TÜRK LOYDU

Chapter 36 – OFFSHORE SERVICE VESSELS

July 2019

This latest edition incorporates all rule changes. The latest revisions are shown with a vertical line. The section title is framed if the section is revised completely. Changes after the publication of the rule are written in red colour.

Unless otherwise specified, these Rules apply to ships for which the date of contract for construction as defined in TL- PR 29 is on or after 1st of July 2019. New rules or amendments entering into force after the date of contract for construction are to be applied if required by those rules. See Rule Change Notices on TL website for details.

"General Conditions" of the respective latest edition will be applicable (see Rules for Classification and Surveys).

If there is a difference between the rules in English and in Turkish, the rule in English is to be considered as valid. This publication is available in print and electronic pdf version. Once downloaded, this document will become UNCONTROLLED. Please check the website below for the valid version.

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Offshore Service Vessels

Section 4 - Intact And Damage Stability

Section 23 - Environmental Protection

AMENDMENTS

Revision	RCS No.	EIF Date*
Section 23	05/2022	01.01.2023
Section 01	04/2019	01.01.2020
Section 03	04/2019	01.01.2020
Section 07	04/2019	01.01.2020
Section 15	04/2019	01.01.2020
Section 18	04/2019	01.01.2020
Section 19	04/2019	01.01.2020
Section 23	04/2019	01.01.2020

* Entry into Force (EIF) Date is provided for general guidance only, EIF dates given in Rule Change Summary (RCS) are considered valid. In addition to the above stated changes, editorial corrections may have been made.

SECTION 1

GENERAL, DEFINITIONS

Note:

Passages printed in italics generally contain recommendations and notes which are not part of the Classification Rules. Requirements quoted in extracts of statutory regulations, which are mandatory besides Classification, may also be printed in italics.

A. Validity, Equivalence

These Rules apply to ships intended for offshore support and supply, offshore towing, and other specialized offshore services.

An Offshore Service Vessel means a vessel which is primarily engaged in the transport of store, materials and equipment to offshore installations as well as offshore construction and which is usually designed with accommodation and bridge erections in the forward part of the vessel and an exposed cargo deck in the after part for the handling of cargo at sea.

Offshore Service Vessel comprise ships that are often named Offshore Supply Vessel and Platform Supply Vessel.The relevant parts of requirements of ;**TL** Rules, Part A Chapter 1 Sections 1÷21 and 23 apply to this kind of vessel with the exception of Sections 16, 18 and the following minimum thicknesses:

- Side shell plating including the bilge strake is not to be less than

  T=7+0,04 L [mm]

L does not need to be taken greater than 100m.

Above a level **T** + cw/2 above base line smaller thicknesses than tmin may be accepted if the stress level permits such reduction. For cw see: **TL** Part 1, Chapter 1, Sec.5.B.2.

- The thickness of the working deck at any position is to be not less than 8 mm.

The specialized offshore services can be subdivided into:

Special purpose ship means a mechanically self-propelled ship which by reason of its function carries on board more than 12 special personnel (MSC.266(84) as amended).

Towing Ships means Offshore Service Vessels, that are equipped for towing operations.

Anchor handling vessels are vessels that supply oil rigs, tow them to location and anchor them up.

Note 1:

AH differ from Offshore Service Vessels in being fitted with winches for towing and anchor handling, having an open stern to allow the decking of anchors, and having more power to increase the bollard pull. The machinery is specifically designed for anchor handling operations. They also have arrangements for quick anchor release, which is operable from the bridge or other normally manned location in direct communication with the bridge.

Note 2:

"Special personnel" means all persons who are not passengers or members of the crew or children of under one year of age and who are carried on board in connection with the special purpose of that ship or because of special work being carried out aboard that ship. (MSC.266(84), as amended)

Service vessels for carrying hazardous and noxious liquid substance are Offshore Service Vessels which transport limited quantities of hazardous and noxious liquid substances in bulk identified in Section 5 for the servicing and resupplying of offshore platforms, mobile offshore drilling units and other offshore installations, including those employed in the search for and recovery of hydrocarbons from the sea-bed.

Fire Fighting Ships are ships specially designed, built, and equipped for fighting fires aboard ships and offshore installations.

Standby Vessels are ships specially designed, built, and equipped for standby and rescue services to offshore installations.

B. Classification And Certification

1. Classification

Classification essentially means the

- Examination of design documents,

construction plans and material specifications to verify compliance with the applicable **TL** Rules and Guidelines defined in H.

- Survey of construction/fabrication of newbuildings or conversions

- Survey of Offshore Service Vessels periodically in order to ascertain that they are maintained in compliance with class requirements

2. Characters of Classification

Class Notations and Characters of Classification are defined in **TL** Rules for Classification and Surveys, Section 2, D.

3. Class Notations

The Notation **OFFSHORE SERVICE VESSEL** is to be assigned to ships designed for support service to offshore installations and built to applicable requirements of this Section and other relevant Sections of these Rules. At the request of the owner, ships having functional equipment as required below may be assigned an additional notation as in Table 1.1:

4. Certification

4.1 Certification According to TL Rules

4.1.1 The application for Certification of a system, sub-system or component of Offshore Service Vessels shall be submitted to **TL** by the manufacturer or operator in writing.

4.1.2 The scope of the documents to be submitted depends on the type and equipment of the system/sub-system or component defined in F. and the following Sections.

4.1.3 Surveys which have to be performed by **TL** are to be notified to **TL** in due time.

4.2 Certificate

4.2.1 After completion and successful testing of the system, sub-system or component a Certificate will be issued by **TL**.

Table 1.1 Additional Notations

Additional Notation	Services	Requirements
HNLS	Carrying hazardous and noxious liquid substances	Section 5
AH	Anchor handling	Section 6
TOW	Towing	Section 6
FF(x)	Fire fighting	Section 17
STANDBY	Standby and rescue	Section 7
OIL RECOVERY VESSEL	Oil recovery and transportation	Part C, Chapter 12
CHEMICAL RECOVERY VESSEL	Chemical recovery and transportation	Part C, Chapter 24
SPECIAL PURPOSE SHIP	Special Purpose	Part A, Chapter 1, Section 31
CRANE	Special Lifting and Transportation Capacity	Section 15
POSMOOR	Positionning	Section 16
DK (x)	Dynamic Positionning	Section 16
DSV 1	Diving Support	Section 18
DSV 2	Diving Support	Section 18
UES 1	Underwater Equipment Support	Section19
UES 2	Underwater Equipment Support	Section 19
UES 3	Underwater Equipment Support	Section 19
UES 4	Underwater Equipment Support	Section 19
HELIW	Helicopter Supporting Infrastructure	Section 21
HELIL	Helicopter Supporting Infrastructure	Section 21
HELILF	Helicopter Supporting Infrastructure	Section 21
ICEOPS	Operation in ICE	Section 22
EP	Environmental Protection	Section 23

4.2.2 **TL** certifies with the Certificate, the technical condition of the plant at the time of the tests and approvals. In addition it will be confirmed that no safety reservations are opposing the operation of the plant.

4.2.3 The validity of the Certificate is 5 years at maximum and can be prolonged after a renewal survey. For maintaining the Certificate the system/subsystem/ component is in general to be subjected to an Annual Survey. The scope has to be agreed with **TL** in each single case.

The Certificate looses its validity if substantial changes are performed to the system/subsystem/component or if a severe damage occurs and the repair has not been agreed and approved by **TL**.

4.3 Certification According to Other Rules

4.3.1 For systems/sub-systems/components, which are not built according to the Rules of **TL**, the other relevant rules, regulations or standards, etc., have to be defined in the application for Certification.

4.3.2 If such systems/sub-systems/components have been constructed and tested under survey of **TL** according to the other recognized rules, etc. they may receive a Certificate by **TL**.

C. Accessibility

All parts of the hull are to be accessible for survey and maintenance.

D. Stability

1. General

Ships with a length of 24 m and above will be assigned Class only after it has been demonstrated that their intact stability is adequate for the service intended.

Adequate intact stability means compliance with standards laid down by the relevant Administration. **TL** reserve the right to deviate there from, if required for special reasons, taking into account the ship's size and type. The level of intact stability for ships of all sizes in any case should not be less than that provided by the International Code on Intact Stability (2008 IS Code), unless special operational restrictions reflected in the class notation render this possible.

Special attention is to be paid to the effect of free surfaces of liquids in partly filled tanks. Special pre-cautions shall be taken for tanks which, due to the geometry, may have excessive free surface moments, thus jeopardizing the initial stability of the vessel, e.g. tanks in the double bottom reaching from side to side. In general such tanks shall be avoided.

Evidence of approval by the competent Administration concerned may be accepted for the purpose of classification.

The above provisions do not affect any intact stability requirements resulting from damage stability calcula-tions, e.g. for ships to which the symbol **+** is assigned.

2. Ships with Proven Damage Stability

Ships with proven damage stability will be assigned the symbol **FS** .

3. Anti-Heeling Devices

3.1 If tanks are used as anti-heeling devices, effects of maximum possible tank moments on intact stability are to be checked. A respective proof has to be carried out for several draughts and taking maximum allowable centres of gravity resulting from the stability limit curve as a basis. In general the heeling angle shall not be more than 10°.

3.2 If the ship heels more than 10°, the **TL** Part B, Chapter 4, Section 16, P.1.4 have to be observed.

3.3 All devices have to comply with the **TL** Part B, Chapter 5, Section 7, G.

3.4 For reduction of static heel or trim see also Section 20, B.2

E. Vibrations and Noise

1. Mechanical vibrations

Operating conditions which are encountered most frequently should be kept free as far as possible from resonance vibrations of the ship hull and individual structural components. Therefore, the exciting forces coming from the propulsion plant and pressure fluctuations should be limited as far as possible. Beside the selection of the propulsion units particular attention is to be given to the ship's lines including the stern post, as well as to the minimisation of possible cavitation. In the shaping of the bow it should be kept in mind *that a large flare above the waterline will not only cause very high local slamming pressures, but will also excite increasingly whipping vibrations of the ship's hull. If critical excitation loads cannot be eliminated, appropriate measures are to be taken on the basis of theoretical investigations at an early design stage.*

For example, the risk of large global and local structural vibrations can be minimized by a global or local vibration analysis, respectively, to be conducted during the steel structures design phase.

Limit values for vibrations aboard ships may be assessed under several aspects. If the application of other national or international rules or standards is not mandatory, the following guidelines and regulations are recommended:
vibration load to the crew:

- *Measurement and analysis techniques: according to ISO 6954, ed. 2000*

- *Limit values:*
  according to ISO 6954, depending on ship type and location within the ship

- *Vibrations of machinery, installations and other equipment:*
  Section 9

2. Noise

Suitable precautions are to be taken to keep noises as low as possible particularly in the crew's quarters, working spaces, special personnel accommodation, etc.

Attention is drawn to regulations concerning noise level limitations, if any, of the flag administration.

F. Documents for Approval

All documents have to be submitted to **TL** in English language.

The documents are to be submitted to **TL** Head Office. All documents are to be submitted at a sufficiently early date so that they can be approved and made available to the Surveyor at the beginning of the manufacture of important components or their installation on the vessel.

1. Documents Related to Hull

1. To ensure conformity with the Rules the following drawings and documents **(1)** are to be submitted to **TL** showing the arrangement and the scantlings of structural members. In specific cases and following prior agreement with **TL** they can also be submitted in paper form in triplicate.

1.1 Midship Section

The cross sectional plans (midship section, other typical sections) shall contain all necessary data on the scantlings of the longitudinal and transverse hull structure as well as details of anchor and mooring equipment.

1.2 Longitudinal Section

The plan of longitudinal sections shall contain all necessary details on the scantlings of the longitudinal and transverse hull structure and on the location of the watertight bulkheads and the deck supporting structures, the arrangement of superstructures and deck houses, as well as supporting structures of cargo masts, cranes, etc.

1.3 Decks

Plans of the decks showing the scantlings of the deck structures, length and breadth of hatches, openings above the engine room, and other deck openings. On each deck, it has to be stated which deck load caused by cargo is to be assumed in determining the scantlings of the decks and their supports.

1.4 Shell

Drawings of shell expansion, containing full details on the location and size of the openings and drawings of the sea chests.

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(1) *A detailed list of documents to be submitted for approval will be provided with the order confirmation and upon request.*

1.5 Ice Strengthening

The drawings listed in 1.1 - 1.4, 1.6, 1.7 and 1.9 shall contain all necessary details on ice strengthening.

1.6 Bulkheads

Drawings of the transverse, longitudinal and wash bulkheads and of all tank boundaries, with details on densities of liquids, heights of overflow pipes and set pressures of the pressure or vacuum relief valves (if any).

1.7 Bottom Structure

1.7.1 Drawings of single and double bottom showing the arrangement of the transverse and longitudinal girders as well as the water and oiltight subdivision of the double bottom.

1.7.2 Docking plan and docking calculation according to Part A, Chapter 1, Section 8, B.6. are to be submitted.

1.8 Engine and Boiler Seatings

Drawings of the engine and boiler seatings, the bottom structure under the seatings and of the transverse structures in the engine room, with details on fastening of the engine foundation plate to the seating, as well as type and output of engine.

1.9 Stem and Stern Post, and Rudder

Drawings of stem and stern post, of rudder, including rudder support. The rudder drawings shall contain details on the ship's speed, the bearing materials to be employed, and the ice strengthening.

Drawings of propeller brackets and shaft exits.

1.10 Longitudinal Strength

All necessary documents for the calculation of bending moments and shear forces. This includes the mass distribution for the envisaged loading conditions and the distribution of section moduli and moduli of inertia over the ship's length.

Loading Guidance Information according to Part A, Chapter 1, Section 6, H.

1.11 Materials

The drawings mentioned in 1.1 - 1.10 and 1.15 shall contain details on the hull materials (e.g. hull structural steel grades, standards, material numbers). Where higher tensile steels or materials other than ordinary hull structural steels are used, drawings for possible repairs have to be placed on board.

1.12 Weld Joints

The drawings listed in 1.1 - 1.9 and 1.15 shall contain details on the welded joints e.g. weld shapes and dimensions and weld quality. For the relevant data for manufacturing and testing of welded joints see Rules for Welding.

1.13 Lashing and Stowage Devices

Drawings containing details on stowage and lashing of cargo incl. cargo rails and stowracks, if applicable.

In the drawings the location of the connections and the appropriate substructures at the ship shall be shown in detail.

Drawings containing separate cargo tanks and their foundations.

1.14 Substructures

Drawings of substructures below steering gears, windlasses chain stoppers and operational equipment as well as masts and boat davits together with details on loads to be transmitted into structural elements.

1.15 Closing Condition

For assessing the closing condition, details on closing appliances of all openings on the open deck in position 1 and 2 according to ICLL and in the shell, i.e. hatchways, cargo ports, doors, windows and side scuttles, ventilators, erection openings, manholes, sanitary discharges and scuppers.

1.16 Watertight Integrity

Drawings containing the main- and local internal subdivision of the hull. Information about arrangements of watertight longitudinal- and transverse bulkheads, cargo hold entrances, air ventilation ducts, down- and crossflooding arrangements.

Drawings showing the external openings and the closing devices thereof.

Drawings showing the watertight subdivision as well asinternal openings and the closing devices thereof.

The Arrangement of windows and deadlights, including, where applicable, information on type of glass.

1.17 Intact Stability

Analysis of an inclining experiment to be performed upon completion of newbuildings and/or conversions, for determining the light ship data.

Intact stability particulars containing all information required for calculation of stability in different loading conditions. For initial assignment of class to new-buildings preliminary particulars will be acceptable.

Stability booklet according to Section 4.

1.18 Damage Stability

Damage stability particulars containing all information required for establishing unequivocal condition for intact stability. A damage control plan with details on watertight subdivision, closable openings in watertight bulkheads as well as cross flooding arrangements and discharge openings. The plan shall contain all data essential for maintaining the survival capability.

1.19 Structural Fire Protection

In addition to the fire control and safety plan also drawings of the arrangement of divisions (insulation, A-, B- and C-divisions) including information regarding **TL**-approval number.

Drawings of air conditioning and ventilation plants.

1.20 Special Particulars for Examination

1.20.1 For ships constructed for special purposes, drawings and particulars of those parts, examination of which is necessary for judging the vessel's strength and safety.

1.20.2 Additional documents and drawings may be required, if deemed necessary.

1.20.3 Any deviations from approved drawings are subject to approval before work is commenced.

2. Additional Documentation

TL reserves the right to request additional documentation if the submitted information is considered insufficient for an assessment. This may especially be the case for machinery and equipment related to new developments and/or which cannot be tested comprehensively on board.

2.1 List of Documents for Different Services

Special documents for different services are defined in the respective Sections.

3. Documents to be kept on Board

The following documentation shall be kept on board and shall be made available to the **TL** Surveyor on request:

- Class Certificate
- Reports on surveys performed previously
- Documentation containing additional Classification requirements
- List of important testing/monitoring procedures to be followed in connection with validity of Class
- Operating and maintenance instructions, warning signs, etc. required for safe operation and maintenance are to be prepared in English and in the operator's language.

4. Modifications and Extensions

Once the documents submitted have been approved by **TL** they are binding for the execution of the work. Subsequent modifications and extensions require the approval of **TL** before becoming effective.

5. Surveys

Survey of the Offshore Service Vessel's construction and components will be carried out on the basis of approved documents. The documentation has to contain all data necessary for final acceptance of the Offshore Service Vessel.

6. Calculations

Calculations shall contain all necessary information concerning reference documents (parts of the specification, relevant drawings, etc.). Literature used for the calculations has to be cited.

Copies of important but not commonly known sources referenced or used, shall be submitted. Any nonstandard symbols used are to be explained.

7. Computer Programs

7.1 In order to increase the flexibility in the design of Offshore Service Vessels **TL** also accepts direct calculations with computer programs. The aim of such analyses should be the proof of equivalence of a design with the rule requirements.

7.2 Direct calculations may also be used in order to optimise a design; in this case only the final results are to be submitted for examination.

7.3 The designer is free to choose computer programs according to "State of the Art". The programs may be checked by **TL** through comparative calculations with predefined test examples. A generally valid approval for a computer program is not given by **TL.**

G. Definitions

1. General

Unless otherwise mentioned, the dimensions according to 2., 3., 4, 5 and 6. are to be inserted [m] into the formulae stated in the following Sections.

Definitions of terms for machinery installations on board Offshore Service Vessels are given in the different Sections of these Rules.

2. Principal Dimensions

2.1 Length L

The length L is the distance in metres on the summer load waterline from the fore side of the stem to the after side of the rudder stock. L is not to be less than 96 % and need not be greater than 97 % of the extreme length of the summer load waterline. In ships with unusual stern and bow arrangement, the length L will be specially considered.

2.2 Length L_c (according to ICLL, MARPOL 73/78, IBC- Code and IGC-Code)

The length L_c is to be taken as 96 % of the total length on a waterline at 85 % of the least moulded depth H_c measured from the top of the keel, or as the length from the fore side of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the designed waterline.

For the definition of the least moulded depth H_c see ICLL, Annex I, Chapter I, Regulation 3 (5).

2.3 Forward Perpendicular F.P.

The forward perpendicular coincides with the foreside of the stem on the waterline on which the respective length L or L_c is measured.

2.4 Breadth B

The breadth B is the greatest moulded breadth of the ship.

2.5 Depth H

The depth H is the vertical distance, at the middle of the length L, from the base line to top of the deck beam at side on the uppermost continuous deck.

In way of effective superstructures the depth is to be measured up to the superstructure deck for determining the ship's scantlings.

2.6 Draught T

The draught T is the vertical distance at the middle of the length L from base line to freeboard marking for summer load waterline.

3. Frame Spacing a

The frame spacing a will be measured from moulding edge to moulding edge of frame.

4. Block Coefficient C_B

Moulded block coefficient at load draught T, based on length L.

$$C_B = \frac{V}{L \cdot B \cdot T}$$

V = Moulded displacement at draught T [m^3]

5. Ship's Speed v_o

Maximum service speed [kn], which the ship is designed to maintain at the summer load line draught and at the propeller RPM corresponding to MCR (maximum continuous rating).

In case of controllable pitch propellers the speed v_o is to be determined on the basis of maximum pitch.

6. Definition of Decks

6.1 Bulkhead Deck

Bulkhead deck is the deck up to which the watertight bulkheads are carried.

6.2 Freeboard Deck

Freeboard deck is the deck upon which the freeboard calculation is based.

6.3 Strength Deck

Strength deck is the deck or the parts of a deck which form the upper flange of the effective longitudinal structure.

6.4 Weather Deck

All free decks and parts of decks exposed to the sea are defined as weather deck.

6.5 Lower Decks

Starting from the first deck below the uppermost continuous deck, the decks are defined as 2nd, 3rd deck, etc.

6.6 Superstructure Decks

The superstructure decks situated immediately above the uppermost continuous deck are termed forecastle deck, bridge deck and poop deck. Superstructure decks above the bridge deck are termed 2nd, 3rd superstructure deck, etc.

6.7 Position of Hatchways, Doorways and Ventilators

For the arrangement of hatches, doors and ventilators the following areas are defined:

Pos. 1 - on exposed freeboard decks
- on raised quarter decks
- on the first exposed superstructure deck above the freeboard deck within the forward quarter of L_c

Pos. 2 - on exposed superstructure decks aft of the forward quarter of L_c located at least one standard height of superstructure above the freeboard deck on exposed superstructure decks within the forward quarter of L_c located at least two standard heights of superstructure above the freeboard deck

7. Material Properties

7.1 Yield Strength R_{eH}

The yield strength R_{eH} [N/mm^2] of the material is defined as the nominal upper yield point. In case of materials without a marked yield point, the proof stress R_p is to be used instead. See also Part A Chapter 1 Section 3, A.4 and A.5 and Part A Chapter 2 Section 2, B.

7.2 Tensile Strength R_m

R_m [N/mm^2] is the minimum tensile strength of the material. See also Part A Chapter 2 Section 2, B.

7.3 Proof Stress R_p

The proof stress Rp [N/mm2] is the stress that will cause a specified permanent extension of a specimen of a tensile test. The specified permanent extension is denoted in the index.

$R_{p0,2}$ = 0,2 % proof stress

$R_{p1,0}$ = 1,0 % proof stress

See also Part A Chapter 2 Section 2, B.

7.4 Young's Modulus E

The Young's modulus E [N/mm^2] is to be set to:

E = 2,06 . 10^5 N/mm^2 for mild and higher strength structural steels

= 0,69 . 10^5 N/mm^2 for aluminium alloys

H. Rules and Regulations to be Considered

1. TL Rules

1.1 The following **TL** Rules also apply, as required for classification and construction of Offshore Service Vessels, in addition to these Rules:

- Classification and Surveys
- Hull Structures (Part A, Chapter-1)
- Machinery Installations (Part B, Chapter-4)
- Electrical Installations (Part B, Chapter-5)
- Automation (Part B,Chapter-4.1)
- Liquefied Gas Tankers (Part C, Chapter-10)
- Chemical Tankers (Part C, Chapter-8)
- Oil Recovery Vessels (Part C, Chapter-12)
- Chemical Recovery Vessels (Part C, Chapter-24)
- Dynamic Positioning Systems (Part C, Chapter-22)
- Stowage and Lashing of Containers (Part D, Chapter-51)
- Ventilation (Part C, Chapter-28)
- Construction of Polar Ships (Part C, Chapter-33)
- Diving Systems (Part D, Chapter-52)
- Submersibles (Part D, Chapter-53)
- Underwater Equipment (Part D, Chapter-54)
- Material (Part A, Chapter 2)
- Welding (Part A, Chapter 3)
- Fire Fighting Ships (Part C, Chapter-11)
- Use of Fuel Cell Systems on Board of Ships and Boats (Part C, Chapter-26)
- Design, Construction and Testing of Pumps (Additional Rule)
- Sea Trials of Motor Vessels (Additional Rule)
- Environmental Service System (Part D, Chapter-76)
- Rules for Classification of Ships Using Gases or Other Low-Flashpoint Fuel (Part D, Chapter-78)

1.2 Designs differing from **TL** Rules for Classification and Construction may be accepted provided that they have been checked by **TL** for their suitability and are recognized as equivalent.

1.3 Offshore Service Vessels or elements thereof whose development is based on new principles and which have not yet been sufficiently proven in practical operation require special approval by **TL**.

1.4 In the cases mentioned in 1.2 and 1.3, **TL** may require the submission of additional documentation and the performance of additional and/or special tests.

2. National Regulations

Compliance with **TL** Rules does not override / change the requirements to comply with applicable national regulations.

Compliance with regulations from national Administrations is not conditional for the assignment of Class.

3. International Conventions and Codes

Where reference is made of international Conventions and Codes these are defined as follows:

1. ICLL

International Convention on Load Lines, 1966, as amended.

2. MARPOL

International Convention for the Prevention of Pollution from Ships, 1973 including the 1978 Protocol as amended.

3. SOLAS

International Convention for the Safety of Life at Sea, 1974, as amended.

4. IBC-Code

International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk as amended.

5. IS-Code

International Code on Intact Stability for all Types of Ships covered by IMO Instruments

6. IMO Resolutions

In addition the following IMO Resolutions and standards shall be observed:

- IMO Resolution A.1122(30): Code for the Transport and Handling of Hazardous and Noxious Liquid Substances in Bulk on Offshore Support Vessels (OSV Chemical Code).

- IMO Resolution A.692(17): "Guidelines and Specifications for Hyperbaric Evacuation Systems"

- IMO Resolution A.714(17), as amended: Code of the Safe Practice for Cargo Stowage and Securing

- IMO Resolution A.831(19), as amended by MSC.185(79): "Code of Safety for Diving Systems"

- IMO Resolution MSC 385(94) and MEPC 264(68): "International Code for Ships Operating In Polar Waters"

- IMO Resolutions MSC.4(48) and MECP.19(22), as amended: International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk.

- IMO Resolution MSC.5(48), as amended: International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk

- IMO Resolution MSC.266(84), as amended: Code of Safety for Special Purpose Ships

- IMO Resolution MSC 391(95): International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels

- IMO Resolution MSC.1/Circ.1580: Guidelines for Vessels with Dynamic Positioning Systems

- IMO Resolution MSC/Circ.884: Guidelines for Safe Ocean Towing

- MEPC.2/Circular: Provisional Categorization of Liquid Substances

7. Further Regulations

- CAP 437 (Civil Aviation Authority): Offshore Helicopter Landing Areas - Guidance to Standards

- International Chamber of Shipping (ICS): Guide to Helicopter/Ship Operations

- Health and Safety Executive: Offshore Helideck Design Guidelines,

- UK Offshore Operators Association: Guidelines for the Management of Offshore Helideck Operations

- Transport Canada TP 14335 E: Winter Navigation on the River and Gulf of St. Lawrence

I. Rounding-Off Tolerances

For rounding of plate thicknesses refer to **TL** Part A, Chapter 1, Section 1, K.

If plate thicknesses are not rounded the calculated required thicknesses shall be shown in the drawings.

The section moduli of profiles usual in the trade and including the effective width according to **TL**, Part A, Chapter 1, Section 3, B.5 and C. may be 3 % less than the required values according to the following rules for dimensioning.

J. Regulations of National Administrations

For the convenience of the user of these Rules several Sections contain for guidance references to such regulations of national administrations, which deviate from the respective rule requirements of this Society but which may have effect on scantlings and construction. These references have been specially marked. Compliance with these regulations of national administrations is not conditional for class assignment.

K. Workmanship

If not stated here, the workmanship has to comply with **TL** Part A, Chapter 1, Sec. 1, N.

SECTION 2

HULL OUTFIT

A. Partition Bulkheads

1. General

Spaces, which are to be accessible for the service of the ship, hold spaces and accommodation spaces are to be gastight against each other.

B. Ceiling

1. Bottom Ceiling

1.1 Where in the cargo spaces a tight bottom ceiling is fitted from board to board, the thickness of a wooden ceiling shall not be less than 60 mm.

1.2 On single bottoms ceilings are to be removable for inspection of bottom plating at any time.

1.3 Ceilings on double bottoms are to be laid on battens not less than 12,5 mm thick providing a clear space for drainage of water or leakage oil. The ceiling may be laid directly on the inner bottom plating, if embedded in preservation and sealing compound.

1.4 It is recommended to fit double ceilings under the hatchways.

1.5 The manholes are to be protected by a steel coaming welded around each manhole, fitted with a cover of wood or steel, or by other suitable means.

2. Side Ceiling, Ceiling at Tank Bulkheads

2.1 In cargo holds side ceiling is to be fitted in general. The side ceiling may be omitted if agreed by the Owner. The side ceilings shall extend from the upper turn of bilge or from tweendeck up to the lower edge of deck beam brackets. The clear distance between adjacent wooden battens shall not exceed 250 – 300 mm. The thickness shall, in general, not be less than 50 mm.

2.2 Where tanks are intended to carry liquids at temperatures exceeding 40 °C, their boundaries facing the cargo hold shall be fitted with a ceiling. At vertical walls, sparred ceilings are sufficient except in holds intended to carry grain. The ceiling may be dispensed only with Owners' consent.

3. Working Deck Ceiling

3.1 The requirements for ceiling of the working deck are given in Part A Chapter 1 Section 7, D.2.5

C. Weathertight Doors

1. All access openings in superstructures and deckhouses shall be fitted with doors of steel or other equivalent material, permanently and strongly attached to the bulkhead, and framed, stiffened and fitted so, that the whole structure is of equivalent strength to the unpierced bulkhead and weathertight when closed.

2. In general such doors have to be built according to ISO 6042 and it has to be safeguarded that they can be operated from both sides of the bulkhead.

3. Unless otherwise permitted by the Administration, doors shall open outwards to provide additional security against the impact of the sea.

4. As far as practical, doorways to the engine room and for direct access to compartments below the freeboard deck are to be located at a deck above the weather deck.

5. In position 1 (*acc. to **ICLL, Reg. 13***) the height above the deck of sills be at least 600 mm. In position 2 (*acc. to **ICLL, Reg. 13***) it shall be at least 380 mm.

6. Where access is provided from the deck above as an alternative to access from the freeboard deck in accordance with ***ICLL, Regulation 3(10)(b)***, the height of sills into a bridge or poop shall be 380 mm. The same shall apply to deckhouses on the freeboard deck.

7. Where access is not provided from above, the height of the sills to doorways in deckhouses on the freeboard deck shall be 600 mm.

8. Where the closing appliances of access openings in superstructure and deckhouses are not in accordance with C.1 and C.2, interior deck openings shall be considered exposed (i.e. situated in the open deck).

9. Where necessary, an arrangement to protect the doors against deck cargo shall be provided.

D. Side Scuttles, Windows and Skylights

1. General

1.1 Side scuttles and windows, together with their glasses, deadlights and storm covers **(1)**, if fitted, shall be of an approved design and substantial construction.

Non-metallic frames are not acceptable.

1.2 Side scuttles are defined as being round or oval openings with an area not exceeding 0,16 m^2.

Round or oval openings having areas exceeding 0,16 m^2 shall be treated as windows.

1.3 Windows are defined as being rectangular openings generally, having a radius at each corner relative to the window size and round or oval openings with an area exceeding 0,16 m^2.

1.4 For the arrangement of side scuttles and windows see Fig. 2.1.

1.5 In case the deckhouse is situated abaft amidships side scuttles to the following spaces shall be fitted with hinged inside deadlights:

- spaces below freeboard deck
- spaces within the first tier of enclosed superstructures
- first tier deckhouses on the freeboard deck protecting openings leading below or considered buoyant in stability calculations

Deadlights shall be capable of being closed and secured watertight if fitted below the freeboard deck.

Deadlights and storm covers fitted above the freeboard deck shall be capable of being weathertight.

1.6 Side scuttles shall not be fitted in such a position that their sills are below a line drawn parallel to the freeboard deck at side and having its lowest point 2,5 % of the breadth (B), or 500 mm, whichever is the greatest distance, above the Summer Load Line.

1.7 If the required damage stability calculations indicate that the side scuttles would become immersed at any intermediate stage of flooding or the final equilibrium waterline, they shall be of the non-opening type.

1.8 Windows shall not be fitted in the following locations:

- Below the freeboard deck
- Below and at the first tier end bulkheads and second tier sides of enclosed superstructure or deckhouse, that is part of the shell plating
- In fore bulkhead of deckhouses below the 4th tier
- In first tier deckhouses that are considered buoyant in the stability calculations

1.9 Permanently attached deadlights are to be provided on windows at locations permitted as follows:

- At sides of deckhouses and superstructures in the second and third tiers above the freeboard deck
- At the aft end bulkheads of superstructures, deckhouses, casings, and companionways in the second tier above the freeboard deck

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(1) *Deadlights are fitted to the inside of windows and side scuttles, while storm covers are fitted to the outside of windows, where accessible, and may be hinged or portable.*

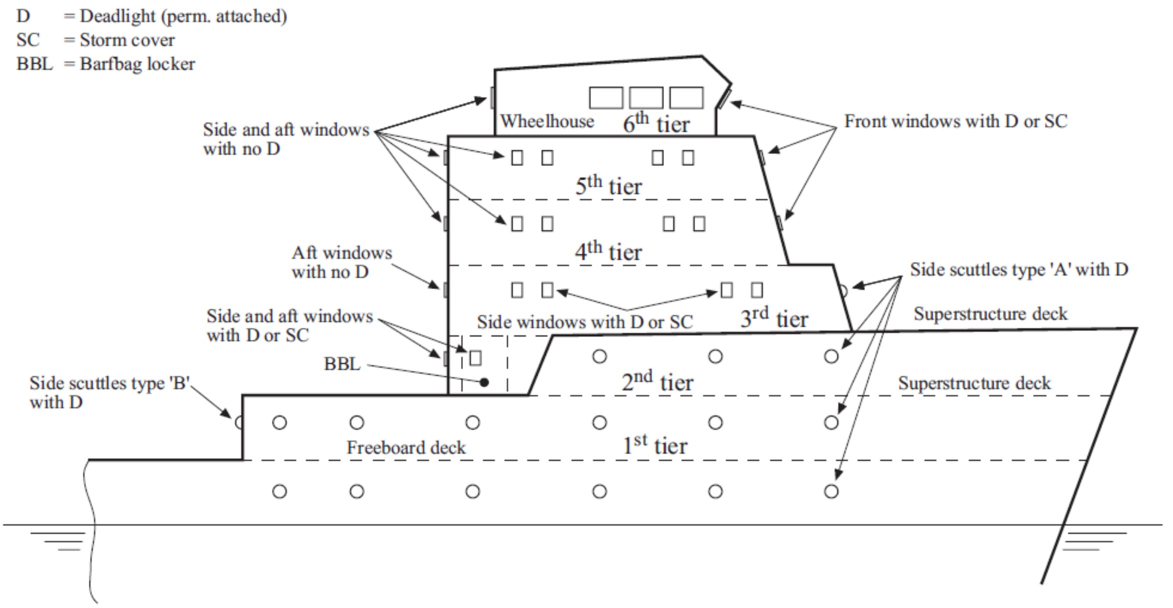

Fig. 2.1.a Side scuttles and windows in supply vessel with complete superstructure and uppermost forecastle

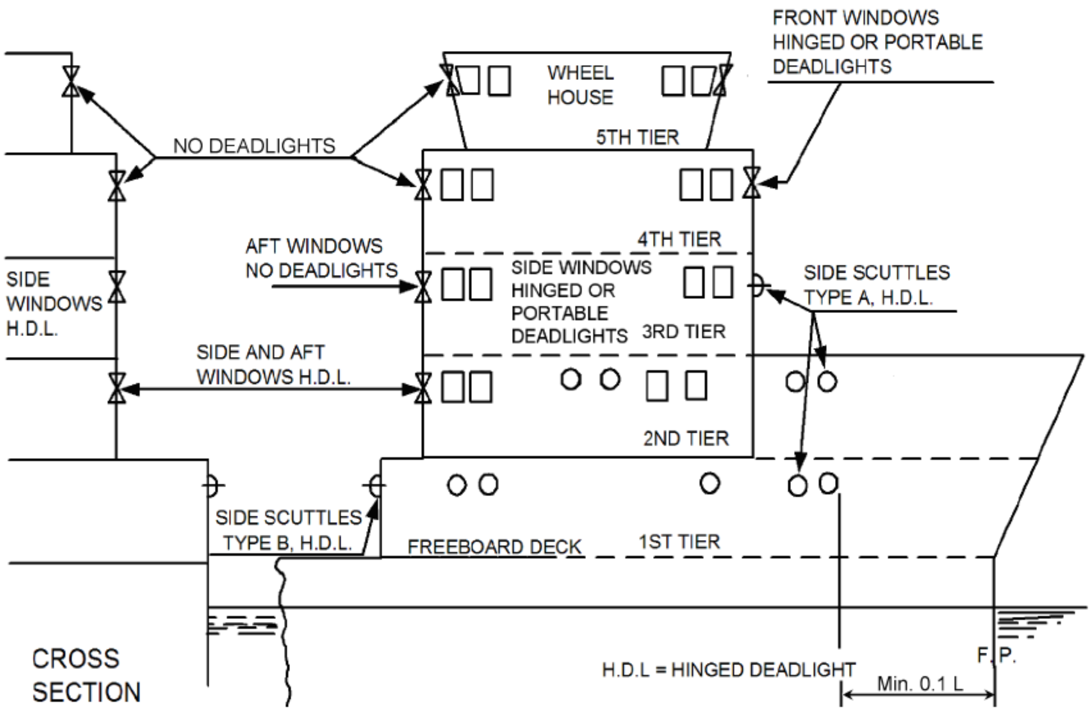

Fig. 2.1.b Side scuttles and windows in supply vessel with forecastle only

Note: *Side scuttles of Type A or Type B are to be are to be in accordance of ISO 1751.*

1.10 Provided, there is a safe access for closing, hinged storm covers may be fitted on windows in the second tier and higher in lieu of deadlights.

1.11 Windows in the wheelhouse front are to have deadlights or storm covers. For storm covers, an arrangement for easy and safe access is to be provided, e.g. gangway with railing. For practical purposes the storm covers or deadlights may be portable if stowed adjacent to the window for quick fitting. At least two of the deadlights or storm covers are to have the means of providing a clear view.

1.12 Deckhouses situated on a raised quarter deck or on the deck of a superstructure other than forecastle of less than standard height may be regarded as being in the second tier as far as the requirements for deadlights are concerned, provided that the height of the raised quarter deck or superstructure is equal to or greater than the standard quarter deck height.

1.13 Fixed or opening skylights shall have a glass thickness appropriate to their size and position as required for side scuttles and windows. Skylight glasses in any position shall be protected from mechanical damage and, where fitted in position 1 or 2, shall be provided with permanently attached deadlights or storm covers.

2. Design Load

2.1 The design load shall be in accordance with Part A Chapter 1 Section 5 and Section 13.

2.2 For ships with a length Lc equal to or greater than 100 m, loads in accordance with ISO 5779 and ISO 5780 standard have to be calculated additionally. The greater value has to be considered up to the third tier.

2.3 Deviations and special cases are subject to separate approval.

3. Frames

3.1 The design has to be in accordance with ISO standard 1751 and 3903 or any other recognised, equivalent national or international standard.

3.2 Variations from respective standards may require additional proof of sufficient strength by direct calculation or tests. This is to be observed for bridge windows in exposed areas (e.g. within forward quarter of ships length) in each case.

4. Glass Panes

4.1 Glass panes have to be made of thermally toughened safety glass (TSG), or laminated safety glass made of TSG. The ISO standards 614, 1095 and 3254 are to be observed.

4.2 The glass thickness for side scuttles has to be determined in accordance with the respective ISO standards 1751 and 1095 or any other equivalent national or international standard, considering the design loads given in 2.

4.3 The glass thickness for windows has to be determined according to the following formulae and in accordance with ISO 3254:

$$t = \frac{b}{200}\sqrt{p\beta} \quad [\text{mm}]$$

b = Shorter side of window [mm]

p = Pressure acc. to 2. [kN/m^2]

β = $(0{,}625\ A_W - 0{,}355)^{0{,}785}\ e^{-A_W/4{,}0}$ for $A_W < 4.0$

= 0,755 for $A_W \geq 4{,}0$

Aw = Aspect ratio of window = $\frac{a}{b}$, with a the longer side of window

but shall be not less than 10 mm.

4.4 Heated glass panes have to be in accordance with ISO 3434.

4.5 An equivalent thickness (t_s) of laminated toughened safety glass is to be determined from the following formula:

$$t_s = \sqrt{t_1^2 + t_2^2 + ... + t_N^2}$$

5. Tests

Windows and side scuttles have to be tested in accordance with the respective ISO standards 1751 and 3903.

Windows in ship safety relevant areas (i.e. wheelhouse and others as may be defined) and window sizes not covered by ISO standards are to be tested at four times design pressure.

E. Scuppers, Sanitary Discharges and Freeing Ports

1. Scuppers and Sanitary Discharges

1.1 Scuppers sufficient in number and size to provide effective drainage of water are to be fitted in the weather deck and in the freeboard deck within weathertight closed superstructures and deckhouses. Cargo decks and decks within closed superstructures are to be drained to the bilge. Scuppers from superstructures and deckhouses which are not closed weathertight are also to be led outside.

1.2 Scuppers draining spaces below the summer load line, are to be connected to pipes, which are led to the bilges and are to be well protected.

1.3 Where scupper pipes are led outside from spaces below the freeboard deck and from weathertight closed superstructures and deckhouses, they are to be fitted with non-return valves of automatic type, which can be operated from a position always accessible and above the freeboard deck. Means showing whether the valves are open or closed (positive means of closing) are to be provided at the control position.

1.4 Where the vertical distance from the summer load waterline to the inboard end of the discharge pipe exceeds 0,01 **L**, the discharge may have two automatic non-return valves without positive means of closing, provided that the inboard valve is always accessible for examination, i.e., the valve is to be situated above the tropical or subdivision load line.

1.5 Where the vertical distance mentioned under 1.4 exceeds 0,02 **L**, a single automatic non-return valve, without positive means of closing may be accepted.

This relaxation is not valid for compartments below the freeboard deck of ships, for which a flooding calculation in the damaged condition is required.

1.6 Scuppers and discharge pipes originating at any level and penetrating the shell either more than 450 mm below the freeboard deck or less than 600 mm above the summer load water line are to be provided with a non-return valve at the shell. This valve, unless required by 1.3, may be omitted if a heavy gauge discharge pipe is fitted.

1.7 Requirements for seawater valves related to operating the power-plant shall be observed, see Part B Chapter 4, Section 16, I.3.

For the special arrangement of seawater valves for operations in ice, see Section 22, D.3

1.8 All valves including the ship side valves required under 1.2 to 1.7 are to be of steel, bronze or other approved ductile material. Ordinary cast iron is not acceptable. Pipe lines are to be of steel or similar material (see also Part B Chapter 4, Section 16).

1.9 Scuppers and sanitary discharges should not be fitted above the lowest ballast waterline in way of lifeboat launching positions or means for preventing any discharge of water into the life boats are to be provided for. The location of scuppers and sanitary discharges is also to be taken into account when arranging gangways and pilot lifts.

2. Freeing Ports

2.1 Where bulwarks on exposed portions of freeboard and/or superstructure decks form wells and when water can be trapped in pipe deck cargo, ample provision is to be made for rapidly freeing the decks of water. In vessels operating in areas where icing is likely to occur, no shutters are to be fitted in the freeing ports.

2.2 Except as provided in 2.3, the minimum freeing port area on each side of the ship for each well on the freeboard deck of a ship of type "B" is to be determined by the following formulae in cases where the sheer in way of the well is standard or greater than standard:

$A = 0{,}7 + 0{,}035\,\ell \quad [m^2]$ for $\ell \leq 20$ m

$= 0{,}7\,\ell \quad [m^2]$ for $\ell > 20$ m

ℓ = length of bulwark [m]

ℓ_{max} = 0,7 L

The minimum area for each well on superstructure decks shall be one half of the area obtained by the formulae.

If the bulwark is more than 1,2 m in average height the required area is to be increased by 0,004 m^2 per metre of length of well for each 0,1 m difference in height.

If the bulwark is less than 0,9 m in average height, the required area may be decreased accordingly.

2.3 In ships with no sheer the area calculated according to 2.2 is to be increased by 50 %. Where the sheer is less than the standard the percentage shall be obtained by linear interpolation.

