1** Portable fire extinguishers

(1) The accommodation spaces, service spaces, control stations, machinery spaces of category *A*, cargo spaces, weather deck and other spaces are to be provided with approved portable fire extinguishers accepted by the Society in accordance with **Table P15.1**.

(2) In addition to the preceding **(1)**, fire extinguishers are to be provided with in accordance with **Table P15.2**. However, other fire extinguishers, differing from those in accordance with **Table P15.2** may be required by the Society taking into account the levels of the fire hazards.

**2** Fixed fire-extinguishing systems for the drill floor and well test areas

(1) Fixed fire-extinguishing systems to protect the drill floor, related equipment (including emergency shut-down equipment, critical structural components, and enclosure fire barriers) and well test areas are to be fitted in accordance with the following **(a)** or **(b)**:

(a) A fixed pressure water-spraying system designed to provide a minimum water application rate of 20.4 $l/min \cdot m^2$ is to be provided. The system is to be designed for manual release from release stations located outside the protected area. Any section valves necessary for the operation of the system are to be located outside the protected area. Automatic release may be accepted by the Society. In addition, the main fire pumps may be used to supply the fixed pressure water-spraying system if they have sufficient capacity to simultaneously supply the fire main at the required flow and pressure.; or

(b) At least two dual-purpose (jet/spray) fire monitors are to be installed. Each monitor is to ensure discharging at a minimum flow rate and pressure 1,900 *l/min* at 1 *MPa*. They are to be arranged such that all areas and equipment can be reached by at least two monitors which are widely separated. The monitors may be operated either remotely or locally. Monitors arranged for local operation are to be sited on an accessible protected position.

(2) Nozzles, piping, fittings and related components are to be designed to withstand exposure to temperatures up to 925°C.

**3** Fixed foam systems for mud processing areas

A suitable fixed foam system is to be installed. The system is to be capable of delivering foam solution at a rate of not less than 6.5 $l/min \cdot m^2$ (4.1 $l/min \cdot m^2$ for Aqueous Film Forming Foam or Film-Forming Fluoroprotein Foam) for 15 *minutes*. Alternatively, a gas fixed fire extinguishing system may be used for enclosed mud processing spaces.

Table P15.1 Minimum Numbers and Distribution of Portable Fire Extinguishers in the Various Types of Spaces Onboard Ships

| Type of space(1) | | Minimum number of extinguishers | Class(es) of extinguisher(s) (2) |
|---|---|---|---|
| Accommodation spaces | Public spaces(3) | 1 per 250 $m^2$ of deck area or fraction thereof | *A* |
| | Corridors | Travel distance to extinguishers should not exceed 25 *m* within each deck | *A* |
| | Stairway | 0 | |
| | Lavatories, cabins, offices, pantries, containing no cooking appliances | 0 | |
| | Hospital | 1 | *A* |
| Service spaces | Laundry drying rooms, pantries containing cooking appliances | 1(4) | *A* or *B* |
| | Lockers and store rooms (having a deck area of 4 $m^2$ or more), baggage rooms and workshops(3) (not part of machinery spaces, galleys) | 1(4) | *B* |
| | Galleys | 1 class *B* and 1 Additional class *F* or *K* for galleys with deep fat fryers | *B*, *F* or *K* |
| | Lockers and store rooms(deck area is less than 4$m^2$) | 0 | |
| | Other spaces in which flammable liquids are stowed | In accordance with **10.6.2, Part R** | |
| Control stations | Control stations (other than wheelhouse) | 1(5) | *A* or *C* |
| | Wheelhouse | 2, if the wheelhouse is less than 50 $m^2$ only 1 extinguisher is required | *A* or *C* |

Notes:

(1) Unless otherwise specified, one of portable fire extinguishers required is to be located at or near entrance and exits in the space. If a space is locked when unmanned, portable fire extinguishers required for that space may be kept inside or outside the space.

(2) The types of portable fire extinguishers are classified below. However, with respect to the application of the

requirements specified in **24.1.2, Part R** such classifications need not apply to extinguishers which have been deemed appropriate for use at certain locations in accordance with standards approved by the relevant Administration or organizations deemed appropriate by the Society.

(3) It is recommended that the portable fire extinguishers except **(1)** above in public spaces and workshop be located at or near the main entrances and exits.

(4) A portable fire extinguisher required for that small space placed outside or near the entrance to that space may also be considered as part of the requirement for the space in which it is located.

(5) If the wheelhouse is adjacent with the chartroom and has a door giving direct access to chartroom, no additional fire extinguisher is required in the chart room.

Fire Classifications

| International Organization for Standardization (ISO standard 3941) | National Fire Protection Association (NFPA 10) |
|---|---|
| Class *A*: Fire involving solid materials, usually of an organic nature, in which combustion normally takes places with the formation of glowing embers. | Class *A*: Fires in ordinary combustible materials such as wood, cloth, paper, rubber and many plastics. |
| Class *B*: Fires involving liquids or liquefiable solids | Class *B*: Fires in flammable liquids, oils, greases, tars, oil base paints, lacquers and flammable gases. |
| Class *C*: Fires involving gases. | Class *C*: Fires, which involve energized electrical equipment where the electrical non-conductivity of the extinguishing medium is of importance. (When electrical equipment is de-energized, extinguishers for class *A* or *B* fires may be used safely.) |
| Class *D*: Fires involving materials. | Class *D*: Fires in combustible metals such as magnesium, titanium, zirconium, sodium, lithium and potassium. |
| Class *F*: Fires involving cooking oils. | Class *K*: Fires involving cooking grease, fats and oils. |

Table P15.2 An Example of the Number and Distribution as Well as Classes of Additional Portable Extinguishers

| Type of Space | Minimum number of extinguishers[a] | Class(es) of extinguisher(s) [c] |
|---|---|---|
| Space containing the controls for the main source of electrical power | 1; and 1 additional extinguisher suitable for electrical fires when main switchboards are arranged in the space | *A* and/or *C* |
| Cranes:<br>With electric motors/hydraulics | not required | - |
| Cranes:<br>With internal combustion engine | 2<br>(1 in cab and 1 at exterior of engine compartment) | *B* |
| Drill floor | 2<br>(1 at each exit) | *C* |
| Helidecks | In accordance with **15.2.13** | *B* |
| Machinery spaces of category *A* | In accordance with **15.2.5** | *B* |
| Machinery spaces of category *A* which are periodically unattended | At each entrance in accordance with **15.2.5**[b] | *B* |
| Main switchboards | 2 in the vicinity | *C* |
| Mud pits, Mud processing areas | 1 for each enclosed space (Travel distance to an extinguisher not to exceed 10 *m* for open space) | *B* |

Notes:

a Minimum sizes are to be in accordance with **24.2.1, Part R**.

b A portable extinguisher provided for that space may be located outside near the entrance to that space.

c The Classes are the same as in **Table P15.1**.

### 15.2.7 International Shore Connection

**1** Ship-type, barge-type and column-stabilized units are to be provided with the at least one international shore connection complying with **Chapter 22, Part R**.

**2** Facilities are to be available enabling such a connection to be used on either side of the unit.

### 15.2.8 Fire-fighters' Outfits

**1** At least two fire-fighters' outfits complying with **23.2.1**, **Part R** are to be provided, each with portable instruments for measuring oxygen and flammable vapour concentrations acceptable to the Society.

**2** Two spare charges are to be provided for each required breathing apparatus. However, for units that are equipped with suitably located means for fully recharging the air cylinders free from contamination, only one spare charge for each required apparatus may be acceptable. The apparatus for recharging air cylinders are to comply with the following requirements **(1)** to **(6)**.

(1) The apparatus for recharging air cylinders are to be one of the following **(a)** or **(b)**:

(a) an apparatus having its power supplied from the emergency supply or being independently diesel-powered.

(b) other apparatus being so constructed or equipped that the air cylinders may be used immediately after recharging.

(2) The apparatus is to be suitably located in a sheltered space above main deck level on the unit.

(3) Intakes for air compressors are to draw from a source of clean air.

(4) The air is to be filtered after compression to eliminate compressor oil contamination.

(5) The recharging capacity is to meet the requirements of *SOLAS* regulation II-2/10.10.2.6.

(6) The equipment and its installation are to be to the satisfaction of the Society.

**3** The fire-fighters' outfits are to be kept ready for use in an easily accessible location that is permanently and clearly marked. They are to be stored in two or more widely separated locations.

**15.2.9 Arrangements in Machinery and Working Spaces**

**1** Means are to be provided for stopping ventilating fans serving machinery and working spaces and for closing all doorways, ventilators, annular spaces around funnels and other openings to such spaces. These means are to be capable of being operated from outside such spaces in case of fire.

**2** Machinery driving forced and induced draught fans, electric motor pressurization fans, oil fuel transfer pumps, oil fuel unit pumps and other similar fuel pumps are to be fitted with remote controls situated outside the space concerned so that they may be stopped in the event of a fire arising in the space in which they are located.

**3** Every oil fuel suction pipe from a storage, settling or daily service tank situated above the double bottom are to be fitted with a cock or valve capable of being closed from out side the space concerned in the event of a fire arising in the space in which such tanks are situated. In the special case of deep tanks situated in any shaft or pipe tunnel, valves on the tanks are to be fitted but control in event of fire may be effected by means of an additional valve on the pipeline or lines outside the tunnel or tunnels.

**15.2.10 Fire Detection and Alarm System**

**1** An automatic fire detection and alarm system complying with the requirements in **Chapter 29, Part R**, are to be provided in spaces having a fire risk, all accommodation and service spaces.

**2** In selecting the type of detector, the following features are to be taken into account:

(1) capability to detect fire at the incipient stage

(2) ability to avoid spurious alarms and trips; and

(3) suitability to the located environment.

**3** The fire detection main indicator board is to be at a manned control station and is to be clearly to indicate where fire has been detected.

**4** Accommodation spaces are to be fitted with smoke detectors.

**5** Thermal detectors are to be fitted in galleys.

**6** Smoke detectors are to be provided in all electrical rooms and control stations.

**7** Flame or thermal detectors are to be installed in drilling and mud processing areas. Smoke detectors may be used in enclosed mud processing areas.

**8** A fixed fire detection and fire alarm system is to be installed in the following spaces. Detection systems using only thermal detectors, in general, are not to be permitted.

(1) periodically unattended machinery spaces;

(2) machinery spaces where the installation of automatic and remote control systems and equipment has been approved in lieu of continuous manning of the spaces; and

(3) machinery spaces where the main propulsion and associated machinery, including the main sources of electrical power, are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room.

**9** A sufficient number of manual fire alarm stations is to be installed at suitable locations, including accommodation spaces, service spaces and control stations, throughout the unit. One manually operated call point is to be located at each exit. Manually operated call points are to be readily accessible in the corridors of each deck such that no part of the corridor is more than 20 *m* from a manually operated call point. Measures are to be taken to prevent inadvertent operation of the manual call alarm system.

**15.2.11 Gas Detection and Alarm System**

**1** Flammable gas detection and alarm system

(1) A fixed automatic gas detection and alarm system are to be provided to the satisfaction of the Society so arranged as to monitor continuously all enclosed areas of the units in which an accumulation of flammable gas may be expected to occur. The fixed automatic combustible gas detection and alarm systems are, as a minimum, to be provided for the following areas:

(a) cellar decks;

(b) drill floors;

(c) ventilation intake of positive pressure driller's cabin;

(d) mud pit areas;

(e) shale shaker areas;

(f) enclosed spaces containing the open components of mud circulation systems from the bell nipple to the mud pits;

(g) ventilation intakes of accommodation spaces;

(h) ventilation intakes of enclosed machinery spaces contiguous to hazardous areas and containing internal combustion engines, boilers, or non-explosion proof electrical equipment;

(i) air intakes to all combustion engines or machinery, including internal combustion engines, boilers, compressors or turbines, located outside of an enclosed machinery space;

(j) at each access door to accommodation spaces;

(k) near other openings, including emergency egress, of accommodation spaces, regardless if these openings are fitted with self-closing and gastight closing appliances.

(2) Notwithstanding **(1)** above, fixed automatic gas detection and alarm systems are not required for the following areas:

(a) near access doors to accommodation spaces where these form part of an air-lock which is provided with a gas detection and alarm system between the two doors of the air-lock;

(b) near emergency egress doors which are fitted with a mechanism to prevent uses other than in an emergency (e.g. doors fitted with security seals acting as a deterrent but easily breakable in a real emergency.);

(c) near other openings which are provided with closing appliances of non-opening type, e.g. bolted closed maintenance ways etc.

(3) The specifications of the fixed automatic gas detection and alarm systems are to be in accordance with the following **(a)** to **(c)**:

(a) the gas detectors are to be connected to an audible and visual alarm system with indicators on the drill floor and in the main control station;

(b) the alarm system is to be capable of clearly indicating at the main control point by aural and visual means the concentration and locations of the gas hazard;

(c) the combustible gas detectors are to alarm at not more than 25 % and at 60 % of the lower explosive limit (*LEL*).

(4) On the unit, at least two portable combustible gas monitoring devices are to be provided, each capable of accurately measuring a concentration of flammable gas.

**2** Hydrogen sulphide detection and alarm system

(1) A fixed automatic hydrogen sulphide gas detection and alarm system is to be provided to the satisfaction of the Society so arranged as to monitor continuously the drilling area, mud processing area and well fluid test area of the unit and capable of giving audible and visual alarms at the main control points. The specifications of the fixed automatic hydrogen sulphide gas detection and alarm systems are to be in accordance with the following **(a)** to **(d)**:

(a) the detectors are to be connected to an audible and visual alarm system with indicators in main control room;

(b) the system is to clearly indicate where gas has been detected;

(c) if the alarm at the main control point is unanswered within 2 *minutes*, the toxic gas (hydrogen sulphide) alarm and the helideck status light specified in **Chapter 17, Part P** is to be automatically activated; and

(d) low level alarm set at 10 *ppm* and high level alarm set not higher than 300 *ppm* are to be provided. The high level alarm is to activate an evacuation alarm.

(2) At least two portable hydrogen sulphide gas monitoring devices are to be provided on the unit.

**15.2.12 Respiratory Protection Equipment for Hydrogen Sulphide**

Breathing devices in accordance with the following **(1)** or **(2)** are to be provided on the unit for each person:

(1) a self-contained breathing apparatus (SCBA) positive-pressure/pressure-demand breathing equipment with full-face piece. The self-contained breathing apparatus is to be rated for the following:

(a) a minimum of 30 *minutes* in working areas where hydrogen sulphide may be encountered; and

(b) a minimum of 15 *minutes* in other working areas; or

(2) a positive-pressure/pressure-demand air line breathing equipment coupled with a SCBA equipped low pressure warning alarm. The self-contained breathing apparatus is to be rated for a minimum of 15 *minutes*. Breathing air supply line stations are to be provided at least in the following areas:

(a) living quarters;

(b) muster/evacuation areas;

(c) drilling areas;

(d) mud processing areas; and

(e) other working areas.

**15.2.13 Fire Extinguishing System for Helicopter Facilities***

**1** This paragraph provides additional measures in order to address the fire safety objectives for units fitted with facilities for helicopters and meets the following functional requirements:

(1) helideck structure is to be adequate to protect the unit from the fire hazards associated with helicopter operations;

(2) fire-fighting appliances are to be provided to adequately protect the unit from the fire hazards associated with helicopter operations;

(3) refuelling facilities and operations are to provide the necessary measures to protect the unit from the fire hazards associated with helicopter operations; and

(4) helicopter facility operation manuals and training are to be provided.

**2** In close proximity to the helideck, the following fire-fighting appliances are to be provided and stored near the means of access to that helideck:

(1) primary extinguishers:
at least two dry powder extinguishers having a total capacity of not less than 45 *kg* but not less than 9 *kg* each;

(2) back-up extinguishers:
carbon dioxide extinguishers of a total capacity of not less than 18 *kg* or equivalent, one of these extinguishers being so equipped as to enable it to reach the engine area of any helicopter using the deck. The back-up extinguishers are to be located so that they would not be vulnerable to the same damage as the primary extinguishers;

(3) a suitable foam application system consisting of monitors or foam-making branch pipes capable of delivering foam to all parts of the helideck in all weather conditions in which the helideck is intended to be available for helicopter operations. The capacity and other specifications of the foam production system are to comply with the following **(a)** to **(c)**:

(a) a minimum application rate of 6 $l/m^2$ (4.1 $l/min \cdot m^2$ for Aqueous Film Forming Foam or Film-Forming Fluoroprotein Foam) within a circle having a diameter equal to $D_H$;

(b) a minimum of 5 *minutes* discharge capability is to be provided; and

(c) foam delivery at the minimum application specified in the preceding **(a)** is to start within 30 *s* of system activation;

(4) the principal agent is to be suitable for use with salt water and a type deemed as appropriate by the Society;

(5) at least two nozzles of an approved dual-purpose type (jet/spray) and hoses sufficient in length to reach any part of the helideck;

(6) in lieu of the above **(3)** to **(5)**, on units constructed on or after 1 January 2020, foam firefighting appliances complying with **Chapter 37, Part R**;

(7) in addition to the fire-fighter's outfits required in **15.2.8**, at least two fire-fighter's outfits; and

(8) At least the following equipment is to be stored in a manner that provides for immediate use and protection from the elements:

(a) adjustable wrench;

(b) blanket, fire-resistant;

(c) cutters, bolt, 600 *mm*;

(d) hook, grab or salving;

(e) hacksaw, heavy duty complete with six spare blades;

(f) ladder;

(g) lift line 5 *mm* diameter and 30 *m* in length;

(h) pliers, side-cutting;

(i) set of assorted screwdrivers;

(j) harness knife complete with sheath; and

(k) crowbar.

**3** Drainage facilities in way of helidecks are to be constructed of steel or other arrangements providing equivalent fire safety, are to lead directly overboard independent of any other system, and are to be designed so that drainage does not fall onto any part of the unit.

**4** Where the unit has helicopter refuelling, the following requirements are to be complied with:

(1) a designated area is to be provided for the storage of fuel tanks which is:

(a) as remote as is practicable from accommodation spaces, escape routes and embarkation stations; and

(b) isolated from areas containing a source of vapour ignition;

(2) the fuel storage area is to be provided with arrangements whereby fuel spillage may be collected and drained to a safe location;

(3) tanks and associated equipment are to be protected against physical damage and from a fire in an adjacent space or area;

(4) where portable fuel storage tanks are used, special attention is to be given to:

(a) design of the tank for its intended purpose;

(b) mounting and securing arrangements;

(c) electric bonding; and

(d) inspection procedures;

(5) storage tank fuel pumps are to be provided with means which permit shutdown from a safe remote location in the event of a fire. Where a gravity-fuelling system is installed, equivalent closing arrangements are to be provided to isolate the fuel source;

(6) the fuel pumping units are to be connected to one tank at a time. The piping between the tank and the pumping unit is to be of steel or equivalent material, as short as possible, and protected against damage;

(7) electrical fuel pumping units and associated control equipment are to be of a type suitable for the location and potential hazards;

(8) fuel pumping units are to incorporate a device which will prevent over-pressurization of the delivery or filling hose;

(9) equipment used in refuelling operations is to be electrically bonded; and

(10) "NO SMOKING" signs are to be displayed at appropriate locations.

**15.2.14 Additional Requirements for Units with Periodically Unattended Machinery Space**

**1** Notwithstanding the requirements in **15.2.5**, units with periodically unattended machinery space are to be provided with the fixed fire extinguishing systems complying with **15.2.14**.

**2** Service pipes are to be compiled with the following requirements **(1)** and **(2)** in order to serve immediate water delivery from the fire main system at a suitable pressure.

(1) One main fire pump is to be operable with remotely starting from the navigation bridge or the control station. And other fire pump, if possible, is to be provided with remote starting device in fire control station in order to be operable with remotely.

(2) The fire main is to be permanently kept for pressurizing, and the entire fire-fighting system is to be protected from freezing.

**3** A fire detection and alarm system complying with the requirement in **Chapter 29, Part R**, are to be provided in the following areas, in addition to the area required in **15.2.10**.

(1) periodically unattended machinery spaces.

(2) spaces in which exhaust pipes of main propulsion and associated machinery are contained. In case where this system need not to be provided in these areas by the discretion of the Society, this requirement may be reduced.

(3) Spaces in which air supply casings of boiler and discharging part are contained. In case where this system need not to be provided in these areas by the discretion of the Society, this requirement may be reduced.

**15.2.15 Fire Control Plan**

The fire control plan specified in **15.2.2, Part R**, is to be permanently exhibited. The following **(1)** to **(18)** are to be clearly indicated on the fire control plan:

(1) locations of fire control stations;

(2) various fire sections enclosed by various classes of fire divisions;

(3) arrangement of fire detectors and manual fire alarm stations;

(4) arrangement of combustible gas detectors;

(5) arrangement of hydrogen sulphide gas detectors;

(6) locations of breathing devices;

(7) general alarm actuating positions;

(8) arrangement of various fire-extinguishing appliances;

(9) locations of fire-fighter's outfits;

(10) location of helicopter crash kit;

(11) arrangement of water spray nozzles and sprinklers (if fitted);

(12) locations of emergency shutdown (such as oil fuel source shutdown, engine shutdown, etc.) stations;

(13) the ventilating system including fire dampers positions, ventilating fans control positions with indication of identification

numbers of ventilating fans serving each section;

(14) arrangement of fire/watertight doors and their remote control positions;

(15) blowout preventer control positions;

(16) escape routes and means of access to different compartments, decks, etc.;

(17) locations of emergency escape breathing devices (*EEBD*); and

(18) arrangement of emergency muster stations and life-saving appliances.

**15.2.16 Operational Readiness and Maintenance**

**1** For operational readiness and maintenance, the following functional requirements are to be met:

(1) gas detection systems, fire protection systems and fire-fighting systems and appliances are to be maintained ready for use; and

(2) gas detection systems, fire protection systems and fire-fighting systems and appliances are to be properly tested and inspected.

**2** At all times while the unit is in service, the requirements of the preceding **-1** are to be complied with. A unit is not in service when:

(1) it is in for repairs or lay up (either at anchor or in port) or in dry-dock; and

(2) it is declared not in service by the owner or the owner's representative.

**3** For operational readiness, the requirements of the following **(1)** and **(2)** are to be complied with:

(1) The following gas detection and fire protection systems specified in **(a)** through **(d)** below are to be kept in good order so as to ensure their intended performance if a fire occurs:

(a) structural fire protection including fire-resisting divisions and protection of openings and penetrations in these divisions;

(b) fire detection and fire alarm systems;

(c) gas detection and alarm systems; and

(d) means of escape systems and appliances.

(2) Fire-fighting systems and appliances and portable gas detection systems are to be kept in good working order and readily available for immediate use. Portable extinguishers which have been discharged are to be immediately recharged or replaced with an equivalent unit.

**4** For maintenance, testing and inspections, the following requirements are to be complied with.

(1) Maintenance, testing and inspections are to be carried out based on the "*Revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances*" (*MSC*.1/*Circ*.1432 as amended, including the amendments by *MSC*.1/*Circ*.1516) developed by the *IMO* and in a manner having due regard to ensuring the reliability of fire-fighting systems and appliances.

(2) The maintenance plan is to be kept on board the unit.

(3) The maintenance plan is to include at least the following fire protection systems and fire-fighting systems and appliances, where installed:

(a) fire mains, fire pumps and hydrants including hoses, nozzles and international shore connections;

(b) fixed fire detection and fire alarm systems;

(c) fixed fire-extinguishing systems and other fire-extinguishing appliances;

(d) automatic sprinkler, fire detection and fire alarm systems;

(e) ventilation systems including fire and smoke dampers, fans and their controls;

(f) emergency shut down of fuel supply;

(g) fire doors including their controls;

(h) general emergency alarm systems;

(i) emergency escape breathing devices;

(j) portable fire extinguishers including spare charges or spare extinguishers;

(k) portable hydrogen sulphide gas detection monitoring devices;

(l) portable flammable gas and oxygen monitoring devices;

(m) gas detection and alarm systems; and

(n) fire-fighter's outfits.

(4) The maintenance programme may be computer-based.

## 15.3 Storage Units

### 15.3.1 General

**1** As for storage units which stores liquids having a flashpoint of 60℃ and under, and similar liquid substances having similar hazardous characteristics on fire, fire extinguishing systems which are complied with the requirements of **15.3.2** to **15.3.7** are to be provided.

**2** As for storage units which stores liquids having flashpoint over 60℃, fire extinguishing systems which are appropriate to the Society are provided.