2.4 In ships having open superstructures, adequate freeing ports are to be provided which guarantee proper drainage.

2.5 The lower edges of the freeing ports shall be as near to the deck as practicable. Two thirds of the freeing port area required shall be provided in the half of the well nearest to the lowest point of the sheer curve.

2.6 All such openings in the bulwarks shall be protected by rails or bars spaced approximately 230 millimetres apart. If shutters are fitted to freeing ports, ample clearance shall be provided to prevent jamming. Hinges shall have pins or bearings of non-corrodible material.

F. Air Pipes, Overflow Pipes, Sounding Pipes

1. Each tank is to be fitted with air pipes, overflow pipes and sounding pipes. The air pipes are to be led to above the exposed deck. The arrangement is to be such as to allow complete filling of the tank. For the arrangement and scantlings of pipes see Part B Chapter 4, Section 16, R. The height from the deck of the point where the water may have access is to be at least 760 mm on the freeboard deck and 450 mm on a superstructure deck.

2. Suitable closing appliances are to be provided for air pipes, overflow pipes and sounding pipes, see also Part B Chapter 4, Section 16, R. Where deck cargo is carried, the closing appliances are to be readily accessible at all times.

In ships for which flooding calculations are to be made, the ends of the air pipes are to be above the damage waterline in the flooded condition. Where they immerge at intermediate stages of flooding, these conditions are to be examined separately.

3. Closely under the inner bottom or the tank top, holes are to be cut into floor plates and side girders as well as into beams, girders, etc., to give the air free access to the air pipes.

Besides, all floor plates and side girders are to be provided with limbers to permit the water or oil to reach the pump suctions.

4. Sounding pipes are to be extended to directly above the tank bottom. The shell plating is to be strengthened by thicker plates or doubling plates under the sounding pipes.

5. Air pipes, valves, etc. are to be fitted in protected positions in order to avoid damage by cargo and to minimize the possibility of flooding of other spaces.

6. Special Strength Requirements for Fore Deck Fittings

6.1 General

The following strength requirements are to be observed to resist green sea forces for the items given below, located within the forward quarter length:

- Air pipes, ventilator pipes and their closing devices

Exempted from these requirements are air pipes, ventilator pipes and their closing devices of cargo venting systems and inert gas systems.

6.2 Application

For all ships on the exposed deck over the forward 0,25 **L**, applicable to:

- all ship types of seagoing service, where the height of the exposed deck in way of the item is less than 0,1 **L** or 22 m above the summer load waterline, whichever is the lesser

6.3 Applied Loading for Air Pipes, Ventilator Pipes and Their Closing Devices

6.3.1 The pressures p [kN/m^2] acting on air pipes, ventilator pipes and their closing devices may be calculated from:

$p = 0,5 \cdot \rho \cdot V^2 \cdot C_d \cdot C_s \cdot C_p$

ρ = Density of sea water (1,025 t/m^3)

V = Velocity of water over the fore deck (13,5 m/sec)

C_d = Shape coefficient

= 0,5 for pipes

= 0,8 for an air pipe or ventilator head of cylindrical form with its axis in the vertical direction

= 1,3 for air pipes or ventilator heads

C_s = Slamming coefficient

= 3,2

C_p = Protection coefficient

= 0,7 for pipes and ventilator heads located immediately behind a breakwater or forecastle

= 1,0 elsewhere and immediately behind a bulwark

6.3.2 Forces acting in the horizontal direction on the pipe and its closing device may be calculated from 6.3.1 using the largest projected area of each component.

6.4 Strength Requirements for Air Pipes, Ventilator Pipes and Their Closing Devices

6.4.1 Bending moments and stresses in air and ventilator pipes are to be calculated at critical positions:

- at penetration pieces
- at weld or flange connections
- at toes of supporting brackets

Bending stresses in the net section are not to exceed 0,8 · R_{eH}. Irrespective of corrosion protection, a corrosion addition to the net section of 2,0 mm is then to be applied.

6.4.2 For standard air pipes of 760 mm height closed by heads of not more than the tabulated projected area, pipe thicknesses and bracket heights are specified in Table 2.1. Where brackets are required, three or more radial brackets are to be fitted.

Brackets are to be of gross thickness 8 mm or more, of minimum length 100 mm, and height according to Table 2.1 but need not extend over the joint flange for the head. Bracket toes at the deck are to be suitably supported.

6.4.3 For other configurations, loads, according to 6.3 are to be applied, and means of support determined in order to comply with the requirements of 6.4.1.

Brackets, where fitted, are to be of suitable thickness and length according to their height. Pipe thickness is not to be taken less than as indicated in the Part B Chapter 4 Section 16, Table 16.22 and 16.23.

6.4.4 For standard ventilators of 900 mm height closed by heads of not more than the tabulated projected area, pipe thicknesses and bracket heights are specified in Table 2.2. Brackets, where required are to be as specified in 6.4.2.

6.4.5 For ventilators of height greater than 900 mm, brackets or alternative means of support are to be specially considered. Pipe thickness is not to be taken less than as indicated in the Part B Chapter 4 Section 16, Table 16.22 and 16.23.

6.4.6 All component part and connections of the air pipe or ventilator are to be capable of withstanding the loads defined in 6.3.

6.4.7 Rotating type mushroom ventilator heads are unsuitable for application in the areas defined in 6.2.

Table 2.1 760 mm air pipe thickness and bracket standards

Nominal pipe diameter [mm]	Minimum fitted (1) gross thickness [mm]	Maximum projected area of head [cm^2]	Height (2) of brackets [mm]
65A	6,0	—	480
80A	6,3	—	460
100A	7,0	—	380
125A	7,8	—	300
150A	8,5	—	300
175A	8,5	—	300
200A	8,5 **(3)**	1900	300 **(3)**
250A	8,5 **(3)**	2500	300 **(3)**
300A	8,5 **(3)**	3200	300 **(3)**
350A	8,5 **(3)**	3800	300 **(3)**
400A	8,5 **(3)**	4500	300 **(3)**

1) *See TL- I LL 36 c.*

2) *Brackets see 5.4.1.3 need not extend over the joint flange for the head.*

3) *Brackets are required where the as fitted (gross) thickness is less than 10,5 mm, or where the tabulated projected head area is exceeded.*

Note:

For other air pipe heights, the relevant requirements of 5.4 are to be applied.

Table 2.2 900 mm ventilator pipe thickness and bracket standards

Nominal pipe diameter [mm]	Minimum fitted gross thickness [mm]	Maximum projected area of head [cm^2]	Height of brackets [mm]
80A	6,3	—	460
100A	7,0	—	380
150A	8,5	—	300
200A	8,5	550	—
250A	8,5	880	—
300A	8,5	1200	—
350A	8,5	2000	—
400A	8,5	2700	—
450A	8,5	3300	

Note:

For other ventilator heights, the relevant requirements of 5.4 are to be applied.

G. Ventilators

1. General

1.1 The height of the ventilator coamings on the exposed freeboard deck, quarter deck and on exposed superstructure decks in the range 0,25 **L** from **F.P.** is to be at least 900 mm.

1.2 On exposed superstructure decks abaft 0,25 **L** from **F.P.** the coaming height is not to be less than 760 mm.

1.3 Ventilators of cargo holds are not to have any connection with other spaces.

1.4 The thickness of the coaming plates is to be 7,5 mm where the clear opening sectional area of the ventilator coamings is 300 cm^2 or less, and 10 mm where the clear opening sectional area exceeds 1600 cm^2. Intermediate values are to be determined by direct interpolation. A thickness of 6 mm will generally be sufficient within not permanently closed superstructures.

1.5 The thickness of ventilator posts should be at least equal to the thickness of coaming as per 1.4.

1.6 The wall thickness of ventilator posts of a clear sectional area exceeding 1600 cm^2 is to be increased according to the expected loads.

1.7 Generally, the coamings and posts shall pass through the deck and shall be welded to the deck plating from above and below.

Where coamings or posts are welded onto the deck plating, fillet welds of a = 0,5 . t_0, subject to Part A Chapter 1 Section 20, B.3.3 should be adopted for welding inside and outside.

1.8 Coamings and posts particularly exposed to wash of sea are to be efficiently connected with the ship's structure.

1.9 Coamings of a height exceeding 900 mm are to be specially strengthened.

1.10 Where the thickness of the deck plating is less than 10 mm, a doubling plate or insert plate of 10 mm thickness is to be fitted. Their side lengths are to be equal to twice the length or breadth of the coaming.

1.11 Where beams are pierced by ventilator coamings, carlings of adequate scantlings are to be fitted between the beams in order to maintain the strength of the deck.

2. Closing Appliances

2.1 Inlet and exhaust openings of ventilation systems are to be provided with easily accessible closing appliances, which can be closed weathertight against wash of the sea. In ships of not more than 100 m in length, the closing appliances are to be permanently attached. In ships exceeding 100 m in length, they may be conveniently stowed near the openings to which they belong.

2.2 For ventilator posts which exceed 4,5 m in height above the freeboard deck or raised quarterdeck and above exposed superstructure decks forward of 0,25 **L** from **F.P.** and for ventilator posts exceeding 2,3 m in height above exposed superstructure decks abaft 0,25 **L** from **F.P.** closing appliances are required in special cases only.

2.3 For the case of fire draught-tight fire dampers are to be fitted.

3. For special strength requirements for fore deck fittings, see F.6.

4. Ventilators are to be fitted in protected positions in order to avoid damage by cargo and to minimize the possibility of flooding of other spaces.

5. Due regard is to be given to the position of the machinery space ventilators. Preferably they should be fitted in a position above the superstructure deck or above an equivalent level.

H. Stowage of Heavy Cargo Items

1. General

1.1 All parts which are intended to be welded to the ship structure are to be made of materials complying with and tested in accordance with the **TL** Part A Chapter 2 Material and Chapter 3 Welding.

1.2 All equipment on deck and in the holds essential for maintaining the safety of the ship and which are to be accessible at sea, e.g. fire fighting equipment, sounding pipes etc., should not be made inaccessible by cargo items or their stowing and lashing equipment.

1.3 For transmitting the forces from the cargo stowing and lashing equipment into the ship's hull adequate welding connections and local reinforcements of structural members are to be provided (see also 2. and 3.).

1.4 Where inner bottom, decks, or hatch covers are loaded with cargo items, adequate substructures, e.g. carlings, half height girders etc., are to be provided and the plate thickness is to be increased where required. For welded-in parts, see Part A Chapter 1 Section 20, B.2.1

2. Load Assumptions

2.1 If available the scantlings of the local ship structures and of the supporting substructures are to be determined on the basis of the Stowage and Lashing Plan.

2.2 For determining scantlings the following design forces are to be used which are assumed to act simultaneously in the centre of gravity of the cargo item:

ship's transverse (y-)direction:

$0{,}5\ g \cdot G$ [kN]

ship's vertical (z-)direction:

$(1 + a_v)\ g \cdot G$ [kN]

G = cargo mass [t]

a_v = see Part A, Chapter 1, Section 5, B.2.1

3. Permissible Stresses

3.1 The stresses in local ship structures and in substructures and lashing devices in the hatch covers of cargo decks are not to exceed the following values:

$$\sigma_b = \frac{R_{eH}}{1{,}5}$$

$$\tau = \frac{R_{eH}}{2{,}3}$$

$$\sigma_v = \sqrt{\sigma_b^2 + 3\tau^2} = \frac{R_{eH}}{1{,}3}$$

3.2 For dimensioning the double bottom in case of single point loads, see Part A Chapter 1 Section 8, B.3.7.3.

3.3 Where other structural members of the hull, e.g. frames, deck beams, bulkheads, hatchway coamings, bulwark stays etc. are subjected to loads from cargo items and lashing devices, these members are to be strengthened wherever necessary so that the actual stresses will not exceed those upon which the formulae in the respective Sections are based.

I. Lashing Arrangements

Lashing eyes and holes are to be arranged in such a way as to not unduly weaken the structural members of the hull. In particular where lashings are attached to frames, they are to be so arranged that the bending moment in the frames is not unduly increased. Where necessary, the frame is to be strengthened.

J. Life Saving Appliances

1. It is assumed that for the arrangement and operation of lifeboats and other life-saving appliances the regulations of **SOLAS 74** or those of the competent Authority are complied with.

2. The design appraisal and testing of life boats with their launching appliances and of other life saving appliances are not part of Classification.

However, approval of the hull structure in way of the launching appliances taking into account the forces from the above appliances is part of classification.

K. Signal and Radar Masts

1. General

1.1 Drawings of masts, mast substructures and hull connections are to be submitted for approval.

1.2 Loose component parts are to comply with **TL** Part D, Chapter 50. They are to be tested and certified by **TL**.

1.3 Other masts than covered by 2. and 3. as well as special designs, shall as regards dimensions and construction in each case be individually agreed with **TL**

2. Single Tubular Masts

The following requirements apply to tubular or equivalent rectangular sections made of steel with an ultimate tensile strength of 400 N/mm^2, which are designed to carry only signals (navigation lanterns, flag and day signals).

2.1 Stayed Masts

2.1.1 Stayed masts may be constructed as simply supported masts (rocker masts) or may be supported by one or more decks (constrained masts).

2.1.2 The diameter of stayed steel masts in the uppermost housing is to be at least 20 mm for each 1 m length of hounding. The length of the mast top above the hound is not to exceed ℓ_w /3 (ℓ_w denotes the hounding [m]).

2.1.3 Masts according to 2.1.2 may be gradually tapered towards the hound to 75 per cent of the diameter at the uppermost housing. The plate thickness is not to be less than 1/70 of the diameter or at least 4 mm, see 4.1.

2.1.4 Wire ropes for shrouds are to be thickly galvanized.

It is recommended to use wire ropes composed of a minimum number of thick wires, as for instance a rope construction 6 × 7 with a tensile breaking strength of 1570 N/mm^2.

2.1.5 Where masts are stayed forward and aft by one shroud on each side of the ship, steel wire ropes are to be used with a tensile breaking strength of 1570 N/mm^2 according to Table 2.3.

Table 2.3 Ropes and shackles of stayed steel masts

h [m]	6	8	10	12	14	16
Rope diameter [mm]	14	16	18	20	22	24
Nominal size of shackle, rigging screw, rope socket	2,5	3	4	5	6	8
h = height of hound above the hauling of the shrouds.						

2.1.6 Where steel wire ropes according to Table 2.3 are used, the following conditions apply:

$b \geq 0{,}3\ h$

$0{,}15\ h \leq a \leq b$

a = The distance of the hauling points of the shrouds from the transverse section through the hound

b = The distance of the hauling points of the shrouds from the longitudinal section through the hound

Alternative arrangements of stayings are to be of equivalent stiffness.

2.2 Unstayed Masts

2.2.1 Unstayed masts may be completely constrained in the uppermost deck or be supported by two or more decks. (In general, the fastenings of masts to the hull of a ship should extend over at least one deck height.)

2.2.2 The scantlings for unstayed steel masts are given in the Table 2.4.

2.2.3 The diameter of masts may be gradually tapered to D/2 at the height of 0,75 ℓ_m.

Table 2.4 Dimensions of unstayed steel masts

Length of mast ℓ_m [m]	6	8	10	12	14
D x t [mm]	160 x 4	220 x 4	290 x 4,5	360 x 5,5	430 x 6,5

ℓ_m = *length of mast from uppermost support to the top*
D = *diameter of mast at uppermost support*
t = *plate thickness of mast*

3. Box Girder and Frame Work Masts

3.1 For dimensioning the dead loads, acceleration forces and wind loads are to be considered.

3.2 Where necessary, additional loads e. g. loads caused by the sea fastening of crane booms or tension wires are also to be considered.

3.3 The design loads for 3.1 and 3.2 as well as the allowable stresses can be taken from the **TL** Part D, Chapter 50.

3.4 Single tubular masts mounted on the top may be dimensioned according to 2.

3.5 In case of thin walled box girder masts stiffeners and additional buckling stiffeners may be necessary.

4. Structural Details

4.1 Steel masts closed all-round shall have a wall thickness of at least 4 mm.

For masts not closed all-round the minimum wall thickness is 6 mm.

For masts used as funnels a corrosion addition of at least 1 mm is required.

4.2 The ship's side foundations are to be dimensioned in accordance with the acting forces.

4.3 Doubling plates at mast feet are permissible only for the transmission of compressive forces since they are generally not suitable for the transmission of tensile forces or bending moments.

4.4 In case of tubular constructions all welded fastenings and connections shall be of full penetration weld type.

4.5 If necessary, slim tubes are to be additionally supported in order to avoid vibrations.

4.6 The dimensioning normally does not require a calculation of vibrations. However, in case of undue vibrations occurring during the ship's trial a respective calculation will be required.

4.7 For determining scantlings of masts made from aluminium or austenitic steel, the requirements given in Part A, Chapter 1 Section 3, B.4. and B.5. apply.

4.8 At masts solid steel ladders have to be fixed at least up to 1,50 m below top, if they have to be climbed for operational purposes. Above them, suitable handgrips are necessary.

4.9 If possible from the construction point of view, ladders should be at least 0,30 m wide.

The distance between the rungs shall be 0,30 m. The horizontal distance of the rung centre from fixed parts shall not be less than 0,15 m. The rungs shall be aligned and be made of square steel bars 20/20 edge up.

4.10 Platforms on masts which have to be used for operational reasons, shall have a rail of at least 0,90 m in height with one intermediate bar. Safe access from the mast ladders to the platform is to be provided.

4.11 On masts additional devices have to be installed consisting of foot, back, and hand rings enabling safe work in places of servicing and maintenance.

L. Loading and Lifting Gear

1. The design appraisal and testing of loading and lifting gear on ships are not part of classification.

However, approval of the hull structure in way of loading and lifting gear taking into account the forces from the gear is part of classification. For proof of fatigue strength, crane foundations/pedestals shall be categorized in the same stress group as the associated cranes.

Requirements of the Section 15 have to be considered in addition.

2. Crane Foundations

2.1 Foundations shall be dimensioned adequately for the conditions "crane in operation" and "crane out of operation".

2.2 Wherever bending moments have to be transmitted and the fixation does not extend over two decks of the vessel, foundations (and boom stowages) are to be joined to the connecting deck and the stiffening arrangements associated with it that the loads can be transmitted safely.

2.3 Doubling plates underneath foundations and boom stowages are permitted only for the transmission of compression forces.

3. Crane Pedestals

3.1 The criteria for a favourable design and the stress calculations for cylindrical and rectangular crane pedestals are defined in the **TL** Part D, Chapter 50.

3.2 Where crane pedestals have conical or trapezoidal transition regions, the corners of the sharp bends, particularly where these are flat plates, shall be stiffened to be able to absorb the deflection forces.

In the case of conical transition regions from a cylindrical crane connection to a rectangular pedestal, the corners of the sharp bends between the curved parts and the flat gussets shall be given special attention. If appropriate the corners are to be stiffened.

3.3 Wherever possible, crane pedestals shall be linked to the hull over a full deck height; if necessary, e.g. in the case of crane pedestals located at the vessel's side, even to a greater depth to the structure of the vessel.

Crane pedestals which by virtue of their location act as stiffness discontinuities in the longitudinal structure of the vessel, such as for instance crane pedestal at the sides are to have suitable taper brackets fitted along the longitudinal walls.

4. Boom Stowages

4.1 Dimensioning

The load condition "crane out of operation" is the decisive condition for boom stowages.

4.2 Design Requirements

The following aspects have to be considered for the design:

- The stowage has to surround the top of the boom without bigger clearance (20 mm maximum).

- The stowage shall have backing of wood or other suitable material.

- The torsion of the vessel's hull has to be considered.

- One side of the stowage shall be higher, sufficiently strong and have backing by suitable material to facilitate the laying-off of the boom by a turning movement.

- A fastening of the boom in the stowage is to be provided, if the loading hook is not fixed by anchoring downwards. The relative movement between boom and stowage shall not be restricted.

- It has to be made possible to reach the stowage by ladders or crampons and a suitable working platform is to be provided.

M. Guard-Rails

1. Efficient guard-rails or bulwarks are to be fitted on all exposed parts of the freeboard and superstructure decks.

The height is to be at least 1,0 m from the deck.

2. The height below the lowest course of the guard-rails is not to exceed 230 mm.

The other courses are not to be spaced more than 380 mm apart.

3. In the case of ships with rounded gunwales the guard-rail supports are to be placed on the flat part of the deck.

4. Guard-rails are to be constructed in accordance with ISO 5480 or equivalent standards.

Equivalent constructions of sufficient strength and safety can be accepted.

5. Guard-rail stanchions are not to be welded to the shell plating.

6. The use of doubling plates below guard-rail stanchions is permitted, if the dimensions are according to Figure 2.2 and the fatigue requirements in Part A Chapter 1 Section 3.D are fulfilled (see respective detail in Table 3.33).

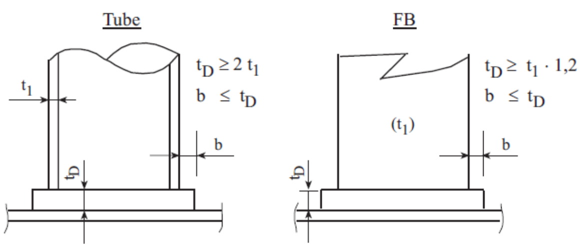

Figure 2.2 Plates below guard-rail stanchions

N. Cargo Rails

1. Where cargo rails are fitted on deck, stanchions of the cargo rail are to be efficiently attached and supported. Scantlings of the stanchions and the cargo rail have to be determined by using the load condition and permissible stresses according to **TL** Part A, Chapter 1, Section 32, C.3

2. The height of cargo rails on the working deck of Anchor Handling and Towing ships according to Section 6 shall be at least 2,2 m measured from top of the deck to the upper edge of the cargo rail.

O. Accesses to Ships

The design appraisal and testing of accesses to ships (accommodation ladders, gangways) are not part of Classification.

However, approval of substructures in way of accommodation ladders and gangways is part of Classification.

P. Moon Pools

1. The following items have to be carefully considered in the design of moon-pools:

- Kinematics of entrapped water in the moon pool (this includes effects like possible resonant water motions (sloshing and piston mode) and influence on ship motions)

- Stress concentrations within the corners of the moon pool opening

2. In order to limit the water motions in the moon pool internal baffling structures should be fitted.

3. Scantlings of moon pools have to be determined under consideration of the requirements in Part A Chapter 1, Section 12, B., G. and Section 5, C.3 and D.8. as applicable for partially filled tanks. The design pressures have to be derived by considering the upper edge of the Moon Pool coaming as the tank top.

Direct load and strength assessments can be required for special arrangements and designs.

4. Moon Pool Hatch Covers have to be designed according to the requirements of Part A Chapter 1, Section 15 as applicable.

SECTION 3

STRUCTURAL FIRE PROTECTION

Page

A. General

1. Application, Submission of Plans

1.1 These regulations apply to ships to be classed for unrestricted service.

For ships classed for restricted service or ships which are intended to trade within specified limits exceptions from the requirements of this Section may be permitted.

1.2 The terms used in this Section correspond to the definitions as per Chapter II–2, Regulation 3 of **SOLAS 74**.

The term "Special Personnel" is as defined in the "Code of Safety for Special Purpose Ships, 2008" (cf. IMO MSC.266(84), as amended). The special personnel may include up to 12 passengers.

1.3 The term "Approved" relates to a material or construction, for which **TL** has issued an Approval Certificate. A type approval can be issued on the basis of a successful standard fire test, which has been carried out by a neutral and recognized fire testing institute.

1.4 The fire safety design and arrangements may differ from the prescriptive regulations of this Section, provided that the design and arrangements meet the fire safety objectives and functional requirements of Chapter II-2 of **SOLAS 74 (1)**. Compliance of the alternative design and arrangements needs to be verified by an engineering analysis.

1.5 The following drawings and documents are to be submitted for perusal:

- Fire division plan
- Insulation plan
- Ventilation and Air condition scheme
- Deck covering plan
- Door plan
- Window plan
- Fire control plan (for information only)
- List of approved materials and equipment
- General Arrangement (for information only).

Additional drawings for ships with more than 60 persons of special personnel and crew or more than 12 passengers:

- Escape way plan incl. escape way calculation
- Evacuation analysis (only Passenger ships)
- Fire load calculation
- Safety sign scheme

1.6 Type "A", "B" and "C" class partitions, fire dampers, duct penetrations as well as the insulation materials, linings, ceilings, surface materials and not readily ignitable deck coverings shall be of approved type.

1.7 For regulations on fire alarm systems and on fire extinguishing arrangements, see the **TL** Part B, Chapter 4, Section 18.

The different services provided by offshore service vessels require different additional fire detection, fire alarm and fire extinguishing measures.

1.8 TL interpretations have to be observed and shall be complied with.

B. Ships with a Total of 60 Persons on Board

The requirements of this section may also be applied to ships with more than 60 persons on board when the total number of special personnel and passengers is limited to a maximum of 12 persons.

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(1) *Reference is made to the "Guidelines on Alternative Design and Arrangements for Fire Safety" adopted by IMO by MSC/ Circ.1002 as amended by MSC.1/Circ.1552.*

Ships of less than 500 GT may deviate from the requirements of this section considering the ship's size, type and range of operation.

1. Materials

1.1 The hull, decks, structural bulkheads, superstructures and deckhouses are to be of steel except where in special cases the use of other suitable material may be approved, having in mind the risk of fire.

1.2 Components made from aluminium alloys require special treatment, with regard to the mechanical properties of the material in case of temperature increase. In principle, the following is to be observed:

1.2.1 The insulation of "A" or "B" class divisions shall be such that the temperature of the structural core does not rise more than 200 °C above the ambient temperature at any time during the applicable fire exposure to the standard fire test.

1.2.2 Special attention shall be given to the insulation of aluminium alloy components of columns, stanchions and other structural members required to support lifeboat and liferaft stowage, launching and embarkation areas, and "A" and "B" class divisions to ensure:

- that for such members supporting lifeboat and liferaft areas and "A" class divisions, the temperature rise limitation specified in 1.2.1 shall apply at the end of one hour; and

- that for such members required to support "B" class divisions, the temperature rise limitation specified in 1.2.1 shall apply at the end of half an hour.

1.2.3 Crowns and casings of machinery spaces of category A shall be of steel construction and be insulated as required by Table 3.1 as appropriate. Openings therein, if any, shall be suitably arranged and protected to prevent the spread of fire.

2. Accommodation and Service Spaces

2.1 One of the following methods of protection shall be adopted in accommodation and service areas:

2.1.1 Method IC: The construction of all internal divisional bulkheading of non-combustible "B" or "C" class divisions generally without the installation of an automatic sprinkler, fire detection and fire alarm system in the accommodation and service spaces, except as required by 10.1; or

2.1.2 Method IIC: The fitting of an automatic sprinkler, fire detection and fire alarm system, as required by 10.2 for the detection and extinction of fire in all spaces in which fire might be expected to originate, generally with no restriction on the type of internal divisional bulkheading; or

2.1.3 Method IIIC: The fitting of a fixed fire detection and fire alarm system, as required by 10.3, in all spaces in which a fire might be expected to originate, generally with no restriction on the type of internal divisional bulkheading, except that in no case shall the area of any accommodation space or spaces bounded by an "A" or "B" class division exceed 50 m². Consideration may be given to increasing this area for public spaces.

2.2 The requirements for the use of non-combustible materials in construction and insulation of the boundary bulkheads of machinery spaces, control stations, service spaces, etc., and the protection of stairway enclosures and corridors will be common to all three methods.

3. Bulkheads Within the Accommodation and Service Spaces

3.1 All bulkheads required to be "B" class divisions shall extend from deck to deck and to the shell 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 lining.

3.2 Method IC

All bulkheads not required by this or other requirements of this Section to be "A" or "B" class divisions, shall be of at least "C" class construction.

3.3 Method IIC

There shall be no restriction on the construction of bulkheads not required by this or other requirements of this Section to be "A" or "B" class divisions except in individual cases where "C" class bulkheads are required in accordance with Table 3.1.

3.4 Method IIIC

There shall be no restriction on the construction of bulkheads not required by this Section to be "A" or "B" class divisions except that the area of any accommodation space or spaces bounded by a continuous "A" or "B" class division shall in no case

Exceed 50 m^2 except in individual cases where "C" class bulkheads are required in accordance with Table 3.1. Consideration may be given to increasing this area for public spaces.

4. Fire Integrity of Bulkheads and Decks

4.1 In addition to complying with the specific provisions for fire integrity of bulkheads and decks mentioned elsewhere in this Section, the minimum fire integrity of bulkheads and decks shall be as prescribed in Table 3.1 and 3.2.

4.2 On ships intended for the carriage of dangerous goods the bulkheads forming boundaries between cargo spaces and machinery spaces of category A shall be insulated to "A-60" standard, unless the dangerous goods are stowed at least 3 m horizontally away from such bulkheads. Other boundaries between such spaces shall be insulated to "A-60" standard.

4.3 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.

4.4 External boundaries which are required in 1.1 to be of steel or other equivalent material may be pierced for the fitting of windows and sidescuttles provided that there is no requirement for such boundaries to have "A" class integrity elsewhere in these requirements. Similarly, in such boundaries which are not required to have "A" class integrity, doors may be of materials to meet the requirements of their application.

4.5 The following requirements shall govern application of the Tables:

Tables 3.1 and 3.2 shall apply respectively to the bulkheads and decks separating adjacent spaces.

4.6 For determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in the following categories 1 to 11.

Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of this regulation, or where it is possible to assign two or more classifications to a space, it shall be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed room within a space that have less than 30 % communicating openings to that space are to be considered separate spaces. The fire integrity of the boundary bulkheads of such smaller rooms shall be as prescribed in Tables 3.1 and 3.2. The title of each category is intended to be typical rather than restrictive. The number in parentheses preceding each category refers to the applicable column or row number in the tables.

[1] Control Stations

Spaces containing emergency sources of power and lighting. Wheelhouse and chartroom. Spaces containing the ship's radio equipment. Fire control stations. Control room for propulsion machinery when located outside the machinery space. Spaces containing centralized fire alarm equipment.

[2] Corridors

Corridors and lobbies.

[3] Accommodation Spaces

Spaces used for public spaces, lavatories, cabins, offices, hospitals, cinemas, games and hobby rooms, barber ships, pantries containing no cooking appliances and similar spaces.

Table 3.1 Fire integrity of bulkheads separating adjacent spaces

Spaces		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Control stations	[1]	A-0**(5)**	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	10	A-60
Corridors	[2]		C									
Accommodation spaces				C**(1)(2)**	B-0 A-0**(3)**	B-0	A-60	A-0	A-0	A-0	10	A-30
Stairways	[4]				B-0 A-0**(3)**	B-0	A-60	A-0	A-0	A-0	10	A-30
Service spaces (low-risk)	[5]					B-0 A-0**(3)**	A-60	A-0	A-0	A-0	10	A-0
Machinery spaces of category A	[6]					C	10	A-0	A-0**(7)**	A-60	10	A-60 **(6)**
Other machinery spaces	[7]							A-0**(4)**	A-0	A-0	10	A-0
Cargo spaces	[8]								10	A-0	10	A-0
Service spaces (high risk)	[9]									A-0**(4)**	10	A-30
Open decks	[10]										-	A-0
Ro/ro cargo spaces	[11]											10,8

Notes to be applied to Table 3.1 to 3.2, as appropriate:

(1) *1 No special requirements are imposed upon bulkheads in methods IIC and IIIC fire protection.*

(2) *In case of method IIC "B" class bulkheads of "B–0" rating shall be provided between spaces or groups of spaces of 50 m^2 and over in area.*

(3) *For clarification as to which applies, see 3. and 5.*

(4) *Where spaces are of the same numerical category and superscript 4 appears, a bulkhead or deck of the rating shown in the Tables in 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.*

(5) *Bulkheads separating the wheelhouse, chartroom and radio room from each other may be "B–0" rating.*

(6) *A–0 rating may be used if no dangerous goods are intended to be carried or if such goods are stowed not less than 3 m horizontally from such bulkhead.*

(7) *For cargo spaces in which dangerous goods are intended to be carried, 4.2 applies.*

(8) *Bulkheads and deck separating ro/ro cargo spaces shall be capable of being closed reasonably gastight and such divisions shall have "A" class integrity in so far as is reasonable and practicable.*

(9) *Fire insulation need not be fitted if the machinery space in category 7, has little or no fire risk.*

(10) *Where a 10 appears in the Tables, the division is required to be of steel or other equivalent material but is not required to be of "A" class standard.*

Table 3.2 Fire integrity of decks separating adjacent spaces

Spaces		[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	10	A-60
Corridors	[2]	A-0	10	10	A-0	10	A-60	A-0	A-0	A-0	10	A-30
Accommodation spaces	[3]	A-60	A-0	10	A-0	10	A-60	A-0	A-0	A-0	10	A-30
Stairways	[4]	A-0	A-0	A-0	10	A-0	A-60					
Service spaces (low-risk)												
Machinery spaces of category A												
Other machinery spaces												
Cargo spaces												
Service spaces (high risk)												
Open decks												
Ro/ro cargo spaces												
See notes under Table 3.5												

[4] Stairways

Interior stairways, lifts, totally enclosed emergency escape trunks 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 shall be regarded as part of the space from which it is not separated by a fire door.

[5] Service Spaces (low risk)

Lockers and store-rooms not having provisions for the storage of flammable liquids and having areas less than 4 m² and drying rooms and laundries.

[6] Machinery Spaces of Category A

Spaces and trunks to such spaces which contain:

internal combustion machinery used for main propulsion; or

internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

any oil-fired boiler or oil fuel unit.

[7] Other Machinery Spaces

Spaces, other than machinery spaces of category A, containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces. Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces)

[8] Cargo Spaces

All spaces used for cargo (including cargo oil tanks) and trunkways and hatchways to such spaces.

[9] Service Spaces (high risk)

Galleys, pantries containing cooking appliances, saunas, paint and lamp rooms, lockers and storerooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids, and workshops other than those forming part of the machinery spaces.

[10] Open Decks

Open deck spaces and enclosed promenades having no fire risk. Enclosed promenades shall have no significant fire risk, meaning that furnishing should be restricted to deck furniture. In addition, such spaces shall be naturally ventilated by permanent openings. Air spaces (the space outside superstructures and deckhouses).

[11] Ro-ro and Vehicle Spaces

5. Protection of Stairways and Lift Trunks in Accommodation Spaces, Service Spaces and Control Stations

5.1 Stairways which penetrate only a single deck shall be protected at least at one level by at least "B-0" class divisions and self-closing doors. Lifts which penetrate only a single deck shall be surrounded by "A-0" class divisions with steel doors at both levels. Stairways and lift trunks which penetrate more than a single deck shall be surrounded by at least "A-0" class divisions and be protected by self-closing doors at all levels.

5.2 On ships having accommodation for 12 persons or less, where stairways penetrate more than a single deck and where there are at least two escape routes direct to the open deck at every accommodation level, consideration may be given reducing the "A-0" requirements of 5.1 to "B-0".

5.3 All stairways shall be of steel frame construction or of other equivalent material.

6. Openings in Fire Resisting Divisions

6.1 Where "A" or "B" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc. or for girders, beams or other structural members, arrangements shall be made to ensure that the fire resistance is not impaired.

6.2 Except for hatches between cargo, special category, store, and baggage spaces, and between such spaces and the weather decks, all openings shall be provided with permanently attached means of closing which shall be at least as effective for resisting fires as the divisions in which they are fitted **(2).**

6.3 The fire resistance of doors shall be equivalent to that of the division in which they are fitted. Doors and door frames in "A" class divisions shall be constructed of steel. Doors in "B" class divisions shall be non-combustible. Doors fitted in boundary bulkheads of machinery spaces of category A shall be reasonably gastight and self-closing. In ships constructed according to method IC the use of combustible materials in doors separating cabins from individual interior sanitary accommodation such as showers may be permitted.

6.4 Doors required to be self-closing shall not be fitted with hold-back hooks. However, hold-back arrangements fitted with remote release devices of the fail-safe type may be utilized.

6.5 In corridor bulkheads ventilation openings may be permitted only in and under class B-doors of cabins and public spaces. Ventilation openings are also permitted in B-doors leading to lavatories, offices, pantries, lockers and store rooms. Except as permitted below, the openings shall be provided only in the lower half of a door. Where such opening is in or under a door the total net area of any such opening or openings shall not exceed 0,05 m^2. Alternatively, a non-combustible air balance duct routed between the cabin and the corridor, and located below the sanitary unit is permitted where the cross-sectional area of the duct does not exceed 0,05 m^2. Ventilation openings, except those under the door, shall be fitted with a grille made of non-combustible material.

6.6 Watertight doors need not be insulated.

7. Ventilation Systems

7.1 Ventilation ducts shall be of non-combustible material. Short ducts, however, not generally exceeding 2 m in length and with a cross-section not exceeding 0,02 m^2 need not be non-combustible, subject to the following conditions:

7.1.1 these ducts shall be of a material having low flame spread characteristics which is type approved **(3).**

7.1.2 they may only be used at the end of the ventilation device;

(2) *Reference is made to the Fire Test Procedure Code, adopted by IMO by Resolution MSC.307(88).*

(3) *Reference is made to the Fire Test Procedure Code, adopted by IMO by Resolution MSC.307(88).*

7.1.3 they shall not be situated less than 600 mm, measured along the duct, from an opening in an "A" or "B" class division including continuous "B" class ceilings.

7.2 Where a thin plated duct with a free crosssectional area equal to, or less than, 0,02 m² passes through "A" class bulkheads or decks, the opening shall 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 decks pierced.

Where ventilation ducts with a free cross-sectional area exceeding 0,02, m^2 pass through "A" class bulkheads or decks, the opening shall be lined with a steel sheet sleeve. However, where such ducts are of steel construction and pass through a deck or bulkhead, the ducts and sleeves shall comply with the following:

7.2.1 The sleeves shall have a thickness of at least 3 mm and a length of at least 900 mm. When passing through bulkheads, this length shall be divided preferably into 450 mm on each side of the bulkhead. These ducts, or sleeves lining such ducts, shall be provided with fire insulation. The insulation shall have at least the same fire integrity as the bulkhead or deck through which the duct passes.

7.2.2 Ducts with a free cross-sectional area exceeding 0,075 m² shall be fitted with fire dampers in addition to the requirements of 7.2.1. The fire damper shall also be capable of being closed manually from both sides of the bulkhead or deck. The damper shall 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 those spaces, provided those ducts have the same fire integrity as the divisions which they pierce.

7.2.3 The following arrangement shall be of an approved type **(2).**

7.2.3.1 fire dampers, including relevant means of operation

7.2.3.2 duct penetrations through "A" class divisions. Where steel sleeves are directly joined to ventilation ducts by means of riveted or screwed flanges or by welding, the test is not required.

7.3 The main inlets and outlets of all ventilation systems shall be capable of being closed from outside the respective spaces in the event of a fire.

7.4 Where they pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges shall be constructed of insulated "A" class divisions. Each exhaust duct shall be fitted with:

7.4.1 a grease trap readily removable for cleaning;

7.4.2 a fire damper located in the lower end of the duct;

7.4.3 arrangements, operable from within the galley, for shutting off the exhaust fan; and

7.4.4 fixed means for extinguishing a fire within the duct (see the **TL** Part C, Chapter 4, Section 18).

7.5 Such measures as are practicable shall be taken in respect of control stations outside machinery spaces in order to ensure that ventilation, visibility and freedom from smoke are maintained, so that in the event of fire the machinery and equipment contained therein may be supervised and continue to function effectively. Alternative and separate means of air supply shall be provided; air inlets of the two sources of supply shall be so disposed that the risk of both inlets drawing in smoke simultaneously is minimized. Such requirements need not apply to control stations situated on, and opening on to, an open deck.

7.6 The ventilation system for machinery spaces of category A, vehicle spaces, ro-ro spaces, galleys, special category spaces and cargo spaces shall, in general, be separated from each other and from the ventilation systems serving other spaces. Except that galley ventilation on ships of less than 4 000 gross tonnage need not be completely separated, but may be served by separate ducts from a ventilation unit serving other spaces. In any case, an automatic fire damper shall be fitted in the galley ventilation ducts near the ventilation unit.

7.7 Ducts provided for the ventilation of machinery spaces of category A, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces shall not pass through accommodation spaces, service spaces or control stations unless the ducts are either:

7.7.1 constructed of steel having a thickness of at least 3 mm and 5 mm for ducts the widths or diameters of which are up to and including 300 mm and 760 mm and over respectively and, in the case of such ducts, the widths or diameters of which are between 300 mm and 760 mm having a thickness to be obtained by interpolation;

suitably supported and stiffened;

fitted with automatic fire dampers close to the boundaries penetrated; and

insulated to "A-60" standard from the machinery spaces, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces to a point at least 5 m beyond each fire damper;
or

7.7.2 constructed of steel suitable supported and stiffened and insulated to "A-60" standard throughout the accommodation spaces, service spaces or control stations.

7.8 Ducts provided for the ventilation to accommodation spaces, service spaces or control stations shall not pass through machinery spaces of category A, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces unless either:

7.8.1 the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro cargo space or special category space are constructed of steel, suitable supported and stiffened and automatic fire dampers are fitted close to the boundaries penetrated; and the integrity of the machinery space, galley, vehicle space, ro-ro cargo space or special category space boundaries is maintained at the penetrations; or

7.8.2 the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro cargo space or special category space are constructed of steel, suitable supported and stiffened, and are insulated to "A-60" standard throughout the accommodation spaces, service spaces or control stations.

7.9 Ventilation ducts with a free cross-sectional area exceeding 0,02 m² passing through "B" class bulkheads shall be lined with steel sheet sleeves of 900 mm in length divided preferably into 450 mm on each side of the bulkheads unless the duct is of steel for this length.

7.10 Power ventilation of accommodation spaces, service spaces, cargo spaces, control stations and machinery spaces shall be capable of being stopped from an easily accessible position outside the space being served. This position should not be readily cut off in the event of a fire in the spaces served. The means provided for stopping the power ventilation of the machinery spaces shall be entirely separate from the means provided for stopping ventilation of other spaces.

8. Restricted Use of Combustible Materials

8.1 All exposed surfaces in corridors and stairway enclosures and surfaces including grounds in concealed or inaccessible spaces in accommodation and service spaces and control stations shall have low flame-spread characteristics. Exposed surfaces of ceilings in accommodation and service spaces (except saunas) and control stations shall have low flamespread characteristics **(3).**

8.2 Paints, varnishes and other finishes used on exposed interior surfaces shall not offer an undue fire hazard and shall not be capable of producing excessive quantities of smoke **(4).**

8.3 Primary deck coverings, if applied, in accommodation and service spaces and control stations shall be of an approved material which will not readily ignite, or give rise to toxic or explosive hazardous at elevated temperatures **(5).**

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(4) *Reference is made to the Fire Test Procedure Code, adopted by IMO by Resolution MSC.307(88).*

(5) *Reference is made to the Fire Test Procedure Code, adopted by IMO by Resolution MSC.307(88).*

8.4 Waste receptacles (see D.10.9)

9. Details of Construction

9.1 Method IC

In accommodation and service spaces and control stations all linings, draught stops, ceilings and their associated grounds shall be of non-combustible materials.

9.2 Methods IIC and IIIC

In corridors and stairway enclosures serving accommodation and service spaces and control stations, ceilings, linings, draught stops and their associated grounds shall be of non-combustible materials.

9.3 Methods IC, IIC and IIIC

9.3.1 Except in cargo spaces or refrigerated compartments of service spaces, insulating materials shall be non-combustible. Vapour barriers and adhesives used in conjunction with insulation, as well as the insulation of pipe fittings, for cold service systems, need not be of non-combustible materials, but they shall be kept to the minimum quantity practicable and their exposed surfaces shall have low flame spread characteristics.

9.3.2 Where non-combustible bulkheads, linings and ceilings are fitted in accommodation and service spaces they may have a combustible veneer with a calorific value **(6)** not exceeding 45 MJ/m^2 of the area for the thickness used.

9.3.3 The total volume of combustible facings, mouldings, decorations and veneers in any accommodation and service space bounded by non-combustible bulkheads, ceilings and linings shall not exceed a volume equivalent to a 2,5 mm veneer on the combined area of the walls and ceilings.

(6) *The gross calorific value measured in accordance with ISO standard 1716 - "Building Materials - Determination of Calorific Potential", should be quoted.*

9.3.4 Air spaces enclosed behind ceilings, panellings, or linings, shall be divided by close-fitting draught stops spaced not more than 14 m apart. In the vertical direction, such air spaces, including those behind linings of stairways, trunks, etc., shall be closed at each deck.

10. Fixed Fire Detection and Fire Alarm Systems and Automatic Sprinkler, Fire Detection and Fire Alarm System

10.1 In ships in which method IC is adopted, a smoke detection system shall be so installed and arranged as to protect all corridors, stairways and escape routes within accommodation spaces.

10.2 In ships in which method IIC is adopted, an automatic sprinkler, fire detection and fire alarm system shall be so installed and arranged as to protect accommodation spaces, galleys and other service spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc. In addition, a fixed fire detection and fire alarm system shall be so arranged and installed as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.

10.3 In ships in which method IIIC is adopted, a fixed fire detection and fire alarm system shall be so installed and arranged as to detect the presence of fire in all accommodation spaces and service spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc. In addition, a fixed fire detection and fire alarm system shall be so arranged and installed as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.

11. Means of Escape

11.1 Unless expressly provided otherwise in this regulation, at least two widely separated and ready means of escape shall be provided from all spaces and group of spaces. Lifts shall not be considered as forming one of the required means of escape.

11.2 Doors in escape routes shall, in general, open in-way of the direction of escape, except that

11.2.1 individual cabin doors may open into the cabins in order to avoid injury to persons in the corridor when the door is opened, and

11.2.2 doors in vertical emergency escape trunks may open out of the trunk in order to permit the trunk to be used both for escape and access.

11.3 Stairways and ladders shall be so arranged as to provide, from all accommodation spaces and from spaces in which the crew is normally employed, other than machinery spaces, ready means of escape to the open deck and thence to the lifeboats and liferafts. In particular the following general provisions shall be complied with:

11.3.1 At all levels of accommodation there shall be provided at least two widely separated means of escape from each restricted space or group of spaces.

11.3.2 Below the lowest open deck the main means of

escape shall be a stairway and the second escape may be a trunk or a stairway.

11.3.3 Above the lowest open deck the means of escape shall be stairways or doors to an open deck or a combination thereof.

11.4 Stairways and corridors used as means of escape shall be not less than 700 mm in clear width and shall have a handrail on one side. Stairways and corridors with a clear width of 1800 mm and above shall have handrails on both sides. The angle of inclination of stairways shall be, in general, 45°, but not greater than 50°, and in machinery spaces and small spaces not more than 60°. Doorways which give access to a stairway shall be of the same size as the stairway **(7).**

11.5 Dispense may be given with one of the means of escape, due regard being paid to the nature and location of spaces and to the numbers of persons who normally might be quartered or employed there.

(7) *Reference is made to the Fire Safety Systems Code adopted by IMO by Resolution MSC.307(88).*

11.6 No dead-end corridors having a length of more than 7 m shall be accepted. A dead-end corridor is a corridor or part of a corridor from which there is only one escape route.

11.7 If a radiotelegraph station has no direct access to the open deck, two means of access to or egress from such station shall be provided, one of which may be a porthole or window of sufficient size or other means to provide an emergency escape.

11.8 At least two means shall be provided in ro-ro cargo spaces where the crew are normally employed. The escape routes shall provide safe escape to the lifeboat and liferaft embarkation decks and shall be located at the fore and aft ends of the space.

11.9 Two means of escape shall be provided from each machinery space of category A. In particular, one of the following provisions shall be complied with:

11.9.1 two sets of steel ladders as widely separated as possible leading to doors in the upper part of the space similarly separated and from which access is provided to the open deck. One of these ladders shall be located within a protected enclosure having fire integrity, including insulation values, in accordance with the Tables 3.1 and 3.2 for category **(4)** space from the lower part of the space to a safe position outside the space. Self-closing fire doors having the same fire integrity shall be fitted in the enclosure. The ladder shall be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The enclosure shall have minimum internal dimensions of at least 800 mm × 800 mm, and shall have emergency lighting provisions;

or

11.9.2 one steel ladder leading to a door in the upper part of the space from which access is provided to the open deck and additionally, in the lower part of the space and in a position well separated from the ladder referred to, a steel door capable of being operated from each side and which provides access to a safe escape route from the lower part of the space to the open deck.

11.9.3 For a ship of a gross tonnage less than 1 000, dispense may be given with one of the means of escape due regard being paid to the dimension and disposition of the upper part of the space.

11.9.4 In the steering gear room, a second means of escape shall be provided when the emergency steering position is located in that space unless there is direct access to the open deck.

11.10 From machinery spaces other than those of category A; two escape routes shall be provided except that a single escape route may be accepted for spaces that are entered only occasionally, and for spaces where the maximum travel distance to the door is 5 m or less.

12. Miscellaneous Items

12.1 The cargo holds and machinery spaces shall be capable of being effectively sealed such as to prevent the inlet of air. Doors fitted in boundary bulkheads of machinery spaces of category A shall be reasonably gastight and self-closing.

12.2 Construction and arrangement of saunas (see D.11.5).

13. Protection of Cargo Spaces

Fire-extinguishing Arrangements in Cargo Spaces

Fire-extinguishing arrangements according to the **TL** Part B, Chapter 4, Section 18 are to be provided for cargo spaces.

14. Protection of Vehicle and Ro-Ro Spaces

14.1 Fire Detection

There shall be provided a fixed fire detection and fire alarm system of an approved type (see also the **TL** Part B, Chapter 4, Section 18).

A sample extraction smoke detection system of an approved type (see also the **TL** Part B, Chapter 4, Section 18) may be accepted as equivalent, except for open ro-ro and vehicle spaces.

14.2 Fire-extinguishing Arrangements

14.2.1 Vehicle spaces and ro-ro spaces which are capable of being sealed from a location outside of the cargo spaces shall be fitted with a fixed gas fireextinguishing system of an approved type (see also the **TL** Part B, Chapter 4, Section 18).

14.2.2 Ro-ro and vehicle spaces not capable of being sealed shall be fitted with a fixed pressure water spraying system for manual operation of an approved type (see also the **TL** Part B, Chapter 4, Section 18).

14.3 Ventilation System

Closed vehicle and ro-ro spaces shall be provided with an effective power ventilation system sufficient to give at least 6 air changes per hour. Beyond this, a higher air exchange rate may be required during the period of loading and unloading and/or depending on the electrical installation. The system for such cargo spaces shall be entirely separate from other ventilation systems and shall be operating at all times when vehicles are in such spaces.

Ventilation ducts serving such cargo spaces capable of being effectively sealed shall be separated for each such space. The system shall be capable of being controlled from a position outside such spaces.

The ventilation shall be such as to prevent air stratification and the formation of air pockets.

Means shall be provided to indicate on the navigating bridge any loss of the required ventilating capacity.

Arrangements shall be provided to permit a rapid shutdown and effective closure of the ventilation system in case of fire, taking into account the weather and sea conditions.

Ventilation ducts, including dampers, shall be made of steel.

Permanent openings in the side plating, the ends or deckhead of the space shall be so situated that a fire in the cargo space does not endanger stowage areas and embarkation stations for survival craft and accommodation spaces, service spaces and control stations in superstructures and deckhouses above the cargo spaces.

15. Special Requirements for Ships Carrying Dangerous Goods

15.1 Ventilation

Adequate power ventilation shall be provided in enclosed cargo spaces. The arrangement shall be such as to provide for at least six air changes per hour in the cargo space based on an empty cargo space and for removal of vapours from the upper or lower parts of the cargo space, as appropriate.

The fans shall be such as to avoid the possibility of ignition of flammable gas air mixtures. Suitable wire mesh guard shall be fitted over inlet and outlet ventilation openings.

Natural ventilation shall be provided in enclosed cargo spaces intended for the carriage of solid dangerous goods in bulk, where there is no provision for mechanical ventilation.

15.2 Insulation of Machinery Space Boundaries

Bulkheads forming boundaries between cargo spaces and machinery spaces of category A shall be insulated to "A-60" standard, unless the dangerous goods are stowed at least 3 m horizontally away from such bulkheads. Other boundaries between such spaces shall be insulated to "A-60" standard.

15.3 Separation of Spaces

15.3.1 In ships having ro-ro spaces, a separation shall be provided between a closed ro-ro space and an adjacent open ro-ro space. The separation shall be such as to minimize the passage of dangerous vapours and liquids between such spaces. Alternatively, such separation need not be provided if the ro-ro space is considered to be a closed cargo space over its entire length and shall fully comply with the requirements of 14.

15.3.2 In ships having ro-ro spaces, a separation shall be provided between a closed ro-ro space and the adjacent weather deck. The separation shall be such as to minimize the passage of dangerous vapours and liquids between such spaces. Alternatively, a separation need not be provided if the closed ro-ro spaces are in accordance with those required for the dangerous goods carried on the adjacent weather deck.

15.4 Miscellaneous Items

The kind and extent of the fire extinguishing equipment are to meet the requirements of the **TL** Part B, Chapter 4, Section 18.

Electrical apparatus and cablings are to meet the requirements of the **TL** Part B, Chapter 5, Section 16.

C. Ships with a Total of 240 Persons on Board

The requirements of this section may also be applied to ships with more than 240 persons on board when the total number of special personnel and passengers is limited to a maximum of 36 persons.

1. Materials

1.1 The hull, decks, structural bulkheads, superstructures and deckhouses are to be of steel or other equivalent materials (aluminium alloy suitably insulated).

1.2 Components made from aluminium alloys require special treatment, with regard to the mechanical properties of the material in case of temperature increase. In principle, the following is to be observed:

1.2.1 The insulation of "A" or "B" class divisions shall be such that the temperature of the structural core does not rise more than 200 °C above the ambient temperature at any time during the applicable fire exposure to the standard fire test.

1.2.2 Special attention shall be given to the insulation of aluminium alloy components of columns, stanchions and other structural members required to support lifeboat and liferaft stowage, launching and embarkation areas, and "A" and "B" class divisions to ensure:

that for such members supporting lifeboat and liferaft areas and "A" class divisions, the temperature rise limitation specified in 1.2.1 shall apply at the end of one hour; and that for such members required to support "B" class divisions, the temperature rise limitation specified in 1.2.1 shall apply at the end of half an hour.

1.2.3 Crowns and casings of machinery spaces of category A shall be of steel construction and be insulated as required by Table 3.3 as appropriate. Openings therein, if any, shall be suitably arranged and protected to prevent the spread of fire.

2. Main Vertical Zones and Horizontal Zones

2.1 The hull, superstructure and deckhouses in way of accommodation and service spaces are to be subdivided into main vertical zones the average length and width of which on any deck is generally not to exceed 40 m.

Subdivision is to be effected by "A" class divisions. As far as practicable, the bulkheads forming the boundaries of the main vertical zones above the bulkhead deck shall be in line with watertight subdivision bulkheads situated immediately below the bulkhead deck. The length and width of main vertical zones may be extended to a maximum of 48 m in order to bring the ends of main vertical zones to coincide with subdivision watertight bulkheads or in order to accommodate a large public space extending for the whole length of the main vertical zone provided that the total area of the main vertical zone is not greater than 1600 m^2 on any deck. The length or width of a main vertical zone is the maximum distance between the furthermost points of the bulkheads bounding it.

The divisions are to extend from deck to deck and to the shell or other boundaries and shall have insulation values in accordance with Table 3.3. At the edges insulating bridges are to be provided where required.

2.2 Where a main vertical zone is subdivided by horizontal "A" class divisions into horizontal zones for the purpose of providing an appropriate barrier between sprinklered and non-sprinklered zones of the ship the divisions shall extend between adjacent main vertical zone bulkheads and to the shell or exterior boundaries of the ship and shall be insulated in accordance with the fire insulation and integrity values given in Table 3.4.

2.3 On ships designed for special purposes (automobile or railroad car ferries), where the provision of main vertical zone bulkheads would defeat the purpose for which the ships is intended, equivalent means for controlling and limiting a fire are to be provided and specifically approved. Service spaces and ship stores shall not be located on ro-ro decks unless protected in accordance with the applicable regulations.

3. Bulkheads within Main Vertical Zones

3.1 All bulkheads within accommodation and service spaces which are not required to be "A" class divisions shall be at least "B" class or "C" class divisions as prescribed in Table 3.3. All such divisions may be faced with combustible materials.

3.2 All corridor bulkheads where not required to be "A" class shall be "B" class divisions which shall extend from deck to deck.

Exceptions may be permitted when continuous "B" class ceilings are fitted on both sides of the bulkhead or when the accommodations are protected by an automatic sprinkler system.

3.3 All bulkheads required to be "B" class division, except corridor bulkheads prescribed in 3.2, shall extend from deck to deck and to the shell or other boundaries unless the continuous "B" class ceilings or linings fitted on both sides of the bulkheads are at least of the same fire resistance as the bulkhead, in which case the bulkhead may terminate at the continuous ceiling or lining.

4. Fire Integrity of Bulkheads and Decks

4.1 In addition to complying with the specific provisions for fire integrity of bulkheads and deck mentioned elsewhere in this Section, the minimum fire integrity of all bulkheads and decks shall be as prescribed in Tables 3.3 to 3.4.

4.2 The following requirements shall govern application of the tables:
Table 3.3 shall apply to bulkheads, separating adjacent spaces. Table 3.4 shall apply to deck, separating adjacent spaces.

Table 3.3 Fire integrity of bulkheads separating adjacent spaces

Spaces		**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**	**[8]**	**[9]**	**[10]**	**[11]**
Control stations	[1]	A-0**(3)**	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	**(7)**	A-60
Corridors	[2]		C**(5)**	B-0**(5)**	A-0**(1)** B-0**(5)**	B-0**(5)**	A-60	A-0	A-0	A-0	**(7)**	A-15
Accommodation spaces	[3]			C**(5)**	A-0**(1)** B-0**(5)**	B-0**(5)**	A-60	A-0	A-0	A-0	**(7)**	A-30 A-0**(4)**
Stairways	[4]				A-0**(1)** B-0**(5)**	A-0**(1)** B-0**(5)**	A-60	A-0	A-0	A-0	**(7)**	A-15
Service spaces (low-risk)	[5]					C**(5)**	A-60	A-0	A-0	A-0	**(7)**	A-0
Machinery spaces of category A	[6]					C	**(7)**	A-0	A-0	A-60	**(7)**	A-60
Other machinery spaces	[7]							A-0**(2)**	A-0	A-0	**(7)**	A-0
Cargo spaces	[8]								**(7)**	A-0	**(7)**	A-0
Service spaces (high risk)	[9]									A-0	**(7)**	A-30
Open decks	[10]											A-0
Ro/ro cargo spaces	[11]											A-0

Notes to be applied to Table 3.1 to 3.2, as appropriate:

(1) *For clarification as to which applies see 3. and 5.*

(2) *Where spaces are of the same numerical category and superscript 2 appears, a bulkhead or deck of the ratings shown in the tables in 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 galley next to a paint room requires an "A–0" bulkhead.*

(3) *Bulkheads separating the wheelhouse and chartroom from each other may be "B–0" rating.*

(4) *In determining the applicable fire integrity standard of a boundary between two spaces which are protected by an automatic sprinkler system, the lesser of the two values given in the tables shall apply.*

(5) *For the application of 2.1, "B–0" and "C", where appearing in Table 3.3, shall be read as "A–0".*

(6) *Fire insulation need not be fitted if the machinery space of category 7, in the opinion of the Administration, has little or no fire risk.*

(7) *Where a 7 appears in the tables, the division is required to be of steel or other equivalent material but is not required to be of "A" class standard.*

Table 3.4 Fire integrity of decks separating adjacent spaces

Spaces		[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	**(7)**	A-30
Corridors	[2]	A-0	**(7)**	**(7)**	A-0	**(7)**	A-60	A-0	A-0	A-0	**(7)**	A-0
Accommodation spaces	[3]	A-60	A-0	**(7)**	A-0	**(7)**	A-60	A-0	A-0	A-0	**(7)**	A-30 A-0**(4)**
Stairways	[4]	A-0	A-0	A-0	**(7)**	A-0	A-60	A-0	A-0	A-0	**(7)**	A-0
Service spaces (low-risk)	[5]	A-15	A-0	A-0	A-0	**(7)**	A-60	A-0	A-0	A-0	**(7)**	A-0
Machinery spaces of category A	[6]	A-60	A-60	A-60	A-60	A-60	**(7)**	A-60**(6)**	A-30	A-60	**(7)**	A-60
Other machinery spaces	[7]	A-15	A-0	A-0	A-0	A-0	A-0	**(7)**	A-0	A-0	**(7)**	A-0
Cargo spaces	[8]	A-60	A-0	A-0	A-0	A-0	A-0	A-0	**(7)**	A-0	**(7)**	A-0
Service spaces (high risk)	[9]	A-60	A-30 A-0**(4)**	A-30 A-0**(4)**	A-30 A-0**(4)**	A-0	A-60	A-0	A-0	A-0	**(7)**	A-30
Open decks	[10]	**(7)**	**(7)**	**(7)**	**(7)**	**(7)**	**(7)**	**(7)**	**(7)**	**(7)**	-	A-0
Ro/ro cargo spaces	[11]	A-60	A-15	A-30 A-0**(4)**	A-15	A-0	A-30	A-0	A-0	A-30	A-0	A-0
See notes under Table 3.3												

[1] Control Stations

Spaces containing emergency sources of power and lighting. Wheelhouse and chartroom. Spaces containing the ship's radio equipment. Fire control stations. Control room for propulsion machinery when located outside the propulsion machinery space. Spaces containing centralized fire alarm equipment.

[2] Corridors

Passenger and crew corridors and lobbies.

[3] Accommodation Spaces

Spaces used for public spaces, lavatories, cabins, offices, hospitals, cinemas, games and hobby rooms, barber shops, pantries containing no cooking appliances and similar spaces.

[4] Stairways

Interior stairways, lifts, totally enclosed emergency escape trunks 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 shall be regarded as part of the space from which it is not separated by a fire door.

[5] Service Spaces (low risk)

Lockers and store-rooms not having provisions for the storage of flammable liquids and having areas less than 4 m^2 and drying rooms and laundries.

[6] Machinery Spaces of Category A

Spaces and trunks to such spaces which contain:

internal combustion machinery used for main propulsion; or

internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

any oil-fired boiler or oil fuel unit.

[7] Other Machinery Spaces

Spaces, other than machinery spaces of category A, containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces. Electrical equipment rooms (auto-telephone exchange , air-conditioning duct spaces)

[8] Cargo Spaces

All spaces used for cargo (including cargo oil tanks) and trunkways and hatchways to such spaces, other than special category spaces.

[9] Service Spaces (high risk)

Galleys, pantries containing cooking appliances, paint and lamp rooms, lockers and store-rooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids, saunas and workshops other than those forming part of the machinery spaces.

[10] Open Decks

Open deck spaces and enclosed promenades having little or no fire risk. Enclosed promenades shall have no significant fire risk, meaning that furnishing should be restricted to deck furniture. In addition, such spaces shall be naturally ventilated by permanent openings. Air spaces (the space outside superstructure and deckhouses).

[11] Special Category Spaces and Ro-Ro Cargo Spaces

4.3 For the purpose of determining the appropriate fire integrity standards to be applied to boundaries between adjacent spaces, such spaces are classified according to their fire risk as shown in the following Categories 1 to 11. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of this regulation, or where it is possible to assign two or more classifications to a space, it shall be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30 % communicating openings to that space are to be considered separate spaces. The fire integrity of the boundary bulkheads of such smaller rooms shall be as prescribed in Tables 3.3 and 3.4. The title of each category is intended to be typical rather than restrictive.

The number in parentheses preceding each category refers to the applicable column or row number in the tables.

4.4 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.

4.5 See D.4.5.

5. Protection of Stairways and Lifts in Accommodation and Service Spaces

5.1 All stairways in accommodation and service spaces are to be of steel frame or other approved equivalent construction; they are to be arranged within enclosures formed by "A" Class divisions, with effective means of closure for all openings.

The following exceptions are admissible:

5.1.1 A stairway connecting only two decks need not be enclosed, provided that the integrity of the pierced deck is maintained by suitable bulkheads or doors at one of the two decks. When a stairway is closed at one 'tween deck space, the stairway enclosed shall be protected in accordance with the tables for decks.

5.1.2 Stairways fitted within a closed public space need not be enclosed.

5.2 Stairway enclosures are to be directly accessible from the corridors and of sufficient area to prevent congestion, having in mind the number of persons likely to use them in an emergency. Within the perimeter of such stairway enclosures, only public spaces, lockers of non-combustible material providing storage for safety equipment and open information counters are permitted. Only public spaces, corridors, public toilets, special category spaces, other escape stairways required by 12.3.3 and external areas are permitted to have direct access to these stairway enclosures. Small corridors or lobbies used to separate an enclosed stairway from galleys or main laundries may have direct access to the stairway provided they have a minimum deck area of 4,5 m^2, a width of no less than 900 mm and contain a fire hose station.

5.3 Lift trunks shall be so fitted as to prevent the passage of smoke and flame from one 'tween deck to another and shall be provided with means of closing so as to permit the control of draught and smoke.

6. Openings in "A" Class Divisions

6.1 Where "A" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., or for girders, beams or other structural members, arrangements shall be made to ensure that the fire resistance is not impaired, subject to the provisions of 6.6.

6.2 All openings in the divisions are to be provided with permanently attached means of closing which shall be at least as effective for resisting fire as the divisions 2. This does not apply for hatches between cargo, special category, store and baggage spaces and between such spaces and the weather decks.

6.3 The construction of all doors and door frames in "A" class divisions, with the means of securing them when closed, shall provide resistance to fire as well as to the passage of smoke and flame, equivalent to that of the bulkheads in which the doors are situated **(2).** Such doors and door frames shall be approved by **TL** and constructed of steel or other equivalent material. Watertight doors need not be insulated.

6.4 It shall be possible for each door to be opened and closed from each side of the bulkhead by one person only.

6.5 Fire doors in main vertical zone bulkheads, galley boundaries and stairway enclosures other than power-operated watertight doors and those which are normally locked, shall satisfy the following requirements:

6.5.1 The doors shall be self-closing and be capable of closing against an angle of inclination of up to 3,5° opposing closure.

6.5.2 The approximate time of closure for hinged fire doors shall be no more than 40 s and no less than 10 s from the beginning of their movement with the ship in upright position. The approximate uniform rate of closure for sliding fire doors shall be of no more than 0,2 m/s and no less than 0,1 m/s with the ship in the upright position.

6.5.3 The doors, except those for emergency escape trunks shall be capable of remote release from the continuously manned central control station, either simultaneously or in groups and shall be capable of release also individually from a position at both sides of the door. Release switches shall have an on-off function to prevent automatic resetting of the system.

6.5.4 Hold-back hooks not subject to central control station release are prohibited.

6.5.5 A door closed remotely from the central control station shall be capable of being re-opened at both sides of the door by local control. After such local opening, the door shall automatically close again (see also the **TL** Part B, Chapter 5, Section 9).

6.5.6 Indication shall be provided at the fire door indicator panel in the continuously manned central control station whether each of the remote-released doors are closed.

6.5.7 The release mechanism shall be so designed that the door will automatically close in the event of disruption of the control system or main source of electric power.

6.5.8 Local power accumulators for poweroperated doors shall be provided in the immediate vicinity of the doors to enable the doors to be operated after disruption of the control system or main source of electric power at least ten times (fully opened and closed) using the local controls (see also the **TL** Part B, Chapter 4, Section 10).

6.5.9 Disruption of the control system or main source of electric power at one door shall not impair the safe functioning of the other doors.

6.5.10 Remote-released sliding or power-operated doors shall be equipped with an alarm that sounds for at least 5 s but no more than 10 s after the door is released from the central control station and before the door begins to move and continue sounding until the door is completely closed.

6.5.11 A door designed to re-open upon contacting an object in its path shall re-open not more than 1 m from the point of contact.

6.5.12 Double-leaf doors equipped with a latch necessary to their fire integrity shall have a latch that is automatically activated by the operation of the doors when released by the control system.

6.5.13 Doors giving direct access to special category spaces which are power-operated and automatically closed need not be equipped with the alarms and remote-release mechanisms required in 6.5.3 and 6.5.10.

6.5.14 The components of the local control system shall be accessible for maintenance and adjusting.

6.5.15 Power-operated doors shall be provided with a control system of an approved type which shall be able to operate in case of fire [2]. This system shall satisfy the following requirements:

6.5.15.1 the control system shall be able to operate the door at the temperature of at least 200 °C for at least 60 min, served by the power supply;

6.5.15.2 the power supply for all other doors not subject to fire shall nor be impaired; and

6.5.15.3 at temperatures exceeding 200 °C the control system shall be automatically isolated from the power supply and shall be capable of keeping the door closed up to at least 945 °C.

6.6 Where a space is protected by an automatic sprinkler system or fitted with a continuous "B" class ceiling, openings in decks not forming steps in main vertical zones nor bounding horizontal zones shall be closed reasonably tight and such decks shall meet the "A" class integrity requirements in so far as is reasonable and practicable.

6.7 The requirements for "A" class integrity of the outer boundaries of a ship shall not apply to glass partitions, windows and sidescuttles, provided that there is no requirement for such boundaries to have "A" class integrity in 8.3. The requirements for "A" class integrity of the outer boundaries of the ship shall not apply to exterior doors, except for those in superstructures and deckhouses facing life-saving appliances, embarkation and external muster station areas, external stairs and open decks used for escape routes. Stairway enclosure doors need not meet this requirement.

6.8 Except for watertight, weathertight doors (semi-watertight doors), doors leading to the open deck and doors which need reasonably gastight, all "A" class doors located in stairways, public spaces and main vertical zone bulkheads in escape routes shall be equipped with a self-closing hose port of material, construction and fire resistance which is equivalent to the door into which it is fitted, and shall be a 150 mm^2 clear opening with the door closed and shall be inset into the lower edge of the door, opposite the door hinges, or in the case of sliding doors, nearest the opening.

7. Opening in “B” Class Divisions

7.1 Where "B" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., or for the fitting of ventilation terminals, lighting fixtures and similar devices, arrangements shall be made to ensure that the fire resistance is not impaired. See also D.7.1.

7.2 Doors and door frames in "B" class divisions and means of securing them shall provide a method of closure which shall have resistance to fire equivalent to that of the divisions 2 except that ventilation openings may be permitted in the lower portion of such doors. Where such opening is in or under a door the total net area of any such opening or openings shall not exceed 0,05 m². Alternatively, a non-combustible air balance duct between the cabin and the corridor, and located below the sanitary unit is permitted where the cross-sectional area of the duct does not exceed 0,05 m². All ventilation openings shall be fitted with a grill made of non-combustible material. Doors shall be non-combustible and approved by **TL**.

7.3 Cabin doors in "B" class division shall be of a self closing type. Hold-backs are not permitted.

7.4 The requirements for "B" class integrity of the outer boundaries of a ship shall not apply to glass partitions, windows and sidescuttles. Similarly, the requirements for "B" class integrity shall not apply to exterior doors in superstructures and deckhouses.

7.5 Where an automatic sprinkler system is fitted:

7.5.1 openings in decks not forming steps in main vertical zones nor bounding horizontal zones shall be closed reasonably tight and such decks shall meet the "B" class integrity requirements in so far as is reasonable and practicable and

7.5.2 openings in corridor bulkheads of "B" class materials shall be protected in accordance with the provisions of 3.2.

8. Windows and Sidescuttles

8.1 All windows and sidescuttles in bulkheads within accommodation and service spaces and control stations other than those to which the provisions of 6.7 and of 7.4 apply, shall be so constructed as to preserve the integrity requirements of the type of bulkheads in which they are fitted.

8.2 Notwithstanding the requirements of the Tables 3.3 and 3.4 all windows and sidescuttles in bulkheads separating accommodation and service spaces and control stations from weather shall be constructed with frames of steel or other suitable material. The glass shall be retained by a metal glazing bead or angle.

8.3 Windows facing life-saving appliances, embarkation and muster areas, external stairs and open decks used for escape routes, and windows situated below liferaft and escape slide embarkation areas shall have the fire integrity as required in the Tables 3.1 and 3.2. Where automatic dedicated sprinkler heads are provided for windows (see also the **TL** Part B, Chapter 4, Section 18), A-0 windows may be accepted as equivalent. Windows located in the ship's side below the lifeboat embarkation areas shall have the fire integrity at least equal to "A-0" class.

9. Ventilation Systems

9.1 Ventilation ducts shall be of non-combustible material. Short ducts, however, not generally exceeding 2 m in length and with a cross-section not exceeding 0,02 m^2 need not be non-combustible, subject to the following conditions:

9.1.1 these ducts shall be of a material having low flame spread characteristics 3 which is type approved;

9.1.2 they may only be used at the end of the ventilation device;

9.1.3 they shall not be situated less than 600 mm, measured along the duct, from an opening in an "A" or "B" class division including continuous "B" class ceilings.

9.2 Where a thin plated duct with a free crosssectional area equal to or less than 0,02 m^2 pass through "A" class bulkheads or decks, the opening shall 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 decks pierced.

Where ventilation ducts with a free cross-sectional area exceeding 0,02 m^2 pass through "A" class bulkheads or decks, the opening shall be lined with a steel sheet sleeve. However, where such ducts are of steel construction and pass through a deck or bulkhead, the ducts and sleeves shall comply with the following:

9.2.1 The sleeves shall have a thickness of at least 3 mm and a length of at least 900 mm. When passing through bulkheads, this length shall be divided preferably into 450 mm on each side of the bulkhead. These ducts, or sleeves lining such ducts, shall be provided with fire insulation. The insulation shall have at least the same fire integrity as the bulkhead or deck through which the duct passes.

9.2.2 Ducts with a free cross-sectional area exceeding 0,075 m^2 shall be fitted with fire dampers in addition to the requirements of 9.2.1. The fire damper shall operate automatically but shall also be capable of being closed manually from both sides of the bulkhead or deck. The damper shall 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 division, without serving those spaces, provided those ducts have the same fire integrity as the divisions which they pierce. The fire dampers should be easily accessible. Where they are placed behind ceilings and linings, these latter should be provided with an inspection door on which a plate reporting the identification number of the fire damper. Such plate and identification number should be placed also on any remote control required.

9.2.3 The following arrangement shall be of anapproved type **(2):**

- fire dampers, including relevant means of operation

- duct penetrations through "A" class divisions. Where steel sleeves are directly joined to ventilation ducts by means of riveted or screwed flanges or by welding, the test is not required.

9.3 The main inlets and outlets of all ventilation systems shall be capable of being closed from outside the respective spaces in the event of a fire.

9.4 Where they pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges shall be constructed of insulated "A" class divisions. Each exhaust duct shall be fitted with:

- a grease trap readily removable for cleaning;

- a fire damper located in the lower end of the duct;

- arrangements, operable from within the galley, for shutting off the exhaust fan; and

- fixed means for extinguishing a fire within the duct (see the **TL** Part B, Chapter 4, Section 18).

9.5 Such measures as are practicable shall be taken in respect of control stations outside machinery spaces in order to ensure that ventilation, visibility and freedom from smoke are maintained, so that in the event of fire the machinery and equipment contained therein may be supervised and continue to function effectively. Alternative and separate means of air supply shall be provided; air inlets of the two sources of supply shall be so disposed that the risk of both inlets drawing in smoke simultaneously is minimized. Such requirements need not apply to control stations situated on, and opening on to, an open deck.

9.6 The ventilation systems for machinery spaces of category A, vehicle spaces, ro-ro spaces, galleys, special category spaces and cargo spaces shall, in general, be separated from each other and from the ventilation system serving other spaces. Except, that the galley ventilation systems need not be completely separated, but may be served by separate ducts from a ventilation unit serving other spaces. In any case, an automatic fire damper shall be fitted in the galley ventilation duct near the ventilation unit.

9.7 Ducts provided for the ventilation of machinery spaces of category A, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces shall not pass through accommodation spaces, service spaces or control stations unless the ducts are either complying with 9.7.1 or 9.7.2:

9.7.1 constructed of steel having a thickness of at least 3 mm and 5 mm for ducts the widths or diameters of which are up to and including 300 mm and 760 mm and over respectively and, in the case of such ducts, the widths or diameters of which are between 300 mm and 760 mm having a thickness to be obtained by interpolation; suitably supported and stiffened; fitted with automatic fire dampers close to the boundaries penetrated; and insulated to "A-60" standard from the machinery spaces, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces to a point at least 5 m beyond each fire damper; or

9.7.2 constructed of steel suitable supported and stiffened in accordance with 9.7.1 and insulated to "A-60" standard throughout the accommodation spaces, service spaces or control stations; except that penetrations of main zone divisions shall also comply with the requirements of 9.11.

9.8 Ducts provided for the ventilation to accommodation spaces, service spaces or control stations shall not pass through machinery spaces of category A, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces unless either complying with 9.8.1 or 9.8.2.

9.8.1 the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro cargo space or special category space are constructed of steel, suitable supported and stiffened in accordance with 9.7.1 and automatic fire dampers are fitted close to the boundaries penetrated; and integrity of the machinery space, galley, vehicle space, ro-ro cargo space or special category space boundaries is maintained at the penetrations; or

9.8.2 the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro cargo space or special category space are constructed of steel, suitable supported and stiffened in accordance with 9.7.1 and are insulated to "A-60" standard within the machinery space, galley, vehicle space, ro-ro cargo space or special category space; except that penetrations of main zone division shall also comply with the requirements of 9.11.

9.9 Ventilation ducts with a free cross-sectional area exceeding 0,02 m^2 passing through "B" class bulkheads shall be lined with steel sheet sleeves of 900 mm in length divided preferably into 450 mm on each side of the bulkheads unless the duct is of steel for this length.

9.10 Power ventilation of accommodation spaces, service spaces, cargo spaces, control stations and machinery spaces shall be capable of being stopped from an easily accessible position outside the space being served. This position should not be readily cut off in the event of a fire in the spaces served. The means provided for stopping the power ventilation of the machinery spaces shall be entirely separate from the means provided for stopping ventilation of other spaces.

9.11 Where in a ship it is necessary that a ventilation duct passes through a main vertical zone division, a fail-safe automatic closing fire damper shall be fitted adjacent to the division. The damper shall also be capable of being manually closed from each side of the division. The operating position shall be readily accessible and be marked in red light-reflecting colour. The duct between the division and the damper shall be of steel or other equivalent material and, if necessary, insulated to comply with the requirements of 6.1. The damper shall be fitted on at least one side of the division with a visible indicator showing whether the damper is in the open position.

10. Restriction of Combustible Materials

10.1 Except in cargo spaces, mail rooms, baggage rooms, saunas **(8)** or refrigerated compartments of service spaces, all linings, grounds, draughts stops, ceilings and insulation's shall be of non-combustible materials **(2).** Partial bulkheads or decks used to subdivide a space for utility or artistic treatment shall also be of non-combustible material.

Linings, ceilings and partial bulkheads or decks used to screen or to separate adjacent cabin balconies shall be of non-combustible material.

10.2 Vapour barriers and adhesives used in conjunction with insulation, as well as insulation of pipe fittings, for cold service systems need not be noncombustible but they shall be kept to the minimum quantity practicable and their exposed surfaces shall have low flame spread characteristics.

10.3 The following surfaces shall have low flamespread characteristics **(3)**:

10.3.1 exposed surfaces in corridors and stairway enclosures, and of bulkheads, wall and ceiling linings in all accommodation and service spaces (except saunas) and control stations;

10.3.2 concealed or inaccessible spaces in accommodation, service spaces and control stations,

10.3.3 exposed surfaces of cabin balconies, except for natural hard wood decking systems.

10.4 The total volume of combustible facings, mouldings, decorations and veneers in any accommodation and service space shall not exceed a volume equivalent to 2,5 mm veneer on the combined area of the walls and ceilings. Furniture fixed to linings, bulkheads or decks need not be included in the calculation of the total volume of combustible materials.

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(8) *Insulation material in saunas shall be non-combustible*

This applies also to traditional wooden benches and wooden linings on bulkheads and ceilings in saunas. In the case of ships fitted with an automatic sprinkler system, the above volume may include some combustible material used for erection of "C" class divisions.

10.5 Combustible materials used on surfaces and linings covered by the requirements of 10.3 shall have a calorific value **(6)** not exceeding 45 MJ/m^2 of the area for the thickness used. This does not apply to surfaces of furniture fixed to linings or bulkheads as well as to traditional wooden benches and wooden linings on bulkheads and ceilings in saunas.

10.6 Furniture in stairway enclosures shall be limited to seating. It shall be fixed, limited to six seats on each deck in each stairway enclosure, be of restricted fire risk, and shall not restrict the passenger escape route.

Furniture shall not be permitted in passenger and crew corridors forming escape routes in cabin areas. Lockers of non-combustible material, providing storage for safety equipment, may be permitted within these areas.

Drinking water dispensers and ice cube machines may be permitted in corridors provided they are fixed and do not restrict the width of the escape route. This applies as well to decorative flower arrangements, statues or other objects d'art such as paintings and tapestries in corridors and stairways.

10.7 Furniture and furnishings on cabin balconies shall comply with the following, unless such balconies are protected by a fixed pressure water-spraying and fixed fire detection and fire alarm systems (see D.10.7).

10.8 Paints, varnishes and other finishes used on exposed interior surfaces, including cabin balconies with the exclusion of natural hard wood decking systems, shall not be capable of producing excessive quantities of smoke and toxic products **(4)**.

10.9 Primary deck coverings, if applied within accommodation and service spaces and control stations, or if applied on cabin balconies, shall be of approved material which will not readily ignite, or give rise to smoke or toxic or explosive hazards at elevated temperatures **(5)**.

10.10 Waste receptacles (see D.10.10).

11. Details of Construction

11.1 In accommodation and service spaces, control stations, corridors and stairways:

air spaces enclosed behind ceilings, panelling or linings shall be suitably divided by close-fitting draught stops not more than 14 m apart;

in the vertical direction, such enclosed air spaces, including those behind linings of stairways, trunks, etc. shall be closed at each deck.

11.2 The construction of ceilings and bulkheads shall be such that it will be possible, without impairing the efficiency of the fire protection, for the fire patrols to detect any smoke originating in concealed and inaccessible spaces.

11.3 Non-load bearing partial bulkheads separating adjacent cabin balconies shall be capable of being opened by the crew from each side for the purpose of fighting fires.

11.4 The cargo holds and machinery spaces shall be capable of being effectively sealed such as to prevent the inlet of air.

Doors leading to machinery spaces of category A are to be provided with self-closing devices and 2 securing devices. All other machinery spaces, which are protected by a gas fire extinguishing system, are to be equipped with self-closing doors.

11.5 Construction and arrangement of saunas (see D.11.5).

12. Means of Escape

12.1 Unless expressly provided otherwise in this regulation, at least two widely separated and ready means of escape shall be provided from all spaces or group of spaces. Lifts shall not be considered as forming one of the required means of escape.

12.2 Doors in escape routes shall, in general, open in-way of the direction of escape, except that

12.2.1 individual cabin doors may open into the cabins in order to avoid injury to persons in the corridor when the door is opened, and

12.2.2 doors in vertical emergency escape trunks may open out of the trunk in order to permit the trunk to be used both for escape and access.

12.3 Stairways and ladders shall be arranged to provide ready means of escape to the lifeboat and liferaft embarkation deck from all passenger and crew spaces and from spaces in which the crew is normally employed, other than machinery spaces. In particular, the following provisions shall be complied with:

12.3.1 Below the bulkhead deck, two means of escape, at least one of which shall be independent of watertight doors, shall be provided from each watertight compartment or similarly restricted space or group of spaces. Due regard being paid to the nature and location of spaces and to the number of persons who normally might be employed there, exceptions are possible, however, stairways shall not be less than 800 mm in clear width with handrails on both sides.

12.3.2 Above the bulkhead deck, there shall be at least two means of escape from each main vertical zone or similarly restricted space or group of spaces at least one of which shall give access to a stairway forming a vertical escape.

12.3.3 At least one of the means of escape required by paragraphs 12.3.1 and 12.3.2 shall consist of a readily accessible enclosed stairway, which shall provide continuous fire shelter from the level of its origin to the appropriate lifeboat and liferaft embarkation decks, or to the uppermost weather deck if the embarkation deck does not extend to the main vertical zone being considered. In the latter case, direct access to the embarkation deck by way of external open stairways and passageways shall be provided and shall have emergency lighting (see also the **TL** Part B, Chapter 5, Section 3 and 11) and slip-free surfaces under foot. Boundaries facing external open stairways and passageways forming part of an escape route and boundaries in such a position that their failure during a fire would impede escape to the embarkation deck shall have fire integrity, including insulation values, in accordance with the Tables 3.3 and 3.4. The widths, number and continuity of escapes shall be as follows:

12.3.3.1 Stairways shall not be less than 900 mm in clear width. Stairways shall be fitted with handrails on each side. The minimum clear width of stairways shall be increased by 10 mm for every one person provided for in excess of 90 persons. The maximum clear width between handrails where stairways are wider than 900 mm shall be 1 800 mm. The total number of persons to be evacuated by such stairways shall be assumed to be two thirds of the crew and the total number of passengers in the areas served by such stairways **(9).**

12.3.3.2 All stairways sized for more than 90 persons shall be aligned fore and aft.

12.3.3.3 Doorways and corridors and intermediate landings included in means of escape shall be sized in the same manner as stairways.

12.3.3.4 Stairways shall not exceed 3,5 m in vertical rise without the provision of a landing and shall not have an angle of inclination greater than 45°.

12.3.3.5 Landings at each deck level shall be not less than 2 m^2 in area and shall increase by 1 m^2 for every 10 persons provided for in excess of 20 persons but need not exceed 16 m^2, except for those landings servicing public spaces having direct access onto the stairway enclosure.

12.3.4 Stairways serving only a space and a balcony in that space shall not be considered as forming one of the means of escape.

12.3.5 A corridor, lobby, or part of a corridor from which there is only one route of escape shall be prohibited. Dead-end corridors used in service areas which are necessary for the practical utility of the ship, such as fuel oil stations and athwartship supply corridors shall be permitted provided such dead-end corridors are separated from crew accommodation areas and are inaccessible from passenger accommodation areas.

(9) *Reference is made to the Fire Test Procedure Code, adopted by IMO by Resolution MSC.307(88).*

Also, a part of the corridor that has a depth not exceeding its width is considered a recess or local extension and is permitted.

12.3.6 In addition to the emergency lighting (see also the **TL** Part B, Chapter 5, Section 3 and 10) the means of escape including stairways and exits, shall be marked by lighting or photoluminescent strip indicators placed not more than 0,3 m above the deck at all points of the escape route including angles and intersections. The marking shall enable passengers to identify all the routes of escape and readily identify the escape exits. If electric illumination is used, it shall be supplied by the emergency source of power and it shall be so arranged that the failure of any single light or cut in a lighting strip, will not result in the marking being ineffective.

Additionally, all escape route signs and fire equipment location markings shall be of photoluminescent material or marked by lighting. Such lighting or photoluminescent equipment shall be of an approved type **(9).**

12.3.7 Public Spaces spanning three or more decks and contain combustibles such as furniture and enclosed spaces such as ships, offices and restaurants shall have at each level within the space two means of escape, one of which shall have direct access to an enclosed vertical means of escape as mentioned under 12.3.3

12.4 If a radiotelegraph station has no direct Access to the open deck, two means of escape from or access to such station shall be provided, one of which may be a porthole or window of sufficient size or another means.

12.5 In special category spaces the number and disposition of the means of escape both below and above the bulkhead deck shall be satisfactory as mentioned under 12.3.1, .2 and .3.

12.6 Two means of escape shall be provided from each machinery space. In particular, the following provisions shall be complied with:

12.6.1 Where the space is below the bulkhead deck the two means of escape shall consist of either:

12.6.1.1 two sets of steel ladders as widely separated as possible, leading to doors in the upper part of the space similarly separated and from which access is provided to the appropriate lifeboat and liferaft embarkation decks. One of these ladders shall be located within a protected enclosure having fire integrity, including insulation values, in accordance with the Tables 3.3 and 3.4 for a category (4) space, from the lower part of the space to a safe position outside the space. Self-closing doors of the same fire integrity standards shall be fitted in the enclosure. The ladder shall be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The protected enclosure shall have minimum internal dimensions of at least 800 mm × 800 mm, and shall have emergency lighting provisions.

12.6.1.2 or one steel ladder leading to a door in the upper part of the space from which access is provided to the embarkation deck an additionally, in the lower part of the space and in a position well separated from the ladder referred to, a steel door capable of being operated from each side and which provides access to a safe escape route from the lower part of the space to the embarkation deck.