### 15.3.2 Fire Extinguishing Systems in Pump Rooms

Pump rooms of the storage units are to be provided with the fixed fire-extinguishing systems required in **10.9.1** and **10.9.2, Part R**.

### 15.3.3 Fire Extinguishing Systems in Machinery Spaces

Machinery spaces of the storage barge are to be provided with following arrangements.

(1) One of the following fixed fire-extinguishing systems:

(a) A fixed gas fire-extinguishing system complying with the requirements of **Chapter 25, Part R**.

(b) A fixed froth fire-extinguishing system complying with the requirements of **Chapter 26, Part R**.

(c) A fixed pressure water-spraying fire-extinguishing system complying with the requirements of **Chapter 27, Part R**.

(2) One approved portable form applicator of not less than 45 *l* capacity or equivalent.

(3) One approved portable form extinguisher for each 750 *kW* of engine power output or part thereof.

### 15.3.4 Fire Extinguishing Systems in Control Rooms

Control rooms of the storage units are to be provided with following portable fire extinguishers.

(1) One approved portable carbon-dioxide extinguisher or one approved portable dry-powder extinguisher.

(2) One approved portable fluid extinguisher or one approved portable foam extinguisher.

### 15.3.5 Fire Extinguishing Systems in Oil Tank Areas

**1** Following fire extinguishing systems are to be provided in oil tank areas.

(1) An inert gas system complying with the requirement in **Chapter 35**, **Part R**. In applying **35.2.6-5(2)**, **Part R**, automatic shut-down of the inert gas blowers and inert gas regulating valve are required even though in the condition of **35.2.10-1**, **Part R**.

(2) A fixed deck foam system complying with the requirement of **Chapter 34, Part R**. Monitor of this system are to be being operable both remotely and manually, in applying to the storage units as they would apply to tankers having 4,000 *ton* of deadweight.

(3) A fixed foam system in tanks complying with the requirements of following **(a)** to **(h)**.

(a) to serve the foam in every oil tanks.

(b) to be immediately and easily being operable.

(c) The rate of delivering foam liquids is to be not less than 4 $l/m^2$ per minute against the horizontal projected area of each oil tank.

(d) In case of storage oil having a flashpoint of less than 21℃, foam liquids of 220 $l/m^2$ capacity, in case of storage oil having a flashpoint of less than 70℃ but not less than 21℃, foam liquids of 120 $l/m^2$ capacity, and in case of storage oil having a flashpoint not less than 70℃, foam liquids of 100 $l/m^2$ capacity, to serve in oil tanks against the horizontal projected are as of tanks. And the expansion rate of foam which means the ratio between the volume generated foams liquids and the volume of liquids mixed water and original foams, as a rule, is not to exceed 12 to 1.

(e) A Pressure of delivering foam liquids at fixed foam delivering duct is to be of sufficient considering the size of storage tank, feature of construction etc., and the capacity of delivering foam liquids at fixed foam delivering duct is to be exceeding 200 *ℓ/min*.

(f) Number, arrangement and piping of fixed foam delivering are to be provided appropriately to be efficiently covered with the surface of oil in storage tanks by the foam delivered from fixed foam delivering duct which is located therein in any oil loading condition.

(g) A fixed foam delivering duct is to be arranged that oil in storage tank does not admit to pipes which are connected to a fixed foam delivering duct to serve foam liquids, and to be constructed that air does not admit to the storage tank through

the fixed foam delivering duct, except during delivering foam liquids.

(h) Main pipings and valves are to be arranged as far as practicable to avoid the system out of action or the system down of action due to damages of pipes.

(4) Portable foam extinguishers and portable dry powder extinguishers complying with the requirements of **Chapter 24, Part R**.

(5) For large sized storage units, deck water-cooling systems and cofferdam water-cooling systems are to be provided. These systems for storage oil tanks used in the event of fire are to be capable of expeditiously discharging a sufficient quantity of water on the entire space of the decks or of accumulating a sufficient quantity of water on the decks with coamings being fitted to their periphery in order to ensure that heat caused by the fire occurring in any one storage oil tank is not transmitted to the other tanks. The capacity of the pumps used in such systems is to be such that they are effective for the cooling service with one of these pumps out of action. Essential pipes and valves are to be so arranged that the damage to the pipes will not lead to the loss or drop of the cooling function.

**2** Capacity of original foam liquids for fixed foam extinguishing systems is to be of capacity which is considered when fixed deck foam system and fixed foam system in tanks are operated simultaneously, in addition to capacity of spare charge. In case where storage units applied to **12.1.1-3, Part B** and appropriate to the Society, the capacity of original foam liquids may be alternated to other storage units respectively. The capacity of alternation, however, may be limited as to immediately operate and to avoid to interfere with a reliable fire-fighting.

#### 15.3.6 Closing Appliances of Openings of Storage Tanks, etc.

All openings which are through the storage tanks, machinery spaces and pump rooms are to be provided with closing appliances to close when fire occurs at therein.

#### 15.3.7 Fire Extinguishing Systems in Accommodation Spaces, Corridors, Service Spaces and Control Stations

In accommodation spaces, corridors, service spaces and control stations, suitable fire extinguishing systems corresponding to the size and purpose of these spaces which are accepted by the Society are provided.

### 15.4 Work-ships which are Engaged In Works with Danger of a Fire or an Explosion

#### 15.4.1 General

**1** The fire extinguishing systems of the unit which is engaged in works with danger of a fire or an explosion is to be in accordance with the requirements in **Chapter 10** and **Chapter 19, Part R**, as a tanker, and additional fire extinguishing systems as deemed appropriate by the Society are to be provided with.

**2** For the fire extinguishing systems for the unit which has a large embarking capacity, the Society may require additional fire extinguishing systems in addition to the requirement in **-1**.

### 15.5 Work-ships which are Engaged In Works without Danger of a Fire or an Explosion

#### 15.5.1 General

**1** The fire extinguishing systems of the unit which is engaged in works without danger of a fire or an explosion is to be in accordance with the requirements in **Chapter 10** and **Chapter 19, Part R**, as a general cargo ship, and additional fire extinguishing systems as deemed appropriate by the Society are to be provided with.

**2** For the fire extinguishing systems for the unit which has a large embarking capacity, the Society may require additional fire extinguishing systems in addition to the requirement in **-1**.

### 15.6 Units which have Accommodation for Particular Personnel or Passengers

#### 15.6.1 General

**1** Units which have accommodation for particular personnel or passengers, such as an accommodation barge, the fire extinguishing systems as deemed appropriate by the Society are provided with, considering the structural arrangements, type of unit, embarking capacity, etc.

**2** The unit which has a small embarking capacity, may be provided the fire extinguishing system complying with the requirement in **Chapter 10** and **Chapter 19, Part R** as a general cargo ship.

# Chapter 16 SAFETY EQUIPMENT

## 16.1 General

### 16.1.1 Application

**1** The safety equipment provided for units fixed on the seabed or positioned for long periods of time are to apply the requirements given in this Chapter.

**2** The safety equipment of units, except for units listed in **-1** above, is to be at the discretion of the Society.

**3** The safety equipment of units is to be according to this **Part**. In addition, attention is to be paid to complying with the National Regulations of the flag state.

## 16.2 Mobile Offshore Drilling Units

### 16.2.1 General Alarm Systems

**1** A general alarm system is to be provided and so installed as to be clearly perceptible in all parts of the unit.

**2** The signals used are to be limited to general emergency, toxic gas (hydrogen sulphide), combustible gas, fire alarm and abandon unit signals.

**3** At least in the following spaces, general alarms are to be capable of being operated:

(1) Main control station;

(2) Drilling console;

(3) Navigation bridge (if any); and

(4) Fire control station (if any).

### 16.2.2 Public Address Systems

A public address system is to allow for the broadcast of messages from the navigation bridge, central control room, emergency response center, engine control room, ballast control station, jacking control station and drilling console.

# Chapter 17 HELICOPTER FACILITIES

## 17.1 General

**1** Each helideck is to be of sufficient size and located so as to provide a clear take-off and approach to enable the largest helicopter using the helideck to operate under the most severe conditions anticipated for helicopter operations.

**2** The helicopter facilities provided for units are to be according to this Part. In addition, attention is to be paid to complying with the National Regulations of the flag state and the coastal state.

## 17.2 Exemptions

Administrations are to consider exemptions from or equivalencies to the provisions of this chapter regarding markings and landing aids when:

(1) The Administration is provided with evidence that the coastal State in whose waters the mobile offshore drilling unit is operating has notified the *International Civil Aviation Organization* (*ICAO*) of differences to its requirements for visual aids

(2) The Administration is provided with evidence that the coastal State in whose waters the mobile offshore drilling unit is operating has established requirements for visual aids that differ from the provisions of this chapter.

## 17.3 Helideck

### 17.3.1 General*

**1** The helideck is to be of a design and construction, adequate for the intended service and for the appropriate prevailing climatic conditions, approved to the satisfaction of the Society.

**2** The helideck is to have a skid-resistant surface.

**3** The helideck is to generate a ground effect. When the deck below helideck level generates the ground effect, the helideck may be constructed in the form of a grating.

**4** The design load in determining the scantlings of the members of helicopter deck is to be in accordance with the requirements in **3.2.7**.

**5** Allowable stresses of the structural members of the helideck are not to exceed the values in **Table P17.1** in association with the design loads prescribed in **-4** above.

**6** The minimum thickness of helideck plating is not to be less than 6 *mm*.

Table P17.1 Allowable Stresses

| Design loads | Structural members | | |
|---|---|---|---|
| | Deck plating | Deck beams | Girders, stanchions, truss support, etc. |
| Helicopter landing impact load | * | $\sigma_Y$ | $0.9\times\sigma_{Y'}$ |
| Stowed helicopter load | $\sigma_Y$ | $0.9\times\sigma_Y$ | $0.8\times\sigma_{Y'}$ |
| Overall distributed load | $0.6\times\sigma_Y$ | $0.6\times\sigma_Y$ | $0.6\times\sigma_{Y'}$ |

Note:

*At the discretion of the Society.

$\sigma_Y$: As specified in **7.2.2**

$\sigma'_Y$: For members subjected to axial compression, $\sigma_Y$ or critical buckling stress, whichever is smaller, is to be considered. ($N/mm^2$)

### 17.3.2 Construction*

The helideck is to meet the following provisions, taking into account the type of helicopter used, the conditions of wind, turbulence, sea state, water temperature and icing conditions:

(1) The helideck is to be of sufficient size to contain an area within which can be drawn a circle of diameter not less than $D_H$ for single main rotor helicopters.

(2) A helideck obstacle-free sector is to comprise of two components, one above and one below helideck level (see **Fig. P17.1**):

(a) Above helideck level:

The surface is to be a horizontal plane level with the elevation of the helideck surface that subtends an arc of at least 210° with the apex located on the periphery of the $D_H$ reference circle extending outwards to a distance that will allow for an unobstructed departure path appropriate to the helicopter(s) the helideck is intended to serve.

(b) Below helideck level:

A zone complying with the following **i)** and **ii)** is to allow for safe clearance from the obstacles below the helideck in the event of an engine failure for the type of helicopter(s) the helideck is intended to serve:

i) Below the plane specified in **(a)** above

ii) Within the (maximum) 210° specified **(a)** above, the surface is to additionally extend downward at a 5:1 falling gradient from the edge of the safety net below the elevation of the helideck to water level for an arc of not less than 180° that pass through the centre of the *FATO*

(3) For single main rotor helicopters, the maximum obstacle height is to comply with the following requirements (see **Fig. P17.2**):

(a) Within the 150° *LOS* out to a distance of 0.12 $D_H$, measured from the point of origin of the *LOS*, objects are not to exceed a height of 0.25 *m* above the helideck.

(b) Beyond that arc specified in **(a)** above, out to a distance of an additional 0.21 $D_H$, the maximum obstacle height is limited to a gradient of one unit vertically for each two units horizontally originating at a height of 0.05 $D_H$ above the level of the helideck.

(4) Objects the function of which requires that they be located on the helideck within the *FATO* are to be limited to landing nets (where required) and certain lighting systems and are not to exceed the surface of the landing area by more than 0.025 *m*. Such objects are only to be present provided they do not cause a hazard to helicopter operations.

(5) Operations by tandem main rotor helicopters are to be specially considered by the Society.

### 17.3.3 Construction for Benign Climates

For benign climates as determined by the coastal State, taking into account the type of helicopter used, the conditions of wind, turbulence, sea state, water temperature and icing conditions, notwithstanding the requirements given in **17.3.2**, the helideck is to meet the following:

(1) The helideck is to be of sufficient size to contain a circle of diameter no less than 0.83 $D_H$.

(2) A helideck obstacle-free sector shall comprise of two components, one above and one below helideck level (see **Fig. P17.1**):

(a) Above helideck level:

The surface is to be a horizontal plane level with the elevation of the helideck surface that subtends an arc of at least 210° with the apex located on the periphery of the $D_H$ reference circle extending outwards to a distance that will allow for an unobstructed departure path appropriate to the helicopter(s) the helideck is intended to serve.

(b) Below helideck level:

The zone complied with following **i)** and **ii)** is to have so that this zone will allow for safe clearance from the obstacles below the helideck in the event of an engine failure for the type of helicopter(s) the helideck is intended to serve;

i) Below the plane specified in **(a)** above

ii) Within the (maximum) 210° specified **(a)** above, the surface is to additionally extend downward at a 5:1 falling gradient from the edge of the safety net below the elevation of the helideck to water level for an arc of not less than 180° that passes through the centre of the *FATO*

(3) For single main rotor helicopters, the maximum obstacle height is to comply with the following requirements. (see **Fig. P17.3**)

(a) Within 0.415 $D_H$ to 0.5 $D_H$ objects are not to exceed a height of 0.025 *m*.

(b) Within the 150° *LOS* out to a distance of 0.12 $D_H$, measured from the point of origin of the *LOS*, objects are not to exceed a height of 0.05 *m* above the helideck.

(c) Beyond that arc, out to a distance of an additional 0.21 $D_H$, the *LOS* rises at a rate of one unit vertically for each two units horizontally originating at a height of 0.05 $D_H$ above the level of the helideck.

(4) Objects the function of which requires that they be located on the helideck within the *FATO* are to be limited to landing nets (where required) and certain lighting systems and are not to exceed the surface of the landing area by more than 0.025 *m*. Such objects are only to be present provided they do not cause a hazard to helicopter operations.

(5) Operations by tandem main rotor helicopters are to be specially considered by the Society.

## 17.4 Arrangements

**1** The helideck is to have recessed tie-down points for securing a helicopter.

**2** The periphery of the helideck is to be fitted with a safety net except where structural protection exists. For the net, the following requirements are to be complied with:

(1) The safety net is to be inclined upwards at an angle of 10° and outwards.

(2) The safety net is to be fitted from below the edge of the helideck to a horizontal distance of 1.5 *m*.

(3) The safety net is to be fitted so that it does not rise above the edge of the deck.

## 17.5 Visual Aids

### 17.5.1 Wind Direction Indicator

**1** A wind direction indicator is to be located on the unit which, in so far as is practicable, indicates the wind conditions over the *TLOF*. The material, shape and colours, etc. of the wind direction indicator are to comply with the following **(1)** to **(3)**.

(1) The wind direction indicator is to be made of lightweight fabric.

(2) The shape of the wind direction indicator is to be a truncated cone. The minimum length of the truncated cone is to be 1.2 *m*, and the minimum diameters at the larger and smaller ends are to be 0.3 *m* and 0.15 *m*, respectively.

(3) The colour of the wind direction indicator is to be a single colour, white or orange, so as to make it clearly visible and understandable from a height of at least 200 *m* above the heliport, having regard to background. However, where it is required to give adequate conspicuity against changing backgrounds, e.g. due to ageing, the wind direction indicator is to be of two colours. The following requirements **(a)** and **(b)** are to be complied with.

(a) The combination of two colours is to be either orange and white or red and white.

(b) The two colours specified in the preceding **(a)** are to be arranged in five alternate bands, the first and last band being the darker colour.

**2** The wind direction indicator is to be visible from a helicopter in flight or in a hover over the helideck. The wind direction indicator is to be located in such a way as to be free from the effects of airflow disturbances caused by nearby objects or rotor downwash.

**3** Where the *TLOF* may be subject to a disturbed air flow then additional wind direction indicators located close to the area are to be provided to indicate the surface wind on those areas.

**4** Units on which night helicopter operations take place are to have provisions to illuminate the wind direction indicators.

### 17.5.2 *TLOF* Perimeter Marking

The *TLOF* perimeter marking is to be located along the perimeter of the *TLOF* and is to consist of a continuous white line with a width of at least 0.3 *m*. This is to be in accordance with **Fig. P17.2** or **Fig. P17.3**.

### 17.5.3 Touchdown/Positioning Marking

**1** A touchdown/positioning marking is to be located so that the following requirements **(1)** and **(2)** are complied with when the pilot's seat is over the marking.

(1) The whole of the undercarriage is within the *TLOF*.

(2) All parts of the helicopter are clear of any obstacle by a safe margin.

**2** In principle, the centre of the touchdown/positioning marking is to be concentric to the centre of the *TLOF*.

**3** A touchdown/positioning marking is to be a yellow circle and have a line width of 1 *m*. The inner diameter of the circle is to be half the $D_H$.

**17.5.4 Heliport Identification Marking**

A heliport identification marking is to be located at the centre of the touchdown/positioning marking specified in **17.5.3**. The heliport identification marking is to consist of a white "*H*" that is 4 *m* high, 3 *m* wide, with a stroke width of 0.75 *m*.

**17.5.5 Helideck Obstacle-free Sector Marking**

**1** Except as provided in the following **-2**, a helideck obstacle-free sector marking is to be located on the *TLOF* perimeter marking and indicated by the use of a black chevron. The helideck obstacle-free sector marking is to comply with the following requirements **(1)** to **(4)**.

(1) Each leg of the chevron is to be 0.8 *m* long and 0.1 *m* wide and is to form the angle in the manner shown in **Fig. P17.4**.

(2) The obstacle-free sector marking is to indicate the origin of the obstacle-free sector.

(3) The obstacle-free sector marking is to indicate the directions of the limits of the sector.

(4) The obstacle-free sector marking is to indicate the verified *D*-value of the helideck.

**2** For a helideck less than $1D_H$, a helideck obstacle free sector marking is to be located at a distance from the centre of the *TLOF* equal to the radius of the largest circle which can be drawn in the *TLOF* or $0.5D_H$, whichever is greater.

**3** The height of the chevron is to equal the width of the *TLOF* perimeter marking, but is to be not less than 0.3 *m*. The chevron may be painted on top of the *TLOF* perimeter marking specified in **17.5.2**.

**17.5.6 *D*-value Marking***

**1** The *D*-value of the helideck is to be painted on the helideck inboard of the chevron specified in **17.5.5** in alphanumeric symbols of 0.1 *m* in height.

**2** The helideck *D*-value is to be marked around the perimeter of the helideck in accordance with **Fig. P17.4** in a colour contrasting with the helideck surface. The *D*-value is to be to the nearest whole number with 0.5 rounded down, e.g., 18.5 marked as 18. In rounding the *D*-value to the whole number, special consideration may be required.

**17.5.7 Maximum Allowable Mass Marking**

**1** A maximum allowable mass marking is to be located within the *TLOF* and so arranged as to be readable from the preferred final approach direction.

**2** The maximum allowable mass marking is to consist of a two- or three-digit number followed by a letter " *t* " to indicate the allowable helicopter mass in tonnes (1,000 *kg*). The marking is to be expressed to one decimal place.

**3** Notwithstanding the requirements of the preceding **-2**, where States require that a maximum allowable weight is indicated in pounds, the marking is to consist of a two- or three-digit number to indicate the allowable helicopter weight in thousands of pounds. The mass marking is not to consist of " *t* " following the number.

**4** The height of the figures is to be 0.9 *m* with a line width of 0.12 *m* and be in a colour which contrasts with the helideck surface. Where possible, the mass marking is to be well separated from the installation identification marking in order to avoid possible confusion on recognition.

**17.5.8 Unit Identification Markings**

**1** The name of the unit is to be clearly displayed on unit identification panels located in such positions that the unit can be readily identified from the air and sea from all normal angles and directions of approach (e.g., high up on the derrick). The height of the figures is to be at least 0.9 *m* with a line width of 0.12 *m*. The unit identification panels are to be highly visible in all light condition. Suitable illumination is to be provided for use at night and in conditions of poor visibility.

**2** In addition to the requirement of the preceding **-1**, the unit's name is to be provided on the helideck and be positioned on the obstacle side of the touchdown/positioning marking with characters not less than 1.2 *m* in height and in a colour contrasting with the background.

**17.5.9 Perimeter Lights**

**1** The perimeter of the *TLOF* is to be delineated by green lights visible omnidirectionally from on or above the landing area. These lights are to be above the level of the deck but are not to exceed 0.25 *m* in height for helidecks sized in accordance with **17.3.2** and 0.05 *m* in height for helidecks sized in accordance with **17.3.3**.

**2** The lights are to be equally spaced at intervals of not more than 3 *m* around the perimeter of the *TLOF*, coincident with the white line delineating the perimeter specified in **17.5.2**.

**3** In the case of square or rectangular decks there are to be a minimum of four lights along each side including a light at each corner of the *TLOF*.

**4** Notwithstanding the requirements of the preceding **-1** to **-3**, flush fitting lights may be used at the inboard (150° limited obstacle sector origin) edge of the *TLOF* where there is a need to move a helicopter or large equipment off the *TLOF*.

**5** Perimeter lights are to meet the chromaticity characteristics given in **Table P17.2**, and the vertical beam spread and intensity characteristics given in **Table P17.3**.

Table P17.2 Perimeter Lighting Chromaticity

| Boundary | Chromaticity |
|---|---|
| Yellow boundary | $x = 0.36 - 0.08y$ |
| White boundary | $x = 0.65y$ |
| Blue boundary | $y = 0.9 - 0.171x$ |

Note:

Both $x$ and $y$ are to be in accordance with the provisions of the *International Commission on Illumination* (*CIE*)

Table P17.3 Green Perimeter Lighting Intensity

| Elevation | Intensity (*cd*) |
|---|---|
| Greater than 0° but not greater than 90° | 60 or less[a] |
| Greater than 20° but not greater than 90° | 3 or more |
| Greater than 10° but not greater than 20° | 15 or more |
| Greater than 0° but not greater than 10° | 30 or more |
| Azimuth (-180° ~ +180°) | |

Note:

a : If higher intensity lighting is provided to assist in conditions of poor visibility during daylight, it is to incorporate a control to reduce the intensity to not more than 60 *cd* for night use.

### 17.5.10 Helideck Floodlights

Helideck floodlights are to be located so as to avoid glare to pilots, and provision is to be made for periodically checking their alignment. The arrangements and aiming of floodlights are to be such that helideck markings are illuminated and that shadows are kept to a minimum. Floodlights are to conform to the same height limitations specified in **17.5.9-1** for perimeter lights.

### 17.5.11 Obstacle Marking and Lighting

**1** Fixed obstacles and permanent equipment, such as crane booms or the legs of self-elevating units, which may present a hazard to helicopters, are to be readily visible from the air during daylight. If a paint scheme is necessary to enhance identification by day, alternate black and white, black and yellow, or red and white bands are to be provided, not less than 0.5 *m* nor more than 6 *m* wide.

**2** Omnidirectional red lights of at least 10 *cd* intensity are to be fitted at suitable locations to provide the helicopter pilot with visual information on objects which may present a hazard to helicopters. Such lighting is to comply with the following requirements **(1)** to **(3)**. However, when deemed appropriate by the Society, alternative equivalent technologies other than those specified in **(1)** to **(3)** may be utilized.

(1) Objects which are more than 15 *m* higher than the landing area are to be fitted with intermediate red lights of the same intensity spaced at 10 *m* intervals down to the level of the landing area (except where such lights would be obscured by other objects).

(2) Structures such as flare booms and towers may be illuminated by floodlights as an alternative to fitting the intermediate red lights, provided that such lights are arranged such that they will illuminate the whole of the structure and not interfere with the helicopter pilot's night vision.

(3) On self-elevating units the leg(s) nearest the helideck may be illuminated by floodlights as an alternative to fitting the intermediate red lights, provided that such lights are arranged such that they will not interfere with the helicopter pilot's night vision.