12.6.2 Where the space is above the bulkhead deck, two means of escape shall be as widely separated as possible and the doors leading from such means of escape shall be in a position from which access is provided to the appropriate lifeboat and liferaft embarkation decks. Where such escapes require the use of ladders these shall be of steel.

12.6.3 A ship of a gross tonnage less than 1 000 may be dispensed with one of the means of escape, due regard being paid to the width and disposition of the upper part of the space; and a ship of a gross tonnage of 1 000 and above, may be dispensed with one means of escape from any such space so long as either a door or a steel ladder provides a safe escape route to the embarkation deck, due regard being paid to the nature and location of the space and whether persons are normally employed in that space.

12.6.4 In the steering gear room, a second means of escape shall be provided when the emergency steering position is located in that space unless there is direct access to the open deck.

12.6.5 One of the escape routes from the machinery spaces where the crew is normally employed shall avoid direct access to any special category space.

12.6.6 Two means of escape shall be provided from a machinery control room within a machinery space, at least one of which shall provide continuous fire shelter to a safe position outside the machinery space.

12.7 Additional Requirements for Ro-Ro Ships

See D.12.7 and D.12.8.

13. Fixed Fire Detection and Fire Alarm Systems and Automatic Sprinkler, Fire Detection and Fire Alarm Systems

In any ship there shall be installed throughout each separate zone, whether vertical or horizontal, in all accommodation and service spaces and, where it is considered necessary, in control stations, except spaces which afford no substantial fire risk (such as void spaces, sanitary spaces, etc.) either:

13.1 a fixed fire detection and fire alarm system (see also the **TL** Part B, Chapter 4, Section 18); or

13.2 an automatic sprinkler, fire detection and fire alarm system and in addition a fixed fire detection and fire alarm system so installed and arranged as to provide smoke detection in corridors, stairways and escape routes within accommodation spaces.

13.3 Cabin balconies (see D.13.3).

14. Protection of Vehicle, Special Category and Ro-Ro Spaces

14.1 The subdivision of such spaces in main vertical zones would defeat their intended purpose. Therefore equivalent protection shall be obtained in such spaces on the basis of a horizontal zone concept. A horizontal zone may include special category and ro-ro spaces on more than one deck provided that the total overall clear height for vehicles does not exceed 10 m, whereas the total overall clear height is the sum of distances between deck and web frames of the decks forming the horizontal zone.

14.2 Structural Protection

The boundary bulkheads and decks of special category spaces shall be insulated as required for category (11) spaces in Tables 3.3 and 3.4, whereas the boundary bulkheads and decks of closed and open ro-ro spaces shall have fire integrity as required for category (8) spaces in Tables 3.3 and 3.4.

Indicators shall be provided on the navigating bridge which shall indicate when any fire door leading to or from the special category space is closed.

14.3 Fixed Fire-extinguishing System

14.3.1 Vehicle spaces and ro-ro spaces which are not special category spaces and are capable of being sealed from a location outside of the cargo spaces shall be fitted with a fixed gas fire-extinguishing system of an approved type (see also the **TL** Part B, Chapter 4, Section 18).

14.3.2 Ro-ro and vehicle spaces not capable of being sealed and special category spaces shall be fitted with a fixed pressure water spraying system for manual operation of an approved type (see also the **TL** Part B, Chapter 4, Section 18).

14.4 Ventilation System

There shall be provided an effective power ventilation system for special category spaces sufficient to give at least 10 air changes per hour and for closed ro-ro and vehicle spaces sufficient to give at least 6 air changes per hour. Beyond this, a higher air exchange rate is required during the period of loading and unloading. The system for such spaces shall be entirely separated from other ventilation systems and shall be operating at all times when vehicles are in such spaces.

Ventilation ducts serving such spaces capable of being effectively sealed shall be separated for each such space. The system shall be capable of being controlled

from a position outside such spaces.
The ventilation shall be such as to prevent air stratification and the formation of air pockets.

Means shall be provided to indicate on the navigating bridge any loss or reduction of the required ventilating capacity.

Arrangements shall be provided to permit a rapid shutdown and effective closure of the ventilation system in case of fire, taking into account the weather and sea conditions.

Ventilation ducts, including dampers, within a common horizontal zone shall be made of steel.

Ducts passing through other horizontal zones or machinery spaces shall be "A-60" class steel ducts complying with 9.11.

Permanent openings in the side plating, the ends or deckhead of the spaces shall be so situated that a fire in the cargo space does not endanger stowage areas and embarkation stations for survival craft and accommodation spaces, service spaces and control stations in superstructures and deckhouses above the cargo spaces.

14.5 Fire Detection

There shall be provided a fixed fire detection and fire alarm system of an approved type (see also the **TL** Part B, Chapter 4, Section 18).
A sample extraction smoke detection system of an approved type (see also the **TL** Part B, Chapter 4, Section 18) may be accepted as equivalent, except for open ro-ro spaces, open vehicle spaces and special category spaces.

An efficient fire patrol system shall be maintained in special category spaces. In case of a continuous fire watch at all times during the voyage, a fixed fire detection and alarm system is not required therein.

15. Special Arrangements in Machinery Spaces of Category A

15.1 The number of skylights, doors, ventilators, openings in funnels to permit exhaust ventilation and other openings to machinery spaces shall be reduced to a minimum consistent with the needs of ventilation and the proper and safe working of the ship.

15.2 Skylights shall be of steel and shall not contain glass panels. Suitable arrangements shall be made to permit the release of smoke in the event of fire, from the space to be protected. The normal ventilation systems may be acceptable for this purpose.

15.3 Means of control shall be provided for permitting the release of smoke and such controls shall be located outside the space concerned so that, in the event of fire, they will not be cut off from the space they serve. The controls shall be situated at one control position or grouped in as few positions as possible. Such positions shall have safe access from the open deck.

15.4 Such doors other than power-operated watertight doors shall be arranged so that positive closure is assured in case of fire in the space, by power-operated closing arrangements or by the provision of selfclosing doors capable of closing against an inclination of 3,5° opposing closure and having a fail-safe hookback facility, provided with a remotely operated release device. Doors for emergency escape trunks need not be fitted with a fail-safe hold-back facility and a remotely operated release device.

15.5 Means of control shall be provided for closing power-operated doors or actuating release mechanism on doors other than power-operated watertight doors. The control shall be located outside the space concerned, where they will not be cut off in the event of fire in the space it serves. The means of control shall be situated at one control position or grouped in as few positions as possible having direct access and safe access from the open deck.

15.6 Windows shall not be fitted in machinery space boundaries. This does not preclude the use of glass in control rooms within the machinery spaces.

15.7 The floor plating of normal passageways shall be made of steel.

16. Special Requirements for Ships Carrying Dangerous Goods

16.1 Ventilation

Adequate power ventilation shall be provided in enclosed cargo spaces. The arrangement shall be such as to provide for at least six air changes per hour in the cargo space based on an empty cargo space and for removal of vapours from the upper or lower parts of the cargo space, as appropriate.

The fans shall be such as to avoid the possibility of ignition of flammable gas air mixtures. Suitable wire mesh guard shall be fitted over inlet and outlet ventilation openings.

16.2 Insulation of Machinery Space Boundaries

Bulkheads forming boundaries between cargo spaces and machinery spaces of category A shall be insulated to "A-60" standard, unless the dangerous goods are stowed at least 3 m horizontally away from such bulkheads. Other boundaries between such spaces shall be insulated to "A-60" standard.

16.3 Miscellaneous Items

The kind and extent of the fire extinguishing equipment are defined in the **TL** Part B, Chapter 4, Section 18.

Electrical apparatus and cablings are to meet the requirements of the **TL** Part B, Chapter 5, Section 14.

D. Ships with More Than 240 Persons on Board

The requirements of this Section may be applied irrespective of the number of special personnel and passengers carried on board.

1. Materials

1.1 The hull, decks, structural bulkheads, superstructures and deckhouses are to be of steel or other equivalent material (Aluminium alloy suitably insulated).

1.2 Components made from aluminium alloys require special treatment, with regard to the mechanical properties of the material in case of temperature increase. In principle, the following is to be observed:

1.2.1 The insulation of "A" or "B" class divisions shall be such that the temperature of the structural core does not rise more than 200 °C above the ambient temperature at any time during the applicable fire exposure to the standard fire test.

1.2.2 Special attention shall be given to the insulation of aluminium alloy components of columns, stanchions and other structural members required to support lifeboat and liferaft stowage, launching and embarkation areas, and "A" and "B" class divisions to ensure:

that for such members supporting lifeboat and liferaft areas and "A" class divisions, the temperature rise limitation specified in 1.2.1 shall apply at the end of one hour; and

that for such members required to support "B" class divisions, the temperature rise limitation specified in 1.2.1 shall apply at the end of half an hour.

1.2.3 Crowns and casings of machinery spaces of category A shall be of steel construction and be insulated as required by Table 3.5 as appropriate. Openings therein, if any, shall be suitably arranged and protected to prevent the spread of fire.

2. Main vertical zones and horizontal zones

2.1 The hull, superstructure and deckhouses are to be subdivided into main vertical zones the average length and width of which on any deck is generally not to exceed 40 m.

Subdivision is to be effected by "A-60" class divisions. Steps and recesses shall be kept to a minimum. Where a category 4.3 [5], 4.3 [9] or 4.3 [10] space is on one side of the division or where fuel oil tanks are on both sides of the division the standard may be reduced to "A-0".

As far as practicable, the bulkheads forming the boundaries of the main vertical zones above the bulkhead deck shall be in line with watertight subdivision bulkheads situated immediately below the bulkhead deck.

The length and width of main vertical zones may be extended to a maximum of 48 m in order to bring the ends of main vertical zones to coincide with subdivision watertight bulkheads or in order to accommodate a large public space extending for the whole length of the main vertical zone provided that the total area of the main vertical zone is not greater than 1600 m^2 on any deck. The length or width of a main vertical zone is the maximum distance between the furthermost points of the bulkheads bounding it.

The divisions are to be extended from deck to deck and to the shell or other boundaries. At the edges insulating bridges are to be provided where required.

2.2 On ships designed for special purposes (automobile or railroad car ferries), where the provision of main vertical zone bulkheads would defeat the purpose for which the ship is intended, equivalent means for controlling and limiting a fire are to be provided and specifically approved. Service spaces and ship stores shall not be located on ro-ro decks unless protected in accordance with the applicable regulations.

3. Bulkheads within Main Vertical Zones

3.1 All bulkheads which are not required to be "A" class divisions shall be at least "B" class or "C" class divisions as prescribed in Table 3.5. All such divisions may be faced with combustible materials.

3.2 All bulkheads required to be "B" class division shall extend from deck to deck and to the shell or other boundaries unless the continuous "B" class ceilings or linings fitted on both sides of the bulkheads are at least of the same fire resistance as the bulkhead, in which case the bulkheads may terminate at the continuous ceiling or lining.

4. Fire Integrity of Bulkheads and Decks

4.1 In addition to complying with the specific provisions for fire integrity of bulkheads and decks mentioned elsewhere in this Part, the minimum fire integrity of all bulkheads and decks shall be as prescribed in Table 3.5 to 3.6.

4.2 The following requirements shall govern application of the tables.

Table 3.5 shall apply to bulkheads and walls not bounding either main vertical zones or horizontal zones.

Table 3.6 shall apply to decks not forming steps in main vertical zones nor bounding horizontal zones.

4.3 For the purpose of determining the appropriate fire integrity standards to be applied to boundaries between adjacent spaces, such spaces are classified according to their fire risk as shown in the following categories 1 to 14. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of this regulation, or where it is possible to assign two or more classifications to a space, it shall be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30 % communicating openings to that space are to be considered separate spaces. The fire integrity of the boundary bulkheads of such smaller rooms shall be as prescribed in Table 3.5 and 3.6.

The title of each category is intended to be typical rather than restrictive. The number in parentheses preceding each category refers to the applicable column or row number in the tables.

Table 3.5 Bulkheads not bounding either main vertical zones or horizontal zones

Spaces		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
Control stations	[1]	**(1)** B-0	A-0	A-0	A-0	A-0	A-60	A-60	A-60	A-0	A-0	A-60	A-60	A-60	A-60
Stairways	[2]		**(1)** A-0	A-0	A-0	A-0	A-0	A-15	A-15	**(3)** A-0	A-0	A-15	A-30	A-15	A-30
Corridors	[3]			B-15	A-60	A-0	B-15	B-15	B-15	B-15	A-0	A-15	A-30	A-0	A-30
Evacuation stations and external escape routes	[4]					-0	**(2)(4)** A-60	**(2)(4)** A-60	**(2)(4)** A-60	A-0 **(4)**	A-0	**(2)** A-60	**(2)** A-60	**(2)** A-60	**(2)** A-60
Open deck spaces	[5]						A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0
Accommodation spaces of minor fire risk	[6]						B-0	B-0	B-0	C	A-0	A-0	A-30	A-0	A-30
Accommodation spaces of moderate fire risk	[7]							B-0	B-0	C	A-0	A-15	A-60	A-15	A-60
Accommodation spaces of greater fire risk	[8]								B-0	C	A-0	A-30	A-60	A-15	A-60
Sanitary and similar spaces	[9]									C	A-0	A-0	A-0	A-0	A-0
Tanks, voids and auxiliary machinery spaces having little or no fire risk	[10]										**(1)** A-0	A-0	A-0	A-0	A-0
Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk	[11]											**(1)** A-0	A-0	A-0	A-15
Machinery spaces and main galleys	[12]												**(1)** A-0	A-0	A-60
Store-rooms, work-shops, pantries, etc.	[13]													**(1)** A-0	A-0
Other spaces in which flammable liquids are stowed	[14]														A-30

Notes to be applied to Table 3.1 to 3.2, as appropriate:

(1) *Where adjacent spaces are in the same numerical category and superscript **(1)** appears, a bulkhead or deck between such spaces need not be fitted. For example, in category [12] a bulkhead need not be required between a galley and its annexed pantries provided the pantry bulkhead and decks maintain the integrity of the galley boundaries. A bulkhead is, however, required between a galley and a machinery space even though both spaces are in category [12].*

(2) *The ship's side, to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to the life rafts and evacuation slides may be reduced to "A-30".*

(3) *Where public toilets are installed completely within the stairway enclosure, the public toilet bulkhead within the stairway enclosure can be of "B" class integrity.*

(4) *Where spaces of category [6], [7], [8] and [9] are located completely within the outer perimeter of the muster station, the bulkheads of these spaces are allowed to be of ''B-O'' class integrity. Control positions for audio, video and light installations may be considered as part of the muster station.*

Table 3.6 Decks not forming steps in main vertical zones nor bounding zones

Spaces above→ Spaces below↓		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
Control stations	[1]	A-30	A-30	A-15	A-0	A-0	A-0	A-15	A-30	A-0	A-0	A-0	A-60	A-0	A-60
Stairways	[2]	A-0	A-0	-	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30	A-0	A-30
Corridors	[3]	A-15	A-0	**(1)** A-0	A-60	A-0	A-0	A-15	A-15	A-0	A-0	A-0	A-30	A-0	A-30
Evacuation stations and external escape routes	[4]	A-0	A-0	A-0	A-0	-	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0
Open deck spaces	[5]	A-0	A-0	A-0	A-0	-	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0
Accommodation spaces of minor fie risk	[6]	A-60	A-15	A-0	A-60	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0
Accommodation spaces of moderate fire risk	[7]	A-60	A-15	A-15	A-60	A-0	A-0	A-15	A-15	A-0	A-0	A-0	A-0	A-0	A-0
Accommodation spaces of greater fire risk	[8]	A-60	A-15	A-15	A-60	A-0	A-15	A-15	A-30	A-0	A-0	A-0	A-0	A-0	A-0
Sanitary and similar spaces	[9]	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0
Tanks, voids and auxiliary machinery spaces having little or no fire risk	[10]	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	**(1)** A-0	A-0	A-0	A-0	A-0
Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk	[11]	A-60	A-60	A-60	A-60	A-0	A-0	A-15	A-30	A-0	A-0	**(1)** A-0	A-0	A-0	A-30
Machinery spaces and main galleys	[12]	A-60	A-60	A-60	A-60	A-0	A-60	A-60	A-60	A-0	A-0	A-30	**(1)** A-30	A-0	A-60
Store-rooms, work-shops, pantries, etc.	[13]	A-60	A-30	A-15	A-60	A-0	A-15	A-30	A-30	A-0	A-0	A-0	A-0	A-0	A-0
Other spaces in which flammable liquids are stowed	[14]	A-60	A-60	A-60	A-60	A-0	A-30	A-60	A-60	A-0	A-0	A-0	A-0	A-0	A-0
See Notes under Table 3.1															

[1] Control Stations

Spaces containing emergency sources of power and lighting. Wheelhouse and chartroom. Spaces containing the ship's radio equipment. Fire control stations. Control room for propulsion machinery when located outside the propulsion machinery space. Spaces containing centralized fire alarm equipment. Spaces containing centralized emergency public address system stations and equipment.

[2] Stairways

Interior stairways, lifts, totally enclosed emergency escape trunks and escalators (other than those wholly contained within the machinery spaces) for passengers and crew and enclosures thereto. In this connection, a stairway which is enclosed at only one level shall be regarded as part of the space from which it is not separated by a fire door.

[3] Corridors

Passenger and crew corridors and lobbies.

[4] Evacuation Stations and External Escape Routes

Survival craft stowage area. Open deck spaces and enclosed promenades forming lifeboat and liferaft embarkation and lowering stations.
Assembly stations, internal and external.
External stairs and open decks used for escape routes.
The ship's side to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to the liferafts and evacuation slide's embarkation areas.

[5] Open Deck Spaces

Open deck spaces and enclosed promenades clear of lifeboat and liferaft embarkation and lowering stations. To be considered in this category, enclosed promenades shall have no significant fire risk, meaning that furnishings shall be restricted to deck furniture. In addition, such spaces shall be naturally ventilated by permanent openings. Air spaces (the space outside superstructures and deckhouses).

[6] Accommodation Spaces of Minor Fire Risk

Cabins containing furniture and furnishings of restricted fire risk. Offices and dispensaries containing furniture and furnishings of restricted fire risk. Public spaces containing furniture and furnishings of restricted fire risk and having a deck area of less than 50 m^2.

[7] Accommodation Spaces of Moderate Fire Risk

Spaces as in category 6 above but containing furniture and furnishings of other than restricted fire risk. Public spaces containing furniture and furnishings of restricted fire risk and having a deck area of 50 m^2 or more. Isolated lockers and small store-rooms in accommodation spaces having areas less than 4 m^2 (in which flammable liquids are not stowed). Sale shops. Motion picture projection and film stowage rooms. Diet kitchens (containing no open flame). Cleaning gear lockers (in which flammable liquids are not stowed). Laboratories (in which flammable liquids are not stowed). Pharmacies. Small drying rooms (having a deck area of 4 m^2 or less). Specie rooms, operating rooms, electrical distribution boards (see 4.3.2 and 4.3.3).

[8] Accommodation Spaces of Greater Fire Risk

Public spaces containing furniture and furnishings of other than restricted fire risk and having a deck area of 50 m^2 or more. Barber shops and beauty parlours. Saunas.

[9] Sanitary and Similar Spaces

Communal sanitary facilities, showers, baths, water closets, etc. Small laundry rooms. Indoor swimming pool area. Isolated pantries containing no cooking appliances in accommodation spaces.Private sanitary facilities shall be considered a portion of the space in which they are located.

[10] Tanks, Voids and Auxiliary Machinery Spaces Having Little or No Fire Risk

Water tanks forming part of the ship's structure. Voids and cofferdams. Auxiliary machinery spaces which do not contain machinery having a pressure lubrication system and where storage of combustibles is prohibited, such as:

Ventilation and air-conditioning rooms; windlass room; steering gear room; stabilizer equipment room; electrical propulsion motor room; rooms containing section switchboards and purely electrical equipment other than oil-filled electrical transformers (above 10 kVA); shaft alleys and pipe tunnels; spaces for pumps and refrigeration machinery (not handling or using flammable liquids).

Closed trunks serving the spaces listed above. Other closed trunks such as pipe and cable trunks.

[11] Auxiliary Machinery Spaces, Cargo Spaces, Cargo and Other Oil Tanks and Other Similar Spaces of Moderate Fire risk

Cargo oil tanks. Cargo holds, trunkways and hatchways. Refrigerated chambers. Oil fuel tanks (where installed in a separate space with no machinery). Shaft alleys and pipe tunnels allowing storage of combustibles. Auxiliary machinery spaces as in category 10 which contain machinery having a pressure lubrication system or where storage of combustibles is permitted. Oil fuel filling stations. Spaces containing oilfilled electrical transformers (above 10 kVA). Spaces containing turbine and reciprocating steam engine driven auxiliary generators and small internal combustion engines of power output up to 110 kW driving generators, sprinkler, drencher or fire pumps, bilge pumps, etc. Closed trunks serving the spaces listed above.

[12] Machinery Spaces and Main Galleys

Main propulsion machinery rooms (other than electric propulsion motor rooms) and boiler rooms. Auxiliary machinery spaces other than those in categories 10 and 11 which contain internal combustion machinery or other oil-burning, heating or pumping units. Main galleys and annexes. Trunks and casings to the spaces listed above.

[13] Store-rooms, Workshops, Pantries, etc.

Main pantries not annexed to galleys. Mainlaundry. Large drying rooms (having a deck area of more than 4 m^2). Miscellaneous stores. Mail and baggage rooms. Garbage rooms. Workshops (not part of machinery spaces, galleys, etc.), lockers and store-rooms having areas greater than 4 m^2, other than those spaces which have provisions for the storage of flammable liquids.

[14] Other Spaces in Which Flammable Liquids Are Stowed

Lamp rooms. Paint rooms. Store-rooms containing flammable liquids (including dyes, medicines, etc.). Laboratories (in which flammable liquids are stowed).

4.3.1 In respect of category [5] spaces **TL** shall determine whether the insulation values in Table 3.5 shall apply to ends of deckhouses and superstructures, and whether the insulation values in Table 3.6 shall apply to weather decks. In no case shall the requirements of category [5] of Table 3.5 or 3.6 necessitate enclosure of spaces which in the opinion of **TL** need not be enclosed.

4.3.2 Electrical distribution boards may be located behind panels/ linings within accommodation spaces including stairway enclosures, without the need to categorize the space, provided no provision for storage is made.

4.3.3 If distribution boards are located in an identifiable space having a deck area of less than 4 m^2, this space shall be categorized in **(7).**

4.4 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.

4.5 At intersections and terminal points of the required fire insulation constructions due regard is to be paid to the effect of thermal bridges. In order to avoid this, the insulation of a deck or bulkhead shall be carried past the intersection or terminal point for a distance of at least 450 mm.

5. Protection of Stairways and Lifts in Accommodation and Service Spaces

5.1 All stairways in accommodation and service spaces are to be of steel frame or other approved equivalent construction; they are to be arranged within enclosures formed by "A" class division, with effective means of closure for all openings.

The following exceptions are admissible:

5.1.1 A stairway connecting only two decks need not be enclosed, provided that the integrity of the pierced deck is maintained by suitable bulkheads or doors at one of the two decks. When a stairway is closed at one 'tween deck space, the stairway enclosure shall be protected in accordance with the tables for decks.

5.1.2 Stairways fitted within a closed public space need not be enclosed.

5.2 Stairway enclosures are to be directly accessible from the corridors and of sufficient area to prevent congestion, having in mind the number of persons likely to use them in an emergency. Within the perimeter of such stairway enclosures, only public toilets, lockers of non-combustible material providing storage for safety equipment and open information counters are permitted. Only public spaces, corridors, public toilets, special category spaces, other escape stairways required by 12.3.3 and external areas are permitted to have direct access to these stairway enclosures.

Small corridors or lobbies used to separate an enclosed stairway from galleys or main laundries may have direct access to the stairway provided they have a minimum deck area of 4,5 m^2, a width of no less than 900 mm and contain a fire hose station.

5.3 Lift trunks shall be so fitted as to prevent the passage of smoke and flame from one 'tween deck to another and shall be provided with means of closing so as to permit the control of draught and smoke.

6. Openings in "A" Class Divisions

6.1 Where "A" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., or for girders, beams or other structural members, arrangements shall be made to ensure that the fire resistance is not impaired, subject to the provisions of 6.6.

6.2 All openings in the divisions are to be provided with permanently attached means of closing which shall be at least as effective for resisting fire as the divisions This does not apply for hatches between cargo, special category, store and baggage spaces and between such spaces and the weather decks.

6.3 The construction of all doors and door frames in "A" class divisions, with the means of securing them when closed, shall provide resistance to fire as well as to the passage of smoke and flame equivalent to that of the bulkheads in which the doors are situated 2. Such doors and door frames shall be approved by **TL** and constructed of steel or other equivalent material. Watertight doors need not be insulated.

6.4 It shall be possible for each door to be opened and closed from each side of the bulkhead by one person only.

6.5 Fire doors in main vertical zone bulkheads, galley boundaries and stairway enclosures other than power-operated watertight doors and those which are normally locked, shall satisfy the following requirements:

6.5.1 The doors shall be self-closing and be capable of closing against an angle of inclination of up to 3,5° opposing closure.

6.5.2 The approximate time of closure for hinged fire doors shall be no more than 40 s and no less than 10 s from the beginning of their movement with the ship in upright position. The approximate uniform rate of closure for sliding fire doors shall be of no more than 0,2 m/s and no less than 0,1 m/s with the ship in the upright position.

6.5.3 The doors, except those for emergency escape trunks shall be capable of remote release from the continuously manned central control station, either simultaneously or in groups and shall be capable of release also individually from a position at both sides of the door. Release switches shall have an on-off function to prevent automatic resetting of the system.

6.5.4 Hold-back hooks not subject to central control station release are prohibited.

6.5.5 A door closed remotely from the central control station shall be capable of being re-opened at both sides of the door by local control. After such local opening, the door shall automatically close again (see also the **TL** Part B, Chapter 5,Section 9).

6.5.6 Indication shall be provided at the fire door indicator panel in the continuously manned central control station whether each of the remote-released doors are closed.

6.5.7 The release mechanism shall be so designed that the door will automatically close in the event of disruption of the control system or main source of electric power.

6.5.8 Local power accumulators for poweroperated doors shall be provided in the immediate vicinity of the doors to enable the doors to be operated after disruption of the control system or main source of electric power at least ten times (fully opened and closed) using the local controls (see also the **TL** Part B, Chapter 4, Section 10).

6.5.9 Disruption of the control system or main source of electric power at one door shall not impair the safe functioning of the other doors.

6.5.10 Remote-released sliding or power-operated doors shall be equipped with an alarm that sounds for at least 5 s but no more than 10 s after the door is released from the central control station and before the door begins to move and continue sounding until the door is completely closed.

6.5.11 A door designed to re-open upon contacting an object in its path shall re-open not more than 1 m from the point of contact.

6.5.12 Double-leaf doors equipped with a latch necessary to their fire integrity shall have a latch that is automatically activated by the operation of the doors when released by the control system.

6.5.13 Doors giving direct access to special category spaces which are power-operated and automatically closed need not be equipped with the alarms and remote-release mechanisms required in 6.5.3 and 6.5.10.

6.5.14 The components of the local control system shall be accessible for maintenance and adjusting.

6.5.15 Power-operated doors shall be provided with a control system of an approved type which shall be able to operate in case of fire **(2).** This system shall satisfy the following requirements:

6.5.15.1 the control system shall be able to operate the door at the temperature of at least 200 °C for at least 60 min, served by the power supply.

6.5.15.2 the power supply for all other doors not subject to fire shall nor be impaired; and

6.5.15.3 at temperatures exceeding 200 °C the control system shall be automatically isolated from the power supply and shall be capable of keeping the door closed up to at least 945 °C.

6.6 The requirements for "A" class integrity of the outer boundaries of a ship shall not apply to glass partitions, windows and sidescuttles, provided that there is no requirement for such boundaries to have "A" class integrity in 8.3. The requirements for "A" class integrity of the outer boundaries of the ship shall not apply to exterior doors, except for those in superstructures and deckhouses facing life-saving appliances, embarkation and external muster station areas, external stairs and open decks used for escape routes. Stairway enclosure doors need not meet this requirement.

6.7 Except for watertight, weathertight doors (semi-watertight doors), doors leading to the open deck and doors which need to be reasonably gastight, all "A" class doors located in stairways, public spaces and main vertical zone bulkheads in escape routes shall be equipped with a self-closing hose port of material, construction and fire resistance which is equivalent to the door into which it is fitted, and shall be a 150 mm square clear opening with the door closed and shall be inserted into the lower edge of the door, opposite the door hinges, or in the case of sliding doors, nearest the opening.

7. Openings in "B" class divisions

7.1 Where "B" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., or for the fitting of ventilation terminals, lighting fixtures and similar devices, arrangements shall be made to ensure that the fire resistance is not impaired. Pipes other than steel or copper that penetrate "B" class divisions shall be protected by either:

- a fire tested penetration device, suitable for the fire resistance of the division pierced and the type of pipe used; or

- a steel sleeve, having a thickness of not less than 1,8 mm and a length of not less than 900 mm for pipe diameters of 150 mm or more and not less than 600 mm for pipe diameters of less than 150 mm, preferably equally divided to each side of the division. The pipe shall be connected to the ends of the sleeve by flanges or couplings; or the clearance between the sleeve and the pipe shall not exceed 2,5 mm; or any clearance between pipe and sleeve shall be made tight by means of non-combustible or other suitable material.

7.2 Doors and door frames in "B" class divisions and means of securing them shall provide a method of closure which shall have resistance to fire equivalent to that of the divisions 2 except that ventilation openings may be permitted in the lower portion of such doors. Where such opening is in or under a door the total net area of any such opening or openings shall not exceed 0,05 m^2. Alternatively, a non-combustible air balance duct routed between the cabin and the corridor, and located below the sanitary unit is permitted where the cross-sectional area of the duct does not exceed 0,05 m^2. All ventilation openings shall be fitted with a grill made of non-combustible material. Doors shall be non-combustible and approved by **TL.**

7.3 Cabin doors in "B" class divisions shall be of a self-closing type. Hold-backs are not permitted.

7.4 The requirements for "B" class integrity of the outer boundaries of a ship shall not apply to glass partitions, windows and sidescuttles. Similarly, the requirements for "B" class integrity shall not apply to exterior doors in superstructures and deckhouses.

8. Windows and Sidescuttles

8.1 All windows and sidescuttles in bulkheads within accommodation and service spaces and control stations other than those to which the provisions of 6.6 and of 7.4 apply, shall be so constructed as to preserve the integrity requirements of the type of bulkheads in which they are fitted.

8.2 Notwithstanding the requirements of the Tables 3.5 to 3.6 all windows and sidescuttles in bulkheads separating accommodation and service spaces and control stations from weather shall be constructed with frames of steel or other suitable material. The glass shall be retained by a metal glazing bead or angle.

8.3 Windows facing life-saving appliances, embarkation and muster areas, external stairs and open decks used for escape routes, and windows situated below liferaft and escape slide embarkation areas shall have the fire integrity as required in the Tables 3.5 to 3.6. Where automatic dedicated sprinkler heads are provided for windows (see also the **TL** Part B, Chapter 4, Section 18). A-0 windows may be accepted as equivalent. Windows located in the ship's side below the lifeboat embarkation areas shall have the fire integrity at least equal to "A-0" class.

9. Ventilation Systems

9.1 In general, the ventilation fans shall be so disposed that the ducts reaching the various spaces remain within the main vertical zone.

9.2 Where ventilation systems penetrate decks, precautions shall be taken, in addition to those relating to the fire integrity of the deck required by 6. to reduce the likelihood of smoke and hot gases passing from one between deck space to another through the system. In addition to insulation requirements contained in 9. vertical ducts shall, if necessary, be insulated as required by the appropriate tables in B.4.

9.3 The main inlets and outlets of all ventilation systems shall be capable of being closed from outside the respective spaces in the event of a fire.

9.4 Except in cargo spaces, ventilation ducts shall be constructed of the following materials:

9.4.1 Ducts not less than 0,075 m^2 in sectional area and all vertical ducts serving more than a single 'tween deck space shall be constructed of steel or other equivalent material.

9.4.2 Ducts less than 0,075 m^2 in sectional area other than vertical ducts referred to in 9.4.1 shall be constructed of non-combustible materials. Where such ducts penetrate "A" or "B" Class divisions due regard shall be given to ensuring the fire integrity of the division.

9.4.3 Short lengths of duct, not in general exceeding 0,02 m² in sectional area nor 2 m in length, need not be non-combustible provided that all of the following conditions are met:

9.4.3.1 the duct is constructed of a material having low flame spread characteristics [3] which is type approved.

9.4.3.2 the duct is used only at the terminal end of the ventilation system; and

9.4.3.3 the duct is not located closer than 0,6 m measured along its length to a penetration of an "A" or "B" class division, including continuous "B" class ceilings.

9.5 Stairway enclosures shall be ventilated by an independent fan and duct system which shall not serve any other spaces in the ventilation system.

9.6 All power ventilation, except machinery and cargo spaces ventilation and any alternative system which may be required under 9.9, shall be fitted with controls so grouped that all fans may be stopped from either of two positions which shall be situated as far apart as practicable. Controls provided for the power ventilation serving machinery spaces shall also be grouped so as to be operable from two positions, one of which shall be outside such spaces. Fans serving power ventilation systems to cargo spaces shall be capable of being stopped from a safe position outside such spaces.

9.7 Where a thin plated duct with a free crosssectional area equal to or less than 0,02 m^2 passes through "A" class bulkheads or decks, the opening shall 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 decks pierced. Where ventilation ducts with a free cross-sectional area exceeding 0,02 m^2 pass through "A" class bulkheads or decks, the opening shall be lined with a steel sheet sleeve. However, where such ducts are of steel construction and pass through a deck or bulkhead, the ducts and sleeves shall comply with the following:

9.7.1 The sleeves shall have a thickness of at least 3 mm and a length of at least 900 mm. When passing through bulkheads, this length shall be divided preferably into 450 mm on each side of the bulkhead. These ducts, or sleeves lining such ducts, shall be provided with fire insulation. The insulation shall have at least the same fire integrity as the bulkhead or deck through which the duct passes.

9.7.2 Ducts with a free cross-sectional area exceeding 0,075 m^2 shall be fitted with fire dampers in addition to the requirements of 9.7.1. The fire damper shall operate automatically but shall also be capable of being closed manually from both sides of the bulkhead or deck. The damper shall 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 those spaces, provided those ducts have the same fire integrity as the divisions which they pierce. The fire dampers should be easily accessible. Where they are placed behind ceilings and linings, these latter should be provided with an inspection door on which a plate reporting the identification number of the fire damper. Such plate and identification number should be placed also on any remote control required.

9.7.3 The following arrangement shall be of an approved type [2].

9.7.3.1 Fire dampers, including relevant means of operation.

9.7.3.2 Duct penetrations through "A" class divisions. Where steel sleeves are directly joined to ventilation ducts by means of riveted or screwed flanges or by welding, the test is not required.

9.8 Exhaust ducts from galley ranges in which grease or fat is likely to accumulate shall meet the requirements as mentioned in 9.11.2 and shall be fitted with:

9.8.1 a grease trap readily removable for cleaning unless an alternative approved grease removal system is fitted;

9.8.2 a fire damper located in the lower end of the duct which is automatically and remotely operated, and in addition a remotely operated fire damper located in the upper end of the duct;

9.8.3 a fixed means for extinguishing a fire within the duct (see also **TL** Part B, Chapter 4, Section 18).

9.8.4 remote control arrangements for shutting off the exhaust fans and supply fans, for operating the fire dampers mentioned in 9.8.2 and for operating the fireextinguishing system, which shall be placed in a position close to the entrance to the galley. Where a multibranch system is installed, means shall be provided to close all branches exhausting through the same main duct before an extinguishing medium is released into the system; and

9.8.5 suitably located hatches for inspection and cleaning.

9.9 Such measures as are practicable shall be taken in respect of control stations outside machinery spaces in order to ensure that ventilation, visibility and freedom from smoke are maintained, so that in the event of fire the machinery and equipment contained therein may be supervised and continue to function effectively. Alternative and separate means of air supply shall be provided; air inlets of the two sources of supply shall be so disposed that the risk of both inlets drawing in smoke simultaneously is minimized. Such requirements need not apply to control stations situated on, and opening on to, an open deck.

9.10 The ventilation systems for machinery spaces of category A, vehicle spaces, ro-ro spaces, galleys, special category spaces and cargo spaces shall, in general, be separated from each other and from the ventilation system serving other spaces.

9.11 Ducts provided for the ventilation of machinery spaces of category A, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces shall not pass through accommodation spaces, service spaces or control stations unless the ducts are either complying with 9.11.1 or 9.11.2.

9.11.1 constructed of steel having a thickness of at least 3 mm and 5 mm for ducts the widths or diameters of which are up to and including 300 mm and 760 mm and over respectively and, in the case of such ducts, the widths or diameters of which are between 300 mm and 760 mm having a thickness to be obtained by interpolation; suitably supported and stiffened; fitted with automatic fire dampers close to the boundaries penetrated; and insulated to "A-60" standard from the machinery spaces, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces to a point at least 5 m beyond each fire damper; or

9.11.2 constructed of steel suitable supported and stiffened in accordance with 9.11.1 and insulated to "A-60" standard throughout the accommodation spaces, service spaces or control stations;

9.11.3 except that penetrations of main zone divisions shall also comply with the requirements of 9.14.

9.12 Ducts provided for the ventilation to accommodation spaces, service spaces or control stations shall not pass through machinery spaces of category A, galleys, vehicle spaces, ro-ro cargo spaces or special category spaces unless either complying with 9.12.1 or 9.12.2.

9.12.1 the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro cargo space or special category space are constructed of steel, suitable supported and stiffened in accordance with 9.11.1 and

automatic fire dampers are fitted close to the boundaries penetrated; and

integrity of the machinery space, galley, vehicle space, ro-ro cargo space or special category space boundaries is maintained at the penetrations; or

9.12.2 the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro cargo space or special category space are constructed of steel, suitable supported and stiffened in accordance with 9.11.1 are insulated to "A-60" standard within the machinery space galley, vehicle space, ro-ro cargo space or special
category space;

9.12.3 except that penetrations of main zone division shall also comply with the requirements in 9.14.

9.13 Ventilation ducts with a free cross-sectional area exceeding 0,02 m² passing through "B" class bulkheads shall be lined with steel sheet sleeves of 900 mm in length divided preferably into 450 mm on each side of the bulkheads unless the duct is of steel for this length.

9.14 Where in a ship it is necessary that a ventilation duct passes through a main vertical zone division, a fail-safe automatic closing fire damper shall be fitted adjacent to the division. The damper shall also be capable of being manually closed from each side of the division. The operating position shall be readily accessible and be marked in red light-reflecting colour.
The duct between the division and the damper shall be of steel or other equivalent material and, if necessary, insulated to comply with the requirements of 6.1. The damper shall be fitted on at least one side of the division with a visible indicator showing whether the damper is in the open position.

9.15 Power ventilation of accommodation spaces service spaces, cargo spaces, control stations and machinery spaces shall be capable of being stopped from an easily accessible position outside the space being served. This position should not be readily cut off in the event of a fire in the spaces served. The means provided for stopping the power ventilation of the machinery spaces shall be entirely separate from the means provided for stopping ventilation of other spaces.

9.16 Controls for shutting down the ventilation fans shall be centralized in a continuously manned central control station. The ventilation fans shall be capable of reactivation by the crew at this location, whereby the control panels shall be capable of indicating closed or off status of fans.

9.17 Exhaust ducts shall be provided with suitably located hatches for inspection and cleaning. The hatches shall be located near the fire damper.

9.18 Where public spaces span three or more open decks and contain combustibles such as furniture and enclosed spaces such as shops, offices and restaurants, the space shall be equipped with a smoke extraction system (see also the **TL** Part B, Chapter 4, Section 18).

10. Restriction of Combustible Materials

10.1 Except in cargo spaces, mail rooms, baggage rooms, saunas **(8)** or refrigerated compartments of service spaces, all linings, grounds, draught stops, ceilings and insulation's shall be of non-combustible materials. Partial bulkheads or decks used to subdivide a space for utility or artistic treatment shall also be of non-combustible material.

Linings, ceilings and partial bulkheads or decks used to screen or to separate adjacent cabin balconies shall be of non-combustible material.

10.2 Vapour barriers and adhesives used in conjunction with insulation, as well as insulation of pipe fittings, for cold service systems need not be noncombustible but they shall be kept to the minimum quantity practicable and their exposed surfaces shall have low flame spread characteristics.

10.3 The following surfaces shall have low flamespread characteristics **(3)**:

10.3.1 exposed surfaces in corridors and stairway enclosures, and of bulkheads, wall and ceiling linings in accommodation and service spaces (except saunas) and control stations;

10.3.2 concealed or inaccessible spaces in accommodation, service spaces and control stations,

10.3.3 exposed surfaces of cabin balconies, except for natural hard wood decking systems.

10.4 The total volume of combustible facings, mouldings, decorations and veneers in any accommodation and service space shall not exceed a volume equivalent to 2,5 mm veneer on the combined area of the walls and ceilings. Furniture fixed to linings, bulkheads or decks need not be included in the calculation of the total volume of combustible materials. This applies also to traditional wooden benches and wooden linings on bulkheads and ceilings in saunas. In the case of ships fitted with an automatic sprinkler system, the above volume may include some combustible material used for erection of "C" class divisions.

10.5 Combustible materials used on surfaces and linings covered by the requirements of 10.3 shall have a calorific value **(6)** not exceeding 45 MJ/m2 of the area for the thickness used. This does not apply to surfaces of furniture fixed to linings or bulkheads as well as to traditional wooden benches and wooden linings on bulkheads and ceilings in saunas.

10.6 Furniture in stairway enclosures shall be limited to seating. It shall be fixed, limited to six seats on each deck in each stairway enclosure, be of restricted fire risk, and shall not restrict the passenger escape route.

Furniture shall not be permitted in passenger and crew corridors forming escape routes in cabin areas. Lockers of non-combustible material, providing storage for safety equipment, may be permitted within these areas.

Drinking water dispensers and ice cube machines may be permitted in corridors provided they are fixed and do not restrict the width of the escape route. This applies as well to decorative flower arrangements, statues or other objects d'art such as paintings and tapestries in corridors and stairways.

10.7 Furniture and furnishings on cabin balconies shall comply with the following, unless such balconies are protected by a fixed pressure water-spraying and fixed fire detection and fire alarm systems.

10.7.1 case furniture shall be constructed entirely of approved non-combustible materials, except that a combustible veneer not exceeding 2 mm may be used on the working surface;

10.7.2 free-standing furniture shall be constructed with frames of non-combustible materials;

10.7.3 draperies and other suspended textile materials shall have qualities of resistance to the propagation of flame not inferior to those of wool having a mass of 0,8 kg/m^2 **(10);**

10.7.4 upholstered furniture shall have qualities of resistance to the ignition and propagation of flame **(11)** and

10.7.5 bedding components shall have qualities of resistance to the ignition and propagation of flame **(12).**

10.8 Paints, varnishes and other finishes used on exposed interior surfaces, including cabin balconies with the exclusion of natural hard wood decking systems, shall not be capable of producing excessive quantities of smoke and toxic products **(4).**

10.9 Primary deck coverings, if applied within accommodation and service spaces and control stations or if applied on cabin balconies, shall be of approved material which will not readily ignite, or give rise to smoke or toxic or explosive hazards at elevated temperatures **(5).**

10.10 Waste receptacles shall be constructed of non-combustible materials with no openings in the sides or bottom. Containers in galleys, pantries, bars, garbage handling or storage spaces and incinerator rooms which are intended purely for the carriage of wet waste, glass bottles and metal cans may be constructed of combustible materials.

11. Details of Construction

11.1 In accommodation and service spaces, control stations, corridors and stairways, air spaces enclosed behind ceilings, panelling or linings shall be suitably

(10) *Reference is made to the Fire Test Procedure Code, adopted by IMO by Resolution MSC.307(88)e.*

(11) *Reference is made to the Fire Test Procedure Code, adopted by IMO by Resolution MSC.307(88).*

(12) *Reference is made to the Fire Test Procedure Code, adopted by IMO by Resolution MSC.307(88).*

divided by close-fitting draught stops not more than 14 m apart. In the vertical direction, such enclosed air spaces, including those behind linings of stairways, trunks, etc. shall be closed at each deck.