**3** An omnidirectional red light of intensity 25 to 200 *cd* is to be fitted to the highest point of the unit and. In the case of self-elevating units, an omnidirectional red light of intensity 25 to 200 *cd* is to be fitted as near as practicable to the highest point of each leg.

**17.5.12 Status Lights**

**1** Status lights are to be installed to provide warning that a condition exists on the unit which may be hazardous for the helicopter or its occupants. The status lights are to be a flashing red light (or flashing red lights), visible to the pilot from any direction of approach and on any landing heading. The system is to be automatically initiated when the toxic gas alarm is initiated as well as being capable of manual activation at the helideck. It is to be visible at a range in excess of the distance at which the helicopter may be endangered or may be commencing a visual approach. The status light system is to comply with the following requirements in **(1)** through **(10)**.

(1) The status light system is to be installed either on or adjacent to the helideck. Additional lights may be installed in other locations on the unit where this is necessary to meet the requirement that the signal be visible from all approach directions, i.e. 360° in azimuth.

(2) The status light system is to have an effective intensity of at least 700 *cd* between 2° and 10° above the horizontal and at least 176 *cd* at all other angles of elevation.

(3) The status light system is to be provided with a facility to enable the output of the lights (if and when activated) to be dimmed to an intensity not exceeding 60 *cd* while the helicopter is landed on the helideck.

(4) The status light system is to be visible from all possible approach directions and while the helicopter is landed on the helideck.

(5) The status light system is to use lights that are "red" as defined by the *International Civil Aviation Organization* (*ICAO*).

(6) The following requirements in **(a)** and **(b)** are to be complied with.

(a) The status light system is to flash at a rate of 120 flashes per minute and, if two or more lights are needed to meet this requirement, they are to be synchronised to ensure an equal time gap (to within 10%) between flashes. Provision is to be made to reduce the flash rate to 60 flashes per minute when a helicopter is on the helideck.

(b) The maximum duty cycle is to be no greater than 50%.

(7) The status light system is to have facilities at the helideck to manually override the automatic activation of the system.

(8) The status light system is to reach full intensity in not more than three seconds at all times.

(9) The status light system is to be designed so that no single failure will prevent the system operating effectively. In the event that more than one light unit is used to meet the flash rate requirement, a reduced flash frequency of at least 60 flashes per minute is acceptable in the failed condition for a limited period.

(10) Where supplementary 'repeater' lights are employed for the purposes of achieving the 'on deck' 360° coverage in azimuth, these are to have a minimum intensity of 16 *cd* and a maximum intensity of 60 *cd* for all angles of azimuth and elevation.

## 17.6 Motion Sensing System

Surface units are to be equipped with an electronic motion-sensing system capable of measuring or calculating the magnitude and rate of pitch roll and heave at the helideck about the true vertical datum.

Fig. P17.1 Obstacle Free Areas (Below Landing Area Level)

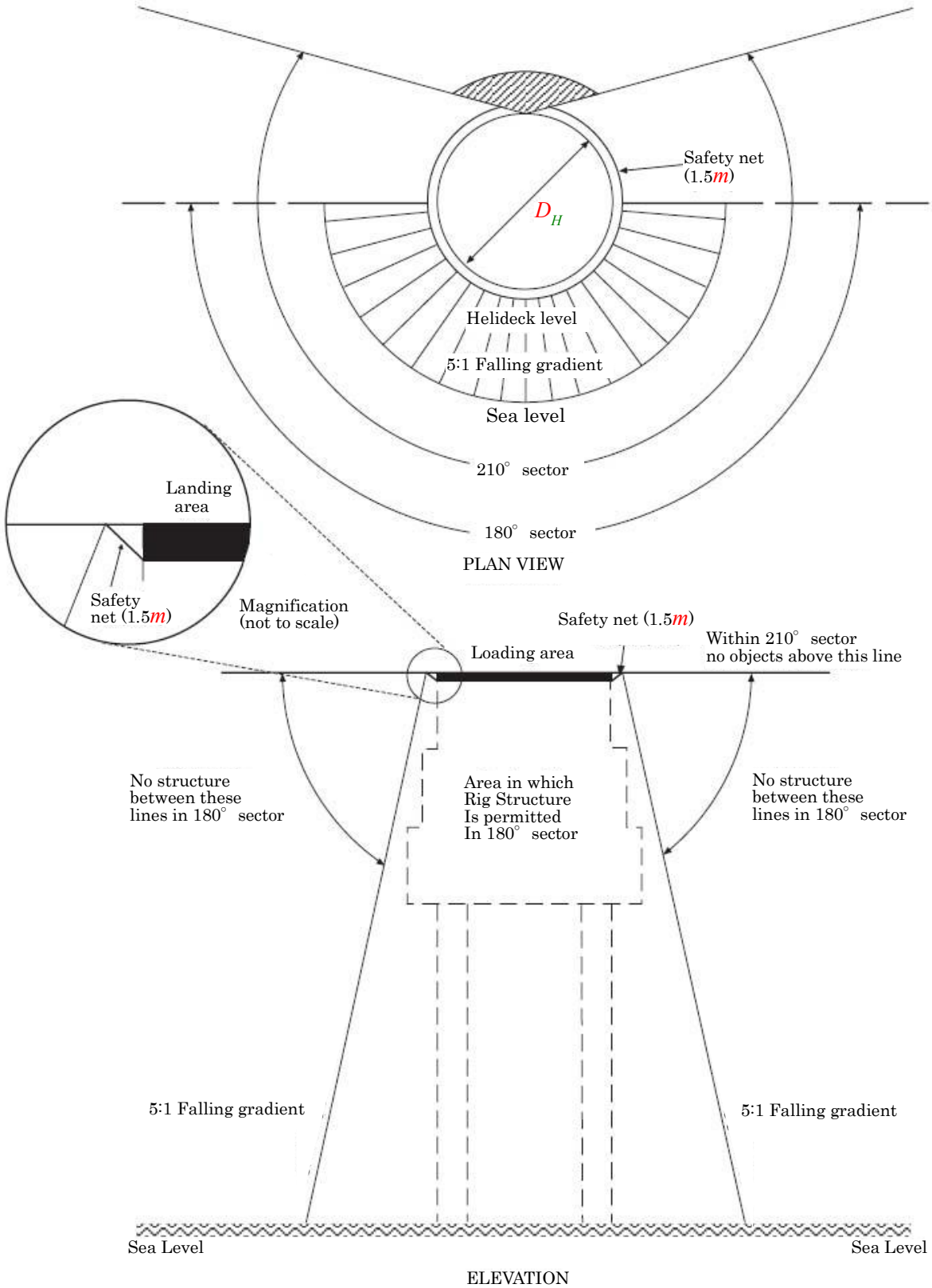
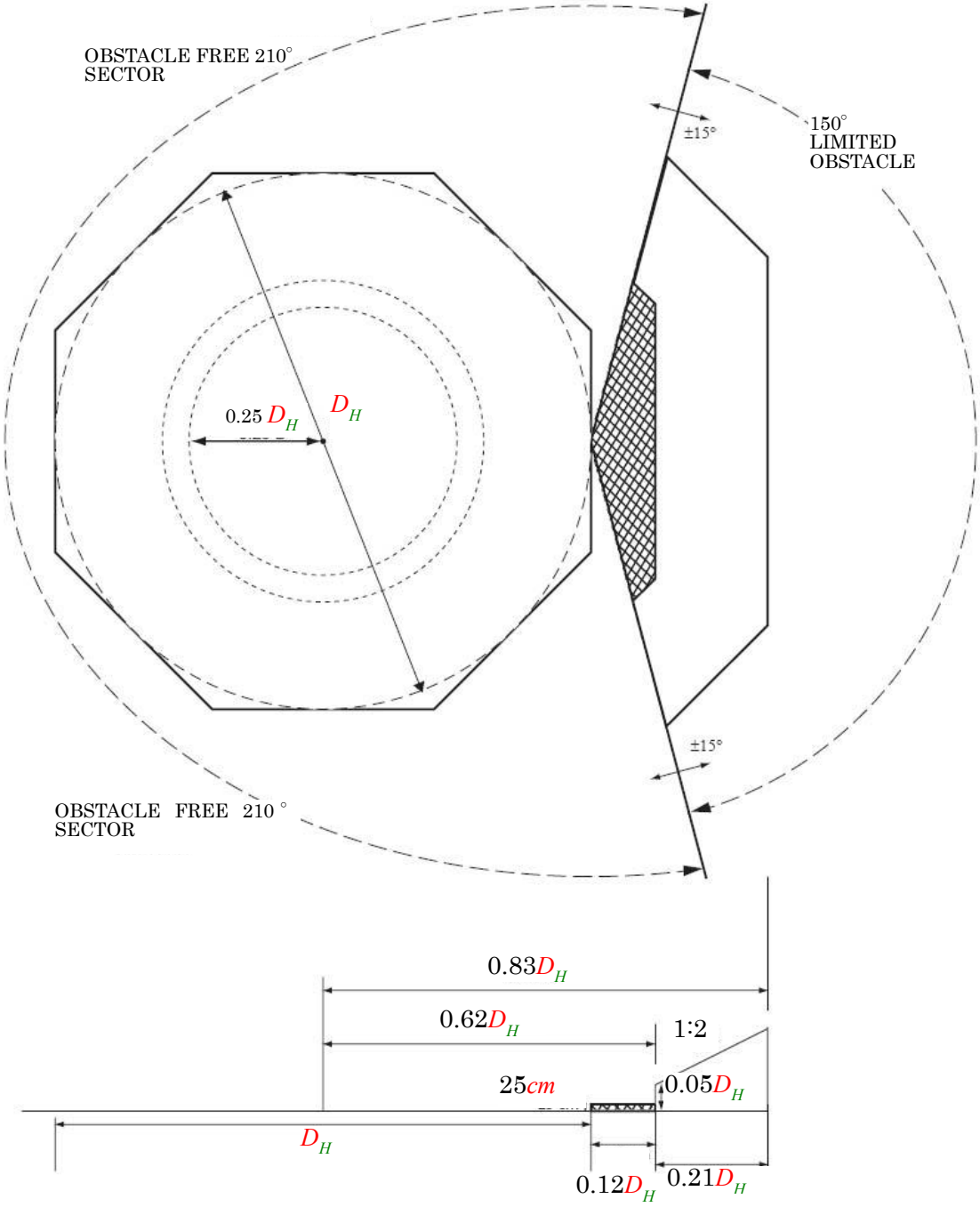


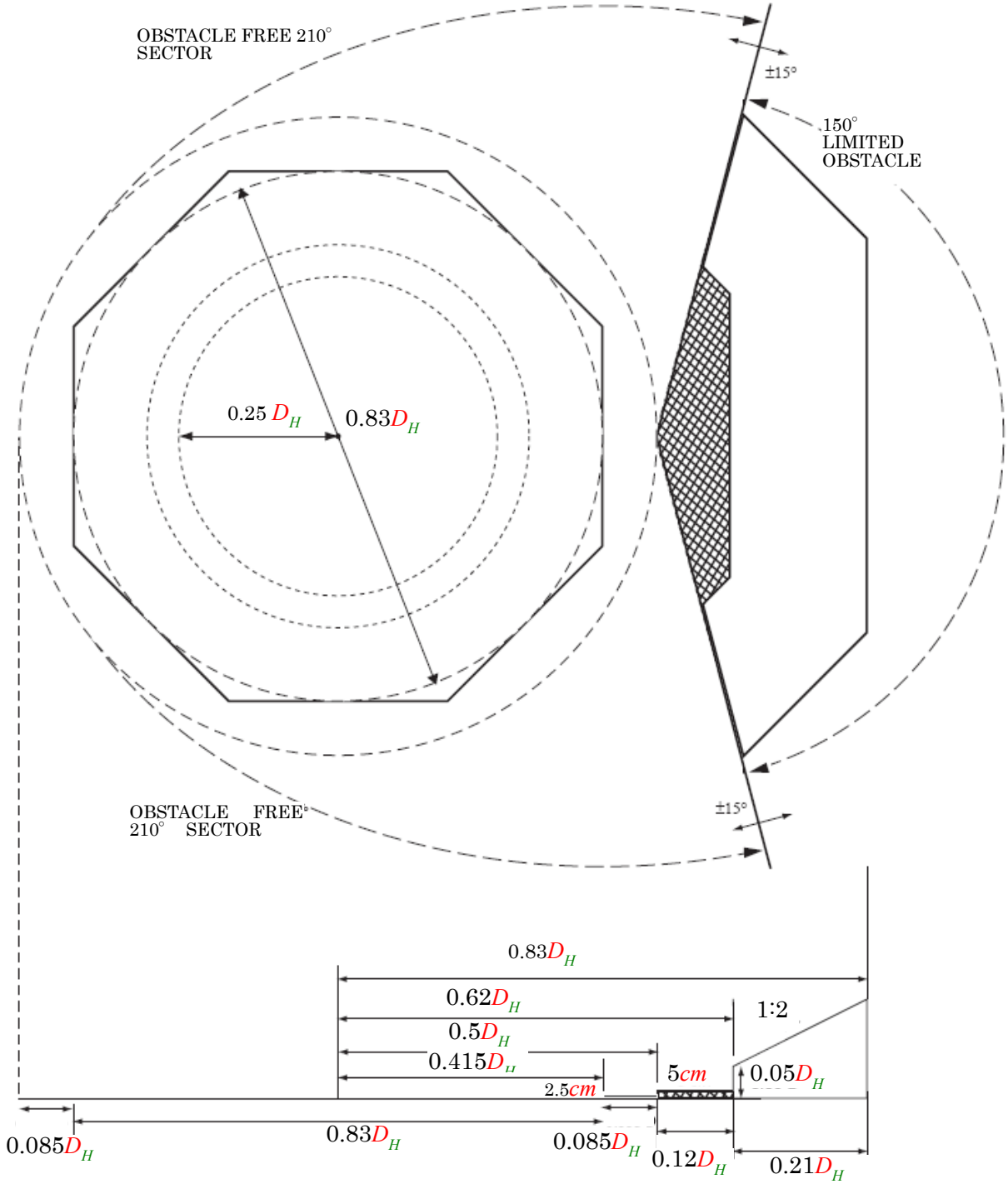
Fig. P17.2 Helideck Obstacle Limitation Sector (Single Main Rotor Helicopters)




Note:

Where the dynamic load bearing area of the helideck enclosed by the *FATO* perimeter marking is a shape other than circular, the extent of the *LOS* as defined in **17.3.2(3)** are represented as lines parallel to the perimeter of the landing area rather than arcs. **Fig. P17.2** has been constructed on the assumption that an octagonal helideck is provided.

Fig. P17.3 Helideck Obstacle Limitation Sector (Single Main Rotor Helicopters for Benign Climate Conditions as Accepted by the Coastal State)

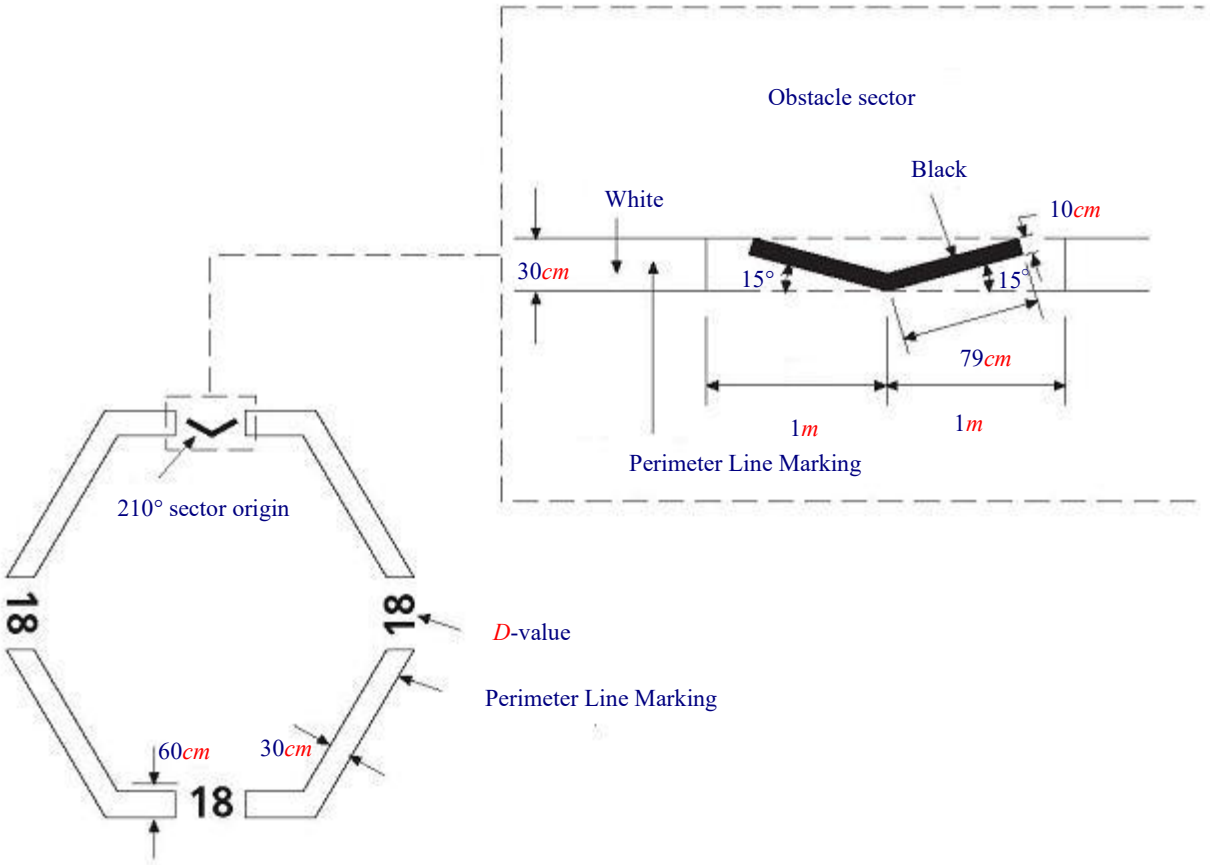



Note: Heights of 2.5*cm* and 5*cm* high shaded areas not to scale

Note:

Where the dynamic load bearing area of the helideck enclosed by the *FATO* perimeter marking is a shape other than circular, the extent of the *LOS* as defined in **17.3.2(3)** are represented as lines parallel to the perimeter of the landing area rather than arcs. **Fig. P17.3** has been constructed on the assumption that an octagonal helideck is provided.

Fig. P17.4 An Example of Obstacle-free Sector Marking (In the Case of a Hexagonal Helideck)



# Chapter 18 OPERATING REQUIREMENT

## 18.1 Operating Manual

### 18.1.1 General

**1** An operating manual approved by the Society is to be provided on board. This operating manual is to include the information for normal operations specified in **18.2.2** and **18.2.4-1**, and for emergency operations specified in **18.2.3**.

**2** The operating manual is to, in addition to providing the necessary general information about the unit, contain guidance on and procedures for operations that are vital to the safety of personnel and the unit.

**3** The operating manual is to be concise and be compiled in such a manner that it is easily understood.

**4** Each operating manual is to be provided with a Table of Contents, an index and wherever possible be cross-referenced to additional detailed information.

**5** The information which is to be readily available on board provided in the operating manual is to, where necessary, be supported by additional material provided in the form of plans, manufacturers' manuals and other data necessary for the efficient operation and maintenance of the unit.

**6** When manufacturers' manuals are provided in accordance with **-5** above, detailed information provided in such manufacturers' manuals need not be repeated in the operating manuals.

**7** Operating and maintenance instructions and engineering drawings for ship machinery and equipment essential to the safe operation of the ship is to be written in a language understandable by those officers and crew members who are required to understand such information in the performance of their duties.

**8** Written procedures for entry into enclosed spaces are to be provided on board which are to take into account the guidance provided in recommendations developed by the *IMO*.

## 18.2 Operating Requirements

### 18.2.1 Application

The provisions in **18.2** are not the conditions for maintenance of classification for which examinations are required but the conditions to be observed by the ship owner, ship master or other persons who may concern with the ship operation.

### 18.2.2 Information for Normal Operations*

**1** The operating manual for normal operations is to include the following general descriptive information, where applicable:

(1) A description and particulars of the unit

(2) A chain of command with general responsibilities during normal operation

(3) Limiting design data for each mode of operation, including draughts, air gap, wave height, wave period, wind, current, sea and air temperatures, assumed seabed conditions, and any other applicable environmental factors, such as icing

(4) A description of any inherent operational limitations for each mode of operation and for each change in mode of operation

(5) The location of watertight and weathertight boundaries, the location and type of watertight and weathertight closures and the location of downflooding points

(6) The location, type and quantities of permanent ballast installed on the unit

(7) A description of the general emergency, toxic gas (hydrogen sulphide), combustible gas, fire alarm and abandon unit signals

(8) For self-elevating units, information regarding the preparation of the unit to avoid structural damage during the setting or retraction of legs on or from the seabed or during extreme weather conditions while in transit.

(9) Light ship data together with a comprehensive listing of the inclusions and exclusions of the equipment that influence light ship data

(10) Stability information setting forth the allowable maximum height of the centre of gravity

(11) A capacity plan showing the capacities and the vertical, longitudinal and transverse centres of gravity of tanks and bulk material stowage spaces

(12) Tank sounding tables or curves showing capacities, the vertical, longitudinal and transverse centres of gravity in graduated intervals and the free surface data of each tank
(13) Acceptable structural deck loadings
(14) Identification of helicopters suited for the design of the helideck and any limiting conditions of operation
(15) Identification and classification of hazardous areas on the unit
(16) Description and limitations of any on-board computer used in operations such as ballasting, anchoring, dynamic positioning and in trim and stability calculations
(17) Description of towing arrangements and limiting conditions of operation
(18) Description of the main power system and limiting conditions of operation
(19) A list of key plans and schematics

**2** The operating manual for normal operations is to also include, where applicable:

(1) Guidance for the maintenance of adequate stability and the use of the stability data
(2) Guidance for the routine recording of lightweight alterations
(3) Examples of loading conditions for each mode of operation and instructions for developing other acceptable loading conditions
(4) For column-stabilized units, a description, schematic diagram and guidance for the operation of the ballast system and of the alternative means of ballast system operation, together with a description of its limitations, such as pumping capacities at various angles of heel and trim
(5) A description, schematic diagram, guidance for the operation of the bilge system and of the alternative means of bilge system operation, together with a description of its limitations, such as draining of spaces not directly connected to the bilge system
(6) Fuel oil storage and transfer procedures
(7) Procedures for changing modes of operation
(8) Guidance on severe weather operations and time required to meet severe storm conditions, including provisions regarding lowering or stowage of equipment, and any inherent operational limitations
(9) Description of the anchoring arrangements and anchoring or mooring procedures and any limiting factors
(10) Personnel transfer procedures
(11) Procedures for the arrival, departure and fuelling of helicopters
(12) Limiting conditions of crane operations
(13) Description of the dynamic positioning systems and limiting conditions of operation
(14) Procedures for ensuring that the requirements of applicable international codes for the stowage and handling of dangerous and radioactive materials are met
(15) Guidance for the placement and safe operation of the well testing equipment. The areas around possible sources of gas release are to be classified in accordance with **13.1.3** for the duration of well test operations
(16) Procedures for receiving vessels alongside
(17) Guidance on safe towing operations such as to reduce to a minimum any danger to personnel during towing operations
(18) Guidance on the implementation of alternative methods for lifeboat drills

### 18.2.3 Operating Manual for Emergency Operations

The operating manual for emergency operations is to include, where applicable:

(1) Description of fire-extinguishing systems and equipment
(2) Description of the life-saving appliances and means of escape
(3) Description of the emergency power system and limiting conditions of operation
(4) A list of key plans and schematics which may be useful during emergency situations
(5) General procedures for deballasting or counterflooding and the closure of all openings which may lead to progressive flooding in the event of damage
(6) Guidance for the person in charge in determining the cause of unexpected list and trim and assessing the potential affects of corrective measures on unit survivability, i.e. strength, stability, buoyancy, etc.
(7) Special procedures in the event of an uncontrolled escape of hydrocarbons or hydrogen sulphide, including emergency shutdown
(8) Guidance on the restoration of mechanical, electrical and ventilation systems after main power failure or emergency shutdown
(9) Ice alert procedures

**18.2.4 Helicopter Facilities**

**1** The operating manual for normal operations specified in 18.2.2 is to include a description and a checklist of safety precautions, procedures and equipment requirements.

**2** If refueling capability is to be provided, the procedures and precautions to be followed during refuelling operations are to be in accordance with recognized safe practices and contained in the operations manual.