11.2 The construction of ceilings and bulkheads shall be such that it will be possible, without impairing the efficiency of the fire protection, for the fire patrols to detect any smoke originating in concealed and inaccessible spaces.

11.3 Non-load bearing partial bulkheads separating adjacent cabin balconies shall be capable of being opened by the crew from each side for the purpose of fighting fires.

11.4 The cargo holds and machinery spaces shall be capable of being effectively sealed such as to prevent the inlet of air.

Doors leading to machinery spaces of category A are to be provided with self-closing devices and two securing devices. All other machinery spaces, which are protected by gas fire extinguishing system, are to be equipped with self-closing doors.

11.5 Construction and Arrangement of Saunas

11.5.1 The perimeter of the sauna shall be of "A" class boundaries and may include changing rooms, showers and toilets. The sauna shall be insulated to "A–60" standard against other spaces except those inside the perimeter and spaces of category (5), (9) and (10).

11.5.2 Bathrooms with direct access to saunas may be considered as part of them. In such cases, the door between sauna and the bathroom need not comply with fire safety requirements.

11.5.3 The traditional wooden lining on the bulkheads and on the ceiling are permitted in the sauna. The ceiling above the oven shall be lined with a noncombustible plate with an air-gap of at least 30 mm. The distance from the hot surfaces to combustible materials shall be at least 500 mm or the combustible materials shall be suitably protected.

11.5.4 The traditional wooden benches are permitted to be used in the sauna.

11.5.5 The sauna door shall open outwards by pushing.

11.5.6 Electrically heated ovens shall be provided with a timer.

12. Means of Escape

12.1 Unless expressly provided otherwise in this

regulation, at least two widely separated and ready means of escape shall be provided from all spaces or group of spaces. Lifts shall not be considered as forming one of the required means of escape.

12.2 Doors in escape routes shall, in general, open in way of the direction of escape, except that:

- individual cabin doors may open into the cabins in order to avoid injury to persons in the corridor when the door is opened

- doors in vertical emergency escape trunks may open out of the trunk in order to permit the trunk to be used both for escape and access

12.3 Stairways and ladders shall be arranged to provide ready means of escape to the lifeboat and liferaft embarkation deck from all passenger and crew spaces and from spaces in which the crew is normally employed, other than machinery spaces. In particular, the following provisions shall be complied with:

12.3.1 Below the bulkhead deck two means of escape, at least one of which shall be independent of watertight doors, shall be provided from each watertight compartment or similarly restricted space or group of spaces. Due regard being paid to the nature and location of spaces and to the number of persons who normally might be employed there, exceptions are possible, however, stairways shall not be less than 800 mm in clear width with handrails on both sides.

12.3.2 Above the bulkhead deck, there shall be at least two means of escape from each main vertical zone or similarly restricted space or group of spaces at least one of which shall give access to a stairway forming a vertical escape.

12.3.3 At least one of the means of escape required by paragraphs 12.3.1 and 12.3.2 shall consist of a readily accessible enclosed stairway, which shall provide continuous fire shelter from the level of its origin to the appropriate lifeboat and liferaft embarkation decks, or to the uppermost weather deck if the embarkation deck does not extend to the main vertical zone being considered. In the latter case, direct access to the embarkation deck by way of external open stairways and passageways shall be provided and shall have emergency lighting (see also the **TL** Part B, Chapter 5, Section 3 and 11) and slipfree surfaces under foot. Boundaries facing external open stairways and passageways forming part of an escape route and boundaries in such a position that their failure during a fire would impede escape to the embarkation deck shall have fire integrity, including insulation values, in accordance with the Tables 3.5 and 3.6. The widths, number and continuity of escapes shall be as follows:

12.3.3.1 Stairways shall not be less than 900 mm in clear width. Stairways shall be fitted with handrails on each side. The minimum clear width of stairways shall be increased by 10 mm for every one person provided for in excess of 90 persons. The maximum clear width between handrails where stairways are wider than 900 mm shall be 1800 mm. The total number of persons to be evacuated by such stairways shall be assumed to be two thirds of the crew and the total number of passengers in the areas served by such stairways **(7).**

12.3.3.2 All stairways sized for more than 90 persons shall be aligned fore and aft.

12.3.3.3 Doorways and corridors and intermediate landings included in means of escape shall be sized in the same manner as stairways. The aggregate width of stairway exit doors to the assembly station shall not be less than the aggregate width of stairways serving this deck.

12.3.3.4 Stairways shall not exceed 3,5 m in vertical rise without the provision of a landing and shall not have an angle of inclination greater than 45°.

12.3.3.5 Landings at each deck level shall be not less than 2 m^2 in area and shall increase by 1 m^2 for every 10 persons provided for in excess of 20 persons but need not exceed 16 m^2, except for those landings servicing public spaces having direct access onto the stairway enclosure.

12.3.4 Stairways serving only a space and a balcony in that space shall not be considered as forming one of the means of escape.

12.3.5 A corridor, lobby, or part of a corridor from which there is only one route of escape shall not be permitted. Dead-end corridors used in service areas which are necessary for the practical utility of the ship, such as fuel oil stations and athwartship supply corridors shall be permitted provided such dead-end corridors are separated from crew accommodation areas and are inaccessible from passenger accommodation areas. Also, a part of the corridor that has a depth not exceeding its width is considered a recess or local extension and is permitted.

12.3.6 In addition to the emergency lighting (see also the **TL** Part B, Chapter 5, Section 3 and 10), the means of escape including stairways and exits, shall be marked by lighting or photoluminescent strip indicators placed not more than 0,3 m above the deck at all points of the escape route including angles and intersections. The marking shall enable passengers to identify all the routes of escape and readily identify the escape exits. If electric illumination is used, it shall be supplied by the emergency source of power and it shall be so arranged that the failure of any single light or cut in a lighting strip, will not result in the marking being ineffective. Additionally, all escape route signs and fire equipment location markings shall be of photoluminescent material or marked by lighting. Such lighting or photoluminescent equipment shall be of an approved type **(7).**

12.3.7 The requirement of 12.3.6 shall also apply to the crew accommodation areas.

12.3.8 Public Spaces spanning three or more decks and contain combustibles such as furniture and enclosed spaces such as shops, offices and restaurants shall have at each level within the space two means of escape, one of which shall have direct access to an enclosed vertical means of escape as mentioned under 12.3.3.

12.4 If a radiotelegraph station has no direct access to the open deck, two means of escape from or access to such station shall be provided, one of which may be a porthole or window of sufficient size or another means.

12.5 In special category spaces the number and disposition of the means of escape both below and above the bulkhead deck shall be satisfactory as mentioned under 12.3.1, .2 and .3.

12.6 Two means of escape shall be provided from each machinery space. In particular, the following provisions shall be complied with:

12.6.1 Where the space is below the bulkhead deck the two means of escape shall consist of either:

12.6.1.1 two sets of steel ladders as widely separated as possible, leading to doors in the upper part of the space similarly separated and from which access is provided to the appropriate lifeboat and liferaft embarkation decks. One of these ladders shall be located within a protected enclosure having fire integrity, including insulation values, in accordance with the Tables 3.5 and 3.6 for a category (2) space, from the lower part of the space to a safe position outside the space. Self-closing doors of the same fire integrity standards shall be fitted in the enclosure. The ladder shall be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The protected enclosure shall have minimum internal dimensions of at least 800 mm × 800 mm, and shall have emergency lighting provisions.

12.6.1.2 or one steel ladder leading to a door in the upper part of the space from which access is provided to the embarkation deck and additionally, in the lower part of the space and in a position well separated from the ladder referred to, a steel door capable of being operated from each side and which provides access to a safe escape route from the lower part of the space to the embarkation deck.

12.6.2 Where the space is above the bulkhead deck, two means of escape shall be as widely separated as possible and the doors leading from such means of escape shall be in a position from which access is provided to the appropriate lifeboat and liferaft embarkation decks. Where such escapes require the use of ladders these shall be of steel.

12.6.3 A ship of a gross tonnage less than 1 000 may be dispensed with one of the means of escape, due regard being paid to the width and disposition of the upper part of the space; and a ship of a gross tonnage of 1 000 and above, may be dispensed with one means of escape from any such space so long as either a door or a steel ladder provides a safe escape route to the embarkation deck, due regard being paid to the nature and location of the space and whether persons are normally employed in that space.

12.6.4 In the steering gear room, a second means of escape shall be provided when the emergency steering position is located in that space unless there is direct access to the open deck.

12.6.5 One of the escape routes from the machinery spaces where the crew is normally employed shall avoid direct access to any special category space.

12.6.6 Two means of escape shall be provided from a machinery control room within a machinery space, at least one of which shall provide continuous fire shelter to a safe position outside the machinery space.

12.7 Additional Requirements for Ro-Ro Ships

12.7.1 Handrails or other handholds shall be provided in all corridors along the entire escape route, so that a firm handhold is available every step of the way, where possible, to the assembly stations and embarkation stations. Such handrails shall be provided on both sides of longitudinal corridors more than 1,8 m in width and transverse corridors more than 1 m in width. Particular attention shall be paid to the need to be able to cross lobbies, atriums and other large open spaces along escape routes. Handrails and other handholds shall be of such strength as to withstand a distributed horizontal load of 750 N/m applied in the direction of the centre of the corridor or space, and a distributed vertical load of

750 N/m applied in the downward direction. The two loads need not be applied simultaneously.

12.7.2 Escape routes shall be provided from every normally occupied space on the ship to an assembly station. These escape routes shall be arranged so as to provide the most direct route possible to the assembly station and shall be marked with relevant symbols.

12.7.3 Where enclosed spaces adjoin an open deck, openings from the enclosed space to the open deck shall, where practicable, be capable of being used as an emergency exit.

12.7.4 Decks shall be sequentially numbered, starting with "1" at the tank top or lowest deck. These numbers shall be prominently displayed at stair landings and lift lobbies. Decks may also be named, but the deck number shall always be displayed with the name.

12.7.5 Simple "mimic" plans showing the "you are here" position and escape routes marked by arrows, shall be prominently displayed on the inside of each cabin door and in public spaces. The plan shall show the directions of escape, and shall be properly oriented in relation to its position on the ship.

12.7.6 Cabin and stateroom doors shall not require keys to unlock them from inside the room. Neither shall there be any doors along any designed escape route which require keys to unlock them when moving in the direction of escape.

12.7.7 The lowest 0,5 m of bulkheads and other partitions forming vertical divisions along escape routes shall be able to sustain a load of 750 N/m to allow them to be used as walking surfaces from the side of the escape route with the ship at large angles of heel.

12.7.8 The escape route from cabins to stairway enclosures shall be as direct as possible, with a minimum number of changes in direction. It shall not be necessary to cross from one side of the ship to the other to reach an escape route. It shall not be necessary to climb more than two decks up or down in order to reach an assembly station or open deck from any passenger space.

12.7.9 External routes shall be provided from open decks, referred to in 12.7.8, to the survival craft embarkation stations.

12.7.10 Designated walkways to the means of escape with a breadth of at least 600 mm shall be provided in special category and open ro-ro spaces to which any passengers carried have access.

12.7.11 At least two means of escape shall be provided in ro-ro spaces where the crew are normally employed. The escape routes shall provide safe escape to the lifeboat and liferaft embarkation decks and shall be located at the fore and aft ends of the space.

12.8 Evacuation analysis for passenger ships

Escape routes are to be evaluated by an evacuation analysis early in the design process **(13).** This analysis shall apply to ro-ro passenger ships and passenger ships carrying more than 36 passengers.

The analysis shall be used to identify and eliminate, as far as practicable, congestion which may develop during an abandonment, due to normal movement of passengers and crew along escape routes, including the possibility that crew may need to move along these routes in a direction opposite the movement of passengers.

In addition, the analysis shall be used to demonstrate the escape arrangements are sufficiently flexible to provide for the possibility that certain escape routes, assembly stations, embarkation stations or survival craft may not be available as a result of a casualty.

(13) *Reference is made to the Guidelines for evacuation analyses for new and existing passenger ships adopted by IMO by MSC.1/Circ. 1533*

13. Fixed Fire Detection and Fire Alarm Systems and Automatic Sprinkler, Fire Detection and Fire Alarm Systems

13.1 Any ship shall be equipped with:

- an automatic sprinkler, fire detection and fire alarm system in all service spaces, control stations and accommodation spaces, including corridors and stairways (see also the **TL** Part B, Chapter 4, Section 18).

- a fixed fire detection and alarm system so installed and arranged as to provide smoke detection in service spaces, control stations and accommodation spaces, including corridors and stairways (see also the **TL** Part B, Chapter 4, Section 18).

13.2 Control stations where water may cause damage to essential equipment may be fitted with a fixed fire-extinguishing system of another type (see also the **TL** Part B, Chapter 4, Section 18).

13.3 Cabin balconies shall be equipped with a fixed fire detection and fire alarm system and a fixed pressure water-spraying system (see also the **TL** Part B, Chapter 4, Section 18). when furniture and furnishings on such balconies are not complying with 10.7.

13.4 Smoke detectors need not be fitted in private bathrooms and galleys. Spaces having little or no fire risk such as voids, public toilets and similar spaces need not be fitted with an automatic sprinkler, or fixed fire detection and alarm system.

14. Protection of Vehicle, Special Category and Ro-Ro Spaces

14.1 The subdivision of such spaces in main vertical zones would defeat their intended purpose. Therefore equivalent protection shall be obtained in such spaces on the basis of a horizontal zone concept. A horizontal zone may include special category and ro-ro spaces on more than one deck provided that the total overall clear height for vehicles does not exceed 10 m, whereas the total overall clear height is the sum of distances between deck and web frames of the decks forming the horizontal zone.

14.2 Structural Protection

The boundary bulkheads and decks of special category spaces and ro-ro spaces shall be insulated to "A-60" class standard. However, where a category 4.3 [5], 4.3 [9] or 4.3 [10] space is on one side of the division the standard may be reduced to "A-0".

Where fuel oil tanks are below a special category space, the integrity of the deck between such spaces may be reduced to "A-0" standard.

Indicators shall be provided on the navigating bridge which shall indicate when any fire door leading to or from the special category space is closed.

14.3 Fixed Fire-extinguishing System

14.3.1 Vehicle spaces and ro-ro spaces which are not special category spaces and are capable of being sealed from a location outside of the cargo spaces shall be fitted with a fixed gas fire-extinguishing system of an approved type (see also the **TL** Part B, Chapter 4, Section 18).

14.3.2 Ro-ro and vehicle spaces not capable of being sealed and special category spaces shall be fitted with a fixed pressure water spraying system for manual operation of an approved type (see also the **TL** Part B, Chapter 4, Section 18).

14.4 Ventilation System

There shall be provided an effective power ventilation system for special category spaces and closed ro-ro and vehicle spaces sufficient to give at least 10 air changes per hour. Beyond this, a higher air exchange rate is required during the period of loading and unloading. The system for such spaces shall be entirely separated from other ventilation systems and shall be operating at all times when vehicles are in such spaces.

Ventilation ducts serving such spaces capable of being effectively sealed shall be separated for each such space. The system shall be capable of being controlled from a position outside such spaces.

The ventilation shall be such as to prevent air stratification and the formation of air pockets.

Means shall be provided to indicate on the navigating bridge any loss or reduction of the required ventilating capacity.

Arrangements shall be provided to permit a rapid shutdown and effective closure of the ventilation system in case of fire, taking into account the weather and sea conditions.

Ventilation ducts, including dampers, within a common horizontal zone shall be made of steel. Ducts passing through other horizontal zones or machinery spaces shall be "A-60" class steel ducts complying with 9.11.1 and 9.11.2.

Permanent openings in the side plating, the ends or deckhead of the space shall be so situated that a fire in the cargo space does not endanger stowage areas and embarkation stations for survival craft and accommodation spaces, service spaces and control stations in superstructures and deckhouses above the cargo spaces.

14.5 Fire Detection

There shall be provided a fixed fire detection and fire alarm system of an approved type (see also the **TL** Part B, Chapter 4, Section 18). A sample extraction smoke detection system of an approved type (see also **TL** Part B, Chapter 4, Section 18) may be accepted as equivalent, except for open ro-ro spaces, open vehicle spaces and special category spaces.

An efficient fire patrol system shall be maintained in special category spaces. In case of a continuous fire watch at all times during the voyage, a fixed fire detection and alarm system is not required therein.

15. Special Arrangements in Machinery Spaces of Category A

15.1 The number of skylights, doors, ventilators, openings in funnels to permit exhaust ventilation and other openings to machinery spaces shall be reduced to a minimum consistent with the needs of ventilation and the proper and safe working of the ship.

15.2 Skylights shall be of steel and shall not contain glass panels. Suitable arrangements shall be made to permit the release of smoke in the event of fire, from the space to be protected. The normal ventilation systems may be acceptable for this purpose.

15.3 Means of control shall be provided for permitting the release of smoke and such controls shall be located outside the space concerned so that, in the event of fire, they will not be cut off from the space they serve. The controls shall be situated at one control position or grouped in as few positions as possible. Such positions shall have safe access from the open deck.

15.4 Such doors other than power-operated watertight doors shall be arranged so that positive closure is assured in case of fire in the space, by power-operated closing arrangements or by the provision of selfclosing doors capable of closing against an inclination of 3,5° opposing closure and having a fail-safe hookback facility, provided with a remotely operated release device. Doors for emergency escape trunks need not be fitted with a fail-safe hold-back facility and a remotely operated release device.

15.5 Means of control shall be provided for closing power-operated doors or actuating release mechanism on doors other than power-operated watertight doors. The control shall be located outside the space concerned, where they will not be cut off in the event of fire in the space it serves. The means of control shall be situated at one control position or grouped in as few positions as possible having direct access and safe access from the open deck.

15.6 Windows shall not be fitted in machinery space boundaries. This does not preclude the use of glass in control rooms within the machinery spaces.

15.7 The floor plating of normal passageways shall be made of steel.

16. Special Requirements for Ships Carrying Dangerous Goods

16.1 Ventilation

Adequate power ventilation shall be provided in enclosed cargo spaces. The arrangement shall be such as to provide for at least six air changes per hour in the cargo space based on an empty cargo space and for removal of vapours from the upper or lower parts of the cargo space, as appropriate.

The fans shall be such as to avoid the possibility of ignition of flammable gas air mixtures. Suitable wire mesh guards shall be fitted over inlet and outlet ventilation openings.

16.2 Insulation of Machinery Space Boundaries

Bulkheads forming boundaries between cargo spaces and machinery spaces of category A shall be insulated to "A-60" standard, unless the dangerous goods are stowed at least 3 m horizontally away from such bulkheads. Other boundaries between such spaces shall be insulated to "A-60" standard.

16.3 Miscellaneous Items

The kind and extent of the fire extinguishing equipment are defined in the **TL** Part B, Chapter 4, Section 18.

Electrical apparatus and cablings are to meet the requirements of the **TL** Part B, Chapter 5, Section 16.

E. Additional Requirements for Ships Carrying Crude Oil and Petroleum Products

(These requirements are additional to those of B., C. and D. except as provided otherwise in 3. and 4.)

1. Application

1.1 Unless expressly provided otherwise, this Section shall apply to tankers carrying crude oil and petroleum products having a flashpoint not exceeding 60 °C (closed cup test), as determined by an approved flashpoint apparatus, and a Reid vapour pressure which is below atmospheric pressure and other liquid products having a similar fire hazard.

1.2 Where liquid cargoes other than those referred to in 1.1 or liquefied gases which introduce additional fire hazards are intended to be carried the requirements for ships carrying liquefied gases in bulk, the **TL** Part C, Chapter 10and the requirements for ships carrying dangerous chemicals in bulk, the **TL** Part C, Chapter 8are to be taken into account.

1.3 Tankers carrying petroleum products having a flashpoint exceeding 60 °C (closed cup test) as determined by an approved flashpoint apparatus shall comply with the provisions of D.

1.4 Chemical tankers and gas carriers shall comply with the requirements of this Section, unless other and additional safety precautions according the requirements for ships carrying liquefied gases in bulk, the **TL** Part C, Chapter 10and the requirements for ships carrying dangerous chemicals in bulk, the **TL** Part C, Chapter 8 apply.

2. Construction

2.1 Exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation shall be constructed of steel and insulated to "A-60" standard for the whole of the portions which face the cargo area and on the outward sides for a distance of 3 m from the end boundary facing the cargo area. In the case of the sides of those superstructures and deckhouses, such insulation shall be carried up to the underside of the bridge deck.

2.2 Entrances, air inlets and openings to accommodation spaces, service spaces and control stations shall not face the cargo area. They shall be located on the end bulkhead not facing the cargo area and/or on the outboard side of the superstructure or deckhouse at a distance of at least 4 % of the length of the ship but not less than 3 m from the end of the superstructure or deckhouse facing the cargo area. This distance, however, need not exceed 5 m.

In this area doors to those spaces not having access to accommodation spaces, service spaces and control stations, such as cargo control stations, provision rooms, store-rooms and engine rooms may be permitted provided that the boundaries of the spaces are insulated to "A-60" standard.

Bolted plates for the removal of machinery may be fitted within the limits of such areas.

Navigating bridge doors and wheelhouse windows may be located within this area, so long as they are so designed that a rapid and efficient gas and vapour tightening of the navigating bridge can be ensured.

2.3 Windows and side scuttles facing the cargo area and on the sides of the superstructures and deckhouses within the limits specified in 2.2 shall be of the fixed (non-opening) type 2.

Such windows and sidescuttles, except wheelhouse windows, shall be constructed to "A-60" class standard and shall be of an approved type, except the "A- 0" class standard is acceptable for windows and sidescuttles outside the limits specified in 2.1.

2.4 Skylights to cargo pump rooms shall be of steel, shall not contain any glass and shall be capable of being closed from outside the pump room.

3. Structure, Bulkheads Within Accommodation and Service Spaces and Details of Construction

For the application of the requirements of B.2., B.3.and B.9. to tankers, only method IC as defined in B.2.1.1 shall be used.

4. Fire Integrity of Bulkheads and Decks

4.1 In lieu of B.4. and in addition to complying with the specific provisions for fire integrity of bulkheads and decks mentioned elsewhere in this Section the minimum fire integrity of bulkheads and decks shall be as prescribed in Tables 3.7 and 3.8.

4.2 The following requirements shall govern application of the Tables:

Tables 3.7 and 3.8 shall apply respectively to the bulkhead and decks separating adjacent spaces.

4.3 For determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in categories 1 to 10 below. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of this regulation, or where it is possible to assign two or more classifications to a space, it shall be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30 % communicating openings to that space are considered separate spaces. The fire integrity of the boundary bulkheads of such smaller rooms shall be as prescribed in Tables 3.7 and 3.8. The title of each category is intended to be typical rather than restrictive. The number in parentheses preceding each category refers to the applicable column or row in the Tables.

[1] Control Stations

Spaces containing emergency sources of power and lighting. Wheelhouse and chartroom. Spaces containing the ship's radio equipment. Fire control stations. Control room for propulsion machinery when located outside the machinery space. Spaces containing centralized fire alarm equipment.

[2] Corridors

Corridors and lobbies.

[3] Accommodation Spaces

Spaces used for public spaces, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, barber shops, pantries containing no cooking appliances and similar spaces.

[4] Stairways

Interior stairways, lifts, totally enclosed emergency escape trunks 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 shall be regarded as part of the space from which it is not separated by a fire door.

[5] Service Spaces (low risk)

Lockers and store-rooms not having provisions for the storage of flammable liquids and having areas less than 4 m^2 and drying rooms and laundries.

[6] Machinery Spaces of Category A

Spaces and trunks to such spaces which contain:

internal combustion machinery used for main propulsion; or

internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

any oil-fired boiler or oil fuel unit.

[7] Other Machinery Spaces

Spaces, other than machinery spaces of category A, containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces. Electrical equipment rooms (auto-telephone exchange and air-conditioning duct spaces).

[8] Cargo Pump Rooms

Spaces containing cargo pumps and entrances and trunks to such spaces.

[9] Service Spaces (high risk)

Galleys, pantries containing cooking appliances, saunas, paint and lamp rooms, lockers and storerooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids, and workshops other than those forming part of the machinery spaces.

[10] Open Decks

Open deck spaces and enclosed promenades having little or no fire risk. Air spaces (the space outside superstructures and deckhouses).

4.4 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.

4.5 External boundaries which are required in B.1. to be of steel or other equivalent material may be pierced for the fitting of windows and sidescuttles provided that there is not requirement for such boundaries to have "A" class integrity elsewhere in these requirements. Similarly, in such boundaries which are not required to have "A" class integrity, doors may be of materials to meet the requirements of their application.

4.6 Permanent approved gastight lighting enclosures for illuminating cargo pump rooms may be permitted in bulkheads and decks separating cargo pump rooms and other spaces provided they are of adequate strength and the integrity and gastightness of the bulkhead or deck is maintained.

4.7 Construction and Arrangement of Saunas

See D.11.5.

F. Helicopter Decks

1. Helicopter decks shall be of a steel or steel equivalent fire-resistant construction. If the space below the helicopter deck forms the deckhead of a deckhouse or superstructure, it shall be insulated to "A-60" class standard.

2. For helicopter decks of aluminium or other low melting metal construction the following provisions shall be satisfied:

2.1 If the helicopter deck is cantilevered over the side of the ship, after each fire on the ship or on the helicopter deck, the helicopter deck shall undergo a structural analysis to determine its suitability for further use.

2.2 If the helicopter deck is located above the ship's deckhouse or similar structure, the following conditions shall be satisfied:

2.2.1 the deckhouse top and bulkheads under the helicopter deck shall have no openings;

2.2.2 all windows under the helicopter deck shall be provided with steel shutters;

Table 3.7 Fire integrity of bulkheads separating adjacent spaces

Spaces		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Control stations	[1]	**(3)** A-0	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	**(6)**
Corridors	[2]		C	B-0	B-0 A-0 **(1)**	B-0	A-60	A-0	A-60	A-0	**(6)**
Accommodation spaces	[3]			C	B-0 A-0**(1)**	B-0	A-60	A-0	A-60	A-0	**(6)**
Stairways	[4]				B-0 A-0**(1)**	B-0 A-0**(1)**	A-60	A-0	A-60	A-0	**(6)**
Service spaces (Low risk)	[5]					C	A-60	A-0	A-60	A-0	**(6)**
Machinery spaces of category A	[6]						**(6)**	A-0	A-0**(4)**	A-60	**(6)**
Other machinery spaces	[7]							A-0**(2)**	A-0	A-0	**(6)**
Cargo spaces	[8]								**(6)**	A-60	**(6)**
Service spaces (High risk)	[9]									A-0**(2)**	**(6)**
Open decks	[10]										

Notes to be applied to Tables 3.3 and 3.4, as appropriate:

(1) *For clarification as to which applies see item 3. and 5.*

(2) *Where spaces are of the same numerical category and **(2)** appears, a bulkhead or deck of the ratings shown in the tables in 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.*

(3) *Bulkheads separating the wheelhouse and chartroom from each other may be "B-0" rating. No fire rating is required for those partitions separating the navigation bridge and the safety centre when the latter is within the navigation bridge.*

(4) *In determining the applicable fire integrity standard of a boundary between two spaces within a main vertical zone or horizontal zone which is not protected by an automatic sprinkler system complying with the provisions of the FSS Code or between such zones neither of which is so protected, the higher of the two values given in the tables shall apply.*

In determining the applicable fire integrity standard of a boundary between two spaces within a main vertical zone or horizontal zone which is protected by an automatic sprinkler system complying with the provisions of the FSS Code or between such zones both of which are so protected, the lesser of the two values given in the tables shall apply. Where a zone with sprinklers and a zone without sprinklers meet within accommodation and service spaces, the higher of the two values given in the tables shall apply to the division between the zones.

(5) *For the application of item 2.2,"B-0" and "C", where appearing in Table 3.3, shall be read as "A-0".*

(6) *Fire insulation need not be fitted if the machinery space of category [7], in the opinion of the Administration, has little or no fire risk.*

(7) *Where **(7)** appears in the tables, the division is required to be of steel or other equivalent material but is not required to be of "A" class standard.*

*However, where a deck, except in a category (10) space, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations should be made tight to prevent the passage of flame and smoke. Divisions between control stations (emergency generators) and open decks may have air intake openings without means for closure, unless a fixed gas fire-fighting system is fitted.For the application of item 2.2 a where **(7)** appears in Table 21.4, except for categories [8] and [10], shall be read as "A-0".*

(8) *Ships constructed before 1 July 2014 shall comply, as a minimum, with the previous requirements applicable at the time the ship was constructed, as specified in SOLAS Chapter II-2, Regulation 1.2.*

Table 3.8 Fire integrity of decks separating adjacent spaces

Spaces above → Space below ↓		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Control stations	[1]	A-0	A-0	A-0	A-0	A-0	A-60	A-0	-	A-0	**(6)**
Corridors	[2]	A-0	**(6)**	**(6)**	A-0	**(6)**	A-60	A-0	-	A-0	**(6)**
Accommodation spaces	[3]	A-60	A-0	**(6)**	A-0	**(6)**	A-60	A-0	-	A-0	**(6)**
Stairways	[4]	A-0	A-0	A-0	**(6)**	A-0	A-60	A-0	-	A-0	**(6)**
Service spaces (Low risk)	[5]	A-15	A-0	A-0	A-0	**(6)**	A-60	A-0	-	A-0	**(6)**
Machinery spaces of category A	[6]	A-60	A-60	A-60	A-60	A-60	**(6)**	A-60 **(5)**	A-0	A-60	**(6)**
Other machinery spaces	[7]	A-15	A-0	A-0	A-0	A-0	A-0	**(6)**	A-0	A-0	**(6)**
Cargo spaces	[8]	-	-	-	-	-	A-0**(4)**	A-0	**(6)**	-	**(6)**
Service spaces (High risk)	[9]	A-60	A-0	A-0	A-0	A-0	A-60	A-0	-	A-0**(2)**	**(6)**
Open decks	[10]	**(6)**	**(6)**	**(6)**	**(6)**	**(6)**	**(6)**	**(6)**	**(6)**	**(6)**	-
See notes under Table 3.7											

2.2.3 the required fire-fighting equipment shall be in accordance with the requirements of Section 17.C.

2.2.4 after each fire on the helicopter deck or in close proximity, the helicopter deck shall undergo a structural analysis to determine its suitability for further use.

3. A helicopter deck shall be provided with both a main and an emergency means of escape and access for fire fighting and rescue personnel. These shall be located as far as apart from each other as is practicable and preferably on opposite sides of the helicopter deck.

SECTION 4

INTACT and DAMAGE STABILITY

A. General

This section applies to every new decked offshore service vessel of 24 m and over but not more than 100 m in length. The intact and damage stability of an offshore service vessel of more than 100 m in length should be to the satisfaction of the Administration.

Provisions for offshore service vessels carrying more than 12 industrial personnel are given in the Special Purpose Ship Code.

B. Intact Stability

The intact stability of the offshore service vessels is to comply with IMO 2008 IS Code respectively (the Code). Special requirements to be applicable to offshore service vessels of 24 m and over but not more than 100 m in length are given.

The intact stability of an offshore service vessel of more than 100 m in length should be to the satisfaction of the Administration.

1. General Criteria

1.1 Beside **TL** Part A, Chapter 1, Section 26, B.1 following items are to assured.

1.2 For vessels engaged in near-coastal voyages, relaxations from the requirements of this section may be permitted by the relevant Administration. It is of the responsibility of the Administration to indicate which set of criteria are to be fulfilled.

2. Precautions Against Capsizing

Precautions and operational procedures against capsizing are to be in accordance with **TL** Part A, Chapter 1, Section 26, D.5.3 and 5.4.

3. Intact Stability Criteria

3.1 Criteria Regarding Righting Lever Curve Properties

3.1.1 Righting Lever Curve criteria have to be in accordance with **TL** Part A, Chapter 1, Section 26, D, 5.5 and 5.6

C. Stability Booklet

1. Guidance in Preparing Stability Information

1.1 Effect of Free Surfaces of Liquids in Tanks

1.1.1 The effect of free surfaces of liquids in tanks are to be in accordance with **TL** Part A, Chapter 1, Sec.26, B.3

1.2 Permanent Ballast

See **TL** Part A, Chapter 1, Section 26, B.5

1.3 Assessment of Compliance With Stability Criteria

1.3.1 For assessment of compliance with stability criteria in general, stability curves using the assumptions given in this section should be drawn for the loading conditions intended by the owner in respect of the ship's operations.

1.3.2 If the owner of the ship does not supply sufficient detailed information regarding such loading conditions, calculation should be made for the Standard loading conditions.

1.4 Standard Conditions of Loading to be Examined

1.4.1 Loading Conditions

The standard loading conditions are defined as follows.

1.4.1.1 For an offshore service vessel the Standard loading conditions should be as for offshore supply vessels, given in **TL** Part A, Chapter 1, Section 26, B.2.9 with additions as follows:

.1 Vessel in ballast departure condition, without cargo but full stores and fuel;

.2 Vessel in ballast arrival condition, without cargo and with 10 % stores and fuel remaining; and

.3 If the ship is equipped with towing gear, realistic loading conditions under consideration of the tow line forces have to be considered.

.4 if the ship is equipped with towing gear, compliance with the stability criteria of Section 6 is to be shown;

1.4.2 Assumptions for Calculating Loading Conditions

1.4.2.1 For offshore service vessels the assumptions for calculating loading conditions should be as for offshore supply vessels, given in **TL** Part A, Chapter 1, Section 26, B.2.12.7 with additions as follows:

1. Where applicable, if the ship is equipped with towing gear, realistic loading conditions shall be included. The tow line forces have to be considered.

1.5 Calculation of Stability Curves

1.5.1 General

1.5.1.1 Hydrostatic and stability curves should be in accordance with **TL** Part A, Chapter 1, Sec. 26, B.9.1

1.5.2 Superstructure, Deckhouses, etc., Which may be Taken Into Account

See **TL** Part A, Chapter 1, Section 26, B.9.2

1.6 Stability Booklet

As far as applicable the stability booklet is to be in accordance with **TL** Part A, Chapter 1, Section 26, B.8.

1.7 Icing Considerations

1.7.1 General

Ice accretion allowances have to be in accordance with **TL** Part A, Chapter 1, Section 26, B.4.3.1.

1.7.2 For guidance relating to ice accretion please refer to Section 25, A.6.3.

D. Damage Stability

The damage stability of the offshore service vessels is to comply with the MSC.235(82) and MSC.335(90) .

The damage stability of an offshore service vessel of more than 100 m in length should be to the satisfaction of the Administration.

Chapter II-1, Regulation 4 through 7-3 of **SOLAS 74** as amended can be used if no other requirement imposed by the Administration.

1. General

Taking into account, as initial conditions before flooding, the standard loading conditions as referred to in C.1.4 and the damage assumptions in 1.1, the vessel should comply with the damage stability criteria as specified in 1.2.

1.1 Damage Assumptions

1.1.1 Damage should be assumed to occur anywhere in the vessel's length between transverse watertight bulkheads.

1.1.2 The assumed extent of damage should be as follows:

.1 Longitudinal extent:

- vessels with the length (L) not greater than 43 m : 10 % of L,
- vessels with length (L) greater than 43 m and less than 80 m : 3 m plus 3 % of L,
- vessels with length (L) from 80 m to 100 m: 1/3 $L^{2/3}$.

.2 Transverse extent:

- vessels with length (L) less than 80 m : 760 mm
- vessels with length (L) 80 m to 100 m : B/20, but not less than 760 mm.

The transverse extent of damage should be measured inboard from the side of the vessel perpendicularly to the centreline at the level of the summer load waterline,

.3 Vertical extent: from the underside of the cargo deck, or the continuation thereof, for the full depth of the vessel.

1.1.3 The transverse extent of damage should be assumed as 760 mm, measured inboard from the side of the vessel perpendicularly to the centreline at the level of the summer load waterline.

1.1.4 For a vessel with length (L) less than 80 m, a transverse watertight bulkhead extending from the vessel's side to a distance inboard of 760 mm or more at the level of the summer load line joining longitudinal watertight bulkheads may be considered as transverse watertight bulkhead for the purpose of the damage calculations.

For a vessel with length (L) from 80 m to 100 m, a transverse watertight bulkhead extending from the vessel's side to a distance inboard of B/20 or more (but not less than 760 mm) at the level of the summer load line joining longitudinal watertight bulkheads may be considered as a transverse watertight bulkhead fort he purpose of the damage calculations.

1.1.5 If pipes, ducts or tunnels are situated within the assumed extent of damage, arrangements should be made to ensure that progressive flooding cannot thereby extend to compartments other than those assumed to be floodable for each case of damage.

1.1.6 If damage of a lesser extent than that specified in 1.1.2 and/or 1.1.3 results in a more severe condition, such lesser extent should be assumed.

1.1.7 Where a transverse watertight bulkhead is located within the transverse extent of assumed damage and is stepped in way of a double bottom or side tank by more than 3,05 m, the double bottom or side tanks adjacent to the stepped portion of the transverse watertight bulkhead should be considered as flooded simultaneously.

1.1.8 Scantlings of tunnels, ducts, pipes, doors, staircases, bulkheads and decks forming watertight boundaries shall be adequate to withstand pressure heights corresponding to the deepest equilibrium waterline in damaged condition.

1.1.9 If the distance between adjacent transverse watertight bulkheads or the distance between the transverse planes passing through the nearest stepped portions of the bulkheads is less than the longitudinal extent of damage given in 1.1..2.1, only one of these bulkheads should be regarded as effective for the purpose of 1.1.1.

1.2 Damage Stability Criteria

1.2.1 The final waterline, taking into account sinkage, heel and trim, should be below the lower edge of any opening through which progressive flooding may take place. Such openings should include air pipes and those which are capable of being closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, and sidescuttles of the non-opening type.

1.2.2 In the final stage of flooding, the angle of heel due to unsymmetrical flooding should not exceed 15°. This angle may be increased up to 17° if no deck immersion occurs.

1.2.3 The stability in the final stage of flooding should be investigated and may be regarded as sufficient if the righting lever curve has at least a range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 100 mm within this range. Unprotected openings should not become immersed at an angle of heel within the prescribed minimum range of residual stability unless the space in question has been included as a floodable space in calculations for damage stability. Within this range, immersion of any of the openings referred to in 1.2.1 and any other openings capable of being closed weathertight may be authorized.

1.2.4 The stability is to be sufficient during intermediate stages of flooding.

1.3 Assumptions for Calculating Damage Stability

1.3.1 Compliance with 1.2 should be confirmed by calculations which take into consideration the design characteristics of the vessel, the arrangements, configuration and permeability of the damaged compartments and the distribution, specific gravities and the free surface effect of liquids.

1.3.2 The permeability of compartments assumed to be damaged should be as follows:

Spaces	**Permeability**
Appropriated to stores	60
Occupied by accommodation	95
Occupied by machinery	85
Void spaces	95
Intended for dry cargo	95

The permeability of tanks should be consistent with the amount of liquid carried, as shown in the loadingconditions specified in 1. The permeability of emptytanks should be assumed to be not less than 95.

1.3.3 The free surface effect should be calculated at an angle of heel of 5° for each individual compartment or the effect of free liquid in a tank should be calculated over the range of positive residual righting arm, by assessing the shift of liquids by moment of transference calculations.

1.3.4 Free surface for each type of consumable liquid should be assumed for at least one transverse pair of tanks or a single centreline tank. The tank or tanks to be taken into account should be those where the effect of free surface is the greatest.

1.3.5 Information on loading restrictions, such as maximum KG or minimum GM curve or table that can be used to determine compliance with the applicable stability criteria shall be included in the stability booklet

1.3.6 For subdivison refer to “supply vessels” in **TL** Part A, Chapter 1, Sec.26, B

1.4 Documents for Approval

The following documents are to be submitted:

- Drawings showing the external openings and the closing devices thereof

- Drawings showing the watertight subdivision as well as internal openings and closing devices thereof

- Damage stability calculation according to MSC 235(82) and 335(90).

  damage control plan and damage control booklet containing all data essential for maintaining the survival capacity, if required.

- Stability information according to this Section

SECTION 5

SERVICE VESSELS FOR CARRYING HAZARDOUS AND NOXIOUS LIQUID SUBSTANCES IN BULK

Page

A. General

This Section has been developed for the design, construction and operation of offshore support vessels (OSVs) which transport hazardous and noxious liquid substances in bulk for the servicing and resupplying of offshore platforms, mobile offshore drilling units and other offshore installations, including those employed in the search for and recovery of hydrocarbons from the seabed.

This Section has been developed in accordance with the requirements set forth in regulation 11.2 of Annex II to the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL) and in recognition of the need for standards which provide an alternative to the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) and the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) for OSVs.

The basic philosophy of this Section is to apply standards contained in the IBC Code and the IGC Code to the extent that is practicable and reasonable taking into account the unique design features and service characteristics of OSVs.

The *Guidelines for the design and construction of offshore supply vessels, 2006* (resolution MSC.235(82)), as amended, are also applicable to OSVs subject to this Section.

To provide an international standard for the safe carriage, by sea in bulk, of chemicals by setting the design and construction standards of vessels involved in such carriage and the equipment, so as to minimize the risks to the vessel, its crew and the environment, having regard to the nature of the products, including flammability, toxicity, asphyxiation, corrosivity and reactivity.

1. Application

1.1 This Section applies to OSVs engaged in the carriage of the products identified in 1.9, regardless of size or voyage.

1.2 This Section should also apply when the cargoes indicated in 1.9 are part of a blending or production process of cargoes used in the search for and exploitation of seabed mineral resources on board vessels used to facilitate such operations.

1.3 Unless expressly provided otherwise, this Section applies to OSVs the keels of which are laid or which, on or after 1 July 2018, are at the stage where:

1.3.1 construction identifiable with the vessel begins; and

1.3.2 assembly has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less;

1.4 Existing OSVs the keel of which were laid or which were at a similar stage of construction on or after 19 April 1990 and before the date specified in 1.3 may be permitted to carry products as assigned for carriage on a type 2 ship in the IBC Code, provided that those OSVs comply with this Section, except for the stability provisions in subsection B of this Section, and subject to the satisfaction of the Administration.

1.5 A vessel, irrespective of the date of construction, which is converted for the carriage of bulk liquids subject to this Section on or after the date specified in 1.3 should be treated as a vessel constructed on the date on which such conversion commences. An OSV which transports a cargo subject to this Section and undergoes modification for the transport of additional cargoes falling under this Section should not be considered as a vessel which has undergone a conversion.

1.6 This Section applies only in the case of bulk carriage involving transfer of the cargo to or from its containment which forms part of the vessel or remains on board.

1.7 For requirements regulating the transport of dangerous goods and marine pollutants in packaged form, including transport of dangerous goods in portable tanks, refer to the International Maritime Dangerous Goods Code (IMDG Code).

1.8 This Section applies in addition to the *Guidelines for the design and construction of offshore supply vessels* (resolution MSC.235(82)), as amended. Where this Section sets forth alternative safety standards, the standards in this Section should be applied.

1.9 Products which may be carried subject to this Section are:

1.9.1 products which are listed in chapters 17 or 18 of the IBC Code and the latest edition of the MEPC.2/Circular (Provisional categorization of liquid substances in accordance with MARPOL Annex II and the IBC Code) and their related references to chapters 15 and 19; or

1.9.2 oil-based/water-based mud containing mixtures of products listed in chapters 17 and 18 of the IBC Code and the MEPC.2 Circular; or

1.9.3 liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen; or

1.9.4 contaminated backloads.

1.10 For a product proposed for carriage in bulk, but not listed in chapters 17 or 18 of the IBC Code, the Administration and port Administrations involved in such carriage should prescribe the suitable preliminary conditions for the carriage, having regard to the criteria for hazard evaluation of bulk chemicals. For the evaluation of the pollution hazard of such a product and assignment of its pollution category, the procedure specified in regulation 6.3 of MARPOL Annex II should be followed. IMO should be notified of the preliminary conditions for consideration for inclusion of the product in the IBC Code.

2. Definitions

The following definitions apply unless expressly provided otherwise in the other Sections.

2.1 *Accommodation spaces* are those spaces used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, barber shops, pantries containing no cooking appliances and similar spaces.

2.2 *Administration* means the Government of the State whose flag the vessel is entitled to fly.

2.3 *Anniversary date* means the day and the month of each year that will correspond to the date of expiry of the Certificate of Fitness.

2.4 *Backload* means contaminated bulk liquids, taken on board a vessel offshore, for transport either back to shore or to an alternate offshore site.

2.5 *Blending additives* means small amounts of liquid substances used during blending of products or production processes of cargoes for use in the search for and exploitation of seabed mineral resources on board vessels used to facilitate such operations.

2.6 *Breadth (B)* means the maximum breadth of the vessel, measured amid vessels to the moulded line of the frame in a vessel with a metal shell and to the outer surface of the hull in a vessel with a shell of any other material. The breadth (*B*) should be measured in metres.

2.7 *Cargo area* is that part of the OSV where:

2.7.1 a pollution hazard only substance having a flashpoint exceeding 60°C and not defined as toxic is likely to be present and includes cargo tanks, portable tanks used as deck cargo tanks, slop tanks, cargo pump-rooms, pump-rooms adjacent to cargo tanks and enclosed spaces in which pipes containing cargoes are located; areas on open deck are not considered part of the cargo area;

2.7.2 a safety hazard substance having a flashpoint exceeding 60°C and not defined as a toxic is likely to be present and includes cargo tanks, portable tanks used as deck cargo tanks, slop tanks, cargo pump-rooms, pump-rooms adjacent to cargo tanks, hold spaces in which independent tanks are located, cofferdams surrounding integral tanks, enclosed spaces in which pipes containing cargoes are located and the following deck areas:

2.7.2.1 within 3 m. of cargo tank installed on deck or portable tanks used as deck cargo tanks;

2.7.2.2 areas on open deck, or semi-enclosed spaces on deck, within 3 m. of any cargo tank access outlet;

2.7.2.3 areas on open deck over an integral tank without an overlaying cofferdam plus the open deck area extending transversely and longitudinally for a distance of 3 m. beyond each side of the tank;

2.7.2.4 areas on open deck, or semi-enclosed spaces on deck, within 3 m of cargo manifold valve, cargo valve, cargo pipe flange, except spaces within the 3 m zone that are separated by an enclosed bulkhead to the minimum height as given in 2.7.2.6;

2.7.2.5 areas on open deck, or semi-enclosed spaces on open deck above and in the vicinity of any cargo tank vent outlet intended for the passage of large volumes of vapour mixture during cargo loading, within a vertical cylinder of unlimited height and 3 m radius centred upon the centre of the outlet, and within a hemisphere of 3 m radius below the outlet;

2.7.2.6 areas on the open deck within spillage coamings surrounding cargo manifold valves and 3 m beyond these, up to a height of 2.4 m above the deck; and

2.7.2.7 compartments for cargo hoses;

2.7.3 a substance having a flashpoint not exceeding 60°C, or defined as toxic or vapours of such cargo, is likely to be present and includes cargo tanks, portable tanks used as deck cargo tanks, slop tanks, cargo pump-rooms, pump-rooms adjacent to cargo tanks, hold spaces in which independent tanks are located, cofferdams surrounding integral tanks, enclosed spaces in which pipes containing cargoes are located and the following deck areas:

2.7.3.1 within 3 m of cargo tank installed on deck or portable tanks used as deck cargo tanks;

2.7.3.2 areas on open deck, or semi-enclosed spaces on deck, within 4.5 m of gas or vapour outlet, cargo manifold valve, cargo valve, cargo pipe flange, cargo pump-room ventilation outlets and cargo tank openings for pressure release provided to permit the flow of small volumes of gas or vapour mixtures caused by thermal variation;

2.7.3.3 areas on open deck, or semi-enclosed spaces on open deck above and in the vicinity of any cargo gas outlet intended for the passage of large volumes of gas or vapour mixture during cargo loading, within a vertical cylinder of unlimited height and 10 m radius centred upon the centre of the outlet, and within a hemisphere of 10 m radius below the outlet;

2.7.3.4 areas on open deck, or semi-enclosed spaces on deck, within 3 m of cargo pump-room entrances, cargo pump-room ventilation inlet, openings into cofferdams;

2.7.3.5 areas on the open deck within spillage coamings surrounding cargo manifold valves and 3 m beyond these, up to a height of 2.4 m above the deck;

2.7.3.6 compartments for cargo hoses; and

2.7.3.7 within the hose landing area**.**

2.8 *Cargo control station* means a location that is manned during cargo transfer operations for the purpose of directing or controlling the loading or unloading of cargo.

2.9 *Cargo pump-room* is a space containing pumps and their accessories for the handling of the products covered by this Section.

2.10 *Cofferdam* is the isolating space between two adjacent steel bulkheads or decks. This space may be a void space or a ballast space.

2.11 *Control stations* are those spaces in which vessels' radio or main navigating equipment or the emergency source of power is located or where the fire-recording or fire-control equipment is centralized. This does not include special fire-control equipment which can be most practically located in the cargo area.

2.12 *Conversion* means a vessel in an unrelated service modified for use as an OSV. Special purpose ships (operated under the Code of Safety for Special Purpose Ships, 2008 (2008 SPS Code)) in support-related service configurations are not considered "in an unrelated service".

2.13 *Dangerous chemicals* means any liquid chemicals designated as presenting a safety hazard, based on the safety criteria for assigning products to chapter 17 of the IBC Code.

2.14 *Dangerous goods* mean the substances, materials and articles covered by the IMDG Code.

2.15 *Deadweight* means the difference in metric tons between the displacement of an OSV in water of a density of 1.025 at the load waterline corresponding to the assigned summer freeboard and the lightweight of the vessel.

2.16 *Deck spread* means portable tanks, piping, equipment, processing equipment and control stations secured to the vessel by permanent means and used in the operation of the vessel.

2.17 *Density* is the ratio of the mass to the volume of a product, expressed in terms of kilograms per cubic metre. This applies to liquids, gases and vapours.

2.18 *Flashpoint* is the temperature in degrees Celsius at which a product will give off enough flammable vapour to be ignited. Values given in this Section are those for a "closed cup test" determined by an approved flashpoint apparatus.

2.19 *Hazardous substance* is any substance either listed in chapter 17 of the IBC Code or having a hazard more severe than one of the minimum hazard criteria given in criteria for hazard evaluation of bulk chemicals as approved by the Organization.

2.20 *Hold space* is the space enclosed by the vessel's structure in which an independent cargo tank is situated.

2.21 *Hose landing area* means an area on the main deck, except those in compartments for cargo hoses, where cargo hoses of substances having a flashpoint not exceeding 60°C and/or defined as toxic are located during cargo transfer.

2.22 *Independent* means that a piping or venting system, for example, is in no way connected to another system and that there are no provisions available for the potential connection to other systems.

2.23 *IBC Code* means the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (resolutions MSC.4(48) and MEPC.19(22)), as amended.

2.24 *IGC Code* means the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (resolution MSC.5(48)), as amended.

2.25 *IMDG Code* means the International Maritime Dangerous Goods Code (resolution MSC.406(96)), as amended.

2.26 *Length (L)* means 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that is greater. In vessels designed with a rake of keel, the waterline on which this length is measured should be parallel to the designed waterline. The length (*L*) should be measured in metres.

2.27 *Lightweight* means the displacement of an OSV in metric tons without cargo, fuel, lubricating oil, ballast water, fresh water and feed water in tanks, consumable stores, and crew and their effects.

2.28 *Machinery spaces of category A* are those spaces and trunks to such spaces which either contain:

2.28.1 internal combustion machinery used for main propulsion;

2.28.2 internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

2.28.3 any oil-fired boiler or oil fuel unit or any oil-fired equipment other than boilers, such as inert gas generators, incinerators, etc.

2.29 *Machinery spaces* are machinery spaces of category A and other spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling station, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

2.30 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, as amended.

2.31 *Noxious liquid substance* means any substance indicated in the Pollution Category column of chapter 17 or 18 of the IBC Code, or the current MEPC.2 Circular or provisionally assessed under the requirements of regulation 6.3 of MARPOL Annex II as falling into categories X, Y or Z.

2.32 *Offshore portable tank* means a portable tank specially designed for repeated use for transport of dangerous goods to, from and between offshore facilities. An offshore portable tank is designed and constructed in accordance with the *Guidelines for the approval of offshore containers handled in open seas* (MSC/Circ.860).

2.33 *Offshore support vessels (OSVs)* are:

2.33.1 multi-mission vessels which are primarily engaged in the transport of stores, materials and equipment to and from mobile offshore drilling units, fixed and floating platforms and other similar offshore installations; or

2.33.2 multi-mission vessels, including well-stimulation vessels, but excluding mobile offshore drilling units, derrick barges, pipe-laying barges and floating accommodation units, which are otherwise primarily engaged in supporting the work of offshore installations.

2.34 *Oil fuel unit* is the equipment used for the preparation of oil fuel for delivery to an oil- fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a gauge pressure of more than 0.18 MPa.

2.35 *Open deck* is defined as an open or semi-enclosed space on cargo deck or inside of the cargo rail. Semi-enclosed spaces are those spaces that either:

2.35.1 are open at two ends; or

2.35.2 have an opening at one end and are provided with adequate natural ventilation effective over their entire length through permanent openings distributed in the side plating or deckhead or from above, the openings having a total area of at least 10% of the total area of the space sides.

2.36 *Organization* is the International Maritime Organization (IMO).

2.37 *Permeability of a space* means the ratio of the volume within that space which is assumed to be occupied by water to the total volume of that space.

2.38 *Pollution hazard only substance* means a substance having an entry only of "P" in column d in chapter 17 of the IBC Code.

2.39 *Port Administration* means the appropriate authority of the country for the port where the vessel is loading or unloading.

2.40 *Portable tank* means a multimodal tank used for the transport of dangerous goods.

2.41 *Propulsion shaft tunnel* is the tunnel or space in which the mechanical transfer of power to a propulsion unit is run.

2.42 *Public spaces* are those portions of the accommodation spaces which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

2.43 *Pump-room* is a space, located in the cargo area, containing pumps and their accessories for the handling of ballast and oil fuel.

2.44 *Recognized standards* are applicable international or national standards acceptable to the Administration or standards laid down and maintained by an organization which comply with the standards adopted by IMO and which are recognized by the Administration.

2.45 *Safety hazard substance* means a substance having an entry of "S" or "S/P" in column d in chapter 17 of the IBC Code.

2.46 *Separate* means that a cargo piping system or cargo vent system, for example, is not connected to another cargo piping or cargo vent system.

2.47 *Service spaces* are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, storerooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

2.48 *SOLAS* means the International Convention for the Safety of Life at Sea, 1974, as amended.

2.49 *Underdeck access way* is a passage passing through the underdeck cargo area without being part of the cargo area providing access to essential areas for operation of the vessel, such as thruster room, propulsion room or steering gear room. The access way may be used to route non-cargo piping and cabling.

2.50 *Vapour pressure* is the equilibrium pressure of the saturated vapour above a liquid expressed in pascals (Pa) at a specified temperature.

2.51 *Void space* is an enclosed space in the cargo area external to a cargo tank, other than a hold space, ballast space, oil fuel tank, cargo pump-room, pump-room, or any space in normal use by personnel.

2.52 *Well-stimulation vessel* means an OSV with specialized equipment and industrial personnel that delivers products and services directly into a well-head.

3. Equivalents

3.1 Where this Section requires that a particular fitting, material, appliance, apparatus, item of equipment or type thereof should be fitted or carried on an OSV, or that any particular provision should be made, or any procedure or arrangement should be complied with, the Administration may allow any other fitting, material, appliance, apparatus, item of equipment or type thereof to be fitted or carried, or any other provision, procedure or arrangement to be made in that vessel, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance, apparatus, item of equipment or type thereof or that any particular provision, procedure or arrangement is at least as effective as that required by this Section. However, the Administration may not allow operational methods or procedures to be made an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof, which are prescribed by this Section, unless such substitution is specifically allowed by this Section.

3.2 Where the Administration allows any fitting, material, appliance, apparatus, item of equipment, or type thereof, or provision, procedure, or arrangement, or novel design or application to be substituted, it should communicate to the Organization the particulars thereof together with a report on the evidence submitted so that the Organization may circulate the same to other Parties to SOLAS or MARPOL, for the information of their officers.

4. Surveys and certification

4.1 Following a satisfactory initial survey of an OSV, the Administration or its duly authorized organization should issue a certificate suitably endorsed to certify compliance with the provisions of this Section. If the language used is not English, French or Spanish, the text should include the translation into one of those languages. The certificate should indicate the cargoes regulated by this Section that the vessel is permitted to carry with any relevant carriage conditions and should have a period of validity not exceeding five years.

4.2 The certificate issued under this Section should have the same force and receive the same recognition as the certificate issued under regulation 7 of MARPOL Annex II and regulations VII/10 and VII/13 of SOLAS.

4.3 The validity of the certificate referred to in 4.1 should be subject to the renewal, intermediate, annual and additional surveys required by the IBC Code, the IGC Code and MARPOL Annex II.

B. Vessel Survival Capability and Location of Cargo Tanks

To ensure that the cargo tanks are located in protected location(s) for the event of minor hull damage and that the vessel can survive the assumed flooding conditions.

1. General

1.1 OSVs subject to this Section should survive the normal effects of flooding following assumed hull damage caused by some external force. In addition, to safeguard the vessel and the environment, the cargo tanks should be protected from penetration in the case of minor damage to the vessel resulting, for example, from contact with a jetty or an offshore installation, and given a measure of protection from damage in the case of collision or stranding, by locating them at specified minimum distances inboard from the vessel's shell plating. Both the assumed damage and the proximity of the cargo tanks to the vessel's shell should be dependent upon the degree of hazard presented by the products to be carried.

1.2 The design standards of this chapter should be applied according to the ship type required for cargoes containing mixtures and individual products indicated in chapter 17 of the IBC Code and the latest edition of the MEPC.2 Circular.

1.3 OSVs subject to this Section may be designed without cargo tank capacity limitation; however, the requirements of this chapter will be applied according to the ship type classified in the IBC Code and quantity of products carried on any single voyage.

1.4 If a vessel is intended to carry more than one product listed in chapter 17 of the IBC Code and the latest edition of the MEPC.2 Circular, the standard of damage should correspond to that product having the most stringent ship type provision. The provisions for the location of individual cargo tanks, however, need only be applied based upon the vessel types related to the respective products certified to be carried.

1.5 The provisions for cargo ships in SOLAS chapter II-1, parts B, B-1, B-2 and B-4, should apply to vessels covered by this Section, except that SOLAS regulations II-1/6 to II-1/7-3 need not apply, unless expressly provided otherwise.

2. Freeboard and intact stability

2.1 OSVs subject to this Section may be assigned the minimum freeboard permitted by the International Convention on Load Lines in force.

2.2 The intact stability of the vessel in all seagoing conditions should comply with the International Code on Intact Stability, 2008 (resolution MSC.267(85)), as amended.

2.3 Solid ballast should not normally be used in double-bottom spaces in the cargo area. Where, however, because of stability considerations, the fitting of solid ballast in such spaces becomes unavoidable, then its disposition should be governed by the need to ensure that the impact loads resulting from bottom damage are not directly transmitted to the cargo tank structure.

2.4 The master of the vessel should be supplied with a loading and stability information booklet. This booklet should contain details of typical service and ballast conditions, provisions for evaluating other conditions of loading and a summary of the vessel's survival capabilities. In addition, the booklet should contain sufficient information to enable the master to load and operate the vessel in a safe and seaworthy manner. All OSVs of 500 gross tonnage and above should comply with SOLAS regulation II-1/5-1.

2.5 OSVs subject to 6.1 and those vessels with a length of 80 m or more subject to 6.2 should be fitted with a stability instrument **(1)** capable of verifying compliance with intact and damage stability provisions, approved by the Administration, having regard to the performance standards recommended by the Organization **(2)**.

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(1) *Refer to the IBC Code, paragraphs 2.2.6 and 2.2.7.*

(2) *Refer to part B of chapter 4 of the International Code on Intact Stability, 2008 (resolution MSC.267(85)), as amended; section 4 of the Guidelines for the approval of stability instruments (MSC.1/Circ.1229)), as amended; and the technical standards defined in part 1 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461).*

3. Non-cargo discharges below the freeboard deck

3.1 The provision and control of valves fitted to non-cargo discharges led through the shell from spaces below the freeboard deck or from within superstructures and deckhouses on the freeboard deck fitted with weathertight doors should comply with the requirements of the relevant regulation of the International Convention on Load Lines in force, except that the choice of valves should be limited to:

3.1.1 one automatic non-return valve with a positive means of closing from above the freeboard deck; or

3.1.2 where the vertical distance from the summer load waterline to the inboard end of the discharge pipe exceeds 0.01*L*, two automatic non-return valves without positive means of closing, provided that the inboard valve is always accessible for examination under service conditions.

3.2 For the purpose of this chapter, "summer load line" and "freeboard deck" have the meanings as defined in the International Convention on Load Lines in force.

3.3 The automatic non-return valves referred to in 3.1.1 and 3.1.2 should be fully effective in preventing admission of water into the vessel, taking into account the sinkage, trim and heel in survival provisions in 8, and should comply with recognized standards.

4. Conditions of loading

Damage survival capability should be investigated on the basis of loading information submitted to the Administration for all anticipated conditions of loading and variations in draught and trim for the conditions for cargoes which the vessels is certified to carry. Conditions where the OSV is not carrying products covered by this Section, or is carrying only residues of such products, need not be considered for the purpose of this Section.

5. Flooding assumptions

5.1 The provisions of 8 should be confirmed by calculations which take into consideration the design characteristics of the vessel; the arrangements, configuration and contents of the damaged compartments; the distribution, relative densities and the free surface effects of liquids; and the draught and trim for all conditions of loading.

5.2 The permeability of spaces assumed to be damaged should be as follows:

Spaces	Permeability
Appropriated to stores	0,60
Occupied by accommodation	0,95
Occupied by machinery	0,85
Voids	0,95
Intended for consumable liquids	0 to 0,95 (*)
Intended for other liquids	0 to 0,95 (*)
Intended for dry cargo	0,95

(*) *The permeability of partially filled tanks should be consistent with the amount of liquid carried in the tank.*

5.3 Wherever damage penetrates a tank containing liquids it should be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

5.4 Every watertight division within the maximum extent of damage defined in 6.1 and 6.2 and considered to have sustained damage in positions given in 7 should be assumed to be penetrated. Where damage less than the maximum is being considered in accordance with 6.3, only watertight divisions or combinations of watertight divisions within the envelope of such lesser damage should be assumed to be penetrated:

5.4.1 where a transverse watertight bulkhead is located within the transverse extent of assumed damage and is stepped in way of a double bottom or side tank by more than 3.05 m, the double bottom or side tanks adjacent to the stepped portion of the transverse watertight bulkhead should be considered as flooded simultaneously; and

5.4.2 if the distance between the transverse planes passing through the nearest stepped portions of the bulkheads is less than the longitudinal extent of damage given in 6.1 and 6.2, only one of these bulkheads should be regarded as effective.

5.5 The vessel should be so designed as to keep unsymmetrical flooding to the minimum consistent with efficient arrangements.

5.6 Equalization arrangements requiring mechanical aids such as valves or cross-levelling pipes, if fitted, should not be considered for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the provisions of 8 and sufficient residual stability should be maintained during all stages where equalization is used. Spaces which are linked by ducts of large cross-sectional area may be considered to be common.

5.7 If pipes, ducts, trunks or tunnels are situated within the assumed extent of damage penetration, as defined in 6, arrangements should be such that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage.

5.8 For vessels subject to 6.1 the buoyancy of any superstructure directly above the side damage should be disregarded. The unflooded parts of superstructures beyond the extent of damage, however, may be taken into consideration provided that:

5.8.1 they are separated from the damaged space by watertight divisions and the provisions of 8.2.2 in respect of these intact spaces are complied with; and

5.8.2 openings in such divisions are capable of being closed by remotely operated sliding watertight doors and unprotected openings are not immersed within the minimum range of residual stability required in 8; however, the immersion of any other openings capable of being closed weathertight may be permitted.

6. Damage assumptions

6.1 For vessels carrying more than 1200 m^3 of products classified in the IBC Code as requiring type 3 ship or type 2 ship, or more than 150 m^3 of products classified in the IBC Code as requiring type 1 ship, the assumed maximum extent of damage should be:

6.1.1 Side damage

	Longitudinal extent	Transverse extent	Vertical extent
	$1/3\ L^{2/3}$	*B*/5 (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)	Upwards without limit (measured from the moulded line of the bottom shell plating at centreline)

6.1.2 Bottom damage

	Location of damage	Longitudinal extent	Transverse extent	Vertical extent
.1	Within 0.3*L* (measured from the forward perpendicular)	$1/3\ L^{2/3}$	B/6	B/15 or 6 m, whichever is less (measured from the moulded line of the bottom shell plating at centreline (see 9.2))
.2	Any other part of the vessel	$1/3\ L^{2/3}$ or 5 m, whichever is less	B/6 or 5 m, whichever is less	B/15 or 6 m, whichever is less (measured from the moulded line of the bottom shell plating at centreline (see 9.2)

6.2 For vessels carrying not more than 1200 m^3 of products classified in the IBC Code as requiring type 3 ship or type 2 ship, and not more than 150 m^3 of products classified in the IBC Code as requiring type 1 ship the assumed maximum extent of damage should be:

Side damage

	Vessel length	Longitudinal extent	Transverse extent	Vertical extent
.1	24 ≤ L ≤ 43 m	0,1 L	760 mm (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)	From the underside of the cargo deck, or continuation thereof, downward for the full depth of the vessel
.2	43 < L < 80 m	3 m + 0,03 L	760 mm (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)	From the underside of the cargo deck, or continuation thereof, downward for the full depth of the vessel
.3	80 ≤ L ≤ 100 m	1/3 $L^{2/3}$	*B*/20, but not less than 760 mm (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)	From the underside of the cargo deck, or continuation thereof, downward for the full depth of the vessel
.4	L > 100 m	1/3 $L^{2/3}$	*B*/15, but not less than 760 mm (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)	From the underside of the cargo deck, or continuation thereof, downward for the full depth of the vessel

6.3 If any damage of a lesser extent than the maximum damage specified in 6.1 or 6.2 would result in a more severe condition, such damage should be considered.

6.4 A transverse watertight bulkhead extending from the vessel's side to a distance inboard not less than the transverse extent of damage indicated in 6.2 measured at the level of the summer load line joining longitudinal watertight bulkheads may be considered as a transverse watertight bulkhead for the purpose of the damage calculations in 6.2.

7. Standard of damage

Vessels should be capable of surviving damage with the assumptions in 5 and 6 determined by the following standards:

7.1 a vessel that carries more than 150 m3 of ship type 1 products should be assumed to sustain damage described in 6.1 anywhere along the length;

7.2 a vessel with a length (*L*) greater than 150 m that carries more than 1200 m^3 of ship types 2 and 3 products should be assumed to sustain damage described in 6.1 anywhere along the length;

7.3 a vessel with a length (*L*) of 150 m or less that carries more than 1200 m^3 of ship types 2 and 3 products and not more than 150 m^3 of ship type 1 products should be assumed to sustain damage described in 6.1 anywhere along the length except involving bulkheads bounding a machinery space of category A;

7.4 a vessel with a length (*L*) greater than 100 m that carries 800 m^3 or more but not more than 1200 m^3 of ship types 2 and 3 products and not more than 150 m3 of ship type 1 products should be assumed to sustain damage described in 6.2 anywhere along the length and should also comply with SOLAS regulations II-1/6 to II-1/7-3 (probabilistic damage stability standard for a cargo ship);

7.5 a vessel with a length (*L*) of 100 m or less that carries 800 m^3 or more but not more than 1200 m^3 of ship types 2 and 3 products and not more than 150 m^3 of ship type 1 products should be assumed to sustain damage described in 6.2 anywhere along the length;

7.6 a vessel with a length (*L*) greater than 100 m that carries less than 800 m^3 of ship types 2 and 3 products and not more than 150 m^3 of ship type 1 products should be assumed to sustain damage described in 6.2 anywhere along the length between transverse watertight bulkheads and should also comply with SOLAS regulations II-1/6 to II-1/7-3 (probabilistic damage stability standard for a cargo ship); and

7.7 a vessel with a length (*L*) of 100 m or less that carries less than 800 m^3 of ship types 2 and 3 products and not more than 150 m^3 of ship type 1 products should be assumed to sustain damage described in 6.2 anywhere along the length between transverse watertight bulkheads.

8. Survival requirements

8.1 Vessels subject to this Section should be capable of surviving the assumed damage specified in 6 to the standard provided in 7 in a condition of stable equilibrium and should satisfy the following criteria**.**

8.2 For vessels subject to 6.1:

8.2.1 in any stage of flooding:

8.2.1.1 the waterline, taking into account sinkage, heel and trim, should be below the lower edge of any opening through which progressive flooding or downflooding may take place; such openings should include air pipes and openings which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and watertight flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, and sidescuttles of the non-opening type;

8.2.1.2 the maximum angle of heel due to unsymmetrical flooding should not exceed 25°, except that this angle may be increased to 30° if no deck immersion occurs; and

8.2.1.3 the residual stability during intermediate stages of flooding should never be significantly less than that required by 8.2.2;

8.2.2 at final equilibrium after flooding:

8.2.2.1 the righting-lever curve should have a minimum range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0.1 m within the 20° range; the area under the curve within this range should not be less than 0.0175 m radians. Unprotected openings should not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in 8.2.1 and other openings capable of being closed weathertight may be permitted; and

8.2.2.2 the emergency source of power should be capable of operating.

8.3 For vessels subject to 6.2:

8.3.1 the final waterline, taking into account sinkage, heel and trim, should be below the lower edge of any opening through which progressive flooding may take place. Such openings should include air pipes and those which are capable of being closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors and sidescuttles of the non-opening type;

8.3.2 in the final stage of flooding, the angle of heel due to unsymmetrical flooding should not exceed 15°. This angle may be increased up to 17° if no deck immersion occurs; and

8.3.3 the stability in the final stage of flooding should be investigated and may be regarded as sufficient if the righting-lever curve has, at least, a range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 100 mm within this range. Unprotected openings should not become immersed at an angle of heel within the prescribed minimum range of residual stability unless the space in question has been included as a floodable space in calculations for damage stability. Within this range, immersion of any openings referred to in 8.3.1 and any other openings capable of being closed weather tight may be authorized.

9. Location of cargo tanks

9.1 Cargo tanks should be located at the following distances inboard:

9.1.1 Cargo tanks for IBC Code ship type 1 products: from the side shell plating, not less than the transverse extent of damage specified in 6.1.1.1, and from the moulded line of the bottom shell plating at centreline, not less than the vertical extent of damage specified in 6.1.2.1, and nowhere less than 760 mm from the shell plating. This provision does not apply to tanks for diluted slops arising from tank washing.

9.1.2 Cargo tanks for IBC Code ship type 2 products: from the moulded line of the bottom shell plating at centreline, not less than the vertical extent of damage specified in 6.1.2, and nowhere less than 760 mm from the shell plating. This provision does not apply to tanks for diluted slops arising from tank washing.

9.1.3 Cargo tanks for IBC Code ship type 3 products: nowhere less than 760 mm from the shell plating. This provision does not apply to tanks for diluted slops arising from tank washing.

9.2 Suction wells installed in cargo tanks for IBC Code ship types 2 and 3 products may protrude below the inner bottom plating provided that such wells are as small as practicable and the protrusion below the inner bottom plating does not exceed 25% of the depth of the double bottom or 350 mm, whichever is less. Where there is no double bottom, the protrusion of the suction well of independent tanks below the upper limit of bottom damage should not exceed 350 mm. Suction wells installed in accordance with this paragraph may be ignored in determining the compartments affected by damage.

C. Vessel Design

To ensure that the cargo containment and handling systems are located in such a way that the consequences of any release of cargo will be minimized, and to provide safe access for operation and inspection. This subsection describes the minimum containment and handling provisions for all liquid cargoes. Additional provisions for those products with higher levels of hazard are described in D.

1. Cargo segregation

1.1 Tanks containing cargoes, residues of cargoes or mixtures containing cargoes subject to this Section should be segregated from machinery spaces as defined in A.2.28 and A.2.29, accommodation and service spaces and from drinking water and stores for human consumption by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, oil fuel tank, or other similar space **(3).** On-deck stowage of permanently attached deck tanks or installation of independent tanks in otherwise empty hold spaces should be considered as satisfying this provision.

1.1.1 For pollution hazards only substances having a flashpoint exceeding 60°C, the segregation provisions need only be met for accommodation spaces, drinking water and stores for human consumption.

1.2 Cargoes, residues of cargoes or mixtures containing cargoes which react in a hazardous manner with other cargoes or oil fuels should:

1.2.1 be segregated from such other cargoes or oil fuels by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, or tank containing a mutually compatible cargo;

1.2.2 have separate pumping and piping systems which should not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and

1.2.3 have separate tank venting systems.

1.3 Cargo piping should not pass through any accommodation, service spaces or machinery space of category A.

(3) *Refer to the interpretation of SOLAS regulation II-2/4.5.1 (MSC/Circ.1120).*

1.4 If cargo piping systems or cargo venting systems are required to be separated, this separation may be achieved by the use of design or operational methods. Operational methods should not be used within a cargo tank or a cofferdam surrounding the cargo tanks, if entry into the cofferdam is required, and should consist of one of the following types:

1.4.1 removing spool pieces or valves and blanking the pipe ends;

1.4.2 arrangements of two spectacle flanges in series, with provisions for detecting leakage into the pipe between the two spectacle flanges; and

1.4.3 blind flange valve with double shut-off and with provisions for detecting leakage in valve body.

1.5 Pumps, ballast lines, vent lines and other similar equipment serving ballast tanks should be separated from similar equipment serving cargo tanks and of cargo tanks themselves.

1.6 For access to all spaces, the minimum spacing between cargo tank boundaries and adjacent vessel structure should be 600 mm.

1.7 Cargo tanks other than those certified to carry substances subject to the provisions of D. may extend to the deck plating. Where cargo is handled on the deck area above a cargo tank, the cargo tank may not extend to the deck plating unless a continuous permanent deck sheathing of min 50 mm of wood or other suitable material of equivalent thickness and construction is fitted.

1.8 Cargoes subject to this Section should not be carried in either the fore or aft peak tanks.

2. Accommodation, service and machinery spaces and control stations

2.1 Accommodation or service spaces or control stations should not be located within the cargo area.

2.2 For a vessel certified to carry safety hazard substances, entrances, air inlets and openings to accommodation, service and machinery spaces and control stations may be accepted in bulkheads facing the cargo deck area if they are located outside the deck area defined in A.2.7.2.

2.3 Propulsion shafts may be routed through cargo pump-rooms.

3. Access to spaces in the cargo area

3.1 Unless expressly provided otherwise in D, the following should apply:

3.1.1 For pollution hazard only substances, at least one access to cargo tanks should be direct from the open deck and designed such as to ensure complete inspection of those substances.

3.1.2 For safety hazard substances, at least one access to each cargo tank, cofferdams and other spaces in the cargo area should be direct from the open deck and designed such as to ensure complete inspection of those substances.

3.1.3 Access to double bottom spaces within the cargo area may be through a cargo pump-room, pump-room, deep cofferdam, pipe tunnel or similar dry compartments with their own direct access from open deck, subject to consideration of ventilation aspects. Where cofferdams are provided over integral tanks, small trunks may be used to penetrate the cofferdam.

3.2 For accesses defined in 3.1 and D.1.8 through horizontal openings, hatches or manholes, the dimensions should be sufficient to allow a person with a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening should be not less than 600 mm by 600 mm.

3.3 For accesses defined in 3.1 and D.1.8 through vertical openings, or manholes providing passage through the length and breadth of space, the minimum clear opening should be not less than 600 mm by 800 mm at a height of not more than 600 mm from the bottom shell or deck plating, unless gratings or other footholds are provided.

3.4 Smaller dimensions may be approved, if at least one main access defined in 3.1 andD.1.8 has dimensions not less than those required in 3.2 and 3.3, respectively. The main access should be identified clearly in an access plan.

3.5 Cargo pump-rooms should be so arranged as to ensure unrestricted access to all valves necessary for cargo handling for a person wearing the required personal protective equipment.

D. Special Requirements for Products With a Flashpoınt not Exceedıng 60°C, Toxic Products and Acids

To ensure that the designs of the vessels are such that the consequences of any release of liquid cargo with severe safety hazards will be minimized, and to provide protection to the vessel and crew from fire, toxic vapour and corrosive substances. The provisions in this chapter are additional to the general provisions of subsection C.

1. General requirements for products with a flashpoint not exceeding 60°C, toxic products and acids

1.1 Unless expressly provided otherwise, the provisions of this section are applicable to products with a flashpoint not exceeding 60°C, toxic products and acids. These provisions are additional to the general provisions of this Section.

1.2 Cargo tanks certified for products or residues of products subject to the provisions of this chapter should be segregated from machinery spaces, propulsion shaft tunnels, solid bulk cargo and underdeck access way if fitted, by means of a cofferdam **(4)**, void space, cargo pump-room, empty tank or other similar space.

1.3 Cargo tanks certified for products subject to the provisions of this chapter need to be separated from the deck plating by cofferdams.

(4) *Refer to the interpretation of SOLAS regulation II-2/4.5.1 (MSC/Circ.1120).*

1.4 Cargo piping should not pass through any underdeck access way or machinery spaces.

1.5 Discharge arrangements for ballast or fresh water sited immediately adjacent to cargo tanks certified for products or residues of products subject to the provisions of this chapter should be outside machinery spaces and accommodation spaces. Filling arrangements may be in the machinery spaces provided that such arrangements ensure filling from main deck level and non-return valves are fitted.

1.6 Bilge pumping systems serving spaces where cargoes or residues of cargoes may occur are to be independent from systems serving spaces outside such areas and are to be entirely situated within the area related to cargos subject to this subsection. The bilge system serving these spaces should be operable from outside the cargo area.

1.7 In order to guard against the danger of hazardous vapours, due consideration should be given to the location of air intakes and openings into accommodation, passageways, service and machinery spaces and control stations in relation to cargo piping and cargo vent systems as defined in A.2.7.

1.8 All access to cargo tanks, cofferdams, void spaces, cargo pump-room, pump-room, empty tank, or other spaces adjacent to cargo tanks certified for products subject to the provisions of this subsection, should be direct from the open deck and such as to ensure their complete inspection. The dimensions of the accesses should be in accordance with C.3.2 to C.3.4.

1.9 High walkways should not be located within the cargo area as defined in A.2.7.3.3.

2. Products with a flashpoint not exceeding 60°C

2.1 The provisions of this item are applicable to products with a flashpoint not exceeding 60°C. These provisions are in addition to the general provisions of C.

2.2 Unless they are located at least 7 m away from the deck area as defined in A.2.7.3, entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the cargo deck area. Doors to spaces not having access to accommodation, service and machinery spaces and control stations, such as cargo control stations and storerooms, may be permitted within such deck area, provided the boundaries of the spaces are insulated to A-60 standard. When arranged within such deck area, windows and sidescuttles facing the deck area should be of a fixed (non-opening) type. Such sidescuttles in the first tier on the main deck should be fitted with inside covers of steel or equivalent material.

3. Toxic products

3.1 The provisions of this item are applicable to toxic products. These provisions are additional to the general provisions of C and to the special requirements in section 15.12 of the IBC Code.

3.2 Unless they are located at least 15 m away from the deck area as defined in A.2.7.3, entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the deck area. Doors to spaces not having access to accommodation, service and machinery spaces and control stations, such as cargo control stations and storerooms, may be permitted within such deck area, provided the boundaries of the spaces have equivalent gas tightening to A-60 standard. Wheelhouse doors and wheelhouse windows may be located within the limits specified above so long as they are designed in such a way that a rapid and efficient gas- and vapour-tightening of the wheelhouse can be assured. Windows and sidescuttles facing the deck area and on the sides of the superstructures and deckhouses within the limits specified above should be of the fixed (non-opening) type. Such sidescuttles in the first tier on the main deck should be fitted with inside covers of steel or equivalent material.

3.3 For a vessel certified to carry toxic products only subject to the requirements of 15.12.3 and 15.12.4 of the IBC Code, entrances, air inlets and openings to accommodation, service and machinery spaces and control stations may be accepted in bulkheads facing the cargo deck area if they are located outside the deck area as defined in A.2.7.3.

3.4 Cargo tanks certified to carry toxic products should be fitted with fixed tank washing arrangements. Other arrangements allowing cleaning of the tank(s) without the need for personnel to enter during the cleaning process may be fitted, if proper safety equipment is used.

3.5 The cargo deck area should be such as to promote natural ventilation and to prevent toxic gas from accumulating in closed or partly closed spaces on deck. A high closed cargo rail in the stern is prohibited. However, if proper natural ventilation can be documented, a higher aft bulwark/cargo rail may be accepted.

3.6 Means should be provided to minimize the range of a possible leak in the hose landing area on the main deck. An example of such means is transverse gutter bars on both sides of the hose landing area in way of the loading stations.

3.7 The set point of the pressure side of the P/V valves should be set at a minimum 0,6 bar gauge.

4. Acids

4.1 The provisions of this item are applicable to acids. These provisions are additional to the general provisions of this Section and to the special requirements in section 15.11 of the IBC Code.

4.2 Floors or decks under acid storage tanks and pumps and piping for acid should have a lining or coating of corrosion-resistant material extending up to a minimum height of 500 mm on the bounding bulkheads or coamings. Hatches or other openings in such floors or decks should be raised to a minimum height of 500 mm; however, where the Administration determines that this height is not practicable, a lesser height may be accepted.

4.3 Flanges or other detachable pipe connections should be covered by spray shields.

4.4 Portable shield covers for connecting the flanges of the loading manifold should be provided. Drip trays of corrosion-resistant material should be provided under loading manifolds for acids.

4.5 Spaces for acid storage tanks and acid pumping and piping should be provided with drainage arrangements of corrosion-resistant materials.

4.6 Deck spills should be kept away from accommodation and service areas by means of a permanent coaming of suitable height and extension.

E. Cargo Containment

To ensure the safe containment of cargo under all design and operating conditions having regard to the nature of the cargo carried.

1. Definitions

1.1 *Independent tank* means a cargo-containment envelope, which is not contiguous with, or part of, the hull structure. An independent tank is built and installed so as to eliminate whenever possible (or in any event to minimize) its stressing as a result of stressing or motion of the adjacent hull structure. An independent tank is not essential to the structural completeness of the vessel's hull.

1.2 *Integral tank* means a cargo-containment envelope which forms part of the vessel's hull and which may be stressed in the same manner and by the same loads which stress the contiguous hull structure and which is normally essential to the structural completeness of the vessel's hull.

1.3 *Gravity tank* means a tank having a design pressure not greater than 0,07 MPa gauge at the top of the tank. A gravity tank may be independent or integral. A gravity tank should be constructed and tested according to recognized standards, taking account of the temperature of carriage and relative density of the cargo.

1.4 *Pressure tank* means a tank having a design pressure greater than 0,07 MPa gauge. A pressure tank should be an independent tank and should be of a configuration permitting the application of pressure-vessel design criteria according to recognized standards.

2. Tank type requirements for individual products

2.1 Requirements for both installation and design of tank types for individual products are shown in column f in the table in chapter 17 of the IBC Code.

2.2 Instead of the use of permanently attached cargo deck tanks complying with the requirements of the IBC Code, portable tanks meeting the construction requirements of the IMDG Code or other portable tanks specifically approved by the Administration may be used for cargoes indicated in A.1.9, provided that the provisions of chapter 17 are complied with. The applicable tank instruction for the products listed as dangerous goods in the IMDG Code should apply. Products with pollution hazard only and a flashpoint above 60°C falling within the scope of this Section, but for which the IMDG Code is not applicable, when carried in packaged form, should be shipped under the tank instruction and special tank requirements as included in the IMDG Code for goods with UN number 3082.

F. Cargo Transfer

To ensure the safe handling of all cargoes, under all normal operating conditions and foreseeable emergency conditions, to minimize the risk to the vessel, its crew and the environment, having regard to the nature of the products involved. This will:

.1 ensure the integrity of integral liquid product tanks, piping systems and cargo hoses;

.2 prevent the uncontrolled transfer of cargo; and

.3 ensure reliable means to fill and empty the cargo tank.

1. Piping scantlings

1.1 Subject to the conditions stated in 1.4, the wall thickness (t) of pipes should not be less than:

$$t = \frac{t_0 + b + c}{1 - \frac{a}{100}} \quad \text{(mm)}$$

where:

t_0 = Theoretical thickness

t_0 = $PD/(2Ke+P)$ (mm)

with

P = Design pressure (MPa) referred to in 1.2

D = Outside diameter (mm)

K = Allowable stress (N/mm^2) referred to in 1.5

e = Efficiency factor equal to 1.0 for seamless pipes and for longitudinally or spirally welded pipes, delivered by approved manufacturers of welded pipes, which are considered equivalent to seamless pipes whennon-destructive testing on welds is carried out in accordance with recognized standards. In other cases, an efficiency factor of less than 1.0, in accordance with recognized standards, may be required depending on the manufacturing process.

b = Allowance for bending (mm). The value of *b* should be chosen so that the calculated stress in the bend, due to internal pressure only, does not exceed the allowable stress. Where such justification is not given, *b* should be not less than

$$b = \frac{Dt_0}{2.5r} \quad (mm)$$

with

r = Mean radius of the bend (mm)

c = Corrosion allowance (mm). If corrosion or erosion is expected, the wall thickness of piping should be increased over that required by the other design provisions.

a = Negative manufacturing tolerance for thickness (%).

1.2 The design pressure *P* in the formula in 1.1 is the maximum gauge pressure to which the system may be subjected in service, taking into account the highest set pressure on the relief valve on the system.

1.3 Piping and piping-system components which are not protected by a relief valve, or which may be isolated from their relief valve, should be designed for at least the greatest of:

1.3.1 for piping systems or components which may contain some liquid, the saturated vapour pressure at 45°C;

1.3.2 the pressure setting of the associated pump discharge relief valve;

1.3.3 the scantlings' maximum possible total pressure head at the outlet of the associated pumps when a pump discharge relief valve is not installed; and

1.3.4 for systems or components which may be separated from their relief valves and which contain only vapour at all times, the superheated vapour pressure at 45°C, assuming an initial condition of saturated vapour in the system at the system operating pressure and temperature.

1.4 The design pressure should not be less than 1 MPa gauge except for open-ended lines, where it should be not less than 0.5 MPa gauge.

1.5 For pipes, the allowable stress *K* to be considered in the formula in 1.1 is the lower of the following values:

R_m/A or R_e/B

where:

R_m = Specified minimum tensile strength at ambient temperature (N/mm^2).

R_e = Specified minimum yield stress at ambient temperature (N/mm^2). If the stress-strain curve does not show a defined yield stress, the 0.2% proof stress applies.

A and *B* should have values of at least *A* = 2.7 and *B* = 1.8.

1.5.1 The minimum wall thickness should be in accordance with recognized standards.

1.5.2 Where necessary for mechanical strength to prevent damage, collapse, excessive sag or buckling of pipes due to weight of pipes and content and to superimposed loads from supports, vessel deflection or other causes, the wall thickness should be increased over that required by 1.1 or, if this is impracticable or would cause excessive local stresses, these loads should be reduced, protected against or eliminated by other design methods.

1.5.3 Flanges, valves and other fittings should be in accordance with recognized standards, taking into account the design pressure defined under 1.2.

1.5.4 For flanges not complying with a standard, the dimensions for flanges and associated bolts should be to the satisfaction of the Administration.

2. Piping fabrication and joining details

2.1 The provisions of this item apply to piping inside and outside the cargo tanks. However, relaxations from these provisions may be accepted in accordance with recognized standards for open-ended piping and for piping inside cargo tanks except for cargo piping serving other cargo tanks.

2.2 Cargo piping should be joined by welding except:

2.2.1 for approved connections to shut-off valves and expansion joints; and

2.2.2 for any practical vessel building and pipe corrosion protection limits taking into account the provisions stated in 2.5 and 3 in relation to any additional flanged connections, the use of flanged connections should be limited as far as possible.

2.3 Cargo piping for products or residues of products which are subject to the provisions of D. should be joined by welding.

2.4 The following direct connections of pipe lengths without flanges may be considered:

2.4.1 Butt-welded joints with complete penetration at the root may be used in all applications.

2.4.2 Slip-on welded joints with sleeves and related welding having dimensions in accordance with recognized standards should only be used for pipes with an external diameter of 50 mm or less. This type of joint should not be used when crevice corrosion is expected to occur.