**3** Fire-fighting personnel, consisting of at least two persons trained for rescue and fire-fighting duties, and fire-fighting equipment are to be immediately available when the helicopter is about to land, landing, refuelling, or during take-off.

**4** Fire-fighting personnel is to be present during refuelling operations. However, the fire-fighting personnel is not to be involved with refuelling activities.

**18.2.5 Material Safety Data Sheets**

Units carrying oil fuel are to be provided with material safety data sheets prior to the bunkering of oil fuel.

**18.2.6 Dangerous Goods**

**1** Dangerous goods are to be stored safely and appropriately according to the nature of the goods. Incompatible goods are to be segregated from one another.

**2** Explosives which present a serious risk are to be stored in a suitable magazine which is to be kept securely closed. Such explosives are to be segregated from detonators. Electrical apparatus and cables in any compartment in which it is intended to store explosives are to be designed and used so as to minimize the risk of fire or explosion.

**3** Flammable liquids which give off dangerous vapours and flammable gases are to be stored in a well-ventilated space or on deck.

**4** Substances which are liable to spontaneous heating or combustion are not to be carried unless adequate precautions have been taken to prevent the outbreak of fire.

**5** Radioactive substances are to be stored and handled in a safe manner.

**18.2.7 Pollution Prevention**

Provision is to be made such that the unit can comply with the requirements of international conventions in force.

**18.2.8 Transfer of Material, Equipment or Personnel**

**1** Transfer operations, including the weights of loads to be handled, any limiting conditions of operation and emergency procedures are to be discussed and agreed between personnel on the unit and on attending vessels prior to commencement of such transfers. Direct communications are to be maintained with the crane operator throughout such operations.

**2** Where appropriate to the operation, the unit is to be equipped with at least two independent means for mooring attending vessels. The mooring positions are to be such that sufficient crane capacity in terms of lift and outreach is available to handle loads in a safe manner.

**3** The arrangement of mooring attachments on the unit to facilitate transfer operations are to have regard to the risk of damage should the attending vessel come in contact with the unit.

**4** The mooring arrangements and procedures are to be such as to reduce to a minimum any danger to personnel during mooring operations.

**5** The mooring lines between the unit and the attending vessel are to, as far as practicable, be arranged so that if a line breaks, danger to personnel on both the attending vessel and the unit is minimized.

**6** Discharges from the unit, such as those from the sewage system or ventilation from bulk tanks, are to be arranged so that they minimize danger to personnel on the deck of attending vessels.

**18.2.9 Diving Systems**

**1** Diving systems, if provided, are to be installed, protected and maintained so as to minimize, so far as practicable, any danger to personnel or the unit, due regard being paid to fire, explosion or other hazards.

**2** Diving systems are to be designed, constructed, maintained and certified in accordance with a national or international standard or code acceptable to the Society, which may be employed for fixed diving systems, if provided.

**18.2.10 Safety of Navigation**

**1** The requirements of the International Regulations for Preventing Collisions at Sea in force are to apply to each unit except when stationary and engaged in drilling operations.

**2** Each unit when stationary and engaged in drilling operations is to comply with the requirements for the safety of navigation of

the coastal state in whose territorial sea or on whose continental shelf the unit is operating.

**3** Each unit when stationary and engaged in drilling operations is to inform the coastal state concerned about its position in latitude and longitude. Details of future movements of units are also to be passed to coastal state before a unit gets underway.

**18.2.11 Emergency Procedures**

**1** Persons in charge

(1) The person on each unit to whom all personnel on board are responsible in an emergency is to be clearly defined. This person is to be designated by title by the owner, manager, operator of the unit or the agent of either of them which has a responsibility of employs or works.

(2) The person in charge is to be well acquainted with the characteristics, capabilities and limitations of the unit. This person is to be fully cognizant of his responsibilities for emergency organization and action, for conducting emergency drills and training, and for keeping records of such drills.

(3) For units where a master is assigned, the master is to be designated as the person in charge at all times.

**2** Manning of survival craft and supervision

(1) There are to be a sufficient number of trained persons on board for mustering and assisting untrained persons.

(2) There are to be a sufficient number of certificated persons on board for launching and operating the survival craft to which personnel are assigned.

(3) Certificated persons specified **(2)** above are to be placed in command and as second-in-command of each lifeboat.

(4) The person in command of the lifeboat and the second-in-command is to have a list of all persons assigned to the boat and to see that persons under their command are acquainted with their duties.

(5) Every lifeboat is to have a person assigned who is capable of operating the lifeboat radio equipment.

(6) Every lifeboat is to have a person assigned who is capable of operating the engine and carrying out minor adjustments.

(7) The person in charge of the unit is to ensure the equitable distribution of persons referred to thought **(1)** to **(3)** above among the unit's survival craft.

**3** Muster list

(1) Muster lists are to be exhibited in conspicuous places throughout the unit including the control rooms and accommodation spaces. Muster lists are to be drawn up in the working language or languages of the crew.

(2) The muster list is to specify details of the general alarm system signals and also the action to be taken in all operating modes by every person when these alarms are sounded, indicating the location to which they are to go and the general duties, if any, they would be expected to perform.

(3) The following duties are to be included in the muster list:

(a) Closing of the watertight doors, fire doors, valves, vent inlets and outlets, scuppers, side scuttles, skylights, portholes and other similar openings in the unit

(b) Equipping of the survival craft and other life-saving appliances

(c) Preparation and launching of survival craft

(d) General preparation of other life-saving appliances

(e) Muster of visitors

(f) Use of communication equipment

(g) Manning of fire parties assigned to deal with fires

(h) Special duties assigned in respect to the use of fire-fighting equipment and installations

(i) Emergency duties on the helicopter deck

(j) Special duties assigned in the event of an uncontrolled escape of hydrocarbons or hydrogen sulphide, including emergency shutdown.

(4) The muster list is to specify substitutes for key persons who may become disabled, taking into account that different emergencies may call for different actions.

(5) The muster list is to show the duties assigned to regularly assigned personnel in relation to visitors in case of emergency.

(6) Each unit is to have a current muster list revised as necessary to reflect any procedural changes.

(7) In deciding on the level of detail to be included in the muster list, account is to be taken of information available in other documents, e.g., operating manual.

**18.2.12 Emergency Instructions**

Illustrations and instructions are to be conspicuously displayed at muster stations, control positions, working spaces and accommodation spaces to inform all on board of:

(1) The method of donning lifejackets

(2) The method of donning immersion suits, if applicable

**18.2.13 Training Manual and Onboard Training Aids**

A training manual and onboard training aids complying with the relevant requirements in *SOLAS* Regulation II-2/15 and *SOLAS* Regulation III /35 are to be provided and relevant information made available to each person on board.

**18.2.14 Practice Musters and Drills***

**1** One abandon unit drill and one fire drill are to be conducted every week. A man overboard drill is to be conducted at least quarterly. Drills are to be so arranged that all personnel participate in a drill at least once a month. A drill is to take place within 24 *h* after a personnel change if more than 25% of the personnel have not participated in abandon unit and fire drills on board that particular unit in the previous month. The Administration may accept other arrangements that are at least equivalent for those units for which this is impracticable.

**2** Drills and exercises are to be conducted in accordance with the recommendations of the *IMO*.

**3** Different lifeboats are to, as far as practicable, be lowered in compliance with the provisions of **-2** above at successive drills.

**4** Drills are, as far as practicable, to be conducted as if there were an actual emergency and to include at least the following:

(1) The functions and use of the life-saving appliances

(2) Except for free-fall lifeboats, starting of engines and lowering of at least one lifeboat and, at least once every three months when conditions permit, launching and manoeuvring with the assigned operating crew on board.

(3) A method according to a guideline deemed appropriate by the Society or another equivalent method acceptable to the Administration may be implemented in lieu of the requirements in **(2)** above.

**5** Drills using davit-launched liferafts are to be in accordance with the following **(1)** to **(3)**.

(1) A liferaft is to be lowered at least quarterly during abandon unit drills. Where practicable, this may include the inflation of a liferaft. This liferaft may be a special liferaft intended for training purposes only and is not to be boarded.

(2) The dedicated training liferafts is to be identical in size, shape and mass to the actual liferaft cases used on board the unit, but of a different colour and prominently marked "*training aid – not for use in emergency*".

(3) During such drills, emphasis is to be placed on ensuring the crew's familiarity with handling all necessary lashings, painters, connecting the training liferaft to the davit, swinging out the davit and lowering the liferaft.

**6** As far as is reasonably practicable, rescue boats are to be launched each month with the assigned crew aboard and manoeuvred in the water. In all cases, these provisions are to be complied with at least once every three months during a man overboard drill to simulate the recovery of a person from the water.

**7** For lifeboats, the requirements specified in *SOLAS* Regulation III/19.3.4.3 are to be applied.

**8** In the case of a lifeboat arranged for free-fall launching, the requirements in *SOLAS* Regulation III/19.3.4.4 are to be applied.

**18.2.15 Enclosed Space Entry and Rescue Drills***

**1** Crew members with enclosed space entry or rescue responsibilities are to participate in an enclosed space entry and rescue drill to be held on board the unit at least once every two months. If a full drill is not held at the appointed time, an entry is to be made in the official log or tour record stating the circumstances and the extent of the drill held.

**2** Enclosed space entry and rescue drills are to be planned and conducted in a safe manner, taking into account, as appropriate, the guidance provided in the recommendations of the *IMO*.

**18.2.16 Onboard Training and Instructions***

**1** All persons are to be provided with familiarization training in accordance with the recommendations of the *IMO*.

**2** All persons are to be provided with training in personal safety and emergency response commensurate with their assigned duties in accordance with the recommendations of the *IMO*.

**3** Personnel engaged in operating a DPS are to have received relevant training and practical experience in accordance with provisions deemed appropriate by the Society.

**18.2.17 Hazardous Areas**

**1** Portable and transportable electrical equipment or spark-producing equipment is not to be introduced into, or remain in, any

area classified as hazardous area zone 0, zone 1 or zone 2 in accordance with **13.1.3** unless the following has been determined:

(1) the equipment is certified as suitable for use in the area in question; or

(2) the area is free of ignitable concentrations of flammable vapours and appropriate controls have been put in place to prevent the introduction of flammable vapours into the area.

**2** Repairs, maintenance and overhaul of certified electrical equipment in hazardous areas are to be performed by suitably qualified personnel in accordance with appropriate international standards.

## 18.3 Records

### 18.3.1 Official Log and Tour Record

An official log or tour record in a format acceptable to the Administration is to be maintained on board the unit to include a record of:

(1) Inspection of lifesaving equipment (Refer to Paragraph 10.18.8 of the "*2009 MODU Code*")

(2) Drills and exercises (Refer to **18.2.11-1(2)**, **18.2.14** and **18.2.15**)

### 18.3.2 Other Records

If not included in the official log or tour record, the following additional information or records are to be maintained for a period acceptable to the Administration:

(1) Survey records for Periodical Surveys

(2) Inspection and maintenance records related to means of access specified in **9.6.5**

(3) Light ship data alterations log specified in **12.5.2-5(3)(b)ii), Part B**

(4) Testing records and equipment changes for anchors and related equipment specified in **10.3.3**

(5) Maintenance, inspection and testing records related to fire-fighting systems specified in **15.2.16-4**

(6) Maintenance records related to life-saving equipment specified in **2.2.3-1(1), Chapter 2 of the Rules for Safety Equipment**

(7) Inspections of cranes and records of tests specified in Chapter 12 of the *2009 MODU Code*

(8) Rated capacities of lifting and hoisting equipment specified in **9.4.1-2**

(9) Muster lists specified in **18.2.11-3**

(10) The electrical equipment register specified in **13.4**

(11) Maintenance and repair of all electrical equipment in hazardous areas for continued certification in accordance with the international standards referred to in paragraph **13.4**

### 18.3.3 Copy of the Documentation

A copy of the documentation, as approved by the Society, indicating any alternative design and arrangements are to be carried on board the unit.

# Chapter 19 COMPUTER-BASED SYSTEMS

## 19.1 General

### 19.1.1 Application

Computer-based systems are to be in accordance with **Part X**.

## Contents

# GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

# Part P MOBILE OFFSHORE DRILLING UNITS AND SPECIAL PURPOSE BARGES

## P1 GENERAL

### P1.1 General

#### P1.1.2 Consideration for Special Units

**1** Among the vessels or offshore structures not primarily intended for the transport of cargoes, those which are positioned for long periods of time or semi-permanent at a specific sea area of oil field, and also fitted with facilities of production, storage and offloading the crude oil/petroleum gases (hereinafter referred to as "crude oil, etc.") drawn up from the seabed are to comply with the requirements specified in **Part PS of the Rules** with respects of hull construction, equipment, arrangement, scantlings, positioning systems, etc.

#### P1.1.5 Record of Design Criteria

The design criteria recorded in the Register Book of units fixed on the seabed or positioned for long periods of time are as follows:

(1) Planned service area (including the area intended to transit);

(2) The maximum water depth at the planned service area;

(3) The following design condition of the operating condition and severe storm condition at the service area:

(a) The maximum wind velocity;

(b) Maximum design wave height and significant wave height, and wave periods relating hereto;

(c) Current and tidal current velocity; and

(d) Others (e.g. icing, snowing); and

(4) The maximum and minimum design service temperature of air at the service area and the maximum and minimum temperature of sea water.

#### P1.1.6 Class Notations

**1** With respect to units complying with relevant requirements given in this Part, notations corresponding to the purposes of those units defined in **1.2.3, Part P of the Rules** are affixed to the Classification Characters as follows.

(1) Mobile offshore drilling units

(a) Self-elevating mobile offshore drilling units: *Self-Elevating Drilling Unit* (abbreviated to *SEDU*)

(b) Column-stabilized mobile offshore drilling units: *Column-Stabilized Drilling Unit* (abbreviated to *CSDU*)

(c) Ship-type mobile offshore drilling units: *Drilling Vessel* (abbreviated to *DV*)

(d) Barge-type mobile offshore drilling units: *Drilling Barge* (abbreviated to *DB*)

In addition, for units complying with the following requirements in addition to requirements in this part, the notation of "*Mobile offshore Drilling Unit*" (abbreviated to *MODU*) is affixed. (For example, in the case of self-elavating mobile offshore drilling units, *Mobile Offshore Drilling Unit/ Self-Elevating Drilling Unit* (abbreviated to *MODU/SEDU*)

(a) **1.1.1-2 of the Rules for Safety Equipment**

(b) **1.1.1-3 of the Rules for Radio Installations**

(c) **The Rules for Anti-Fouling Systems on Ships**

(2) Storage units: *Storage Barge* (abbreviated to *SB*)

In cases where oil is stored, the notation to be affixed is "*Oil Storage Barge*", and additional descriptions regarding flash points of oil are affixed. (For example, *Oil Storage Barge, Flash point below 60 ℃*)

(3) Moored floating units: Notations corresponding to the purpose of such units are affixed.
(For example, Hotel ships: *Floating Hotel* (abbreviated to *FH*))

(4) Plant barges: Notations corresponding to the types of installed industrial factories are affixed.
(For example, Plant barges for generating electricity: *Power Plant Barge* (abbreviated to *PPB*))

(5) Accommodation barges: *Accommodation Barge* (abbreviated to *AB*)

**2** The notations specified in **1.1.6-2, Part P of the Rules** are as follows:

(1) Anchor mooring system defined in **10.2.2(1), Part P of the Rules**: *AM*

(2) Tension mooring system defined in **10.2.2(2), Part P of the Rules**: *TM*

(3) Single point mooring system defined in **10.2.2(3), Part P of the Rules**: *SPM*

(4) Dolphin mooring system defined in **10.2.2(4), Part P of the Rules**: *DM*

(5) Other mooring system defined in **10.2.2(5), Part P of the Rules**: *OM*

(6) Class 1 DPS defined in **10.2.3-1(1), Part P of the Rules**: *DPS 1*

(7) Class 2 DPS defined in **10.2.3-1(2), Part P of the Rules**: *DPS 2*

(8) Class 3 DPS defined in **10.2.3-1(3), Part P of the Rules**: *DPS 3*

## P1.2 Definition

### P1.2.3 Purposes of Units

**1** Storage units specified in **1.2.3(2), Part P of the Rules** are categorized as follows:

(1) Large sized storage units
Large sized storage units mean the units which are stationed at smooth water area and whose length is exceeding 350*m*. However, one tank capacity of storage tank is not exceeding 100,000$m^3$.

(2) Other storage units
These units mean the units excluding preceding **(1)** and which are included that are also provided with production installation.

### P1.2.10 Light Ship Weight

With respect to the provisions of **1.2.10, Part P of the Rules**, the weight of mediums on board for the fixed firefighting systems (e.g. freshwater, $CO_2$, dry chemical powder, foam concentrate, etc.) is to be included in the light ship weight.

### P1.2.22 Units for Self-propulsion System

The "navigable speed for own machinery" referred to in **1.2.22, Part P of the Rules** means a speed which the unit is capable of steering and being kept navigability for an extended period of time (period required to get the nearest port for repairs), and normally 7 *knots* may be regarded as a navigable speed. However, for the unit restricted the service area, the navigable speed are in accordance with the discretion of the Society considering the sea condition at the service area.

### P1.2.35 "*H*" Class Divisions

The "national or international standards deemed appropriate by the Society" specified in **1.2.35, Part P of the Rules**, refers to any of the following: *BS EN 1363-2:1999 "Fire resistance tests Alternative and additional procedures"*, *ASTM E1529-14a "Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies"*, or *ISO 20902-1 "Fire test procedures for divisional elements that are typically used in oil, gas and petrochemical industries – Part 1: General requirements"*.

# P2 MATERIALS AND WELDING

## P2.1 General

### P2.1.1 General

In applying **2.1.1-6, Part P of the Rules,** reference is to be made to *IMO* Resolution *A*.962(23) "*Guidelines on Ship Recycling*".

# P3 DESIGN LOADS

## P3.1 General

### P3.1.1 General

Where the requirement of **3.1.1-3, Part P of the Rules** is applied to, the return period may be adopted three times of the period intended to operate, as a standard. In this case, however, the return period needs not exceed that specified by the requirement in **3.1.1-2, Part P of the Rules**.

## P3.2 Design Loads

### P3.2.2 Wind Loads

**1** In considering the design of structure and the stability, wind velocity referred to the Rules means the mean wind velocity for one minute. If the data of wind velocity are not given the wind velocity for one minute, a suitable spectrum are determined by the data and the design wind velocity for one minute need to be calculated from this spectrum using a statistical method.

**2** Notwithstanding **-1**, wind velocity designed for anchor mooring installation is determined by considering the response of structure due to wind and weather data stationed at the area, normally wind velocity for one hour may be regarded as a design wind velocity.

### P3.2.6 Deck Loads

With deck loads due to vehicles passing through on the deck, consideration is to be given to the relative motion on vehicles against the hull.

# P4 STABILITY

## P4.1 General

### P4.1.2 General

Notwithstanding **4.1.2-3, Part P of the Rules**, where mooring installations having sufficient strength and sufficient safety not to be failure during service period to restrain the heel or trim of units, the effects such as reaction force of mooring installations may be considered, if necessary to consider the change of restoring force or moment due to change of water level induced by tide, high tide or tsunami.

## P4.5 Verification of Stability by Other Means

### P4.5.1 Intact Stability

Where intact stability is verified by the model tests or calculation method, following **(1)** to **(5)** items at least are to be taken into account:

(1) environmental conditions representing realistic winds including gusts and waves appropriate for world-wide service in various conditions of a unit;

(2) dynamic response of a unit. Analyses are to include the results of wind tunnel tests, wave tank model tests, and non-linear simulation, as appropriate. Any wind and spectra used are to cover sufficient frequency ranges to ensure that critical motion response are obtained;

(3) potential for flooding taking into account dynamic responses in a seaway;

(4) possibility of capsizing considering the unit's restoration energy and the static inclination due to the mean wind velocity and the dynamic response; and

(5) an adequate safety margin for uncertainties.

### P4.5.2 Damage Stability

Where damage stability is model tests or calculation method, following **(1)** and **(2)** in addition to **P4.5.1** are to be taken into account as appropriate:

(1) on column-stabilized unit, the flooding of any one watertight compartment wholly or partially below the waterline which is a pump room, a room containing machinery with a salt water cooling system or a compartment adjacent to the sea; and

(2) an adequate safety margin against capsizing.

# P5 WATERTIGHT BULKHEADS

## P5.2 Closing Appliances

### P5.2.3 External Openings

With respect to the provisions of **5.2.3, Part P of the Rules**, the number of air pipes and sounding pipes for the watertight compartments of self-elevating unit leg bottoms may be reduced subject to the following conditions:

(1) Stability requirements are satisfied even under flooded conditions.

(2) Safe passage is possible to allow for the confirmation of the inside of the compartment. In such cases, the confirmation procedure is to be described in the operation manual.

# P6 HULL CONSTRUCTION

## P6.2 Materials for Structural Members

### P6.2.1 Categories of Structural Members

**1** The application categories of the structural members of self-elevating units are as follows:

(1) Secondary structural members
  (a) Internal framing, including bulkheads and girders, in cylindrical legs
  (b) Internal bulkheads and framing members of upper hull
  (c) Internal bulkheads and framing members of bottom mat, except the portion which is considered primary structural member
  (d) Deck, side and bottom plating of upper hull, except the portion which is considered primary structural member
  (e) Floating frames or yokes in jacking or other self-elevating systems
  (f) Substructures and movable skid beam structures supporting the drilling derrick, except the portion where is considered primary structural member
  (g) Other structural members considered equivalent to the preceding **(a)** through **(f)**

(2) Primary structural members
  (a) External plating of cylindrical legs
  (b) Plating of all components of lattice type legs, except the portion which is considered special structural member
  (c) Combination bulkhead, deck, side and bottom plating within the upper hull which form "box" or "*I*" type main supporting structure
  (d) Jack-house supporting structure and bottom footing structure which receive initial transfer of load from legs
  (e) Internal bulkheads, shell and deck of bottom mat supporting structure which receive major loads
  (f) Fixed frames in jacking or other self-elevating systems
  (g) Movable cantilever structures supporting the drilling derrick
  (h) Other structural member considered equivalent to either of the preceding **(a)** through **(g)**

(3) Special portion of structural members
  (a) Vertical columns in way of intersections of mat structure
  (b) Intersections of lattice type leg structures which incorporate novel construction, including the use of steel castings
  (c) Other structural members considered equivalent to either of the preceding **(a)** or **(b)** which are structurally important or subjected to stress concentration

**2** The application categories of structural members of column-stabilized units are as follows:

(1) Secondary structural members
  (a) Internal structures including bulkheads and girders in columns, decks, lower hulls, and bracings
  (b) Upper platform decks, or decks of upper hull, except the portion which is considered primary or special structural member
  (c) Large diameter vertical columns with low length-to-diameter ratios, except at intersections
  (d) Other structural members considered equivalent to the preceding **(a)** through **(c)**

(2) Primary structural members
  (a) External shell structural members of columns, lower and upper hulls, and bracings
  (b) Deck plating, heavy flanges, bulkheads and main girders within the upper hull or platform, which form "box" or "*I*" type supporting substructure or drilling derrick, and which do not receive major concentrated loads
  (c) Bulkheads, flats or decks, and framing which provide local reinforcement or continuity of structure in way of intersections, except the portion which is considered special structural member
  (d) Other structural members considered equivalent to the preceding **(a)** to **(c)**

(3) Special structural members
  (a) External shell structural members in way of intersections of columns, decks and lower hulls
  (b) Portion of structural members corresponding to the preceding **(2)(b)** which receive major concentrated loads

(c) Major intersections of bracing members

(d) External brackets, portions of bulkheads, flats and frames which receive concentrated load at intersections of major structural members

(e) "Through" members used at connections of columns, upper platform decks, and upper or lower hulls, which provide proper alignment and adequate load transfer

(f) Other structural members considered equivalent to the preceding **(a)** through **(e)** which are structurally important or receive concentrated loads

# P7 STRENGTH OF HULL

## P7.1 General

### P7.1.6 Fatigue Strength

**1** General

(1) The possibility of fatigue damage is to be considered in the major structure of column-stabilized and self-elevating units. However, omission of fatigue analysis may be accepted by the Society in consideration of the intended mode, operating sea area and design life of the unit.

(2) Fatigue analyses are to be carried out on the portions of the structural members in way of stress concentration which are possible to cause detrimental fatigue cracks.

(3) In fatigue analyses, all kinds of repeated loads are, in principle to be considered. In general, wave loads are to be considered.

(4) The fatigue design life of the structure is to be at least the design life of the unit. It is normally not to be less than 20 *years*. However, consideration may be given to the fatigue design life by taking account of the intended mode, operating sea area, service period of the unit and also the type and extent of the fatigue analysis.

**2** Fatigue analyses

(1) Fatigue analyses are to be based on the long-term distribution of repeated stresses, fatigue design curves and calculation methods approved by the Society to be appropriate.

(2) In determining the long-term distribution of repeated stresses, it may be assumed that the long-term distribution of stress ranges is represented by a proper form a theoretical distribution and the maximum stress range which is statistically predicted. On the long-term distribution of repeated stresses due to wave loads, it may be directly calculated by the probabilistic method on the basis of long-term wave data.

(3) Calculation of cumulative fatigue damage may be based on the assumption linear cumulative damage (Palmgren-Miner rule).

(4) It is recommended that fatigue analyses of weld joints should be made on the basis of hot spot strains or stresses. When approved by the Society, however, an adequate fatigue design curve based on nominal stress corresponding to the type of joint may be applied.

Note: The outline of the method of fatigue analysis, fatigue analysis on the basis of hot spot strains and its fatigue design curve are shown in **Appendix P1** as reference materials.

**3** Recommended measures to improve fatigue strength

(1) For structural members exposed to corrosive environments where fatigue strength is considered critical, effective corrosion controls are to be done by electric protection or other equally effective means.

(2) For structural members where fatigue strength is considered critical, special attention is to be paid to weld defects during fabrication. In their welding, full penetration welding is recommended.

# P8 LOAD LINES

## P8.2 Load Lines

### P8.2.2 Self-elevating Units

**1** In the application of the regulations of *ILLC*, where moonpools are arranged within the hull in open communication with the sea, the volume of the moonpool is not to be included in calculation of any hydrostatic properties. An addition is to be made to the geometric freeboard, if the moonpool has a larger cross-sectional area above the waterline at 85% of the depth for freeboard than below, corresponding to the lost buoyancy. This addition for the excess portion above 85% of the depth for freeboard use is to be made as follows, as prescribed for recesses in regulation 32-1. If an enclosed superstructure contains part of the moonpool, a deduction should be made from the effective length of the superstructure.

(1) Where open wells or recesses are arranged in the freeboard deck, a correction equal to the volume of the well or recess to the freeboard deck divided by the waterplane area at 85% of the depth for freeboard use are to be added to the freeboard obtained after all other corrections have been applied, except bow height correction.

(2) In stability calculation, free surface effects of the flooded well or recess are to be taken into account.

**2** Where small notches or relatively narrow cut-outs at the stern of the unit, the same procedure for correction described in **-1** is to be carried out.

**3** Narrow wing extensions at the stern of the unit are to be considered as appendages.

### P8.2.4 Ship-type Units and Barge-type Units

**1** Where a recess in the freeboard deck extends to both sides of the ship but is not in excess of 1*m* in length, it is to be treated as a recess that does not extend to the sides of the ship for the application of regulation 32-1 of *ILLC*.

**2** In the application of the regulations of *ILLC*, where moonpools are arranged within the hull in open communication with the sea, the volume of the moonpool is not to be included in the calculation of any hydrostatic properties. An addition is to be made to the geometric freeboard, if the moonpool has a larger cross-sectional area above the waterline at 85% of the depth for freeboard use than below, corresponding to the lost buoyancy. This addition for the excess portion above 85% of the depth for freeboard use is to be made as follows, as prescribed for recesses in regulation 32-1. If an enclosed superstructure contains part of the moonpool, a deduction should be made from the effective length of the superstructure.

(1) Where open wells or recesses are arranged in the freeboard deck, a correction equal to the volume of the well or recess to the freeboard deck divided by the waterplane area at 85% of the depth for freeboard use are to be added to the freeboard obtained after all other corrections have been applied, except bow height correction.

(2) In stability calculation, free surface effects of the flooded well or recess are to be taken into account.

**3** Where small notches or relatively narrow cut-outs at the stern of the unit, the same procedure for correction described in **-2** is to be carried out.

**4** Narrow wing extensions at the stern of the unit are to be considered as appendages.

# P9 HULL EQUIPMENTS

## P9.4 Equipment for Special Purpose

### P9.4.2 Mobile Offshore Drilling Units

**1** The design and supporting structures of drilling derricks referred to in **9.4.2-2, Part P of the Rules** are, in general, to be in accordance with the following **(1)** to **(6)** in addition to *API Spec 4F* (*Specification for Drilling and Well Serving Structures*):

(1) The following **(a)** to **(c)** are to be considered with respect to design loads in addition to that specified in *API Spec 4F*:

(a) The wind velocities and wind loads specified in **3.2.2, Part P of the Rules**

(b) Loads caused by snow and icing

(c) The deck loads specified in **3.2.6, Part P of the Rules**

(2) Consideration is to be given to the local strength and fatigue strength of drilling derricks and special attention is to be paid to vortex-induced vibrations.

(3) Materials used in drilling derricks are to be in accordance with **6.2, Part P of the Rules** in addition to **Chapter 2, Part P of the Rules**. In addition, with respect to the requirements of **6.2, Part P of the Rules**, the structural members of drilling derricks are to be considered as either primary structural members or secondary structural members.

(4) Welding used for drilling derricks is to be in accordance with **Chapter 2, Part P of the Rules**. In addition, butt welded parts are, as a rule, to be of the full-penetration type.

(5) At least one escape route from the drilling derrick is to be provided. However, in cases where workers regularly man the upper parts of a drilling derrick, the escape route from the drilling derrick is not to lead to the drilling floor.

(6) In cases where bolted connections are to be used for drilling derricks, the following **(a)** and **(b)** are to be complied with in addition to **(1)**:

(a) Bolts based on standards deemed appropriate by the Society are to be used. In addition, when bolts are selected, consideration is to be given to stress corrosion cracking and fatigue strength.

(b) Appropriate measures are to be provided to bolted connections in the main load carrying members such as the upper parts and foundations of drilling derricks.

**2** Supporting structures of drilling derricks

(1) A structural analysis is to be performed for drilling derricks, drilling floors and substructures (including the supporting structures of the drilling derricks and drilling floors) in accordance with the requirements in **7.2.1, Part P of the Rules**. Allowable stresses are not to exceed the values in **Table P7.1, Part P of the Rules** according to the kind of stress.

(2) The loads used for structural analysis in **(1)** above are to be in accordance with the following **(a)** and **(b)**. In addition, when deemed necessary by the Society, additional requirements may be requested.

(a) Loads taken in operating condition, the dead load of the ship, loads caused by snow and icing, as well as the loads transmitted from hooks, fastlines, deadlines, setbacks, rotary tables and riser tensioners are to be considered in the static loading condition.

(b) The static loads specified in **(a)** as well as dynamic loads such as wind loads and loads due to ship acceleration and inclination are to be considered in combined loads.

(3) For self-elevating ships having movable cantilever constructions and skid beams which support substructures, a structural analysis is to be performed for such cantilever constructions and skid beams according to **7.2.1, Part P of the Rules**. Allowable stresses are not to exceed the values in **Table P7.1, Part P of the Rules** according to the kind of stress. Reaction forces transmitted from movable cantilever constructions and skid beams are to be considered in the loads acting on hull constructions.

## P9.6 Means of Access

**P9.6.1 General**

**1** For the purpose of **9.6, Part P of the Rules,** appropriate means of access are to be provided to enable close-up examinations of positions where close-up examinations and thickness measurements are required in accordance with the provisions of **Part B of the Rules** and positions with critical structural areas. In application, "critical structural areas" are locations which have been identified from calculations to require monitoring or from the service history of similar or sister ships to be susceptible to cracking, buckling, deformation or corrosion which would impair the structural integrity of the ship. Each space for which close-up inspection is not required such as fuel oil tanks and void spaces forward of cargo area, may be provided with a means of access necessary for overall survey intended to report on the overall conditions of the hull structure.

**2** The means of access may be those permanently fixed to the hull, such as stagings, walkways, ladders, and steps (hereinafter, referred to as "permanent means of access") and those that are prepared for temporary use, such as inflatable rafts and portable ladders. Where structural members can be utilized as stagings or walkways, they can be regarded as permanent means of access.

**3** For the purpose of **9.6, Part P of the Rules**, the following definitions apply.

(1) Rung means the step of a vertical ladder or step on a vertical surface.

(2) Tread means the step of an inclined ladder or step for a vertical access opening.

(3) Flight of an inclined ladder means the actual stringer length of an inclined ladder. For vertical ladders, it is the distance between the platforms.

(4) Stringer means either:

(a) The frame of a ladder

(b) The stiffened horizontal plating structure fitted on the side shell, transverse bulkheads and/or longitudinal bulkheads in the space

For the purpose of ballast tanks of less than 5 *m* width, the horizontal plating structure is credited as a stringer and a longitudinal permanent means of access, if it provides a continuous passage of 600 *mm* or more in width past frames or stiffeners on the side shell or longitudinal or transverse bulkhead. Openings in stringer plating utilized as permanent means of access shall be arranged with guard rails or grid covers to provide safe passage on the stringer or safe access to each transverse web.

(5) Vertical ladder means a ladder of which the inclined angle is 70 *degrees* and over up to 90 *degrees*. A vertical ladder shall not be skewed by more than 2 *degrees*.

(6) Overhead obstructions mean the deck or stringer structure including stiffeners above the means of access.

(7) Distance below deck head means the distance below the plating.

(8) Cross deck means the transverse area of the main deck which is located inboard and at both sides of a transverse bulkhead. Between large hatches/holds or between moonpool opening and hatches/holds of a drillship or column stabilized unit.

(9) Hold means any dry space other than a machinery space located within the hull of surface units (ship-type or barge-type) and self-elevating units or within the upper hull, columns or pontoons of column-stabilized units. Dry storage spaces and void spaces are considered holds.

**4** With respect to the provisions of **9.6.1-2, Part P of the Rules**, the use of alternative means of access may be accepted where:

(1) Such means provide accessibility and safety equivalent to permanent means

(2) The use of such means are approved by the Administration and the ship's owner

**P9.6.2 Means of Access to Spaces**

**1** With respect to the provisions of **9.6.2, Part P of the Rules**, the vertical distance between deck and horizontal stringer; horizontal stringers; decks; deck or horizontal stringer and the bottom of the space; deck or horizontal stringer and platform; and platforms means the vertical distance between the upper surface of the lower deck, horizontal stringer or platform and the lower surface of the upper deck, horizontal stringer or platform.

**2** With respect to the provisions of **9.6.2, Part P of the Rules**, special attention is to be paid to the structural strength where any access opening is provided in the main deck or cross deck.

**3** Means of access required in **9.6.2-1** and **-2, Part P of the Rules** is only applicable to integral tanks. Independent tanks can be excluded. Also, spud cans and jack cases of self-elevating units can be excluded.

**4** With respect to the provisions of **9.6.2-2, Part P of the Rules**, the wording "not intended for the carriage of oil or hazardous cargoes" applies only to "similar compartments", and access may be from pump-rooms, deep cofferdams, pipe tunnels, cargo holds

and double hull spaces.

**5** "Deck" specified in **9.6.2-3, Part P of the Rules** means "weather deck".

**6** With respect to the provisions of **9.6.2-4, Part P of the Rules**, where deemed necessary for aligning resting platform arrangements with hull structures, the vertical distance from the deck to a platform, between such platforms, or a platform and the tank bottom may be not more than 6.6 *m*.

**7** With respect to the provisions of **9.6.2-4(2)**, **(4)**, **-5(3)** and **(7), Part P of the Rules**, adjacent sections of a vertical ladder are to be in accordance with following **(1)** to **(3)**. (Refer to **Fig. P9.6.2-1**, **Fig. P9.6.2-2** and **Table P9.6.2**)

(1) The minimum "lateral offset" between two adjacent sections of a vertical ladder is the distance between the sections, upper and lower, so that the adjacent stringers are spaced of at least 200 *mm*, measured from half thickness of each stringer.

(2) Adjacent sections of vertical ladder are to be installed so that the upper end of the lower section is vertically overlapped, in respect to the lower end of the upper section, to a height of 1,500 *mm* in order to permit a safe transfer between ladders. However, this requirement does not apply to cases where structural members (e.g. side stringers) are used to move between adjacent vertical ladders and are provided with safety measures such as handrails.

(3) No section of the access ladder is to be terminated directly or partly above an access opening.

Fig. P9.6.2-1 Vertical ladder - ladder passing through linking platform

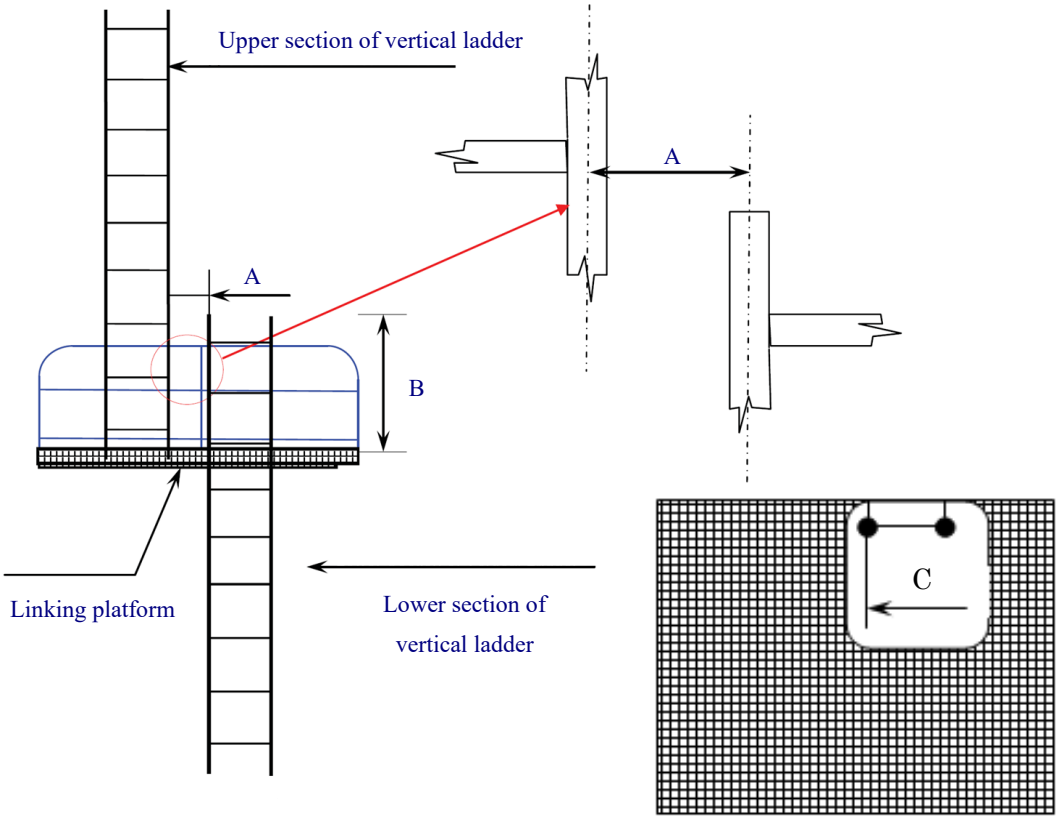


Fig. P9.6.2-2 Vertical ladder - side mount

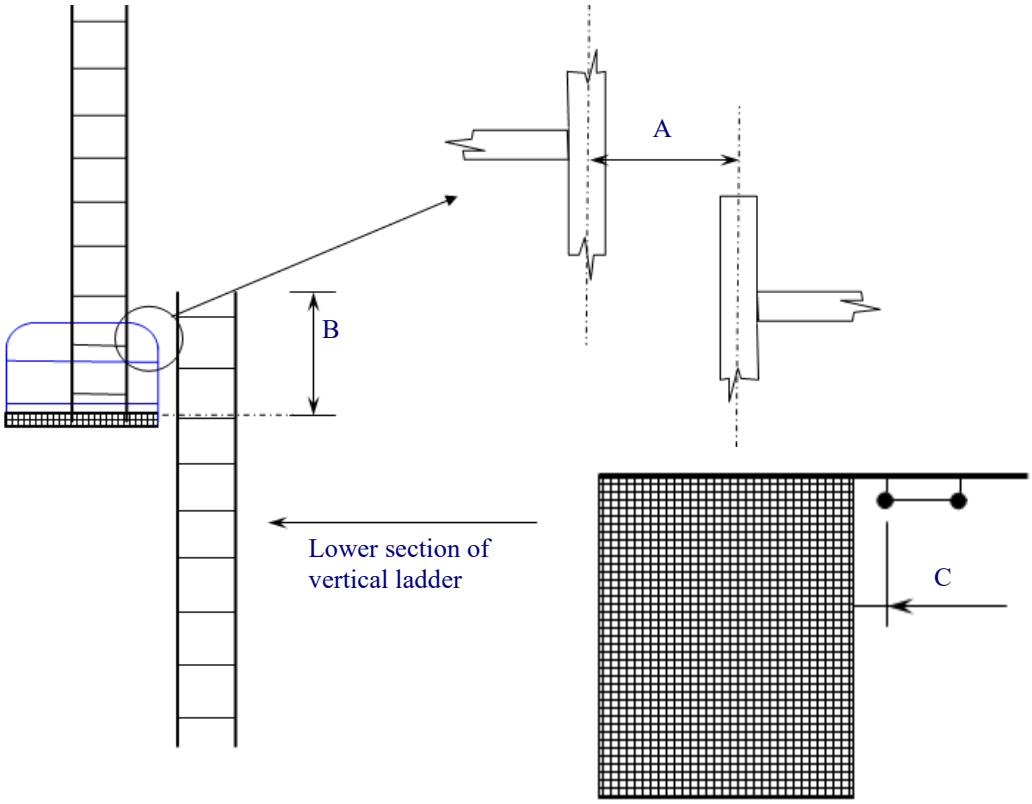



Table P9.6.2 Dimensions

| | | |
|---|---|---|
| A | Horizontal separation between two vertical ladders, stringer to stringer | ≥ 200 *mm* |
| B | Stringer height above landing or intermediate platform | ≥ 1,500* *mm* |
| C | Horizontal separation between ladder and platform | 100 *mm* ≤ C < 300 *mm* |
| Note<br>* : the minimum height of the handrail of resting platform is 1,000 *mm* | | |

**P9.6.3 Means of Access within Spaces**

**1** Alternative means of access specified in **9.6.3, Part P of the Rules** include, but are not limited to, such devices as:

(1) Hydraulic arm fitted with a stable base

(2) Wire lift platform

(3) Staging

(4) Rafting

(5) Robot arm or remotely operated vehicle (*ROV*)

(6) Portable ladders more than 5 *m* long are only to be utilized if fitted with a mechanical device to secure the upper end of the ladder. Where hooks for securing at the upper end of a ladder are provided as a mechanical device, such hooks are to be designed so that a movement fore/aft and sideways can be prevented at the upper end of the ladder

(7) Other means of access, approved by and acceptable to the Society

**2** With respect to the provisions of **9.6.3, Part P of the Rules**, the selection of an alternative means of access is to be based on the following conditions. Refer to **Annex 14.16, Part 1, Part C of the Rules** for details.

(1) Such means provide accessibility and safety equivalent to permanent means

(2) Such means are suitable for use in an environment of the intended spaces

(3) Where the use of means such as *ROV* for the inspection of under deck structures, such means can be introduced into the space directly from a deck access

(4) Such means comply with or are based on appropriate safety standards

(5) Where the use of means other than those specified in **P9.6.3-1(3)**, **(4)** or **(6)**, such means are approved by the Administration and the ship's owner

**3** Where a boat is used as an alternative means, **14.16.2.4-6, Part 1, Part C of the Rules** is to apply. Rafts or boats alone may be allowed for survey of the under deck areas for tanks or spaces if the depth of the webs is not more than 1.5 *m*. If the depth of the webs is more than 1.5 *m*, rafts or boats alone may be allowed only if permanent means of access are provided to allow safe entry and exit. This means either:

(1) Access direct from the deck via a vertical ladder and small platform approximately 2 *m* below the deck in each bay

(2) Access to the deck from a longitudinal permanent platform having ladders to the deck at each end of the tank

The platform is to, for the full length of the tank, be arranged at or above the maximum water level needed for rafting of the under deck structure. For this purpose, the ullage corresponding to the maximum water level is to be assumed not more than 3 *m* from the deck plate measured at the midspan of the deck transverses and in the middle of the length of the tank. A permanent means of access from the longitudinal permanent platform to the water level indicated above is to be fitted in each bay (*e.g.*, permanent rungs on one of the deck webs inboard of the longitudinal permanent platform).

**4** With respect to the provisions of **9.6.3, Part P of the Rules**, it is to be demonstrated that portable means for inspection can be deployed and made readily available in the areas where needed.

**5** For the purpose of **9.6.3**, **Part P of the Rules**, the height of a space means the vertical distance between the top surface of the bottom plate of the space and the lower surface of the top plate of the space. In general, the height is to be measured from the lowest position to the highest position in each tank. However, for a space the height of which varies at different bays/sections, the requirements of **9.6.3, Part P of the Rules** may be applied to such bays/sections of that space which fall under the criteria.

**6** With respect to the provisions of **9.6.3, Part P of the Rules**, special attention is to be paid to the structural strength where any access opening is provided in the structural members.

**7** Unless stated otherwise in **9.6.3, Part P of the Rules**, vertical ladders that are fitted on vertical structures for inspection are to comprise of one or more ladder linking platforms spaced not more than 6 *m* apart vertically and displaced to one side of the ladder. Adjacent sections of ladder are to be laterally offset from each other by at least the width of the ladder.

**8** In the application of **9.6.3-1(1), Part P of the Rules**, the provisions of **(a)** to **(c)** define access to underdeck structures and the provisions of **(d)** to **(f)** define access to vertical structures. These provisions are linked to the presence of underdeck structures and transverse webs on longitudinal bulkheads. If there are no underdeck structures (deck longitudinals and deck transverses) but there are vertical structures in the cargo tank supporting transverse and longitudinal bulkheads (including brackets supporting deck transverses), in addition to access in accordance with applicable provisions of **(d)** to **(f)** of **9.6.3-1(1), Part P of the Rules**, access in accordance with the provisions of **(a)** to **(c)** of **9.6.3-1(1), Part P of the Rules** is to be provided for inspection of the upper parts of vertical structure on transverse and longitudinal bulkheads. For example, there is need to provide continuous longitudinal permanent means of access in accordance with the provisions of **9.6.3-1(1)(b), Part P of the Rules** when the deck longitudinals and deck transverses are fitted on the deck but supporting brackets are fitted under the deck.

**9** Notwithstanding **-1**, for the application of **9.6.3-1(1)(d), Part P of the Rules**, wire lift platforms or other means which can provide an equal level of safety as permanent means of access specified in that sub-paragraph, are assumed as alternative means of access. However, rafting and permanent fittings for rafting are not permitted as alternatives to the continuous longitudinal permanent means of access specified in **P9.6.3-1(2)**.

**10** For tanks containing oil products other than crude oil (e.g. fuel oil, diesel oil, base oil) where lower corrosion is expected, **(1)** and **(2)** of **9.6.3-1, Part P of the Rules** is not to be applied. For tanks containing products considered corrosive (e.g. brine, drilling mud), **(1)** and **(2)** of **9.6.3-1, Part P of the Rules** is to be applied.

**11** "Means of access deemed appropriate by the Society" stipulated in **9.6.3-1(4), Part P of the Rules** generally presumes the use of boats. The provisions of **-3** above apply.

**12** For the purpose of **9.6.3-2, Part P of the Rules**, the continuous permanent means of access may be a wide longitudinal, which provides access to critical details on the opposite side by means of platforms attached as necessary on the web frames. Where the vertical opening of the web frame is located in way of the open part between the wide longitudinal and the longitudinal on the opposite side, platforms are to be provided on both sides of the web frames to allow safe passage through the web frame.

**13** With respect to the vertical distance of 6 *m* specified in **9.6.3-2(1)(a)** and **(b), Part P of the Rules**, excess of not more than 10% may be accepted as a reasonable deviation, where deemed necessary for the integration of the permanent means of access with the

structure itself.

**14** Means of access specified in **9.6.3-2(1)(a), Part P of the Rules** are to be connected to an access ladder from the deck required in **9.6.2-1, Part P of the Rules**. Where two access hatches are required, access ladders at each end of the tank are to lead to the means of access.