2.4.3 Screwed connections, in accordance with recognized standards, should only be used for accessory lines and instrumentation lines with external diameters of 25 mm or less.

2.5 Expansion of piping should normally be allowed for by the provision of expansion loops or bends in the piping system:

2.5.1 bellows, in accordance with recognized standards and installed in an easily accessible location, may be specially considered; and

2.5.2 slip joints should not be used.

2.6 Welding, post-weld heat treatment and non-destructive testing should be performed in accordance with recognized standards.

3. Flange connections

3.1 Flanges should be of the welded-neck, slip-on or socket-welded type. However, socket-welded-type flanges should not be used with an external diameter above 50 mm.

3.2 Flanges should comply with recognized standards as to their type, manufacture and test.

4. Test requirements for piping

4.1 The test provisions of this section apply to piping inside and outside cargo tanks. However, relaxations from these provisions may be accepted in accordance with recognized standards for piping inside tanks and open-ended piping.

4.2 After assembly, each cargo piping system should be subject to a hydrostatic test to at least 1.5 times the design pressure. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the hydrostatic test may be conducted prior to installation aboard the vessel. Joints welded on board should be hydrostatically tested to at least 1.5 times the design pressure.

4.3 After assembly on board, each cargo piping system should be tested for leaks to a pressure depending on the method applied.

5. Piping arrangements

5.1 Cargo piping should not be installed under deck between the outboard side of the cargo containment spaces and the skin of the vessel unless clearances required for damage protection (see B.9) are maintained; but such distances may be reduced where damage to the pipe would not cause release of cargo provided that the clearance required for inspection purposes is maintained.

5.2 Cargo piping located below the main deck may run from the tank it serves and penetrate tank bulkheads or boundaries common to longitudinally or transversally adjacent cargo tanks, ballast tanks, empty tanks, pump-rooms or cargo pump-rooms provided that inside the tank it serves it is fitted with a stop valve operable from the weather deck and provided cargo compatibility is assured in the event of piping failure. As an exception, where a cargo tank is adjacent to a cargo pump-room, the stop valve operable from the weather deck may be situated on the tank bulkhead on the cargo pump-room side, provided an additional valve is fitted between the bulkhead valve and the cargo pump. A totally enclosed hydraulically operated valve located outside the cargo tank may, however, be accepted, provided that the valve is:

5.2.1 designed to preclude the risk of leakage;

5.2.2 fitted on the bulkhead of the cargo tank which it serves;

5.2.3 suitably protected against mechanical damage;

5.2.4 fitted at a distance from the shell as required for damage protection; and

5.2.5 operable from the weather deck.

5.3 If a cargo pump serves more than one tank, a stop valve should be fitted in the line to each tank.

5.4 Cargo piping installed in pipe tunnels should also comply with the provisions of 5.1 and 5.2. Pipe tunnels should satisfy all tank provisions for construction, location and ventilation and electrical hazard provisions. Cargo compatibility should be assured in the event of a piping failure. The tunnel should not have any other openings except to the weather deck and cargo pump-room or pump-room.

5.5 Cargo piping passing through bulkheads should be so arranged as to preclude excessive stresses at the bulkhead and should not utilize flanges bolted through the bulkhead.

5.6 In order to prevent any generation of static electricity, the outlets of filling lines should be led as low as possible in the tanks, except for vessels intended to carry pollution hazard only substances having a flashpoint exceeding 60°C or oil products having a flashpoint exceeding 60°C.

6. Cargo-transfer control systems

6.1 For the purpose of adequately controlling the cargo, cargo-transfer systems should be provided with:

6.1.1 one stop valve capable of being manually operated on each tank filling and discharge line, located near the tank penetration; if an individual deep well pump is used to discharge the contents of a cargo tank, a stop valve is not required on the discharge line of that tank;

6.1.2 one stop valve and break-away fitting at each cargo-hose connection; and

6.1.3 remote shutdown devices for all cargo pumps and similar equipment which should be capable of being activated from a dedicated cargo control location and which is manned at the time of cargo transfer and from at least one other location outside the cargo area and at a safe distance from it; cargo controls located in the vessel wheelhouse are acceptable as one of the cargo control locations.

6.2 For certain products, additional cargo-transfer control requirements are shown in column o in the table of chapter 17 of the IBC Code.

6.3 Pump discharge pressure gauges or readouts should be provided outside the cargo pump-room.

7. Vessels' cargo hoses

7.1 Liquid and vapour hoses used for cargo transfer should be compatible with the cargo and suitable for the cargo temperature.

7.2 Hoses subject to tank pressure or the discharge pressure of pumps should be designed for a bursting pressure not less than 5 times the maximum pressure the hose will be subjected to during cargo transfer.

7.3 Drip trays for collecting cargo residues in cargo lines and hoses should be provided in the area of pipe and hose connections under the manifold area.

7.4 Each type of cargo hose, complete with end-fittings, should be prototype tested at a normal ambient temperature with 200 pressure cycles from zero to at least twice the specified maximum working pressure. After this cycle pressure test has been carried out, the prototype test should demonstrate a bursting pressure of at least 5 times its specified maximum working pressure at the extreme service temperature. Hoses used for prototype testing should not be used for cargo service. Thereafter, before being placed in service, each new length of cargo hose produced should be hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure but not more than two-fifths of its bursting pressure. The hose should be stencilled or otherwise marked with the date of testing, its specified maximum working pressure and, if used in services other than the ambient temperature services, its maximum and minimum service temperature, as applicable. The specified maximum working pressure should not be less than 10 bar gauge.

G. Cargo Tank Venting

To protect cargo containment systems from harmful overpressure or underpressure at all times.

1. General

1.1 All cargo tanks should be provided with a venting system appropriate to the cargo being carried and these systems should be independent of the air pipes and venting systems of all other compartments of the vessel. Tank venting systems should be designed so as to minimize the possibility of cargo vapour accumulating about the decks, entering accommodation, service and machinery spaces and control stations and, in the case of flammable vapours, entering or collecting in spaces or areas containing sources of ignition. Tank venting systems should be arranged to prevent entrance of water into the cargo tanks.

1.2 The venting systems should be connected to the top of each cargo tank and, as far as practicable, the cargo vent lines should be self-draining back to the cargo tanks under all normal operational conditions of list and trim. Where it is necessary to drain venting systems above the level of any pressure/vacuum valve, capped or plugged drain cocks should be provided.

1.3 Provision should be made to ensure that the liquid head in any tank does not exceed the design head of the tank. Suitable high-level alarms, overflow control systems or spill valves, together with gauging and tank filling procedures, may be accepted for this purpose. Where the means of limiting cargo tank overpressure includes an automatic closing valve, the valve should comply with the appropriate requirements of 15.19 of the IBC Code.

1.4 Tank venting systems should be designed and operated so as to ensure that neither pressure nor vacuum created in the cargo tanks during loading or unloading exceeds tank design parameters. The main factors to be considered in the sizing of a tank venting system are as follows:

1.4.1 design loading and unloading rate;

1.4.2 gas evolution during loading: this should be taken account of by multiplying the maximum loading rate by a factor of at least 1.25;

1.4.3 density of the cargo vapour mixture;

1.4.4 pressure loss in vent piping and across valves and fittings; and

1.4.5 pressure/vacuum settings of relief devices.

1.5 Tank vent piping connected to cargo tanks of corrosion-resistant material or to tanks which are lined or coated to handle special cargoes as required by chapter 15 of the IBC Code, should be similarly lined or coated or constructed of corrosion-resistant material.

1.6 The master should be provided with the maximum permissible loading and unloading rates for each tank or group of tanks consistent with the design of the venting systems.

2. Types of tank venting systems

2.1 An open tank venting system is a system which offers no restriction except for friction losses to the free flow of cargo vapours to and from the cargo tanks during normal operations. An open venting system may consist of individual vents from each tank, or such individual vents may be combined into a common header or headers, with due regard to cargo segregation. In no case should shut-off valves or any other means of stoppage, including spectacle blanks and blank flanges, be fitted either to the individual vents or to the header.

2.2 A controlled tank venting system is a system in which pressure- and vacuum-relief valves or pressure/vacuum valves are fitted to each tank to limit the pressure or vacuum in the tank. A controlled venting system may consist of individual vents from each tank or such individual vents on the pressure side only as may be combined into a common header or headers, with due regard to cargo segregation. In no case should shut-off valves or any other means of stoppage, including spectacle blanks and blank flanges, be fitted either above or below pressure- or vacuum-relief valves or pressure/vacuum valves. Provision may be made for bypassing a pressure- or vacuum-relief valve or pressure/vacuum valve under certain operating conditions provided that the requirement of 2.6 is maintained and that there is suitable indication to show whether or not the valve is bypassed.

2.3 Controlled tank venting systems should consist of a primary and a secondary means of allowing full flow relief of vapour to prevent overpressure or underpressure in the event of failure of one means. Alternatively, the secondary means may consist of pressure sensors fitted in each tank with a monitoring system in the vessel's cargo control room or position from which cargo operations are normally carried out. Such monitoring equipment should also provide an alarm facility which is activated by detection of overpressure or underpressure conditions within a tank.

2.4 The outlets of a controlled tank venting system should direct the vapour discharge upwards in the form of unimpeded jets and the position should be arranged at a height of not less than 6 m above the weather deck.

2.5 The outlet height referred to in 2.4 may be reduced to 3 m above the weather deck provided that high-velocity venting valves of an approved type with an exit velocity of at least 30 m/s are fitted.

2.6 Controlled tank venting systems fitted to tanks to be used for cargoes having a flashpoint not exceeding 60°C should be provided with devices to prevent the passage of flame into the cargo tanks. The design, testing and locating of the devices should comply with the provisions of the Administration, which should contain at least the standards adopted by the Organization.

2.7 In designing venting systems and in the selection of devices to prevent the passage of flame for incorporation into the tank venting system, due attention should be paid to the possibility of the blockage of these systems and fittings by, for example, the freezing of cargo vapour, polymer build-up, atmospheric dust or icing up in adverse weather conditions. In this context it should be noted that flame arresters and flame screens are more susceptible to blockage. Provisions should be made such that the system and fittings may be inspected, operationally checked, cleaned or renewed as applicable.

2.8 Pressure tanks should be fitted with pressure relief devices that are so designed as to direct the discharge away from personnel and have a set pressure and capacity which is in accordance with standards acceptable to the Administration taking into account the design pressure referred to in F.1.5.

3. Venting requirements for individual products

Venting requirements for individual products are shown in column g and additional requirements in column o in the table of chapter 17 of the IBC Code.

4. Cargo tank gas freeing

4.1 The arrangements for gas freeing cargo tanks used for cargoes other than those for which open venting is permitted should be such as to minimize the hazards due to the dispersal of flammable or toxic vapours in the atmosphere and to flammable or toxic vapour mixtures in a cargo tank. Accordingly, gas freeing operations should be carried out such that vapour is initially discharged:

4.1.1 through the vent outlets specified in 2.4 and 2.5; or

4.1.2 through outlets at least 2 m above the cargo tank deck level with a vertical exit velocity of at least 30 m/s maintained during the gas freeing operation; or

4.1.3 through outlets at least 2 m above the cargo tank deck level with a vertical exit velocity of at least 20 m/s which are protected by suitable devices to prevent the passage of flame.

When the flammable vapour concentration at the outlets has been reduced to 30% of the lower flammable limit and, in the case of a toxic product, the vapour concentration does not present a significant health hazard, gas freeing may thereafter be continued at cargo tank deck level.

4.2 The outlets referred to in 4.1.2 and 4.1.3 may be fixed or portable pipes.

4.3 In designing a gas freeing system in conformity with 4.1, particularly in order to achieve the required exit velocities of 4.1.2 and 4.1.3, due consideration should be given to the following:

4.3.1 materials of construction of system;

4.3.2 time to gas free;

4.3.3 flow characteristics of fans to be used;

4.3.4 the pressure losses created by ducting, piping, cargo tank inlets and outlets;

4.3.5 the pressure achievable in the fan driving medium (e.g. water or compressed air); and

4.3.6 the densities of the cargo vapour/air mixtures for the range of cargoes to be carried.

H. Electrical Installations

To ensure electrical installations are designed so as to minimize the risk of fire and explosion from flammable products, and to ensure availability of electrical generation and distribution systems relating to the safe carriage, handling and conditioning of cargoes.

1. General requirements

1.1 The provisions of this chapter are applicable to vessels carrying cargoes which are inherently, or due to their reaction with other substances, flammable or corrosive to the electrical equipment, and should be applied in conjunction with applicable electrical requirements of part D of chapter II-1 of SOLAS.

1.2 Electrical installations should be such as to minimize the risk of fire and explosion from flammable products. Appropriate precautions should be taken to recognize the risks that might be associated with deterioration of the electrical system and equipment on account of the environment created by the products.

1.3 Electrical installation should be in accordance with standards acceptable to the Organization.5

1.4 Electrical equipment or wiring should not be installed in hazardous areas unless essential for operational purposes or safety enhancement.

1.5 Where electrical equipment is installed in hazardous areas as provided for in 1.4, it should be selected, installed and maintained in accordance with standards not inferior to those acceptable to the Organization **(5)**. Equipment for hazardous areas should be evaluated and certified or listed by an accredited testing authority or notified body recognized by the Administration. Automatic isolation of non-certified equipment on detection of a flammable gas should not be accepted as an alternative to the use of certified equipment.

1.6 To facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones in accordance with recognized standards **(5)**.

1.7 The lighting system in hazardous areas should be divided between at least two branch circuits. All switches and protective devices should interrupt all poles or phases and should be located in a non-hazardous area.

2. Electrical requirements for individual products

Electrical requirements for individual products are shown in column i in the table of chapter 17 of the IBC Code.

I. Fire-Fighting Requirements

To ensure that suitable systems are provided to protect the vessel and crew from fire in the cargo area.

1. Application

1.1 For the carriage of liquids covered by this Section, the requirements for tankers in chapter II-2 of SOLAS should apply to vessels covered by this Section, irrespective of tonnage, including vessels of less than 500 GT, except that:

(5) *Reference is made to the recommendations published by the International Electrotechnical Commission, in particular to the publication IEC 60092-502:1999.*

1.1.1 regulations 10.8 (cargo tank protection) and 10.9 (protection of cargo pump-rooms in tankers) should not be applied;

1.1.2 the provisions of 3 of this subsection should be applied in lieu of regulation 10.8 (cargo tank protection);

1.1.3 the provisions of 2 of this subsection should be applied in lieu of regulation 10.9 (protection of cargo pump-rooms in tankers);

1.1.4 regulation 4.5.1.1 (positioning of machinery spaces aft of cargo tanks, slop tanks, cargo pump-rooms and cofferdams), regulation 4.5.1.2 (requirements for location of the main cargo control station), regulations 4.5.1.4 (combination carriers) and 4.5.2.1 (access to accommodations and boundary bulkheads) to 4.5.2.3 (windows facing cargo area) need not be applied;

1.1.5 with regard to regulation 9.2.4.1, the Administration may permit use of a method other than IC as defined in regulation 9.2.3.1.1.1;

1.1.6 for spaces other than cargo pump-room spaces, the requirements of regulation 9.2.3 (cargo vessels except tankers) may be applied in lieu of those in regulation 9.2.4.2; additionally, regulation 9.2.4.2.5 (A-60 standard) need not be applied provided that the exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation are located outside the cargo deck area defined in A.2.7.3;

1.1.7 regulations 4.5.3 (cargo tank venting), 4.5.4 (ventilation), 4.5.7 (gas measurement) and 4.5.8 (air supply to double hull spaces and double bottom spaces) need not be applied where alternative arrangements are provided, having due regard to the provisions of this Section;

1.1.8 for vessels below 2,000 GT, regulations 10.2 (water supply systems), 10.4 (fixed fire-extinguishing systems) and 10.5 (fire-extinguishing arrangements in machinery spaces) should apply as they would apply to cargo vessels of 2,000 GT and over;

1.1.9 regulation 4.5.10 should apply to vessels of 500 GT and over, replacing "hydrocarbon gases" by "flammable vapours" in the regulation; and

1.1.10 regulations 13.3.4 (EEBDs) and 13.4.3 (EEBDs) should apply to vessels of 500 GT and over.

1.2 Notwithstanding the provisions of 1.1, vessels engaged solely in the carriage of products which are identified in chapter 17 of the IBC Code as non-flammable (entry "NF" in column i of the table of minimum requirements) need not comply with requirements for tankers specified in SOLAS chapter II-2, provided that they comply with the requirements for cargo vessels of that chapter, except that regulation 10.7 (fire-extinguishing arrangements in cargo spaces) need not apply to such vessels and 2 and 3 hereunder need not apply.

1.3 For vessels engaged solely in the carriage of products with a flashpoint exceeding 60°C (entry "Yes" in column i of the table of minimum requirements), the requirements of SOLAS chapter II-2 may apply as specified in regulation II-2/1.6.4 (tankers carrying petroleum products with a flashpoint exceeding 60°C) in lieu of the provisions of this chapter.

1.4 For vessels engaged in both carriage of products with a flashpoint exceeding 60°C and products with a flashpoint not exceeding 60°C, the provisions of 2 and 3 are only applicable to the cargo areas and pump-rooms in connection with the tanks for carriage of products with a flashpoint not exceeding 60°C. Further, the requirement for tankers in SOLAS chapter II-2, as referred to in 1.1 above, is only applicable to cargo areas, cargo space, cargo tanks, pump-rooms, control stations and other spaces in connection with the tanks for carriage of products with a flashpoint not exceeding 60°C.

2. Cargo pump-rooms

2.1 The cargo pump-room of any vessel to which the provisions of 1.4 apply should be provided with a fixed carbon dioxide fire-extinguishing system as specified in SOLAS regulation II-2/10.9.1.1. A notice should be exhibited at the controls stating that the system is only to be used for fire-extinguishing and not for inerting purposes, due to the electrostatic ignition hazard. The alarms referred to in SOLAS regulation II-2/10.9.1.1.1 (safe alarms) should be safe for use in a flammable cargo vapour/air mixture. For the purpose of this requirement, an extinguishing system should be provided which would be suitable for machinery spaces. However, the amount of gas carried should be sufficient to provide a quantity of free gas equal to 45% of the gross volume of the cargo pump-room in all cases.

2.2 Cargo pump-rooms of vessels which are dedicated to the carriage of a restricted number of cargoes should be protected by an appropriate fire-extinguishing system approved by the Administration.

2.3 If cargoes are to be carried which are not suited to extinguishment by carbon dioxide or equivalent media, the cargo pump-room should be protected by a fire-extinguishing system consisting of either a fixed pressure water spray or high-expansion foam system. The International Certificate of Fitness should reflect this conditional requirement.

3. Protection of the cargo area

3.1 Every vessel should be provided with a fixed deck foam system in accordance with the provisions of 3.2 to 3.8.

3.2 The system should be located and sized to supply simultaneously foam to the deck area as defined in A,2.7.3 to A,2.7.5 and A,2.7.7.

3.3 All parts of the areas are to be protected by either fixed foam monitor(s) or fixed nozzles or a combination of both.

3.4 In case of foam monitors, one monitor may be sufficient and the distance from the monitor to the farthest extremity of the protected area should not be more than 75% of the monitor throw in still air conditions. The monitor(s) should be in a location that is not above the cargo tanks and is readily accessible and operable in the event of fire in the areas protected.

3.5 The deck foam system should be capable of simple and rapid operation. The main control station for the system should be suitably located outside of the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fires in the areas protected.

3.6 Application rate should be 10 *l*/min/m2 with sufficient supply for at least 30 min for tanks without an overlying cofferdam and 20 min for tanks with an overlying cofferdam. Water supply to the fixed foam fire-extinguishing system should be in addition to the water supply required for the vessels fire main.

3.7 The foam concentrates should be compatible with the cargo carried.

3.8 In addition, the vessel should carry in a readily available position, at cargo deck level, two portable foam applicator units with at least four portable 20 *l* containers with foam concentrate, for use with water supplied by the vessels fire main.

4. Special requirements

All fire-extinguishing media determined to be effective for each product are listed in column l in the table of chapter 17 in the IBC Code. Refer to the Material Safety Data Sheet (MSDS) for each product to be carried.

J. Mechanical Ventilation in the Cargo Area

To ensure that arrangements are provided for enclosed spaces in the cargo area to control the accumulation of flammable and/or toxic vapours.

1. Application

1.1 For vessels to which this Section applies, the provisions of this chapter replace the requirements of SOLAS regulations II-2/4.5.2.6 and 4.5.4.1.

1.2 However, for products addressed under I,1.3, except acids and products for which 15.12 and/or 15.17 of the IBC Code applies, SOLAS regulations II-2/4.5.2.6 and 4.5.4.1 may apply in lieu of the provision of 10.2 of this chapter.

1.3 For non-flammable products addressed under I.1.2, except acids and products for which 15.12 and/or 15.17 of the IBC Code applies, the provisions for permanent installations in 3 may apply for spaces required to be entered during normal cargo handling operations.

2. Spaces normally entered during normal cargo handling operations

2.1 Cargo pump-rooms, spaces containing cargo handling equipment and other enclosed spaces where cargo vapours may accumulate should be fitted with fixed mechanical ventilation systems, capable of being controlled from outside such spaces. The ventilation should be run continuously to prevent the accumulation of toxic vapours. A warning notice requiring the use of such ventilation prior to entering should be placed outside the compartment.

2.2 Mechanical ventilation inlets and outlets should be arranged to ensure sufficient air movement through the space to avoid accumulation of toxic or asphyxiant vapours, and to ensure a safe working environment.

2.3 The ventilation system should have a capacity of not less than 30 changes of air per hour, based upon the total volume of the space.

2.4 Where a space has an opening into an adjacent more hazardous space or area, it should be maintained at an overpressure. It may be made into a less hazardous space or non-hazardous space by overpressure protection in accordance with standards acceptable to the Organization.6

2.5 Ventilation systems should be permanent and should normally be of extraction type. Extraction from above and below the floor plates should be possible.

2.6 Ventilation intakes should be so arranged as to minimize the possibility of recycling hazardous vapours from any ventilation discharge opening.

2.7 Ventilation ducts serving hazardous areas should not be led through accommodation, service or machinery spaces or control stations.

2.8 Electric motors driving fans should be placed outside the ventilation ducts that may contain flammable vapours. Ventilation fans should not produce a source of ignition in either the ventilated space or the ventilation system associated with the space. For hazardous areas, ventilation fans and ducts adjacent to the fans should be of non-sparking construction, as defined below:

2.8.1 impellers or housing of non-metallic construction, with due regard being paid to the elimination of static electricity;

2.8.2 impellers and housing of non-ferrous materials;

2.8.3 impellers and housing of austenitic stainless steel; and

2.8.4 ferrous impellers and housing with not less than 13 mm design tip clearance.

2.9 Any combination of an aluminium or magnesium alloy fixed or rotating component and a ferrous fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and should not be used in these places.

2.10 Where fans are required by this chapter, full required ventilation capacity for each space should be available after failure of any single fan or spare parts should be provided comprising a motor, starter spares and complete rotating element, including bearings of each type.

2.11 Protection screens of not more than 13 mm square mesh should be fitted to outside openings of ventilation ducts.

2.12 Where spaces are protected by overpressure the ventilation should be designed and installed in accordance with standards acceptable to the Organization **(6)**.

3. Spaces not normally entered

Enclosed spaces where cargo vapours may accumulate should be capable of being ventilated to ensure a safe environment when entry into them is necessary. This should be capable of being achieved without the need for prior entry. For permanent installations, the capacity of 8 air changes per hour should be provided and for portable systems, the capacity of 16 air changes per hour. Fans or blowers should be clear of personnel access openings, and should comply with 2.8.

K. Instrumentation and Automation Systems

To ensure that the instrument and automation systems provide for the safe carriage and handling of cargoes.

1. General

1.1 Each cargo tank should be provided with a means for indicating level.

1.2 If loading and unloading of the vessel is performed by means of remotely controlled valves and pumps, all controls and indicators associated with a given cargo tank should be concentrated in at least one cargo control station.

1.3 Instruments should be tested to ensure reliability under working conditions and recalibrated at regular intervals. Test procedures for instruments and the intervals between recalibration should be in accordance with manufacturers' recommendations.

2. Level indicators for cargo tanks

2.1 Each cargo tank should be fitted with a liquid level gauging device or devices, arranged to ensure a level reading is always obtainable whenever the cargo tank is operational. The device(s) should be designed to operate throughout the design pressure range of the cargo tank and at temperatures within the cargo operating temperature range.

2.2 Where the installation of liquid level gauging devices are impractical due to the properties of the cargo, such as liquid muds, a visual means of indicating the cargo tank level should be provided for cargo loading operations, subject to approval by the Administration.

2.3 Where only one liquid level gauge is fitted, it should be arranged so that it can be maintained in an operational condition without the need to empty or gas free the tank.

(6) *Refer to IEC 60092-502:1999.*

2.4 Cargo tank liquid level gauges may be of the following types, subject to special requirements for particular cargoes shown in column j in the table of chapter 17 of the IBC Code:

2.4.1 Open device, which makes use of an opening in the tanks and may expose the gauge to the cargo or its vapour. An example of this is the ullage opening.

2.4.2 Restricted device, which penetrates the tank and which, when in use, permits a small quantity of cargo vapour or liquid to be exposed to the atmosphere. When not in use, the device is completely closed. The design should ensure that no dangerous escape of tank contents (liquid or spray) can take place in opening the device.

2.4.3 Closed device, which penetrates the tank but which is part of a closed system and keeps tank contents from being released. Examples are the float-type systems, electronic probe, magnetic probe and protected sight-glass. Alternatively, an indirect device which does not penetrate the tank shell and which is independent of the tank may be used. Examples are weighing of cargo and pipe flowmeter.

3. Overflow control

The requirements of 15.19 of the IBC Code are applicable where specific reference is made in column o in the table of chapter 17 thereof, and are in addition to the provisions for gauging devices as stated in 2.

4. Vapour detection

4.1 Vessels carrying toxic or flammable products or both should be equipped with at least two instruments designed and calibrated for testing for the specific vapours in question. If such instruments are not capable of testing for both toxic concentrations and flammable concentrations, then two separate sets of instruments should be provided.

4.2 Vapour-detection instruments may be portable or fixed. If a fixed system is installed, at least one portable instrument should be provided.

4.3 When toxic-vapour-detection equipment is not available for some products which require such detection, as indicated in column k in the table of chapter 17 of the IBC Code, the Administration may exempt the vessel from the requirement, provided an appropriate entry is made on the Certificate of Fitness. When granting such an exemption, the Administration should recognize the necessity for additional breathing-air supply and an entry should be made on the Certificate of Fitness drawing attention to the requirements of 14.2.4 and 16.4.2.2 of the IBC Code.

4.4 Vapour-detection requirements for individual products are shown in column k in the table of chapter 17 of the IBC Code.

L. Pollutİon Prevention Requirements

To ensure control of pollution from noxious liquid substances from OSVs.

1. Each vessel certified to carry noxious liquid substances should be provided with a Cargo Record Book, a Procedure and Arrangements Manual and a Shipboard Marine Pollution Emergency Plan developed for the vessel in accordance with MARPOL Annex II and approved by the Administration.

2. Discharge into the sea of residues of noxious liquid substances permitted for carriage under this Section, tank washings, or other residues or mixtures containing such substances, is prohibited. Any discharges of residues and mixtures containing noxious liquid substances should be to port reception facilities. As a consequence of this prohibition, there are no requirements for efficient stripping and underwater discharge arrangements in MARPOL Annex II.

M. Life-Saving Appliances and Arrangements

To ensure that life-saving appliances and arrangements are provided in such a way to protect the life and safety of personnel on OSVs, having regard to the nature and volume of cargo carried.

For vessels carrying more than 1,200 m3 of cargoes with a flashpoint not exceeding 60°C or carrying cargoes emitting toxic vapours or gasses, the requirements for chemical tankers of SOLAS chapter III should apply.

N. Personnel Protection

To ensure that protective equipment is provided for crew members, taking into account both routine operations or emergency situations and possible short-term or long-term effects of the product being handled.

1. Protective equipment

1.1 Suitable protective equipment, including eye protection to a recognized national or international standard, should be provided for protection of crew members engaged in normal cargo operations, taking into account the characteristics of the products being carried.

1.2 Personal protective and safety equipment required in this chapter should be kept in suitable, clearly marked lockers located in readily accessible places. Special arrangements should apply to contaminated clothing as appropriate.

2. First aid equipment

2.1 A stretcher that is suitable for hoisting an injured person from spaces below deck should be kept in a readily accessible location.

2.2 The vessel should have on board medical first aid equipment, including oxygen resuscitation equipment, based on the provisions of the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG) for the cargoes listed on the Certificate of Fitness.

3. Safety equipment

3.1 Vessels carrying cargoes for which "15.12", "15.12.1" or "15.12.3" is indicated in column o in the table of chapter 17 of the IBC Code should have on board sufficient but not less than three complete sets of safety equipment, each permitting personnel to enter a gas-filled compartment and perform work there for at least 20 min. Such equipment should be in addition to that required by SOLAS regulation II-2/10.10.

3.2 Each complete set of safety equipment should consist of:

3.2.1 one self-contained positive pressure air-breathing apparatus incorporating full face mask, not using stored oxygen and having a capacity of at least 1,200 *l* of free air; each set should be compatible with that required by SOLAS regulation II-2/10.10;

3.2.2 protective clothing, boots and gloves to a recognized standard;

3.2.3 steel-cored rescue line with belt; and

3.2.4 explosion-proof lamp.

3.3 For the safety equipment required in 3.1, all vessels should carry either:

3.3.1 one set of fully charged spare air bottles for each breathing apparatus;

3.3.2 a special air compressor suitable for the supply of high-pressure air of the required purity;

3.3.3 a charging manifold capable of dealing with sufficient spare air bottles for the breathing apparatus; or

3.3.4 fully charged spare air bottles with a total free air capacity of at least 6,000 *l* for each breathing apparatus on board in excess of the requirements of SOLAS regulation II-2/10.10.

3.4 A cargo pump-room on vessels carrying cargoes which are subject to the requirements of 15.18 of the IBC Code or cargoes for which in column k in the table of chapter 17 thereof toxic-vapour-detection equipment is required but is not available should have either of the following:

3.4.1 A low-pressure line system with hose connections suitable for use with the breathing apparatus required by 3.1. This system should provide sufficient high-pressure air capacity to supply, through pressure-reduction devices, enough low-pressure air to enable two men to work in a gas-dangerous space for at least 1 h without using the air bottles of the breathing apparatus. Means should be provided for recharging the fixed air bottles and the breathing apparatus air bottles from a special air compressor suitable for the supply of high-pressure air of the required purity.

3.4.2 An equivalent quantity of spare bottled air in lieu of the low-pressure air line.

3.5 Safety equipment as required by 3.2 should be kept in a suitable clearly marked locker in a readily accessible place near the cargo pump-room or cargo area.

3.6 The breathing apparatus should be inspected at least once a month by a responsible officer, and the inspection recorded in the vessel's logbook. The equipment should be inspected and tested by an expert at least once a year.

4. Emergency equipment

4.1 Vessels carrying cargoes, for which "Yes" is indicated in column n of chapter 17 of the IBC Code, should be provided with suitable respiratory and eye protection sufficient for every person on board for emergency escape purposes, subject to the following:

4.1.1 filter-type respiratory protection is unacceptable;

4.1.2 self-contained breathing apparatus should have a duration of service of at least 15 min; and

4.1.3 emergency escape respiratory protection should not be used for fire-fighting or cargo handling purposes and should be marked to that effect.

4.2 One or more suitably marked decontamination showers and eyewash stations should be available on deck, taking into account the size and layout of the vessel. The showers and eyewashes should be operable in all ambient conditions.

O. Operational Requirements

To ensure that all crew members involved in cargo operations have sufficient information about cargo properties and operating the cargo system so they can conduct cargo operations safely.

1. General

1.1 The quantity of a cargo required to be carried should be in accordance with the requirements in 16.1.1 and 16.1.2 of the IBC Code.

1.2 Tanks carrying liquids at ambient temperatures should be loaded in such a way as to avoid the tank becoming liquid-full during the voyage, having due regard to the highest temperature which the cargo may reach.

1.3 When carrying cargo requiring controlled venting in column g in the table of chapter 17 of the IBC Code, the access to any surrounding areas in the horizontal plane and upwards of the vent outlet should be restricted within a 4 m horizontal zone.

2. Cargo information

2.1 A copy of this Section and the IBC Code, or national regulations incorporating the requirements of this Section and the IBC Code, should be on board every vessel covered by this Section.

2.2 Any cargo offered for bulk shipment should be indicated in the shipping documents by the product name under which it is listed in chapter 17 or 18 of the IBC Code or the latest edition of MEPC.2 Circular or under which it has been provisionally assessed. Where the cargo is a mixture, an analysis indicating the dangerous components contributing significantly to the total hazard of the product should be provided, or a complete analysis if this is available. Such an analysis should be certified by the manufacturer or by an independent expert acceptable to the Administration.

2.3 Information should be on board, and available to all concerned, giving the necessary data for the safe carriage of the cargo in bulk. Such information should include a cargo stowage plan, to be kept in an accessible place, indicating all cargo on board, including for each dangerous chemical carried:

2.3.1 a full description of the physical and chemical properties, including reactivity, necessary for the safe containment of the cargo;

2.3.2 action to be taken in the event of spills or leaks;

2.3.3 countermeasures against accidental personal contact;

2.3.4 fire-fighting procedures and fire-fighting media; and

2.3.5 procedures for cargo transfer, tank cleaning, gas freeing and ballasting.

2.4 For those cargoes required to be stabilized or inhibited, the cargo should be refused if the certificate required by these paragraphs is not supplied.

2.5 If sufficient information, necessary for the safe transportation of the cargo, is not available, the cargo should be refused.

2.6 Where column o in the table of chapter 17 of the IBC Code refers to paragraph 16.2.6 of the IBC Code, the cargo's viscosity at 20°C should be specified on a shipping document, and if the cargo's viscosity exceeds 50 mPa·s at 20°C, the temperature at which the cargo has a viscosity of 50 mPa·s should be specified in the shipping document.

2.7 Where column o in the table of chapter 17 of the IBC Code refers to paragraph 16.2.9 of the IBC Code, the cargo's melting point should be indicated in the shipping document.

3. Personnel training (7)

3.1 All personnel should be adequately trained in the use of protective equipment and have basic training in the procedures appropriate to their duties necessary under emergency conditions.

3.2 Personnel involved in cargo operations should be adequately trained in handling procedures.

(7) *Refer to parts A and B of the Seafarers' Training, Certification and Watchkeeping Code (STCW Code).*

3.3 Officers should be trained in emergency procedures to deal with conditions of leakage, spillage or fire involving the cargo and a sufficient number of them should be instructed and trained in essential first aid for cargoes carried, based on the guidelines developed by the Organization **(8)**.

4. Opening of and entry into cargo tanks

4.1 During handling and carriage of cargoes producing flammable and/or toxic vapours or when ballasting after the discharge of such cargo, or when loading or unloading cargo, cargo tank lids should always be kept closed. With any hazardous cargo, cargo tank lids, ullage and sighting ports and tank washing access covers should be open only when necessary.

4.2 Enclosed space entry should be planned and conducted in a safe manner, taking into account, as appropriate, the guidance provided in the recommendations developed by the Organization **(9)**.

4.3 Personnel should not enter such spaces when the only hazard is of a purely flammable nature, except under the close supervision of a responsible officer **(10)**.

5. Simultaneous carriage of deck cargo and products

5.1 Deck cargo and products covered by this Section should not be loaded or unloaded simultaneously.

(8) *Refer to the IMO/WHO/ILO Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), as amended.*

(9) *Refer to the Revised recommendations for entering enclosed space aboard ships (resolution A.1050(27)).*

(10) *Refer to the IMO/WHO/ILO Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), as amended, which provides advice on the treatment of casualties in accordance with the symptoms exhibited as well as equipment and antidotes that may be appropriate for treating the casualty, and to the relevant provisions of parts A and B of the Seafarers' Training, Certification and Watchkeeping Code (STCW Code*

5.2 Notwithstanding the provisions of 5.1, deck cargo and pollution hazard only products having a flashpoint exceeding 60°C, may be loaded or unloaded simultaneously provided that:

5.2.1 each operation is defined and assigned to qualified personnel dedicated to that specific operation;

5.2.2 a safe working distance between the operations on board is observed; and

5.2.3 the procedures, plans and instructions on board identify specific criteria for when the simultaneously performed operations should not be conducted.

5.3 During loading or unloading operations covered by this Section only personnel engaged in cargo operation should be permitted to be in the cargo deck area; personnel not engaged in cargo operation should be kept to a minimum in the adjacent open main deck.

5.4 For toxic cargoes, cargo tank pressure indication including audible and visual alarms situated at the cargo control station and cargo area should meet the following:

5.4.1 arrangement is to be in accordance with the alternative means as defined in G,2.3, with the activation point for over/underpressure to be set at 110% and 90%, respectively, of the P/V valve setting;

5.4.2 an independent audible and visual pressure alarm, set to be activated at 90% of the P/V valve opening set pressure, is to be fitted to warn crew of imminent vapour release; and

5.4.3 the arrangement in subparagraph 5.4.2 is capable of being deactivated during loading.

5.5 During loading of toxic cargoes, deck cargo should not be located in the cargo deck area as defined in A,2.7.3. Once a cargo loading operation is completed, deck cargo may be carried in the area defined in A,2.7.3.3, provided that the area in A,2.7.3.2 is kept free from deck cargo and relevant cargo deck areas clearly marked.

P. Backloading of Contaminated Bulk Liquids

To ensure that arrangements and procedures are provided to control potential accumulation of hydrogen sulphide, an explosive atmosphere, and other potential hazards backloaded from the installation.

1. Preamble

1.1 Backloading of contaminated bulk liquids could present a threat to human health and to the marine environment.

1.2 Contaminated backloads should therefore be:

1.2.1 transported and handled in accordance with the provisions of this Section; and

1.2.2 returned to shore for treatment or disposal.

2. General

2.1 Unless expressly provided otherwise, this subsection should apply to new and existing vessels.

2.2 The provisions of this chapter should apply in conjunction with all other provisions of this Section.

2.3 For the carriage of contaminated backloads, the requirements in chapter 17 of the IBC Code should apply as described in 4.4.

2.4 Contaminated bulk liquids should not contain traces of hydrogen sulphide (H_2S) prior to or during loading of the cargo.

2.5 Even if the test carried out before backloading indicates that H_2S is not present and that the contaminated bulk liquid has a flashpoint exceeding 60°C, a separation of the chemical components may occur during the voyage, resulting in a release of H_2S and a corresponding lowering of the flashpoint to 60°C or less.

2.6 H_2S detection equipment should be provided on board vessels carrying contaminated backloads prone to H2S formation. It should be noted that scavengers and biocides, when used, may not be 100% effective in controlling the formation of H_2S.

2.7 Contaminated bulk liquids should not contain radioactive materials which are subject to the applicable requirements for such materials.

3. Documentation

3.1 In lieu of the cargo information specified in O,2.3, the shipper and/or owner of the contaminated bulk liquids should provide the master or his or her representative with information as required in 3.2 prior to backloading.

3.2 Information concerning the contaminated bulk liquid should be confirmed in writing using the appropriate analysis form. The information concerning the contaminated bulk liquid should at least include:

3.2.1 a sample description;

3.2.2 descriptions of the components of the mixture, name, concentration and Material Safety Data Sheet (MSDS), if available;

3.2.3 flashpoint (ºC);

3.2.4 hydrogen sulphide (H_2S) level (ppm) **(11)**;

3.2.5 lower explosive limit (LEL) level (%);

3.2.6 oxygen level (%);

3.2.7 pH;

3.2.8 bulk specific gravity (kg/m^3);

3.2.9 water content (% volume);

3.2.10 oil content (% volume);

3.2.11 solids content (% volume);

3.2.12 date and time of the analysis;

3.2.13 details of any treatment to remove or prevent the formation of H_2S;

(11) *H_2S level should be 0 ppm.*

3.2.14 any other relevant information; and

3.2.15 conclusions of the test results, including confirmation that the components of the mixtures are compatible.

4. Operation

4.1 Responsibilities

4.1.1 The master should not accept loading of any contaminated bulk liquid which is not properly documented in accordance with 3.

4.1.2 The master should ascertain whether the contaminated bulk liquid is within the safe limits of the vessel and tanks, especially with regard to the flashpoint of the specific liquid, before backloading commences.

4.1.3 The responsibility for ensuring that cargoes are properly prepared for carriage on board the vessel rests with the shipper and/or owner of the cargoes concerned.

4.2 Carriage requirements

4.2.1 Contaminated bulk liquids should be carried in accordance with the applicable minimum carriage requirements for contaminated bulk liquids specified in chapter 17 of the IBC Code or the latest edition of the MEPC.2/Circular.

4.2.2 In addition to the provisions in 4.2.1, H_2S and LEL gas detection is required for carriage of contaminated bulk liquid as follows:

4.2.2.1 fixed vapour detection instruments with audible and visual alarms to indicate H_2S and LEL levels exceeding 5 ppm and 10%, respectively, installed in the venting system of the relevant tanks; and

4.2.2.2 portable instruments for all personnel on the working deck.

4.3 H_2S precaution

4.3.1 Contaminated bulk liquid should be discharged from the vessel as soon as possible, preferably at the first port of call.

4.3.2 The need to clean the dirty tanks should be reviewed on each voyage to minimize the risk of biological activity and H_2S build up from any residue.

4.3.3 Prior to backloading to a dirty tank, the potential for biological activity resulting in H_2S in the dead volume and sludge should be considered. The offshore analysis of the previous contaminated bulk liquid should be compared with analyses of a sample representative for the liquid when unloading.

4.3.4 If H_2S or flammable vapour is detected during loading of contaminated bulk liquids the transfer should be stopped immediately.

4.3.5 Vessel-specific procedures for measures to be taken when H_2S is detected during loading, transport, discharge and cleaning of contaminated bulk liquids should be included in the vessel's safety management system.

4.4 Contaminated backloads

4.4.1 Based on the information contained in 3.2, the entry for "offshore contaminated bulk liquid P" in chapter 17 of the IBC Code should be used for backloads that:

4.4.1.1 are pollutant only and do not present any safety hazards **(12)** or where the pre-backloading tests do not indicate any safety hazards (the backload may contain components with safety hazards, as long as they are so diluted that the final mixture presents no safety hazard);

4.4.1.2 have a flashpoint greater than 60°C; or

4.4.1.3 do not have the potential to become more hazardous during transport.

4.4.2 Based on the information contained in 3.2, the entry for "offshore contaminated bulk liquid S" in chapter 17 of the IBC Code should be used for backloads that:

4.4.2.1 have been treated to remove or prevent breakout of H_2S;

4.4.2.2 are expected to present both pollution and safety hazards or where the initial pre-backloading tests indicate a potential or actual safety hazard;

4.4.2.3 may contain substances with a flashpoint not exceeding 60°C;

4.4.2.4 have the potential to become more hazardous during transport; or

4.4.2.5 are to be backloaded to a dirty tank the content of which has not been analysed.

R. Discharging and Loading of Portable Tanks on Board

To ensure the safe handling of all cargoes to and from portable tanks which form part of the vessel or remain on board, under all normal operating conditions and foreseeable emergency conditions, to minimize the risk to the vessel, its crew and the environment, having regard to the nature of the products involved.

1. Preamble

1.1 This Section applies only in the case of bulk carriage involving transfer of the cargo to or from its containment. The carriage of dangerous goods in packaged form is regulated under SOLAS chapter VII Part A and should comply with the relevant requirements of the IMDG Code. The IMDG Code is also applicable for environmentally hazardous substances in packaged form under MARPOL Annex III. Provisions of 4.2.1 of the IMDG Code provide that: "Portable tanks shall not be filled or discharged while they remain on board."

(12) *Safety hazards are defined in paragraph 21.3.1 of the IBC Code.*

1.2 The current operation practice is to carry portable tanks in two ways:

1.2.1 Offshore portable tanks and their contents are loaded and offloaded to the offshore installation by the use of a crane, in which case the IMDG Code applies; or

1.2.2 Offshore portable tanks and portable tanks are loaded with their contents onto a vessel by crane or filled while on board and used as deck tanks in a "deck spread". Then the contents are pumped to the offshore installation or to the seabed. These tanks can also be used to receive backloads from the installation and will be secured to the deck, in which case the cargo is shipped under this Section.