**15** With respect to the provisions of **9.6.3-2(2), Part P of the Rules**, notwithstanding the provisions of **-5**, the height of a bilge hopper tank located outside of the parallel part of the ship may be taken as the maximum of the clear vertical distance measured from the bottom plating to the hopper plating of the tank.

**16** With respect to the provisions of **9.6.3-2(2), Part P of the Rules** in regards to the foremost and aftermost bilge hopper ballast tanks with raised bottoms, a combination of transverse and vertical means of access for access to the upper knuckle point for each transverse web may be accepted in place of the longitudinal permanent means of access.

**17** With respect to the provisions of **9.6.3-2(2), Part P of the Rules**, a ladder or ladders are to be provided between the longitudinal continuous permanent means of access and the bottom of the space.

**18** The movable means of access to the underdeck structure of the cross deck required in **9.6.3-3(4), Part P of the Rules** need not necessarily be carried aboard the ship.

**P9.6.4 Specifications for Means of Access and Ladders**

**1** With respect to the provisions of **9.6.4-1, Part P of the Rules**, permanent means of access are to be designed so as to ensure sufficient residual strength during the service life of the ship and, in general, the initial corrosion protection which is the same as the hull structural members is to be applied.

**2** With respect to the provisions of **9.6.4-3, Part P of the Rules**, slopping structures are structures that are sloped by 5 or more degrees from the horizontal plane when a ship is in the upright position at even-keel. Non-skid construction is to be such that the surface on which personnel walk provides sufficient friction to the sole of boots even when the surface is wet and covered with thin sediment.

**3** Details of the guard rails required in **9.6.4-4, Part P of the Rules** are to be in accordance with the following.

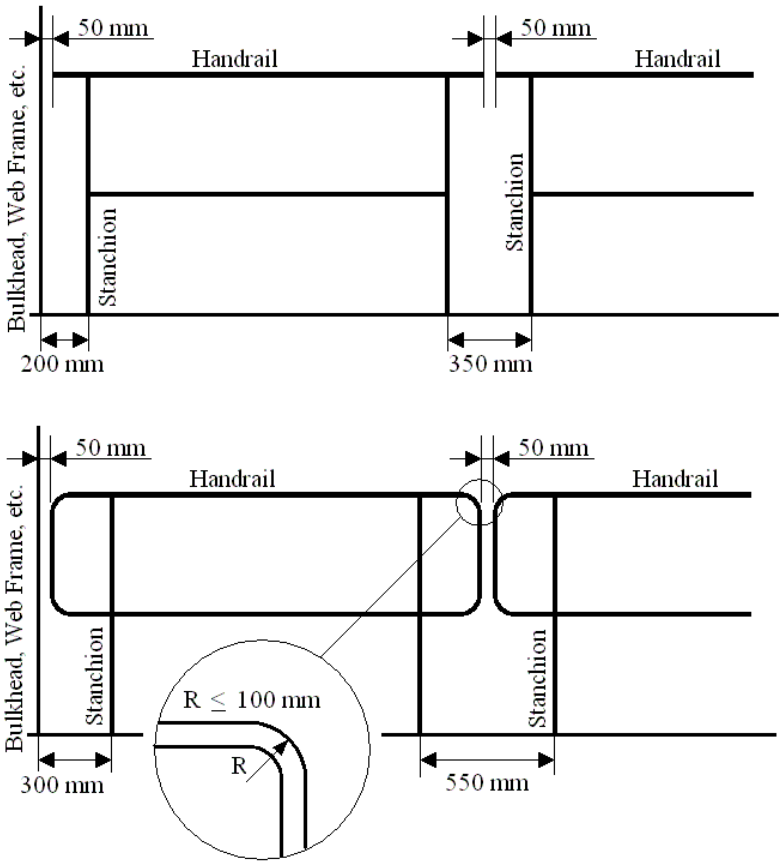
(1) Where guard rails are divided into several parts, the gaps of discontinuous top handrail are not to exceed 50 *mm*. When the top and mid handrails are connected by a bent rail, the outside radius of the bent part is not to exceed 100 *mm* (see **Fig. P9.6.4-1**).

(2) The gaps between the top handrail and other structural members are not to exceed 50 *mm*.

(3) Where guard rails are divided into several parts, the maximum distance between the adjacent stanchions across the handrail gaps is to be 350 *mm*. However, when the top and mid handrails are connected together, the maximum distance may be 550 *mm* (see **Fig. P9.6.4-1**).

(4) The maximum distance between the stanchion and other structural members is not to exceed 200 *mm*. However, when the top and mid handrails are connected together, the maximum distance may be 300 *mm* (see **Fig. P9.6.4-1**).

Fig. P9.6.4-1 Detail of handrails



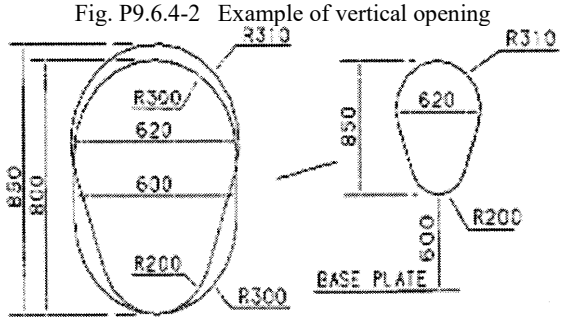

**4** For guard rails required in **9.6.4-4, Part P of the Rules**, use of alternative materials such as *GRP* is to be subject to compatibility with the liquid carried in the tank. Non-fire resistant materials are not to be used for means of access to a space with a view to securing an escape route at high temperatures.

**5** The minimum clear opening of 600 *mm* × 600 *mm* specified in **9.6.4-5, Part P of the Rules** is to be rounded appropriately and may have corner radii up to 100 *mm* maximum. Where larger corner radii are adopted for avoiding stress concentration, a larger opening is to be provided so as to ensure accessibility equivalent to a opening of 600 *mm* × 600 *mm*. For example, 600 *mm* × 800 *mm* with 300 *mm* of corner radii may be accepted.

**6** The minimum clear opening of 600 *mm* × 800 *mm* specified in **9.6.4-6, Part P of the Rules** is to be rounded appropriately and may have corner radii up to 300 *mm* maximum. Such openings, in general, are to be 800 *mm* in height. However, an opening of 600 *mm* in height and 800 *mm* in width may be accepted as access openings in vertical structures where it is not desirable to make large openings in the structural strength aspects, i.e. girders and floors in double bottom tanks.

**7** With respect to the provisions of **9.6.4-6, Part P of the Rules**, an access opening having other dimensions, i.e. an opening as shown in **Fig. P9.6.4-2**, may be accepted subject to verification of easy evacuation of an injured person on a stretcher.

Fig. P9.6.4-2 Example of vertical opening



**8** With respect to the provisions of **9.6.4-6, Part P of the Rules**, where the vertical manhole is at a height of more than 600 *mm* above the bottom plate, it is to be demonstrated that an injured person can be easily evacuated.

**9** Smaller dimensions of minimum clear opening stipulated in **9.6.4-7, Part P of the Rules** are to be in accordance with **Table S3.4.4, Part S of the Guidance**.

**10** With respect to the provisions of **9.6.4-8, Part P of the Rules**, where the vertical manhole is at a height of more than 600 *mm* above the bottom plate, it is to be demonstrated that an injured person can be evacuated.

**11** With respect to the provisions of **9.6.4-9, Part P of the Rules**, details of ladders and other means are to be in accordance with the following.

(1) Permanent inclined ladders are to be inclined at an angle of less than 70 *degrees*. There is to be no obstructions within 750 *mm* of the face of the inclined ladder, except that in way of an opening this clearance may be reduced to 600 *mm*. Such clearance is to be measured perpendicular to the face of the ladder. A minimum climbing clearance in width is to be 600 *mm*. For this purpose, handrails may be provided within such climbing clearance. Resting platforms of adequate dimensions are to be provided, normally at a maximum of 6 *m* vertical height. Where deemed necessary for aligning resting platform arrangements with hull structures, the vertical distance from deck to such platforms, between such platforms or such platforms and the tank bottom may be not more than 6.6 *m*. In this case, the flights of inclined ladders are not to be more than 9 *m* in actual length. Ladders and handrails are to be constructed of steel or equivalent material of adequate strength and stiffness and securely attached to the structure by stays. The method of support and length of stay is to be such that vibration is reduced to a practical minimum. In holds, ladders are to be designed and arranged so that stores handling difficulties are not increased and the risk of damage from stores handling gear is minimized.

(2) The width of inclined ladders between stringers is not to be less than 400 *mm*. The width of inclined ladders for access to a hold is to be at least 450 *mm*. The treads are to be equally spaced at a distance apart, measured vertically, of between 200 *mm* and 300 *mm*. When steel is used, the treads are to be formed of two square bars of not less than 22 *mm* × 22 *mm* in section, fitted to form a horizontal step with the edges pointing upward. The treads are to be carried through the side stringers and attached thereto by double continuous welding. All inclined ladders are to be provided with handrails of substantial construction on both sides. The vertical height of handrails is not to be less than 890 *mm* from the centre of the step and two course handrails is to be provided.

(3) For vertical ladders, the width and construction are to be in accordance with the following. Other details are to be in accordance with international or national standards accepted by the Society.

(a) The minimum width of vertical ladders is to be 350 *mm*.

(b) The vertical distance between the rungs is to be equal and is to be between 250 *mm* and 350 *mm*.

(c) When steel is used, the rungs are to be formed of single square bars of not less than 22 *mm* × 22 *mm* in section, fitted to form a horizontal step with the edges pointing upward.

(d) Vertical ladders are to be secured at intervals not exceeding 2.5 *m* apart to prevent vibration.

(e) A minimum climbing clearance in width is to be 600 *mm* other than the ladders placed between the hold frames. A clearance of 600 *mm* perpendicular to the ladder is to be kept as far as possible.

(4) For spiral ladders, the width and construction are to be in accordance with international or national standards accepted by the Society.

(5) Resting platforms placed between ladders are to follow the provisions of **9.6.4-1** to **-4, Part P of the Rules**.

(6) Portable ladders are to be in accordance with or are based on appropriate safety standards. No free-standing portable ladder is to be more than 5 *m* long unless accepted by the provisions of **P9.6.3-1(6)**.

(7) For the selection of portable and movable means of access, refer to **Annex 14.16, Part 1, Part C of the Rules**.

### P9.6.5 Ship Structure Access Manual

**1** The Ship Structure Access Manual required in **9.6.5, Part P of the Rules** is to contain at least the following two parts.

(1) Part I

This part is to comprise plans, instructions and inventory required in **9.6.5-1(1)** to **(7), Part P of the Rules** and the following matters are to be addressed. This part is to be approved by the Society when any content is changed.

(a) Approval/re-approval procedure for the manual, i.e. any changes of the permanent, portable, movable or alternative means of access within the scope of **9.6, Part P of the Rules** are subject to review and approval by the Society.

(b) Verification of means of access is to be part of a survey for continued effectiveness of the means of access in that space which is subject to the survey.

(c) Inspection of means of access is to be carried out by the crew and/or a competent inspector of the company as a part of regular inspection and maintenance.

(d) Actions to be taken if means of access are found unsafe to use.

(e) In case of use of portable equipment, plans showing the means of access within each space indicating from where and how each area in the space can be inspected.

(2) Part II

This part is to comprise of forms for record of inspections and maintenance, and change of inventory of portable equipment due to additions or replacements after construction. The form in this part is approved by the Society when the ship is under survey for classification during construction.

**2** The Ship Structure Access Manual required in **9.6.5-1, Part P of the Rules** is to be prepared in a language(s) which all the crew can understand. As a minimum the English version is to be provided.

**3** "Critical structural areas" specified in **9.6.5-1(3), Part P of the Rules** are to be in accordance with the provisions of **P9.6.1-1**.

# P10 POSITIONING SYSTEMS

## P10.1 General

### P10.1.2 General

**1** For mobile offshore drilling units which are installed the dynamic positioning systems as solely positioning systems, the dynamic positioning system is to be of the Class 2 DPS or Class 3 DPS specified in **10.2.3, Part P of the Rules**.

**2** For units which are positioned by other ships' power in the service area, are operating in transferring within limiting areas at a specific route, or are operating safely without positioning, positioning systems need not to be installed.

**3** DPS installed on mobile offshore drilling units and special purpose barges, etc. are to comply with the requirements of **Chapter 12, Part B of the Rules**. DPS installed on work-ships are to comply with the requirements of **Chapter 15, Part B of the Rules**.

## P10.2 Classification of Positioning Systems

### P10.2.2 Classification of Mooring Systems

**1** Any anchor mooring system except sinkers in the seabed are to be regarded as positioning systems to be provided in units. In this case, however, the documents which are shown that sinkers are designed not to move in any severe conditions assumed at the design stage are to be submitted to the Society for reference.

**2** Anchor mooring system means a mooring system comprising multiple points, multiple lines catenary mooring lines. A single point mooring system comprising one or multiple lines of catenary mooring lines is to be included in the single point mooring system.

**3** Any tension mooring systems except those supporting members embedded on the seabed are to be regarded as positioning systems to be provided in units. In this case, however, the documents which are shown that those supporting systems are designed not to move in any severe conditions assumed at the design stage are to be submitted to the Society for reference.

**4** Tension mooring system means a mooring system using multiple points, multiple tension lines used in a so-called tension leg platform (TLP), and those without provided with upright tension lines are not to be included in this category. In tension mooring lines which are taken only from one point of a unit, they are to be included in the single point mooring system.

**5** Any single point mooring system provided for mooring units and directly moor the units with supporting members embedded on the seabed or fixtures at sea are to be regarded as positioning system to be provided in the units except those supporting systems embedded on the seabed. Any single point mooring system provided in a distance from the unit and serve to moor the unit indirectly with a mooring rope, etc., may not be regarded as positioning systems to be provided in units.

**6** Single point mooring system includes CALM (Catenary Anchor Leg Mooring), in which multiple catenary mooring lines and one buoy are used, and, SALM (Single Anchor Leg Mooring), in which one tension mooring line and one buoy are used, and the spar buoy type, the tower type or the turret type, which are modifications of SALM.

**7** In the case of dolphin mooring system, the bodies of dolphins are not to be regarded as positioning systems to be provided in units. However, connecting systems such as mooring lines to moor the unit with dolphins, if they are used exclusively to moor the unit, are to be regarded as positioning systems to be provided in units.

**8** Dolphin mooring system means those comprising dolphins such as fixed piles mooring unit with mooring ropes, or concrete caissons arranged with rubber fenders fitted to dolphins, and in some cases, chains or connecting equipment are fitted additionally.

### P10.2.3 Dynamic Positioning Systems

Failure mode effective analysis (FMEA) means the analysis method to investigate that where failures of one of all installations and systems consisting on the DPS are assumed, effectiveness of the assumed failures is assessed against the safety of units and its environment, and normally considering the relationship of probability of failure occurrence and its effectiveness. Where probability of failure occurrence is based on either the operating duration of systems or frequency of environmental forces acting on the systems corresponding to the systems to be considered.

## P10.3 Anchor Mooring Systems

### P10.3.1 General

Anchor mooring systems specified in **10.3.1-12, Part P of the Rules** may be so designed that thruster force capacity in accordance with the followings is included.

(1) Where thruster systems are come under the Class 2 DPS, 100% of thruster force capacity when one thruster is considered to fail in operating condition or severe storm condition and 100% of all thruster capacity when one mooring line is considered to be broken

(2) Where thruster systems are come under the Class 1 DPS, 70% of thruster force capacity when one thruster is considered to fail in operating condition and severe storm condition in case where this DPS is always operated and redundant system is secured by manually and 70% of all thruster capacity when one mooring line is considered to be broken.

### P10.3.2 Calculating the Tension of Mooring Line

**1** Standard method for quasi-static calculation method is as follows.

(1) Tension obtained by summing up the following **(a)** to **(c)** is to be taken as the maximum tension for each mooring line.

(a) Static tension (initial tension) in a mooring line in its position of initial equilibrium

(b) Static tension in a mooring line generated by a steady horizontal displacement (this position displaced is to be taken as the steady position of equilibrium) from the initial position of equilibrium of a unit due to steady wind and current loads and wave drifting force (steady tension)

(c) Quasi-static tension in a mooring line due to the maximum displacement caused by unit motion (excluding those with a long period) induced by waves around the steady position of equilibrium in a horizontal plane (varying tension)

(2) Mooring lines are to be treated as springs having non-linear reacting characteristics against displacements of their upper ends. Non-linear spring characteristics are to be determined by the catenary theory, appropriate analytical procedure or model experiments.

(3) Winds and waves are to be assumed to come in all directions except when a unit is operated in an enclosed sea area. Winds and waves at least in the direction as each mooring line, and the directions of unit's length and breadth are to be included in calculations. Wind velocity and wave heights are, as a rule, to be assumed equal to the maximum values of the design conditions in all directions. For wave heights, however, different values may be used depending upon the wave directions after obtaining approval from the Society on the basis of observation results or predictions when a unit is operated in a enclosed sea area.

(4) Directions of currents are to be assumed to be compatible with directions of winds and waves unless the service areas are specified.

(5) Optimization of distributed tension by coordinating the initial tension may be considered when determining a steady position of equilibrium. This, however, is to be specified in the unit operating booklet. The effects of a unit's sinkage or heeling (steady displacements in a vertical plane) may not be considered in oridinary cases, except in the case of mooring systems in which these effects are predicted not to be negligible.

(6) The maximum value of unit's motion due to waves is to be calculated on regular waves or irregular waves according to the design conditions using proper analytical procedure or model experiments as follows.

(a) The wave height of regular waves is to be the design maximum wave height. However, the design significant wave height may be used for calculating wave drifting force. The wave period is to be of the most severe for the tension in a mooring line within the applicable range (normally, the longest period)

(b) For calculating wave heights or irregular waves, proper wave spectra (normally, Pieson-Moskowits type spectrum) having a typical wave height equal to the design maximum wave height are to be assumed. In this case, the maximum value of unit's motion is to be the maximum expected value during a period continuing two hours or more. The maximum expected value is not to be smaller than 1.8 times the significant value. Calculations of unit's motions may be carried out within the frequency region.

(c) Generally, unit's motions may be determined for the initial state of equilibrium. If, however, the effects of changes in a unit's draught and attitude from the initial state of equilibrium upon unit's motions are predicted not to be negligible, unit's motions are to be determined for the steady of equilibrium.

(d) Generally, the effects of the spring characteristics of mooring lines on unit's motions may be considered negligible. If the

natural periods of surging, swaying and yawing of a unit are similar to the predicted wave period, the non-linear spring characteristics of mooring lines are to be taken into account after being subjected to linearization properly.

**2** The safety factors of mooring lines are defined as the value obtained by dividing the Rule required value as the breaking load of each mooring line by the maximum tension of each mooring line determined through the quasi-static analytical procedure. The safety factors are shown in **Table P10.3.2-2** corresponding to the unit's conditions and the kind of mooring lines used.

**3** When anchor mooring systems are used in combination with propelling systems such as thrusters, the safety factors of mooring lines may be reduced to 0.6 times of those specified in **Table P10.3.2-2** in operating condition and severe storm condition, and 0.75 times in operating condition and severe storm condition with one line broken.

Table P10.3.2-2 Safety Factors of Mooring Lines

| Condition of units | Kind of mooring line | |
|---|---|---|
| | Chain cables and Wire ropes | Synthetic ropes |
| Operating condition | 3.0 | 5.0 |
| Severe storm condition | 2.0 | 3.0 |
| Operating condition with one line broken | 2.0 | 3.0 |
| Severe storm condition with one line broken | 1.4 (2.0) | 2.0 (3.0) |

Note:

Values in parentheses apply to those mooring lines arranged on the opposite side of the units if they are moored in the proximity of other units or offshore structures.

## P10.7 Dynamic Positioning Systems

### P10.7.1 General

**1** The DP-control systems and computer systems used for the Class 2 DPS and Class 3 DPS are to be approved by the Society in accordance with the requirements of **Chapter 1, Part 7 of the Guidance for the Approval of Materials and Equipment for Marine Use**.

**2** The DP-control systems and computer systems used for the Class 1 DPS, as a rule, are to be approved by the Society in accordance with the requirements of **Chapter 1, Part 7 of the Guidance for the Approval of Materials and Equipment for Marine Use** as far as practicable.

### P10.7.5 DP-control Systems

The wording "an appropriate international quality standard recognized by the Society" specified in **10.7.5-1(10), Part P of the Rules** means ISO 90003.

### P10.7.6 Computer System

Computer systems installed on Class 2 DPS and Class 3 DPS are to comply with **Chapters 1**, **2** and **3, Part X of the Rules**.

# P11 MACHINERY INSTALLATIONS

## P11.1 General

### P11.1.4 General Requirements for Machinery Installations

**1** To ensure due restoration of the machinery from a dead ship condition, the detailed starting-up systems for one driving unit of the air compressors specified in **13.13.3, Part D of the Rules** (referred to as the main air compressors) and two driving units of the generators of the main power plant specified in **12.1.5, Part P of the Rules** (referred to as the main generators) are to be as given in **Table P11.1.4-1**.

**2** As for machinery of the unit which may anchor or operate in cold districts, the measures in the following **(1)** to **(3)** are to be taken.

(1) Equipment to drain cooling water at anchorage or in operation, equipment to prompt starting without risk of fire, and suitable equipment to prevent fuel oil and lubricating oil from freezing are to be provided as occasion demands.

(2) The valves, cocks, distance pieces, etc. attached to the shell plating are to be so arranged as not to be damaged by ice or due to coldness.

(3) The inlet ports for circulating water or cooling water on the shell plating are to be so arranged as not to be chocked by ice.

**3** For units provided with auxiliary propelling machinery for which docking is impracticable, considerations are to be given so as to enable the measurement of weardown of the stern bearings and the inspection and repair of bearings and water sealings in an afloat condition.

**4** "Special consideration" specified in **11.1.4-5, Part P of the Rules** means that measures deemed appropriately by the Administration (for example, risk assessments and treatments for the ship which has a large embarking capacity, or application of the *SPS Code*) are to be taken.

### P11.1.6 Bilge Pipings

**1** Omission of bilge suction pipes

For small compartments such as echo sounder recesses, the provision of bilge suction pipes may be omitted subject to the approval of the Society.

**2** Bilge suction pipes passing through deep tanks

Bilge suction pipes passing through deep tanks serving as the permanent ballast tank, welded pipe joints may not be required in case where flange joints corresponding to a nominal pressure one rank higher than that according to the design pressure are used.

**3** Valves on bilge suction piping

Valves on the bilge suction piping are to be operable from a position in a machinery space or a shaft tunnel, or to be capable of being remotely controlled from a readily accessible place.

**4** Omission of bilge piping

Bilge piping for the watertight compartments of self-elevating unit leg bottoms may be reduced subject to the following conditions:

(1) Stability requirements are satisfied even under flooded conditions.

(2) Safe passage is possible to allow the confirmation of the inside of the compartment. In such cases, the confirmation procedure is to be described in the operation manual.

### P11.1.8 Ballast Pipings

In case where gravitational ballasting/deballasting is intended by using sea chests provided in the permanent ballast tanks, double stop valves being operable from a position on the freeboard are to be provided.

### P11.1.14 Jacking Systems

**1** In applying **11.1.14-2, Part P of the Rules**, materials are to meet the specified values for impact tests equivalent to or greater than those of steels used for hull construction in cases where materials are used for which there are no specified values for the impact tests in **Part K of the Rules**.

**2** The wording "permanently attended control station" specified in **11.1.14-3, Part P of the Rules** means the locations where jacking systems are controlled. In cases where fixation systems are separately provided as holding mechanisms, the locations where

such systems are controlled are also included.

**3** The wording "requirements specified otherwise by the Society" specified in **11.1.14-7, Part P of the Rules** means the requirements specified in **Annex 5.3.1, Part D of the Rules**.

**P11.1.15 Additional Requirements for the Unit which has the Main Propulsion Machinery**

**1** In the application of **11.1.15-2.(1), Part P of the Rules**, tests and open-up inspections of cylinders of reciprocating internal combustion engines used as main propulsion machinery may be required when considered necessary by the Society.

**2** Unconventional machinery referred to in **11.1.15, Part P of the Rules** means waterjet propulsion systems and azimuth thrusters specified in the requirements in **Chapters 19** and **20 of Part D of the Rules** as well as the machinery with novel design features specified in **1.1.3, Part D of the Rules**.

Table P11.1.4-1 Starting-up System in the Restoration from a Dead Ship

| Items to be restored | | | Items necessary for staring-up | | | Remarks |
|---|---|---|---|---|---|---|
| Equipment | Driving unit | Staring method | Equipment | Driving unit | Staring method | |
| Main air compressor & main generator | Diesel engine | Compressed air | Emergency air compressor | Engine | Manual | —— |
| | | | | | Battery | Applicable only to a case where a manually startable generator for charging (or emergency generator) is provided. |
| | | | | Electric motor | —— | Applicable only to a case where a manually startable generator for electric motors (or emergency generator) is provided. |
| | | | | Manual | —— | Applicable only to a case where the requirement for the volume of compressed air is small. |
| | | Battery | Generator for charging or emergency generator | Engine | Manual | —— |
| Main air compressor | Electric motor | —— | Generator for electric motor or emergency generator | | Compressed air | Applicable only to a case where a manually startable emergency air compressor is provided. |

Notes:

1. The equipment and driving unit given in the above table are to be capable of running without being fed from any other power supply except the power required for starting-up.
2. Items of equipment not shown in the table are to be dealt with on each case.

# P12 ELECTRICAL INSTALLATIONS

## P12.1 General

### P12.1.3 Tests

**1** The wording "tests for any equipment with small capacities as specified in **(2)** and **(3)** are to be conducted as deemed appropriate by the Society" specified in **12.1.3-1, Part P of the Rules** means those shop tests for electrical motors whose capacities at continuous ratings are less than 100 *kW* and controlgears of those motors may be substituted for by manufacturer tests. In such cases, submission or presentation of test records may be required by the Society.

**2** The wording "subject to the approval of the Society" in **12.1.3-2, Part P of the Rules** means **Chapter 4, Part 2 of the Rules for Approval of Manufacturers and Service Suppliers**. Equipment and cables approved are made public on the "List of Approved Materials and Equipment".

**3** The wording "to be subject to type tests" in **12.1.3-3, Part P of the Rules** means **Part 8 of the "Guidance for the Approval of Materials and Equipment for Marine Use"**. Equipment and cables approved are made public on the "List of Approved Materials and Equipment".

**4** Cables requiring type approval are to be as follows:

(1) Cables used for power feeding systems and power distribution circuits for power, lighting and internal communications and used for control circuits

(2) Flexible cords used for feeding for power systems and power distribution circuits and control circuits

(3) Multicore vinyl insulated cables for 150*V* electronic equipment

**5** Type tests may be carried out for flexible cords, vinyl sheathed cords, insulated cables for switchboards and control equipment, coaxial cables, etc., other than those specified in **-3** in case where request is made by the manufacture.

**6** In applying **12.1.3-10, Part P of the Rules,** the tests for cells (or modules), accumulator battery systems and electrical power converters referred to in **Annex 2.11.1-2, Part H of the Rules** are to be carried out at manufacturing plants or other locations for ships equipped with accumulator battery systems to which **Annex 2.11.1-2, Part H of the Rules** is applied.

### P12.1.5 Main Source of Electrical Power and Lighting Systems

**1** In **12.1.5-2, Part P of the Rules**, electrical installations listed in the following **(1)** to **(3)** may be excluded from the electrical installations which are to be power supplied in the event of any one generating set being stopped.

(1) Thrusters not forming part of main propulsion plant or dynamic positioning system (DPS)

(2) Refrigerating compressors for air conditioning installations

(3) Others as deemed acceptable by the Society

**2** In case where transformers are to supply power for the electrical auxiliaries services necessary for maintaining the unit in normal operational and habitable conditions, at least two transformers are to be provided. Note, however, that in transformer used exclusively for a specific load where such is deemed acceptable by the Society, one set of transformer may be accepted.

**3** The capacities of transformers specified in **-2** are to be such that power feeding necessary for services to provide normal operational conditions of propulsion and safety even in the event of failure on one set of transformer is available. Further, at least the minimum habitable conditions are secured with the equipment including the items for cooking, heating, provision refrigeration, mechanical ventilation, sanitary and fresh water services.

**4** Notwithstanding the requirements in **-2**, one set of transformers is acceptable if the respective primary and secondary sides of three single phase transformers are formed by delta connections, and if necessary power can be supplied as transformers of *V* connections in case either one of the transformers fails.

**5** Arrangement of transformers are to be as follows. (*See* **Fig. P12.1.5-1**)

(1) Each transformer is to be located as a separate unit with separate enclosure or equivalent thereto.

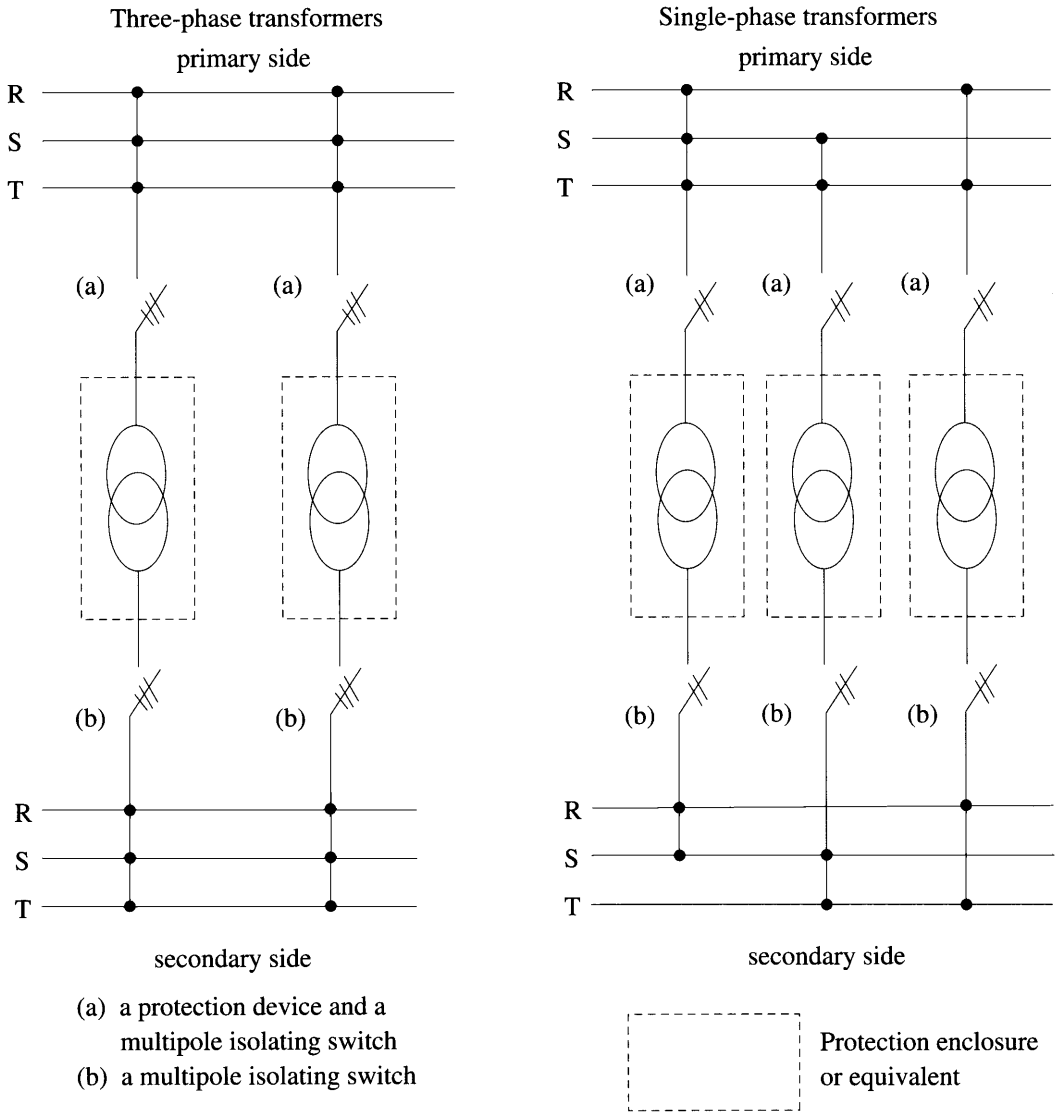
(2) Each transformer is to be served by separate circuits on the primary and secondary sides.

(3) Each primary circuit is to be provided with a protection device and a multipole isolating switch.

(4) Each secondary circuit is to be provided with a multipole isolating switch.

**6** "Special consideration" specified in **12.1.5-4, Part P of the Rules** means that measures deemed appropriate by the Administration (for example, risk assessments and treatments for the ship which has a large embarking capacity, or application of the *SPS Code*) are to be taken.

Fig. P12.1.5-1 Arrangement of Transformers




**P12.1.6 Emergency Source of Electrical Power**

**1** The automatic starting system specified in **12.1.6-7(1)(c), Part P of the Rules** is to comply with the requirements listed in the following **(1)** to **(3)**.

(1) The source of stored energy is to have such a capacity which is capable of starting the prime mover at least 6 *times*.

(2) In case where the automatic starting system is of the consecutive starts, the number of starts is to be 3 or less.

(3) For automatic starting system, a means is to be provided to hold such an allowance of source of energy capable of starting the prime mover 3 *times* further after making the initial consecutive starts.

**2** "Special consideration" specified in **12.1.6-15, Part P of the Rules** means that measures deemed appropriate by the Administration (for example, risk assessments and treatments for the ship which has a large embarking capacity, or application of the *SPS Code*) are to be taken.

**P12.1.8 Additional Requirements for the Unit which has the Main Propulsion Machinery**

**1** In units in which reciprocating internal combustion engines are used as main propulsion machinery (excluding electric propulsion ships), the generator driven by the propulsion plant provided on board the unit is to comply with the requirements listed in the following **(1)** to **(5)** if it is provided as one of main source of electrical power specified in **12.1.5-1, Part P of the Rules**.

(1) Main source of electrical power is to be such that generating capacity of the generator(s) specified in **12.1.5-2, Part P of the Rules** is capable of being maintained under all sailing and manoeuvring conditions including crash stop in the event of any one generating set being stopped. When there are only two generators, one of which is driven by propulsion plant, a means is to be provided so that the propulsion machine can be started without resource to those generators.

(2) Where main source of electrical power is such that operation of generating set(s) is to be changed to that of generating set(s) not depending upon the propulsion plant according to the unit's speed (e.g. ahead, stop, astern), such change need be made both automatically along with the control of the propulsion plant and by remote operation from the position where the propulsion plant is being controlled. In this case power supply is not to be interrupted by this change.

(3) A means is to be provided so that a quick restration of power supply can be obtained after an electrical power interruption caused inevitable by the speed variation of propulsion plant e.g. due to sudden stop or speed reduction of the propulsion plant.

(4) In a unit which is so designed that the propulsion plant is controlled from navigation bridge during the generator driven by the propulsion plant is being used, a device to indicate the running of the generator and other devices indicating information necessary for operation of the generator are to be provided on the navigation bridge.

(5) Main source of electrical power including the generator driven by the propulsion plant is not to be less effective and reliable than those consisted of only the separately driven generators.

**2** In units in which reciprocating internal combustion engines are used as main propulsion machinery (excluding electric propulsion ships), the generator driven by the propulsion plant provided on board the unit in addition to the main source of electrical power required by **12.1.5-1, Part P of the Rules** is to comply with the requirements listed in the following **(1)** and **(2)**.

(1) A means is to be provided so that a quick restoration of power supply can be obtained after an electrical power interruption caused inevitably by the speed variation of propulsion plant e.g. due to sudden stop or speed reduction of the propulsion plant.

(2) In a unit which is so designed that the propulsion plant is controlled from navigation bridge during the generator driven by the propulsion plant is being used, means listed in the following **(a)** to **(c)** or equivalent thereto are to be provided.

(a) A means is to be provided to maintain voltage and frequency of the generator concerned within the pre-set range unless an alarm device is provided on the navigation bridge to operate when the voltage or the frequency deviates from the specified range.

(b) Main source of electrical power is to be such that operation of generating set(s) is so changed automatically or by the remote operation from the navigation bridge as to operate generating set(s) not depending upon the propulsion plant when the voltage or the frequency of the generator concerned has deviated or is expected to deviate from the pre-set range. In this case the time involved for changing of operation of generating set(s) is not to be longer than 45 *seconds* if electrical power supply is interrupted.

(c) The following items are to be indicated at the position near the remote control lever for propulsion plant on the navigation bridge. Those are to be indicated automatically or by the remote operation from the main control station of the propulsion plant when the generator concerned is brought into operation:

i) Running of the generator driven by propulsion plant; and

ii) Speed range of the propulsion plant within which generator driven by propulsion plant in serviceable. (rpm - rpm)

**3** In **12.1.8-3(2), Part P of the Rules**, procedures from a dead ship condition to starting the main propulsion plant are to comply with the requirements in **P11.1.4-1**.

## P12.2 Mobile Offshore Drilling Units

### P12.2.3 Main Source of Electrical Power and Lighting Systems

Provisions for maintaining or immediately restoring electrical power to any equipment for propulsion and steering specified in **12.2.3-1, Part P of the Rules** are to comply with following:

(1) In cases where the electrical power can normally be supplied by one generator, the following requirements are to be complied with:

(a) Adequate provisions are to be made for automatic starting and connecting to main switchboards of standby generators of sufficient capacities to permit propulsion and steering and to ensure ship safety with automatic restarting of important auxiliaries including sequential operations in cases where there has been a loss of electrical power to those generators in

operation.

(b) The amount of time for automatic starting and connecting to main switchboards of those standby generators specified in **(a)** above is to be not more than a period of 45 *seconds* after any loss of power.

(2) If electrical power is normally simultaneously supplied by more than one generator in parallel operations, provisions are to be made to ensure that, in cases where there is a loss of electrical power to any one of these generating sets, all remaining ones are kept in operation without any overloads to permit propulsion and steering, and to ensure ship safety. (See **2.3.6, Part H of the Rules**)

(3) Other provisions deemed appropriate by the Society.

**P12.2.4 Emergency Source of Electrical Power**

"Installations as required by Chapter IV, the Annex to *SOLAS* Convention" as specified in **12.2.4(4)(b), Part P of the Rules** are the installations which are required by *GMDSS* (Global Maritime Distress and Safety System).

## P12.4 Units which are Engaged in a Special Work and are Stationed for a Long Period of Time

**P12.4.3 Emergency Source of Electrical Power**

"Installations as required by Chapter IV, the Annex to *SOLAS* Convention" as specified in **12.4.3(4)(b), Part P of the Rules** are the installations which are required by *GMDSS*.

## P12.5 Units which have Accommodation for Particular Personnel or Passengers

**P12.5.3 Emergency Source of Electrical Power**

"Installations as required by Chapter IV, the Annex to *SOLAS* Convention" as specified in **12.5.3(4)(b), Part P of the Rules** are the installations which are required by *GMDSS*.

# P13 MACHINERY INSTALLATIONS, ELECTRICAL INSTALLATIONS, AND SO ON IN HAZARDOUS AREAS

## P13.2 Ventilation Systems

### P13.2.1 Mobile Offshore Drilling Units

The ventilation fans which are "designed so as to reduce the risk of sparks" specified in **13.2.1-5(6), Part P of the Rules** mean those ventilation fans complying with the requirements of **R4.5.4-1(2)**. For the purpose of this requirement, protection screens of not more than 13*mm* square mesh are to be fitted in the inlet and outlet ventilation openings of the ducts fitted with such fans on the open deck.

### P13.2.2 Storage Units

The ventilation fans which are "constructed so as not to emit sparks" specified in **13.2.2-1(2)(c), Part P of the Rules** mean those ventilation fans complying with the requirements of **R4.5.4-1(2)**. For the purpose of this requirement, protection screens of not more than 13*mm* square mesh are to be fitted in the inlet and outlet ventilation openings of the ducts fitted with such fans on the open deck.

# P14 FIRE PROTECTION AND MEANS OF ESCAPE

## P14.1 General

### P14.1.1 Application

For ships to which **Annex 2.11.1-2, Part H of the Rules** is applied and which are also subject to **14.1.1-1, Part P of the Rules**, the term "**Chapter 9, Part R**" in **1.2.3, Annex 2.11.1-2, Part H of the Rules** is to be read as "**Chapter 14, Part P**" and structural fire protection is to comply with **1.2.3, Annex 2.11.1-2, Part H of the Rules**.

## P14.2 Mobile Offshore Drilling Units

### P14.2.2 Construction of Fire Protection

**1** The "vital machinery and equipment" specified in **14.2.2-8, Part P of the Rules**, are those that are essential to the safety of the MODU and all personnel on board. They include, but are not limited to, fire pumps, emergency sources of power, dynamic positioning systems, remote blowout preventer activation controls, and other operational or safety systems the sudden failure of which may result in hazardous situations. This does not include spaces (e.g. the driller's cabin) located on the drill floor.

**2** The "national or international standards deemed appropriate by the Society" specified in **14.2.2-8(1), Part P of the Rules**, refer to *ISO 13072:2015* or *API RP 2 FB*.

**3** With respect to the "calorific value" specified in **14.2.2-8(11), Part P of the Rules**, reference is made to **R5.3.2**.

# P15 FIRE EXTINGUISHING SYSTEMS

## P15.2 Mobile Offshore Drilling Units

### P15.2.13 Fire Extinguishing System for Helicopter Facilities

**1** In **15.2.13-1(4), Part P of the Rules**, reference is to be made to the *International Civil Aviation Organization Airport Services Manual, Part* 1*, Rescue and Fire Fighting, chapter* 8*, Extinguishing Agent Characteristics, paragraph* 8.1.5*, Foam Specifications table* 8-1*, level 'B'*.

**2** With respect to foam fire-fighting appliances specified in **15.2.13-2(3), Part P of the Rules**, reference is to be made to the "*Guidelines for the Approval of Helicopter Facility Foam Fire-fighting Appliances*" (*MSC.*1/*Circ.*1431) in addition to the requirements specified in **15.2.13-2(3), Part P of the Rules**.

# P17 HELICOPTER FACILITIES

## P17.3 Helideck

### P17.3.1 General

The “ground effect” specified in **17.3.1-3, Part P of the Rules** refers to the effect where, the lift of the main wing and tail or the thrust of rotor blade is increased when a fixed-wing aircraft or rotor blade machine flies in proximity to the ground.

### P17.3.2 Construction

With respect to the application of **17.3.2** and **17.3.3, Part P of the Rules**, refer to the requirement of heliports specified in Volume II, the Annex 14 to *ICAO* Convention are to be applied.

## P17.5 Visual Aids

### P17.5.6 *D*-value Marking

In **17.5.6-2, Part P of the Rules,** “special consideration may be required” means that Helidecks designed specifically for AS332L2 and EC 225 helicopters, each having a D-value of 19.5 *m*, are to be rounded up to 20 in order to differentiate between helidecks designed specifically for L1 models.

# P18 OPERATING REQUIREMENT

## P18.1 Operating Manual

### 18.1.1 General

The wording "a guideline deemed appropriate by the Society" specified in **18.1.1-8, Part P of the Rules** refers to the "recommendations developed by the *IMO*" (*IMO* Resolution *A*.1050(27)).

## P18.2 Operating Requirement

### P18.2.2 Information for Normal Operations

**1** Where a computer for stability calculation is on board the units as a supplement to the stability information specified in **18.2.2-1(10), Part P of the Rules**, this computer is to comply with **Annex U1.2.2 "GUIDANCE FOR STABILITY COMPUTER", Part U of the Guidance**.

**2** Operating manual for the dynamic positioning system specified in **18.2.2-2(13), Part P of the Rules** is to include the following **(1)** to **(11)** items.

(1) Location checklist (refer to paragraph 4.1 of IMO *MSC*.1/*Circ*.1580)
(2) Watchkeeping checklist (refer to paragraph 4.2 of *IMO MSC*.1/*Circ*.1580)
(3) DP operating instructions (refer to paragraph 4.4 of *IMO MSC*.1/*Circ*.1580)
(4) Annual tests and procedures (testing procedures for dynamic positioning systems are acceptable.) (refer to paragraph 5.1.1.3 of *IMO MSC*.1/*Circ*.1580)
(5) Classification and periodical (5-year) surveys and procedures (testing procedures for dynamic positioning systems are acceptable.) (refer to paragraphs 5.1.1.1 and 5.1.1.2 of *IMO MSC*.1/*Circ*.1580)
(6) Examples of tests and procedures after modifications and non-conformities (refer to paragraphs 5.1.1.4 of *IMO MSC*.1/*Circ*.1580)
(7) Blackout recovery procedure
(8) List of critical components
(9) Examples of operating modes
(10) Decision support tools such as ASOG
(11) Capacity plots (refer to paragraph 4.5 of *IMO MSC*.1/*Circ*.1580)

### P18.2.14 Practice Musters and Drills

**1** The wording "recommendations developed by the *IMO*" specified in **18.2.14-2, Part P of the Rules** refers to "*Recommendations for the Training and Certification of Personnel on Mobile Offshore Units (MOUs)*" (*IMO* Resolution *A*.1079(28)).

**2** The wording "a guideline deemed appropriate by the Society" specified in **18.2.14-4(3), Part P of the Rules** refers to the "*Guidelines on Alternative Methods for Lifeboat Drills on MODUs*" (*MSC*.1/*Circ*.1486).

**3** In applying **18.2.14-7, Part P of the Rules**, reference is to be made to "*Guidelines on Alternative Methods for Lifeboat Drills on MODUs*" (*MSC*.1/*Circ*.1486).

### P18.2.15 Enclosed Space Entry and Rescue Drills

In applying **18.2.15-2, Part P of the Rules**, reference is to be made to "*Revised Recommendations for Entering Enclosed Spaces aboard Ships*" (*IMO* Resolution *A*.1050(27)).

### P18.2.16 Onboard Training and Instructions

**1** In applying **18.2.16, Part P of the Rules**, reference is to be made to "*Recommendations for the Training and Certification of Personnel on Mobile Offshore Units (MOUs)*" (*IMO* Resolution *A*.1079(28)).

**2** The wording "provisions deemed appropriate by the Society" specified in **18.2.16-3, Part P of the Rules** means the *STCW* Convention, the *STCW* Code and the *Guidelines for Dynamic Positioning System (DP) Operator Training* (*IMO MSC*/*Circ.*738).

## P18.3 Records

### P18.3.1 Official Log and Tour Record

The wording "*tour record*" specified in **18.3.1, Part P of the Rules** refers to the Association of Drilling Contractors' "*Daily Drilling Report*".

# Appendix P1 REFERENCE MATERIALS FOR CALCULATION OF STRENGTH

## 1.1 Outline of Fatigue Analysis Procedure

A fatigue analysis on the basis of hot spot strain consists basically of the following steps. (*See* **Fig. P1.1**) When the nominal stress of a structural members is directly used, the step **(2)** will be omitted and an adequate fatigue design curve corresponding to the type of joint may be applied in the process **(3)**.

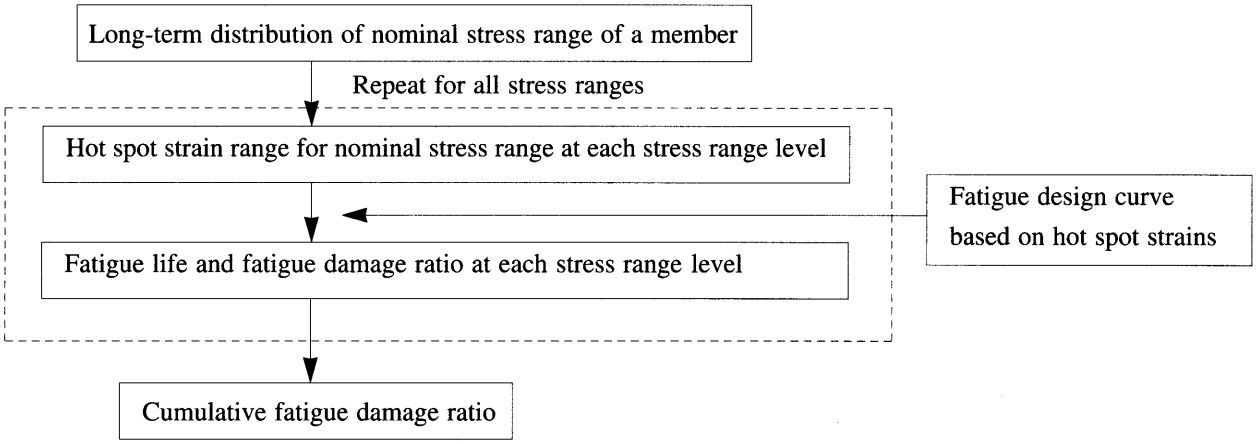
(1) Determination of the long-term distribution of nominal stress range of a structural member during the fatigue design life.

(2) Calculation of the hot spot strains corresponding to respective nominal stresses for each level of stress range.

(3) Calculation of the fatigue life (the number of repetitions) of the strain range at each level by using the fatigue design curve based on hot spot strain.

(4) Calculation of the cumulative fatigue damage ration by summing up respective fatigue damage rations for each level (i.e., the ratio of the repeated stress cycles to the fatigue life at each nominal stress level).

Fig. P1.1 Outline of Fatigue Analysis Procedure Based on Hot Spot Strains




## 1.2 Long-term Distributions of Stresses of Structural Members

The long-term stress distribution may be determined by either of the following **1.2.1** or **1.2.2**.

### 1.2.1 Simplified Method Utilizing Theoretical Distribution of Stress Range

This is a method to obtain the long-term stress distribution by assuming a form of a theoretical distribution of stress range in lieu of calculating the long-term stress distribution directly and by applying the maximum stress range which is separately estimated during the fatigue design life. To obtain the maximum stress range corresponding to the fatigue design life, deterministic methods based on design waves or design wave spectra and the analysis of overall strength may be applied. In obtaining the long-term stress distribution, an adequate theoretical distribution should be selected considering the type of loads and dynamic characteristics of structures, etc. When any other theoretical distributions are not considered adequate, the following Weibull distribution may be used.

$$P(\Delta S) = 1 - N_t^{-s}$$

$$p(\Delta S) = (h/\Delta S)sln(N_t)N_t^{-s}$$

where:

$P(\Delta S)$: cumulative probability of stress range

$p(\Delta S)$: probability density of stress range

$N_t$: total number of stress cycles during the fatigue design life

$\Delta S_{max}$: maximum stress range during the fatigue design life

$h$ : Weibull parameter

$s = (\Delta S/\Delta S_{max})^h$

When wave loads are considered, $1 \times 10^8$ may be taken as the total number of stress cycles $N_t$ for the fatigue design life of 20 *years*. the parameter $h$ is to be determined on the basis of the calculation or measured data on the past, but when none of these date are available, it may be postulated as $h$ = 1.0, i.e., exponential distribution.

**1.2.2 Probabilistic Method on the Basis of Long-term Wave Data**

When long-term wave data in the sea area of unit operations are available, the long-term stress distribution due to wave loads may be directly calculated by combining the stress response function obtained from the analysis of overall strength wave spectra. The procedures of this method are outlined as follows: (*See* **Fig. P1.2**)

(1) Determination of the joint probability density of wave period and wave height on the basis of the long-term wave data in the operating sea area. In this case, the observed data of wave height for each wave period may be fitted to an adequate theoretical distribution to correct dispersions involved in the observed data.

(2) Selection of an adequate wave spectrum in the short-term sea state according to the operating sea area. In ocean areas, where the growth of wave is not limited, the Pierson-Moskowitz type wave spectrum may be used in general. In coastal areas, where the growth of waves is limited, it is desirable to adopt the wave spectrum for a finite fetch such as the JONSWAP type spectrum.

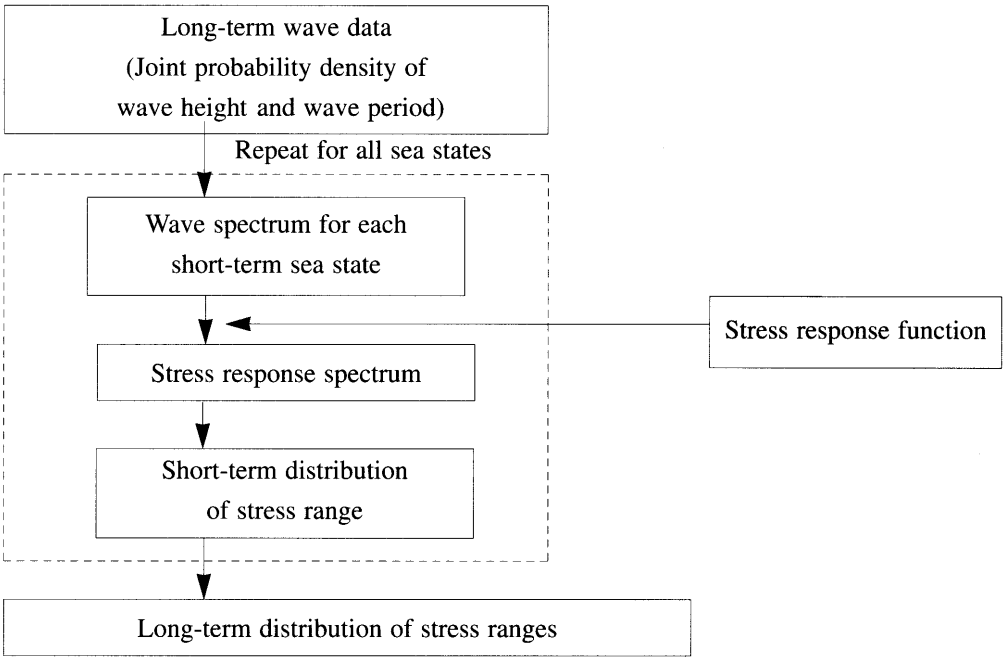
(3) Calculation of the wave-induced response functions of the nominal stresses of the structural members through analysis of overall strength.

(4) Calculation of the stress response spectra for each short-term sea state by combining the preceding wave spectrum and stress response functions, and determination of the short-term distribution of stress. In this case, it may be assumed that the short-term distribution of stress ranges follows the Rayleigh distribution.

(5) Calculation of the long-term distribution of stress ranges by multiplying the short-term distribution of stress ranges by the probability of occurrence determined in the preceding **(1)** for each short-term sea state, and by summing up them for all sea states.

(6) Determination of the total number of stress cycles either by postulating directly or by calculating from the mean period of stress response and the probability of occurrence for each short-term sea state. The maximum stress range may be estimated as the stress range at such a level that a probability of exceedance of the long-term stress distribution is equal to the inverse number of the total number of stress cycles.

Fig. P1.2 Calculation Procedure of Long-term Stress Distribution of Structural Members Based on Long-term Wave Data



## 1.3 Hot Spot Strain

### 1.3.1 Definition of Hot Spot Strain

The hot spot is defined as the portion of the geometric discontinuity (for example, a weld toe) where stress is maximum and a fatigue crack is possible to initiate, and the local strain at the hot spot is defined as the hot spot strain. The hot spot strain ($\varepsilon_{hot}$) is mainly dependent on the three quantities as expressed by the following equation. (*See* **Fig. P1.3**)

$$\varepsilon_{hot} = f(S_n\, K_{ts}\, K_{tw})$$

where:

$S_n$ : nominal stress of a structural member determined by the sectional area, section modulus and so on

$K_{ts}$ : elastic stress concentration factor due to gross structural discontinuity at a hot spot zone

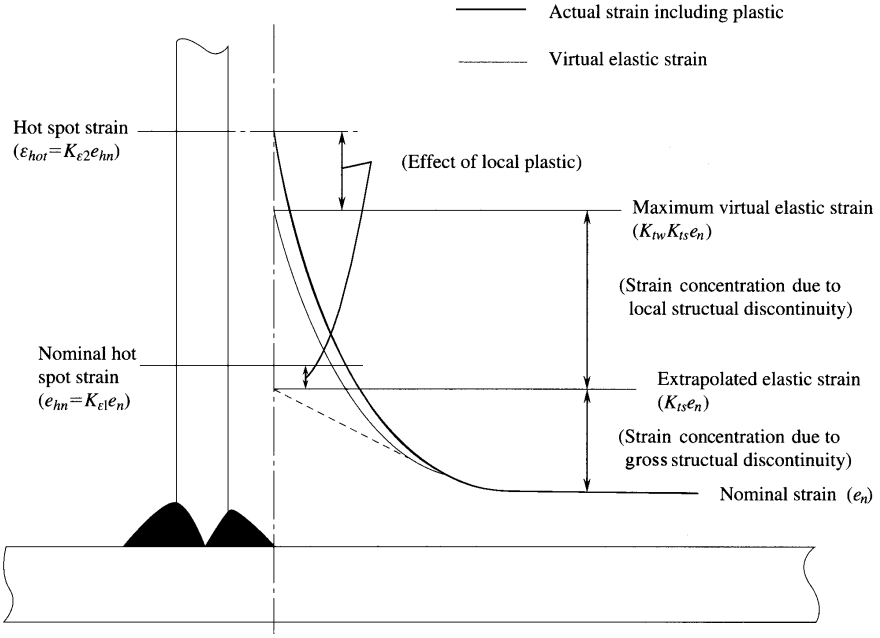
$K_{tw}$ : elastic stress concentration factor due to local structural discontinuity at hot spot zone

The nominal stress ($S_n$) of a structural member is to be taken as an equivalent stress combining each stress at the position free from any stress concentration, which is calculated by the analysis of overall strength. When the thickness is increased at the portion of stress concentration, it may be taken into account, but the effects of stiffeners should be neglected.

The elastic stress concentration factor due to gross structural discontinuity ($K_{ts}$) is the ratio of the 'nominal elastic hot spot stress' to the nominal stress, and represents the extent of the stress concentration resulting from such gross shape of the structure as brace-to-chord connections. Here, the 'nominal elastic hot spot stress' is defined as the greatest stress value of the extrapolation to the spot of the elastic principal stress distribution near the hot spot. This stress concentration factor may be obtained either by thin-shell finite-element-analysis, physical model studies or semi-empirical formulate.

The elastic stress concentration factor due to local structural discontinuity ($K_{tw}$) is the ratio of the maximum virtual elastic stress at the hot considering the local geometry to the nominal elastic hot spot stress, and represents the extent of the stress concentration resulting from such local shape near the hot spot at profile of weld toe. This elastic stress concentration factor may be obtained either by the solid finite-element-analysis of elastic stress or physical model studies. However, when no post-weld treatment is applied to the weld joints, the effect of stress concentration at the weld toe due to local imperfection caused in the course of fabrication is additionally considered.

Fig. P1.3 Outline of Fatigue Analysis Procedure Based on Hot Spot Strains



### 1.3.2 Effects of Local Yielding

(1) Plastic strain concentration factor

When the local plastic (yielding) at the hot spot due to of the stress concentration is not negligible, hot spot strain should be estimated by using the plastic strain concentration factor and plastic stress concentration factor. To take the effects of plastic into consideration in estimating the strain or stress concentration, the following Stowell's equation is recommended to be adopted. Other equally suitable equations (e.g., Neuber's equation) may be used in substitution for it.

$$K\sigma = K\varepsilon/(K\varepsilon - K_t + 1)$$

where:

$K_t$ : elastic stress concentration factor

$K\sigma$: plastic stress concentration factor

$K\varepsilon$: plastic strain concentration factor

(2) Stress-strain relationship under cyclic loading

When the effects of local plastic (yielding) are considered, the stress-strain relationship under cyclic loading is to be estimated by mechanical tests on the material used, as a rule. However, the following simplified equation of relation may be used.

$$\varepsilon = \sigma/E + a(\sigma/E)^{1/n}$$

$$1/n = 0.0086\sigma_u + 0.036$$

$$log\ a = -0.238 + 2.24\ (1/n)$$

where:

$\varepsilon$ : strain

$\sigma$ : stress ($N/mm^2$)

$E$ : Young's modulus ($N/mm^2$)

$\sigma_u$: tensile strength of material ($N/mm^2$), generally, use the minimum specified value, but when the accurate value is obtained by material tests, etc., such a value may be used.

### 1.3.3 Method of Estimating Hot Spot Strain

The hot spot strain is estimated from the nominal stress by the following procedures. (*See* **Fig. P1.4**)

(1) Estimate the elastic stress concentration factor due to gross structural discontinuity ($K_{ts}$).

(2) Determine the elastic stress concentration factor due to local structural discontinuity ($K_{tw}$).

(3) Set the nominal stress amplitude ($S_a$) at a given stress level form the long-term distribution of the nominal stress ranges.

(4) Estimate the amplitudes of the nominal stress and nominal strain near the hot spot ($S_{ha}$ and $e_{ha}$) considering the effects of the local plastic.

When the nominal elastic hot spot stress ($K_{ta}S_a$) is smaller than the yielding stress under cyclic loadings ($\sigma_y'$), the effect of the local plastic is neglected according to the following **(a)**, and when greater, it is taken into consideration according to the following **(b)**.

However, when the stress-strain relationship under cyclic loading referred to **1.3.2(2)** is applied, the following **(b)** may be applied with no relation to the yielding stress under cyclic loadings ($\sigma_y'$).

(a) When $\sigma_y' \geq K_{ts}S_a$, apply $K_{ts}$ regarding as linear elastic.

$$S_{ha} = K_{ts}S_a$$

$$e_{ha} = S_{ha}/E$$

(b) When $\sigma_y' < K_{ts}S_a$ , apply the equation of plastic stress (strain) concentration factor and the stress-strain relationship under cyclic loading considering the local plastic. The following four equations of relation are solved numerically to obtain $S_{ha}, e_{ha}, K_{\sigma 1}$ and $K_{\varepsilon 1}$.

$$S_{ha} = K_{\sigma 1}S_a$$

$$e_{ha} = K_{\varepsilon 1}e_a$$

$$K_{\sigma 1} = K_{\varepsilon 1}/(K_{\varepsilon 1} - K_{ts} + 1)$$

$$e_{ha} = S_{ha}/E + a(S_{ha}/E)^{1/n}$$

where:

$K_{\sigma 1}$ and $K_{\varepsilon 1}$ :the plastic stress concentration factor and plastic strain concentration factor due gross structural discontinuity, respectively.

(5) Estimate the amplitudes of hot spot stress ($\sigma_a$) and hot spot strain ($\varepsilon_a$).
When the maximum virtual elastic ($K_{tw}K_{ts}S_a$) is smaller than the yielding stress under cyclic loadings ($\sigma'_y$), the effect of the local plastic is considered negligible, and when greater, it is taken into consideration according to the following **(b)**. However, when the stress-strain relationship referred to in **1.3.2(2)** is applied, the following **(b)** may be applied with no relation to the yielding stress under cyclic loadings ($\sigma'_y$).

(a) When $\sigma'_y \geq K_{tw}K_{ts}S_a$, apply $K_{tw}$ regarding as linear elastic.

$$\sigma_a = K_{tw}S_{ha}$$
$$\varepsilon_a = \sigma_a/E$$

(b) When $\sigma'_y < K_{tw}K_{ts}S_a$, obtain $\sigma_a$ and $\varepsilon_a$ by numerically solving the following four equations in the same manner taken in **(4)(b)** considering the local plastic.

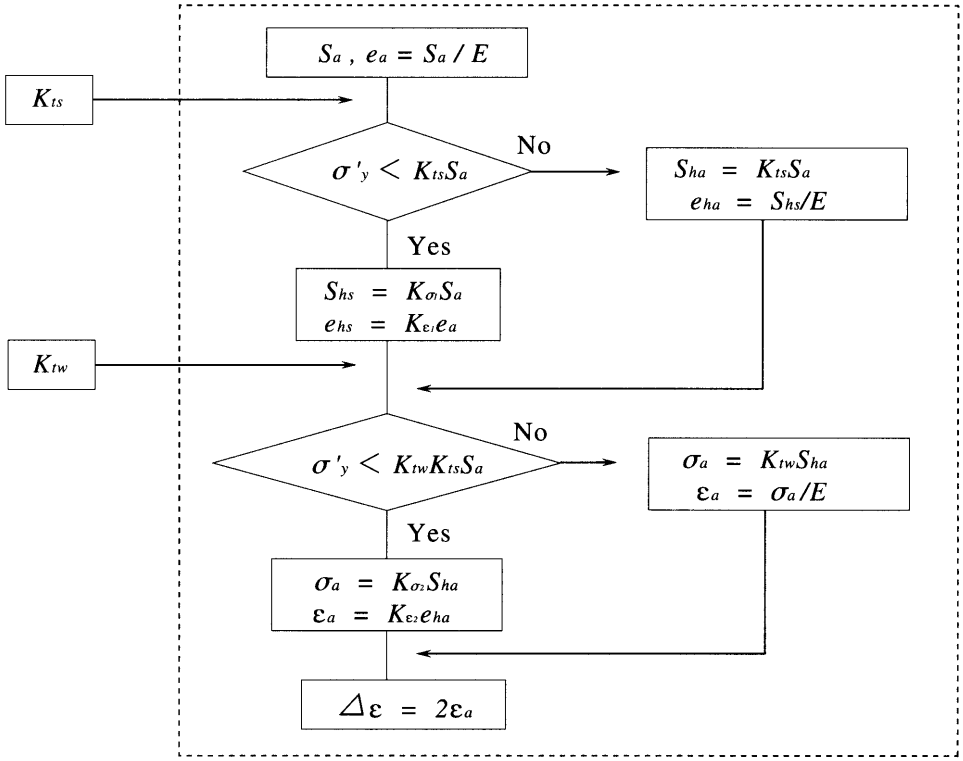
$$\sigma_a = K_{\sigma 2}S_{ha}$$
$$\varepsilon_a = K_{\varepsilon 2}e_{ha}$$
$$K_{\sigma 2} = K_{\varepsilon 2}/(K_{\varepsilon 2} - K_{tw} + 1)$$
$$\varepsilon_a = \sigma_a/E + a(\sigma_a/E)^{1/n}$$

where:

$K_{\sigma 2}$ and $K_{\varepsilon 2}$ :the plastic stress concentration factor and plastic strain concentration factor due to local structural discontinuity, respectively.

(6) The hot spot strain range ($\Delta\varepsilon$) is as twice as $\varepsilon_a$. Repeat the processes **(3)** to **(5)** for stress level of the long-term distribution of the nominal stress.

Fig. P1.4 Outline of Procedures to Estimate Hot Spot Strain




Repeat for all stress levels of the long-term distribution of the nominal stress ranges

### 1.4 Fatigue Design Curve

The following equations express the fatigue curve corresponding to the hot spot strain range referred to **1.3** (*See* **Fig. P1.5**).

No effects of thickness and corrosion are, however, included in this fatigue design curve. Hence, proper attention should be additionally paid to the reduction of fatigue strength by the thickness effect for structural members with a large thickness, and to the reduction of fatigue strength by corrosion for cases where no sufficient corrosion controls are provided.

$N = 10^{-3.711} \times \Delta\varepsilon^{-3.395}$ ($N \leq 10^7$)

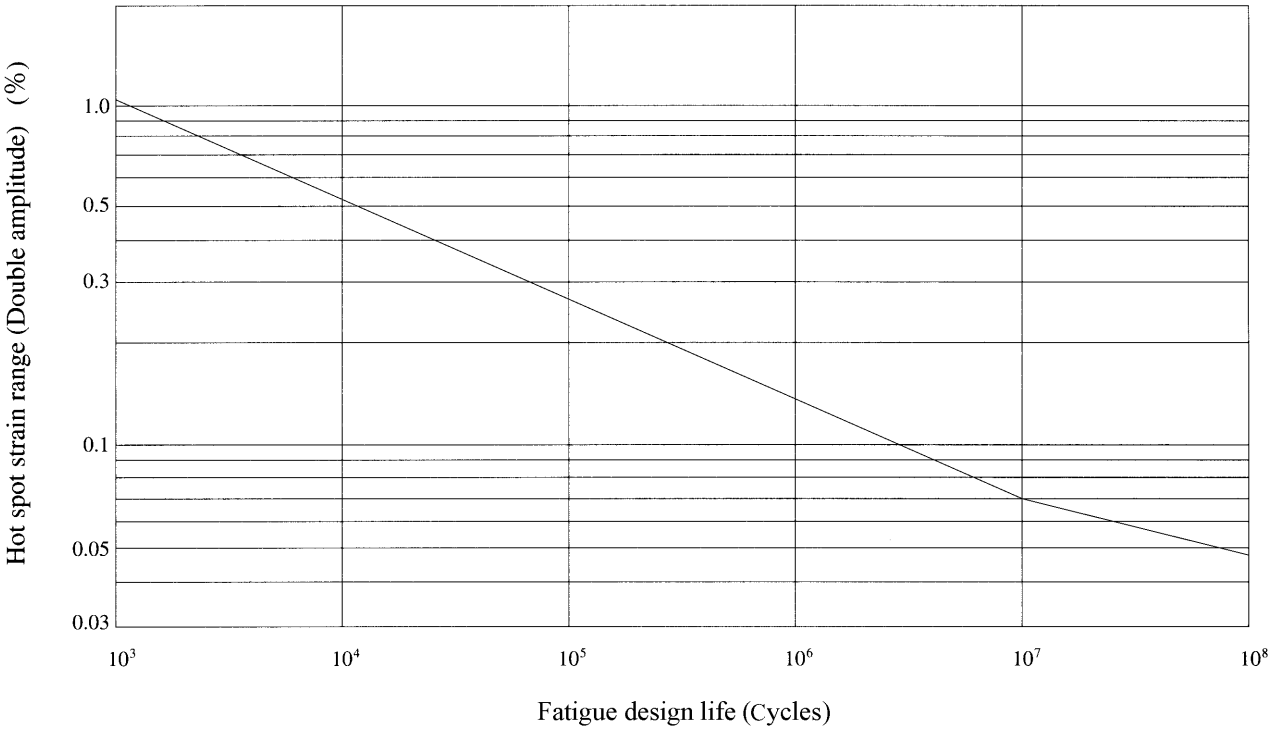
$N = 10^{-11.267} \times \Delta\varepsilon^{-5.790}$ ($N > 10^7$)

where:

$N$ : fatigue life under the cyclic loadings of constant amplitude (number of repetitions)

$\Delta_\varepsilon$: hot spot strain range (double amplitude)

Fig. P1.5 Fatigue Design Curve Based on Hot Spot Strain




### 1.5 Cumulative Fatigue Damage Radio

The cumulative fatigue ratio ($D$) is calculated by the following equation on assumption that it follows the linear cumulative dampage rule of Palmgren-Miner:

$$D = \int_0^{\Delta S_{max}} \frac{N_t p(\Delta S)}{N(\Delta\varepsilon)} d\Delta S$$

where:

$p(\Delta S)$: long-term probability density of the nominal stress range ($\Delta S$) obtained from **1.2**

$N(\Delta\varepsilon)$: fatigue life for the hot spot strain range ($\Delta\varepsilon$) obtained from the fatigue design curve specified in **1.4**

$\Delta S_{max}$: maximum nominal stress range during the fatigue design life

$N_t$ : total number of stress cycles during the fatigue design life

### 1.6 Tubular Joints

#### 1.6.1 Nominal Stress

As the nominal stress amplitude ($S_a$) of tubular joints, the combined stress calculated from the following equation may be

used.

$$S_a = |S_x| + \sqrt{{S_y}^2 + {S_z}^2}$$

where:

$S_x$: stress amplitude by axial force

$S_y$ and $S_z$: stress amplitudes by bending moment

**1.6.2 Elastic Stress Concentration Factors due to Geometric Discontinuity of the Structural Members**

When the elastic stress concentration factor due to the geometric discontinuity ($K_{ts}$) for tubular joints is obtained through the elastic stress analysis by the finite element method, the followings are to be considered.

(1) As the standard practice for the convenience, the assumed position of the joint spot may be the point which is 1.5 times the bracing plate thickness distant from the intersection of plate thickness centre lines of the chord and bracing.

(2) As the standard size of elements used in the finite element analysis, the followings may be applied according to the position of the structural members.

(a) In the proximity of the intersections: $0.5\sqrt{Rt}$

(b) As it departs from the intersections: $1.0\sqrt{Rt}$～$2.0\sqrt{Rt}$

(c) Far distant from the intersections: $R/2$

where:

$R$: radius of curvature of tubular member

$t$ : plate thickness of tubular member

(3) In the proximity of the intersections, the finite elements are to be as close to the rectangular shape as practicable.

**1.6.3 Elastic Stress Concentration Factor due to Local Discontinuity**

As the standard practice, use the following elastic stress concentration factor due to local structural discontinuity ($K_{tw}$) produced by profile of weld toe. However, an improvement of the fatigue strength by the post-weld treatment may be considered only when the condition of the treatment is satisfactory.

(a) As-welded: 2.6

(b) when suitable post-weld treatment is carried out: 1.8