2. General

2.1 This chapter applies when using offshore portable tanks and portable tanks allowed under E,2.2.

2.2 A portable tank, for the purpose of this section, means a multimodal tank used for the transport of dangerous goods of class 1 and classes 3 to 9. The portable tank includes a shell fitted with service equipment and structural equipment necessary for the transport of dangerous substances. The portable tank should be capable of being filled and discharged without the removal of its structural equipment. It should possess stabilizing members external to the shell, and should be capable of being lifted when full. It should be designed primarily to be loaded onto a vehicle or vessel and should be equipped with skids, mountings or accessories to facilitate mechanical handling. Road tank-vehicles, rail tank-wagons, non-metallic tanks and intermediate bulk containers are not considered to fall within the definition of portable tanks.

2.3 The provisions of this chapter should apply in conjunction with all other provisions of this Section.

2.4 Chemicals, including blending additives, transported in portable deck tanks which are considered to fall outside the scope of A,1.9 may be carried in limited amounts in accordance with provisions acceptable to the Administration. The aggregate amount of such chemicals which may be transported should not exceed 10% of the vessel's maximum authorized quantity of products subject to this Section. An individual tank should contain not more than 10 m^3 of these chemicals. The discharge of these chemicals into the sea from OSVs is prohibited.

3. Arrangement of deck spread

3.1 All pumping equipment, processing equipment, pipework, valves and hoses should be compatible with the substances being transferred.

3.2 Pipework connecting deck spread tanks to bulk tanks within the cargo area of the vessel should have two valve separation and should comply with the provisions of subsection F.

3.3 In addition to the cargo segregation required by subsections C and D, the general stowage and segregation requirements given in chapter 7 of the IMDG Code should apply. The segregation requirements may be relaxed subject to approval by the Administration.

3.4 Cargo tank vent systems of portable tanks allowed under E,2.2 should be to the satisfaction of the Administration, taking into account the requirements of chapter 6 of the IMDG Code.

3.5 Arrangements of products with a flashpoint not exceeding 60°C, toxic products and acids should comply with the provisions in subsection D, as applicable.

3.6 Deck spills should be kept away from accommodation and service areas by means of a coaming of suitable height and extension.

4. Shipment of cargo in portable tanks used as deck tanks

4.1 A procedure for the carriage of portable tanks should be completed and submitted to the Administration or any organization recognized by it, for consideration and approval prior to arranging the deck spread.

4.2 The portable tank should be physically secured to the vessel, in accordance with the vessel's cargo securing manual to prevent loss in the event of an incident while at sea. The arrangements for securing the portable tanks to the vessel should be of such strength as to withstand the forces likely to be encountered during the voyage to and from the area of operation.

4.3 The portable tank(s) and pumping system should be monitored regularly on the sea passage to ensure the physical security of the portable tanks.

4.4 The pipework and valves should be secured to prevent movement.

4.5 The loading and unloading of the portable tanks should not be undertaken at the same time as other deck cargo is being handled.

4.6 Portable tank(s) should be filled through a manifold system.

4.7 Discharge into the sea of portable tank contents, residues, tank washings, or other residues or mixtures containing such substances, is prohibited. Any discharges of residues and mixtures containing noxious liquid substances should be to port reception facilities.

S. Carriage of Liquefied Gases

To ensure that the vessel's design, arrangement and operational procedures are such as to minimize the risk to the vessel, its crew and the environment, when carrying liquefied gases in bulk.

1. General requirements

1.1 The provisions of this subsection should apply when liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen are carried.

1.2 The Administration may allow adjustments to specific requirements in the IGC Code regarding the cargo containment, materials of construction, vent system for cargo containment and cargo transfer, taking into account existing industry standards and practices, if they are at least as effective as that required by the IGC Code.

1.3 Unless expressly provided otherwise, these provisions are additional to the general provisions of this Section.

1.4 In regard to the provisions connected to the cargo area, the vessel survival capability and location of the cargo tanks, liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen should be regarded as a safety hazard substance with type 2 ship having a flashpoint exceeding 60°C and not defined as a toxic.

1.5 Liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen should be carried in accordance with the applicable minimum carriage requirements specified in chapter 19 of the IGC Code and the special requirements specified in chapter 17 of the IGC Code for the respective products.

2. Accommodation, service and machinery spaces and control stations

Unless they are located at least 7 m away from the deck area as defined in A,2.7.2, entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the cargo deck area. Doors to spaces not having access to accommodation, service and machinery spaces and control stations, such as cargo control stations and storerooms, may be permitted within such deck area, provided the boundaries of the spaces have equivalent gas tightening to A-60 standard. Wheelhouse doors and wheelhouse windows may be located within the limits specified above as long as they are designed in such a way that a rapid and efficient gas and vapour tightening of the wheelhouse can be ensured. Windows and sidescuttles facing the deck area and on the sides of the superstructures and deckhouses within the limits specified above should be of the fixed (non-opening) type. Such sidescuttles in the first tier on the main deck should be fitted with inside covers of steel or equivalent material.

3. Cargo containment

The cargo tank should be in accordance with chapter 4 of the IGC Code. The design and testing of the tanks for liquid nitrogen should be as required for independent tanks type C.

4. Materials of construction

Materials of construction should comply with the requirements of chapter 6 of the IGC Code.

5. Vent system for cargo containment

The vent system for cargo containment should comply with the requirements of chapter 8 of the IGC Code.

6. Cargo transfer

6.1 The cargo transfer system should comply with the requirements of chapter 5 of the IGC Code.

6.2 Drip trays resistant to cryogenic temperatures should be provided at manifolds transferring liquefied gases or at other flanged connections in the liquefied gas system.

7. Vapour detection

Each enclosed space used for handling or storage of a liquefied gas should be fitted with a sensor continuously monitoring the oxygen content of the space and an alarm indicating low oxygen concentration. For semi-enclosed spaces portable equipment may also be acceptable.

8. Gauging and level detection

The gauging and level detection arrangements should comply with the requirements of chapter 13 of the IGC Code.

9. Emergency shutdown system

9.1 Emergency shut-off valves should be provided in liquid outlet lines from each liquefied gas tank. The controls for the emergency shut-off valves should meet the provisions given in F,6.1.3 for remote shutdown devices.

9.2 In the case of transfer operations involving pressures in excess of 5 MPa, arrangements for emergency depressurizing and disconnection of the transfer hose should be provided. The controls for activating emergency depressurization and disconnection of the transfer hose should meet the provisions given in F,6.1.3 for remote shutdown devices.

10. Personnel protection

Vessels carrying liquefied gases should have safety equipment on board in accordance with N,3.

11. Carriage on open deck

Instead of the use of permanently attached deck tanks, portable tanks meeting the design of independent tanks type C may be used provided that the provisions of section R,3 are complied with.

12. Carriage of other liquefied gases listed in chapter 19 of the IGC Code

12.1 This Section does not consider liquefied gases other than liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen. When a vessel is intended for carriage of other liquefied gases listed in chapter 19 of the IGC Code, flag Administration and coastal State Administrations involved should take appropriate steps to ensure implementation of the relevant requirements of the IGC Code, taking into account the unique design features and service characteristics of the vessel, as well as the limitation. Furthermore, additional provisions should be established based on the principles of this Section as well as recognized standards that address specific risks not envisaged by it. Such risks may include, but not be limited to:

12.1.1 fire and explosion;

12.1.2 evacuation;

12.1.3 extension of hazardous areas;

12.1.4 pressurized gas discharge to shore;

12.1.5 high-pressure gas venting;

12.1.6 process upset conditions;

12.1.7 storage and handling of flammable refrigerants;

12.1.8 continuous presence of liquid and vapour cargo outside the cargo containment system;

12.1.9 tank overpressure and underpressure;

12.1.10 vessel-to-vessel transfer of liquid cargo; and

12.1.11 collision risk during berthing manoeuvres.

12.2 The Organization should be notified of the conditions for carriage prescribed by the flag Administration and coastal State Administrations involved, so that the specific liquefied gases may be considered for inclusion in this Section.

SECTION 6

ANCHOR HANDLING AND TOWING SHIPS

A. General

1. The requirements of TL Rules, Part A, Chapter 1, Hull, Sections 1 ÷ 25 with the exception of Sections 16 and 21 apply to the class notation Anchor Handling **(AH)** and Towing **(TOW),** unless otherwise mentioned in this Section.

2. Offshore Service Vessels specially designed, built, and equipped for handling anchors of a floating offshore installation, in compliance with the requirements of this section, may be given the Class Notation **AH** (equipped for anchor handling).

3. Offshore Service Vessels specially designed, built, and equipped for towing operations other than anchor handling, in compliance with the requirements of this section, may be given the Class Notation **TOW** (equipped for towing operation).

4. Documentation

In addition to plans and particulars required by Part A Chapter 1 Section 1 G, details of local strengthening of the following items, where applicable, shall be submitted for approval:

- Arrangement and integration into the hull of equipment, tanks, supports, foundations, etc. in conjunction with their weight, working load, and holding capability information.

- For unusual structural arrangement and equip-ment, calculations demonstrating acceptable structural strength.

- Foundations and support structures for anchor handling and laying arrangements for anchors carried as cargo.

B. Hull Structure

1. Structural Configuration

The main features of an anchor handler dictating the structural configurations are the following:

- A clear after deck to handle the anchors effectively.

- Easy accessible safety barriers on working deck for crew.

- One or more winches designed to deploy and recover the anchors.

- A large horizontal stern roller for anchor handling process, installed in the stern, usually at deck level.

- A rounded form in way of the area for shipping/ unshipping anchors at stern.

- If fitted, chain lockers under the main winch. Anchor handlers are sometimes required to store rig or mooring chain and, for this purpose, most are fitted with chain lockers under the main winch. These chain lockers may double as ballast or brine tanks when not in use.

- Equipment for temporary securing of an anchor, such as shark jaws.

- Towing pins in way of the stern roller.

- Heavy duty bollards.

The main features of a Offshore Service Vessel equipped for towing operation other than anchor handling, dictating the structural configuration, are similar to that for anchor handling except:

- A large horizontal stern roller

- Increased chain locker capacity

- Strengthening of the deck for anchor handling

- Equipment for temporary securing of an anchor (shark jaws etc.)

2. Scantlings, General

For the determination of hull structure scantlings the draught T is not to be taken less than 0,85 H.

3. Shell Plating

3.1 Anchor handling activities often give rise to areas of high local loads and/or frequent impacts, such as in way of the stern roller or immediately adjacent to heavy duty bollards. The shell in way of high loads and/or frequent impacts is to be suitably reinforced by increasing shell plate thickness, adding stiffening supports, or other appropriate means.

3.2 The bulwark shall be arranged with an inward inclination in order to reduce the probability and frequency of damages. Square edges are to be chamfered.

4. Deck Structure

4.1 Deck areas, where there are arrangements to collect and handle anchors and associated equipment, are to be protected by wooden sheating. Alternatively, this can be omitted if the plate thickness is increased by 2,5 mm.

4.2 Depending on the towrope arrangement, the deck in the aft region may have to be strengthened (beams, plate thickness), if considerable chafing and/or impact is to be expected. See also C.1.5.

5. Safe Location

5.1 For assignment of the class notation AH crash rails of a height of at least 2.2 m measured from top of the deck to the upper edge of the crash rail have to be provided inside the bulwark. In addition a safe location near the open working deck for stand by during the pulling procedure has to be arranged for the operating personnel.

6. Stern Frame

6.1 The cross sectional area of a solid stern frame is to be 20 % greater than required according to **TL,** Chapter 1, Section 10, B.2.1. For fabricated stern frames, the thickness of the propeller post plating is to be increased by 20 % compared to the requirements of Chapter 1, Section 10, B.2.2. The section modulus W_Z of the sole piece is to be increased by 20 % compared to the modulus determined according to **TL,** Chapter 1 Section 10, B.3.

6.2 Scantlings of foundations and supports of the stern roller shall be based on two times the working load. Scantlings of supports for the stern roller shall be based on the maximum forces occurring during anchor handling.

7. Foundations of Towing Gear

7.1 The foundations of the towing winch, and of any guiding elements such as towing posts or fair- leads, where provided, shall be thoroughly connected to the ship's structure, considering all possible directions of the towrope.

7.2 The scantlings of foundations and supports of the towing winch and towing bollard shall be based on the breaking strength of the towline.

7.3 The stresses in the foundations and fastening elements shall not exceed the permissible stresses shown in Table 6.1, assuming a load equal to the winch holding capacity.

Table 6.1 Permissible stresses

Type of stress	Permissible stress
Axial and bending tension and axial and bending compression with box type girders and tubes	$\sigma = 0{,}83 \cdot R_{eH}$
Axial and bending compression with girders of open cross sections or with girders consisting of several members	$\sigma = 0{,}72 \cdot R_{eH}$
Shear	$\tau = 0{,}48 \cdot R_{eH}$
Equivalent stress	$\sigma_{eq} = 0{,}85 \cdot R_{eH}$
R_{eH} = yield strength or 0,2 % - proof stress	

7.4 Deformations of foundations and fastening elements shall be minimized for adequate stiffness to assure functionality of towing gear.

7.5 Direct calculation by means of Finite Element Analysis to verify the compliance with the requirements given in 7.3 and 7.4 is strongly recommended.

8. Equipment Foundations

When considering the loads, all expected operating directions are to be considered. Foundations for deck equipment, such as winches, shark jaws and stern roller, are to be in accordance with 7. as applicable

C. Towing Gear/Towing Arrangement

1. General Design Requirements

1.1 The towing gear shall be arranged in such a way as to minimise the danger of capsizing; the working point of the towing force is to be placed as low as practicable, see also F.

1.2 The attachment point of the towrope shall be arranged closely behind the centre of buoyancy.

1.3 The arrangement of the equipment shall be such that the towrope is led to the winch drum in a controlled manner under all foreseeable conditions (directions of the towrope).

1.4 Towrope protection sleeves or other adequate means shall be provided to prevent the directly pulled towropes from being damaged by chafing/abrasion.

1.5 At locations, where the towing rope bears on structural elements (e.g. cargo rails, bulwarks, stern rail or tailgate) during normal operation, the design of this equipment have to ensure that the radius of bend is at least 10 times the diameter of the towing rope.

2. Definition of Loads

2.1 The design force T corresponds to the tow- rope pull (or the bollard pull, if the towrope pull is not defined) stipulated by the owner. The design force may be verified by a bollard pull test, see 4.2 and **TL** Rules, Chapter 58, Ocean Towage.

2.2 The minimum breaking force of the towrope is based on the design force, see 3.3

2.3 The holding capacity of the towing winch (towrope in the first layer) shall correspond to 80 % of the minimum breaking load F_{min} of the towrope, see 3.3. The rated winch force is the hauling capacity of the winch drive when winding up the towrope, see Section 13, B.3.3

3. Towropes

3.1 Towrope materials shall correspond to the **TL,** Part A, Chapter 2, Section 10. All wire ropes should have as far as possible the same lay.

3.2 The length of the towrope shall be chosen according to the tow formation (masses of Offshore Service Vessel and towed object), the water depth and the nautical conditions. Regulations of flag state authorities have to be observed. It is recommended, that tow line lengths be longer than tow line lengths as required in **TL,** Part A Chapter 1 Section 17 table 17.1, For length of towrope for bollard pull test, see **TL** Rules, Chapter 58, Ocean Towage.

3.3 The required minimum breaking force F_{min} of the towrope is to be calculated on the basis of the design force T and a utility factor K, as follows:

F_{min} =K.T

K = 2,5 for T < 200 kN and

= 2,0 for T > 1 000 kN

For T between 200 and 1 000 kN, K may be interpolated linearly.

3.4 For ocean towages, at least one spare towrope with attachments shall be available on board.

3.5 The required minimum breaking force F_{min} of the tricing rope is to be calculated on the basis of the holding capacity of the tricing winch and a utility factor K = 2,5.

4. Testing

4.1 Workshop testing

4.1.1 Accessory towing gear components, towropes

4.1.1.1 Accessories subjected to towing loads, shall generally be tested to minimum breaking force F_{min} of the towrope at the manufacturer, see 3.3.

4.1.1.2 For all accessories, Test Certificates have to be submitted.

4.1.1.3 TL reserve the right of stipulating an endurance test to be performed at towing gear components, where considered necessary for assessment of their operability.

4.2 Initial testing of towing gear on board and bollard pull test.

4.2.1 The installed towing gear has to be tested on the ship using the bollard pull test to simulate the towrope pull.

4.2.2 Bollard pull test

In general a bollard pull test will be carried out before entering into service of the vessel. The test can be witnessed and certified by **TL,** see the **TL** Rules, Chapter 58, Ocean Towage.

D. Steering Gear/Steering Arrangement

1. Steering Stability

Steering stability, i.e. stable course maintaining capability of the ship, shall be ensured under all normally occurring towing conditions. Rudder size and rudder force shall be suitable in relation to the envisaged towing conditions and speed.

2. Special steering arrangements

Steering units and arrangements not explicitly covered by the Rules mentioned above, and combinations of such units with conventional rudders, will be considered from case to case.

E. Anchoring/Mooring Equipment

1. Equipment Numeral

The equipment with anchors and chains as well as the recommended towropes of ships for unrestricted service is to be determined according to **TL,** Part A Chapter 1 Section 17, B. However, for the determination of the equipment numeral the term 2 • h • B may be substituted by the term

$2\ (a \cdot B + \sum h_i \cdot b_i)$

b_i is the breadth of the superstructure tier "i", considering only tiers with a breadth greater than B/4.

F. Stability

1. Vessels with AH notations additional Intact stability is to be in accordance with **TL,** Part A, Chapter 1, Section 29, F with exception of heeling lever curve calculation described as below:

2. For vessels that are used for anchor handling and which at the same time are utilizing their towing capacity and/or tractive power of the winches, calculations must be made showing the acceptable vertical and horizontal transverse force/tension to which the vessel can be exposed. The calculations must consider the most unfavourable conditions for transverse force/tension and as a minimum include the following:

2.1 Calculations must be made for the maximum acceptable tension in wire/chain, including the maximum acceptable transverse force/tension that can be accepted in order for the vessel's maximum heeling to be limited to one of the following angles, whichever occurs first:

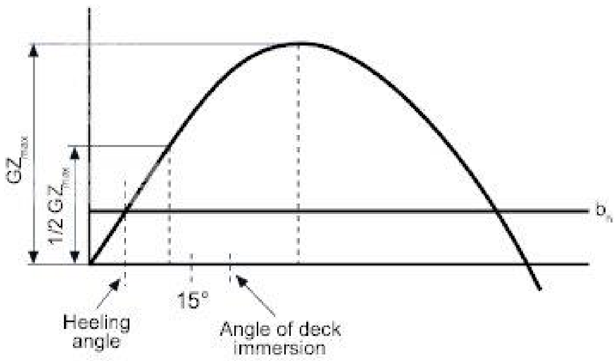


Figure 6.1 GZ-Courve

- Heeling angle equivalent to a GZ-value equal to 50 % of GZ-max;

- The angle of flooding, which results in water aft on working deck when the deck is calculated as flat; or

- 15 degrees.

2.2 The heeling moment must be calculated as the total effect of the horizontal and vertical transverse components of force/tension in the wire or the chain. The torque arm of the horizontal components shall be calculated as the distance from the height of the work deck at the guide pins to the centre of main propulsion propeller or to centre of stern side propeller if this projects deeper. The torque arm of the vertical components shall be calculated from the centre of the outer edge of the stern roller and with a vertical straining point on the upper edge of the stern roller.

2.3 The other loading conditions for the vessel shall be as stated for anchor handling in approved stability calculations and in accordance with prevailing practice with regards to loads on deck and winch reels. The vertical force from the tension shall be included in the loading conditions, upon which calculations of trim and curve for righting arm (GZ-curve) are based.

2.4 Information stating the maximum force / tension in wire or chain, as well as corresponding lateral point of direction according to the calculations, must be communicated to the vessel's crew and be displayed next to the control desk or at another location where the navigator on duty easily can see the information from his command post.

2.5 The displayed information must be in the form of simple sketches showing the vessel's GZ-curve for righting arm in addition to a table stating the relevant combinations of force/tension and point of direction which gives the maximum acceptable heeling moment.

G. Escape Routes and Safety Measures

1. Engine Room Exit

In the engine room an emergency exit is to be provided on or near the centreline of the vessel, which can be used at any inclination of the ship. The cover shall be weather tight and is to be capable of being opened easily from outside and inside. The axis of the cover is to run in athwart ship direction.

2. Safe Handling of Towing Gear

See requirements under C.1, C.3 and C.5.

3. Fire Safety

3.1 Structural fire protection measures shall be as outlined in Section 3, as applicable according to the size of the vessel. The fire fighting equipment shall conform Section 17.C, as applicable.

3.2 Additional or deviating regulations of the competent Administration may have to be observed.

H. Additional Requirements for Active Escorting

1. Scope, Application

1.1 The following requirements are not mandatory for the Class Notation **TOW** or **AH** but may be introduced in addition if escort duties have to be provided by special offshore service vessels.

2. Characteristics of Active Escort Tugs

The following escort characteristics are to be determined by approved full scale trials:

- Maximum steering force T_{Ey} [kN] at a test speed of advance V_t [kn], normally 8 to 10 knots

- Manoeuvring time t [s]

- Manoeuvring coefficient K = 31 / t [-] or 1, whichever is less

2.2 A test certificate indicating the escort characteristics is issued on successful completion of such trials.

3. Definitions

3.1 Active Escort Tug is a tug performing the active escort towing.

3.2 Assisted vessel is the vessel being escorted by an Active Escort Tug.

3.3 Indirect towing is a typical manoeuvre of the Active Escort Tug where the maximum transverse steering force is exerted on the stern of the assisted vessel while the Active Escort Tug is at an oblique angular position. The steering force T_{Ey} [kN] is provided by the hydrodynamic forces acting on the Active Escort Tug's hull, see Figure 13.1 in Section 13.

3.4 Test speed V_t [kn] is the speed of advance (through the water) of the assisted vessel during full scale trials.

3.5 The manoeuvring time t [s] is the time needed for the Active Escort Tug to shift in indirect towing from an oblique angular position at the stern of the assisted vessel to the mirror position on the other side, see Figure 13.1 in Section 13. The length of the towline during such a manoeuvre should not be less than 50 m and the towline angle need not be less than 30°.

4. Arrangement and Design

4.1 Hull

4.1.1 The hull of the Active Escort Tug is to be designed to provide adequate hydrodynamic lift and drag forces when in indirect towing mode. Hydrodynamic forces, towline pull and propulsion forces shall be in balance during active escort towing thereby minimising the required propulsion force itself.

4.1.2 Freeboard is to be provided in such a way, that excessive trim at higher heeling angles is avoided.

4.1.3 A bulwark is to be fitted all around the weather deck.

4.2 Propulsion

In case of loss of propulsion during indirect towing the remaining forces are to be so balanced that the resulting turning moment will turn the Active Escort Tug to a safer position with reduced heel.

5. Stability of Active Escort Tugs

For stability of escort tugs please refer to **TL**, Part C, Chapter 13.

6. Full Scale Trials

6.1 Procedure

6.1.1 A documented plan, describing all parts of the trial shall be submitted for approval before commencement of the trials, including:

- Towage arrangement plan

- Data of assisted vessel including SWL of the strong points

- Intended escort test speed

- Calculated maximum steering force T_{Ey} [kN]

6.1.2 Full scale trials shall be carried out in favourable weather and sea conditions which will not significantly influence the trial results.

6.1.3 The size of the assisted vessel shall be sufficiently large to withstand the transverse steering forces of the tug without using too large rudder angles.

6.2 Recordings

At least the following data are to be recorded continuously during the trial for later analysis:

Assisted vessel:

- Position
- Speed over ground and through the water
- Heading
- Rudder angle
- Angle of towline
- Wind (speed and direction), sea-state

Active Escort Tug:

- Position and speed over ground
- Heading
- Length, angle β and pull of towrope T_E
- Heeling angle

SECTION 7

STANDBY VESSELS

A. General

1. Vessels specially designed, built, and equipped for standby and rescue services to offshore installations, in compliance with the requirements of this section, may be given the Class Notation **STANDBY VESSEL** (Standby and rescue). The requirements of **TL**, Part A, Chapter 1, Sections 1 ÷ 24 and Section 26 with the exception of Sections 16 and 21 apply to Standby Vessels (**STANDBY VESSEL**) unless otherwise mentioned in this Section.

2. The following main features of standby vessels dictate their structural configuration:

- Designated and illuminated winching area for helicopter operations,
- Clearly marked and lighted rescue zones at the side of the vessel,
- Survivors area,
- Fast rescue boat.

B. Documentation

In addition to plans and particulars required by **TL** Part A Chapter 1 Section 1, G., the following plans and particulars shall be submitted for approval:

- Arrangement of rescue areas,
- Rescue and safety equipment plan, showing position and quantity of safety and rescue equipment on board (see D.),
- Towing arrangement (if applicable),
- Foundation and support structural plans of towing hook or towing winch, stating maximum breaking force of winch and breaking strength of towline (if applicable),
- Scantlings of towing hook (if applicable),
- Arrangement for the fast rescue craft,
- Arrangement of windows and side scuttles, frames and deadlights with information on type of glass and references to standards.

C. Towing Arrangement

1. When the ship is fitted with means for emergency towing, the towing winch shall satisfy the requirements given in Section 6 respectively.

2. The towing wire and all connected parts shall have a minimum breaking load of 0,04 P_S in tons, where P_S is the total power of the propulsion engines [kW].

3. All loose gear of the towing equipment, such as shackles, rings, wires, and ropes, shall be delivered with a works test certificate.

D. Hull Arrangement and Strength

1. Hull

1.1 The section modulus of the main deck frames and the tween deck frames have to be determined as defined in **TL** Part A, Chapter 1, Section 8.C. All frame ends shall have brackets.

1.2 The breadth of the shear strake at the strength deck shall be at least 800 + 5 L in [mm], where L is the rule length in [m]. In way of fenders, the shear strake thickness shall be at least:

$$t = a\,\frac{10 + 0{,}0833L}{0.8 + 0{,}033L} \quad [\mathrm{mm}]$$

where a is the stiffener spacing in [mm]. Where fenders are omitted, this minimum thickness shall be increased by 50 percent.

1.3 The plating thickness of the main weather deck shall not be less than 8 mm or 6 + 0,02 L + t_k in [mm], where t_k is the corrosion addition in [mm], see **TL** Part A, Chapter 1, Section 3.

1.4 Bulwark plating thickness shall be at least 7,5 mm. On the main weather deck the bulwark stays shall have a depth of at least 350 mm at deck, and they are to be positioned at every second frame. Open rails shall have ample scantlings and efficient supports.

1.5 The stresses in the foundations and the supporting structure of towing winch shall not exceed the permissible stresses shown in Section 6, Table 6.1, assuming the load given in Section 6, C.2.

2. Freeing Ports and Scuppers

The area of freeing ports and scuppers in the side bulwarks on the cargo deck are at least to meet the requirements of **TL,** Part A, Chapter 1, Section 16. The arrangement of freeing ports and scuppers shall be carefully considered to ensure the most effective drainage of water trapped on the weather deck.

E. Rescue Zone Arrangement

1. On each side, the ship shall be arranged with a rescue zone of at least 8 m length. The area shall be clearly marked on the ship's sides. Its location shall be sufficiently far way from the propellers and clear of any side discharges up to 2 m below the load waterline.

2. Access routes from the rescue zones to the helicopter winch zone, if provided, shall have slip-resistant deck coating or wooden lining, or the surfaces shall be treated to give equivalent slip-resistant properties.

3. The ship's sides in way of the rescue zone shall be free of obstructions, such as fenders.

4. Satisfactory lighting shall be available along the rescue zone, capable of providing a minimum illumination level of 150 lux at the rescue zone and 50 lux at areas 20 m from the ship.

5. The deck area in way of the zone should preferably be free of air pipes, valves, smaller hatches, etc. However, when this is impractical, proper arrangement shall be provided to protect against personnel injury.

6. Bulwarks and railings in way of the rescue zones shall be of a type easily opened or removed to enable direct boarding on deck.

7. A searchlight shall be available on each side and operated from the navigation bridge. The searchlights should be able to provide an illumination level of 50 lux in clear air, within a circular area of at least 10 m diameter up to distance of 250 m.

8. Each rescue zone shall be provided with a scrambling net made of corrosion resistant and nonslip material.

9. The ship shall be provided with power assisted means capable of ensuring careful recovery of disabled persons from the sea.

10. A decontamination area equipped with a shower system shall be arranged for cleaning survivors and crew before entering the superstructure.

F. Survivors Accommodation

1. The ship shall have a treatment room for casualties, sanitary rooms, and an enclosed space with fixed seats to accommodate survivors. These spaces shall be provided with lighting and means to control temperature and humidity suitable for the area of operation. Each space intended for survivors shall have an emergency exit.,

2. All spaces intended for survivors, including corridors used for access, shall have a slip-resistant deck coating. Corridors and doors shall be dimensioned to allow adequate transport of survivors on stretchers.

3. Sanitary facilities shall be available exclusively for survivors. At least one installation that includes a toilet, a wash basin, and a shower shall be provided for each group of 50 survivors.

G. Safety Equipment

1. The ship shall be equipped with at least one fast rescue craft of type complying with IMO MSC / Circ. 809 with addendum, arranged and maintained to be permanently ready for use under severe weather conditions. The launching arrangement shall be of SOLAS approved type.

2. The following minimum safety equipment shall be provided for ships of less than 500 gross tonnage:

- One line throwing appliance with at least four projectiles and four lines,
- One daylight signaling lamp,
- Six SOLAS type approved lifebuoys, four being equipped with a self igniting light and buoyant line,
- One SOLAS type approved immersion suit for each crew member,
- One SOLAS type approved lifejacket for each crew member and for 25 % of the number of survivors the ship is designed to carry.

3. The treatment room for survivors shall have adequate equipment and medical supplies. Treatment room equipment and medical stores should be arranged as required by local regulations or based on recognized standards. The ship shall be provided with blankets of sufficient quantity for the number of survivors the ship is designed to carry.

H. Deck Houses and Superstructures

1. Scantlings

1.1 Stiffeners shall have effective end connections. Stiffeners on front bulkheads of the lowest tier shall have brackets at both ends.

2. Weathertight Doors

2.1 In general, arrangement and sill heights of weathertight doors are to comply with Section 2, C. Doors in exposed positions on the lowest weather deck and in lowest unprotected fronts and sides shall be of steel.

3. Windows

3.1 In general, windows larger than 1000 x 710 or an area greater than 0,71 m^2 will not be accepted. Exceptions can be made in the aft ends of deckhouses, after special consideration.

SECTION 8

ADDITIONAL STRUCTURAL REQUIREMENTS

A. Helicopter Decks

1. General

1.1 The starting/landing zone is to be dimensioned for the largest helicopter type expected to use the helicopter deck.

The maximum permissible take-off weight is to be indicated in the drawing and will be entered in the technical file of the Class Certificate.

1.2 For scantling purposes, other loads (cargo, snow/ice, etc.) are to be considered simultaneously or separately, depending on the conditions of operation to be expected. Where these conditions are not known, the data contained in 2, may be used as a basis.

1.3 The following provisions in principle apply to starting/landing zones on special pillar-supported landing decks or on decks of superstructures and deckhouses.

1.4 Requirements regarding structural fire protection are to be provided in Section 3.

1.5 Beside these rules, rules for the relevant national or international standards and regulations have to be fulfilled according to the flag state. The following examples are given as reference:

- Guide to Helicopter/Ship Operations, published by the International Chamber of Shipping (ICS)
- Offshore Helicopter Landing Areas - Guidance to Standards CAP 437 (Civil Aviation Authority)
- IMO Res. A.855(20): Standards for on board Helicopter facilities
- Offshore Helideck Design Guidelines, Health and Safety Executive
- Guidelines for the Management of Offshore Helideck Operations, UK Offshore Operators Association

2. Design loads

The design load cases (LC) which are described in 2.1 - 2.3 are to be considered.

As first approximation the wind loads on the helicopter (WHe) or on the structure of the helicopter deck (WSt) may be determined as following values:

$$W = 0{,}5 \cdot \rho \cdot v_w^2 \cdot A \cdot 10^{-3} \quad [kN]$$

ρ = Air density [kg/m^3]

= 1,2 for an air temperature of 20°

A = Area exposed to wind [m^2]

v_w = Wind velocity [m/s]

2.1 LC 1

Helicopter lashed on deck, with the following vertical forces acting simultaneously:

a) Wheel and/or skid force P acting at the points resulting from the lashing position and distribution of the wheels and/or supports according to helicopter construction.

$$P = 0.5G\left(1 + a_V\right) \quad [kN]$$

G = Maximum permissible take-off weight [kN],

a_V = Vertical acceleration (see, Part A, Chapter 1, Section 5, B.)

P = Evenly distributed force over the contact area for single wheel according to data supplied by helicopter manufacturers. The contact area is to be taken 30 x 30 cm if not specified by the helicopter manufacturer. For dual wheels or skids the contact area is to be determined individually in accordance with given dimensions,

e = Wheel or skid distance according to helicopter types to be expected.

b) Force due to weight of helicopter deck M_e as follows:

$$M_e(1 + a_V) \quad [kN]$$

c) Load p = 2.0 kN/m^2 evenly distributed over the entire landing deck for taking into account snow or other environmental loads

2.2 LC 2

helicopter lashed on deck, with the following horizontal and vertical forces acting simultaneously:

- Wheel and/or skid force P acting vertically at the points resulting from the lashing position and distribution of the wheels and/or supports according to helicopter construction, see **LC 1**:

  P = 0,5 · G [kN]

- Vertical force on supports of the deck due to weight of helicopter:

  M_e [kN]

- Load p = 2,0 kN/m2 evenly distributed over the entire landing deck for taking into account snow or other environmental loads

- Horizontal forces on the lashing points of the helicopter:

  H = 0,6 · G + W_{He} [kN]

W_{He} = Wind load [kN] on the helicopter at the lashing points

wind velocity v_W = 50 [m/ s]

- Horizontal force on supports of the deck due to weight and structure of helicopter deck:

H = 0,6 · M_e + W_{St} [kN]

W_{St} = Wind load [kN] on the structure of the helicopter deck

wind velocity v_W = 50 [m/ s]

2.3 LC 3

Normal landing impact, with the following forces acting simultaneously:

a) Wheel and/or skid load P at two points simultaneously, at an arbitrary (most unfavourable) point of the helicopter deck (landing zone + safety zone) see **LC 1**

$$P = 0.75\,G \quad [kN]$$

P to be increased by 15 % if the helicopter deck is part of a deckhouse with accommodations below

b) Load p = 0.5 kN/m^2 evenly distributed over the entire landing deck for taking into account snow or other environmental loads

c) Force due to weight of helicopter deck M_e as follows:

M_e [kN]

d) Wind load on structure in accordance with the wind velocity admitted for helicopter operation (vw):

W_{St} [kN]

where no data are available, v_w = 25 m/s may be used

2.1 LC4

emergency/crash landing impact with following vertical forces:

- Wheel and/or skid load P at two points simultaneously, at an arbitrary (most unfavourable) point of the helicopter deck (landing zone + safety zone), see **LC 1**

  P = 1,25 · G [kN]

- Forces due to weight of helicopter deck, evenly distributed loads and wind loads according to **LC 3** are to be considered.

3. Scantlings of Structural Members

3.1 Stresses and forces in the supporting structure are to be evaluated by means of direct calculations.

3.2 Permissible stresses for stiffeners, girders and substructure:

$$\sigma_{zul} = \frac{235}{k \cdot \gamma_f} \qquad [N/mm^2]$$

γ_f = Safety factors according to Table 8.1.

Table 8.1 Safety factor Yf

Structural element	Yf		
	LC 1 LC 2	**LC 3**	**LC 4**
stiffeners (deck beams)	1,25	1,10	1,00
main girders (deck girders)	1,45	1,45	1,10
load-bearing structure (pillar system)	1,70	2,00	1,20

3.3 The thickness of the plating is to be determined according to **TL** Part A, Chapter1, Section 7, D.7.2, where the coefficient c may be reduced by 5 %

3.4 Proof of sufficient buckling strength is to be carried out in accordance with **TL** Part A, Chapter 1, Section 3 C. for structures subjected to compressive stresses.

4. Helicopter Deck Equipment

4.1 Deck Sheathing

- The landing deck sheathing has to comply with the following requirements:

- Resistant against increased mechanical impact at starting and landing procedure

- Resistant against aircraft fuel, hydraulic and lubricating oils

- Resistant against dry fire extinguishing powder and foams

- Resistant against defrosting expedient and salt

- Friction coefficient μ = 0,65 at minimum, to be checked periodically

No flights shall be undertaken to helicopter decks where essential visual aids for landing are insufficient. Adequate cleaning operations or preventive measures have to be executed regularly on the deck.

4.2 Rope Netting

Tautly-stretched rope netting should be provided to aid the landing of helicopters with wheeled undercarriages in adverse weather conditions. The intersections should be knotted or otherwise secured to prevent distortion of the mesh. It is preferable that the rope be 20 mm diameter sisal, with a maximum mesh size of 200 mm. The rope should be secured every 1,5 metres round the landing area perimeter and tensioned to at least 2225 N.

The location of the net should ensure coverage of the area of the aiming circle but should not cover helicopter deck markings.

Helicopter deck netting may not be applied if only helicopters with skids are used.

4.3 Helicopter Lashing Points

Sufficient flush fitting (when not in use) or removable semi-recessed lashing points shall be provided for fastening the maximum sized helicopter for which the helicopter deck is designed. They shall be so located and be of such strength and construction to secure the helicopter when subjected to weather conditions pertinent to the design considerations of the offshore service vessel. They shall also take into account the inertial forces resulting from the movement of the service vessel.

4.4 Marking

The marking of the helicopter deck shall be done according to international or national regulations and standards, see 1.5.

4.5 Wind Direction Indicator

A wind direction indicator shall be located on the offshore service vessel which, in so far as is practicable, indicates the actual wind conditions over the helicopter deck. Units on which night helicopter operations take place shall have provisions to illuminate the wind direction indicator, see Section 24, G.

5. Personnel Safety Measures

5.1 Means of Escape

At least two means of escape have to be provided from the helicopter deck. They shall be situated at the maximum possible distance from each other.

5.2 Safety Net and Railings

Safety nets for personnel protection shall be installed around the landing area except where adequate structural protection against falls exists. The netting used shall be of a flexible nature, with the inboard edge fastened level with, or just below, the edge of the helicopter landing deck. The net itself shall extend 1,5 m in the horizontal plane and be arranged so that the outboard edge is slightly above the level of the landing area, but by not more than 0,25 m, so that it has an upward and outward slope of at least 10°. The net shall be strong enough to withstand and contain, without damage a 75 kg weight being dropped from a height of 1 m.

If handrails are used, they shall be retractable, collapsible and removable and painted in a contrasting colour scheme. Procedures shall be in place to retract, collapse or remove them prior to helicopter arrival. Once the helicopter has landed and the crew have indicated that passenger movement may commence, the hand rails may be raised and locked in position. The hand rails shall be retracted, collapsed or removed again prior to the helicopter take-off.

6. Drainage

Every helicopter deck shall have a drainage system which will direct any rainwater and fuel spills within its boundary to a safe place. Any distortion of the deck's surface due to, for example, loads from a helicopter at rest shall not modify the landing area drainage system to the extent of allowing spilled fuel to remain on deck. A system of guttering or a slightly raised kerb shall be provided around the perimeter to prevent spilled fuel falling on to other parts of the service vessel and to conduct the spillage to an appropriate drainage system.

The capacity of the drainage system shall be sufficient to accept a maximum spillage of fuel on the deck. The calculation of the amount of spillage to be contained shall be based on an analysis of the helicopter type, fuel capacity, typical fuel loads and uplifts. The design of the drainage system shall preclude blockage by debris. The helicopter deck area shall be properly sealed so that spillage will only route into the drainage system

B. Support Structure for Thruster Units (Azimuth Thrusters, Podded Drives and DKx Thruster Units)

The space where the thruster unit is connected to the ship hull in general has to be surrounded by longitudinal and transverse watertight bulkheads. Suitable watertight access openings to the space have to be provided.

1. Loads

1.1 The following loads have to be considered for the determination of the scantlings of the supporting structure:

Maximum transient thrust, torque and other forces and moments experienced during all envisaged operating modes as permitted by the steering and propulsor drive control systems. Refer also to the Section 10, F.4.

- Self weight in water under consideration of the ship's pitch and heave motion and flooded volume, where applicable. See **TL** Part A, Chapter 1, Sec.5, B.

- Thruster to thruster and/or thruster to ship hydrodynamic interference effects and effects of ship manoeuvring and of ship motions.

1.2 Special account is to be taken of any manoeuvring conditions that are likely to give rise to high mean or vibratory loadings.

2. Support Structure

2.1 A system of primary structural members is to be provided in order to support the main slewing bearing of the thruster unit and to transfer the maximum design loads into the ship's hull without undue deflection.

2.2 The hull support structure in way of the slewing bearing shall be sufficiently stiff that the bearing manufacturer's limits on seating flatness are not exceeded due to hull flexure considering the loads defined under 1. For the verification of the structural design direct calculation is required, see 3.

2.3 Thrusters should be supported where practical within a double bottom structure. Generally a system of primary members including a pedestal girder directly supporting the slewing ring and bearing is to be provided. The pedestal girder is to be integrated with the ship's structure by means of radial girders and transverses aligned to their outer ends with the ship's bottom girders and transverses. Alternative arrangements have to provide an equivalent degree of strength and rigidity.

2.4 The shell envelope plating and tank top plating in way of the aperture for the thruster unit are to be increased by 50% over the rule minimum thickness over an extent of at least the radial girders acc. to 2.3. In any case the thickness of the plating is not to be less than the actual fitted thickness of the surrounding shell or tank top plating.

2.5 The scantlings of the primary members of the support structure are to be based on the design stresses defined in 3.3. Primary member scantlings are not to be less than those required by **TL** Part A, Chapter 1, Section 8, B.2 or B.3 respectively.

2.6 The web thickness of the pedestal girder shall not be less than the required shell envelope minimum rule thickness at that position.

2.7 Full penetration welds are to be applied at the pedestal girder boundaries and in way of the end connections between the radial girders and the pedestal girder.

3. Direct Calculations

3.1 The mesh geometry and the element size has to be able to reflect the stiffness of the supporting structure as well as the deformations with sufficient accuracy. For vibration analysis the model has to be able to reflect the expected frequency range.

3.2 The loads applied to the mathematical model, refer to 1, are to include the self weight, dynamic acceleration due to ship motion, hydrodynamic loads, hydrostatic pressure, propeller forces and shaft bearing support forces. In situations where a thruster unit can operate in the flooded conditions or where flooding of a thruster unit adds significant mass to that unit, details are to be included.

3.3 Based on the most unfavourable combination of normal service loading conditions, the following stresses are not to be exceeded:

Shear stress:	90/k
Bending stress:	150/k
Equivalent v. Mises stress:	180/k
Localised v. Mises peak stress:	R_{eH}

With k the material factor according to **TL**, Part A, Chapter 1, Section 3, A.2.2 and R_{eH} the nominal upper yield stress of the material.

If the design is based on extreme or statistically low probability loads, proposals to use alternative acceptance stress criteria may be considered.

3.4 Where a fatigue assessment is provided, details of cumulative load history and stress range together with the proposed acceptance criteria are to be submitted for consideration.

3.5 For cast structures, the localised von Mises stress should not exceed 0,6 times the nominal 0,2 % proof or yield stress of the material for the most unfavourable design condition.

SECTION 9

GENERAL REQUIREMENTS for MACHINERY and SYSTEMS

Page

A. Basic Technical Requirements

1. Ambient Conditions

1.1 General

1.1.1 The selection, layout and arrangement of all shipboard machinery, equipment and appliances shall be such as to ensure faultless continuous operation under the ambient and environmental conditions specified in the following.

The specified ambient and environmental conditions are in general the basis for the design of the Offshore Service Vessel and the services performed by these vessels. If in special cases the actual conditions deviate from this basis, they shall be clearly defined in the Classification contract and/or in the vessel specification, see also 3.

1.1.2 Account is to be taken of the effects on the machinery installation of distortions of the ship's hull.

1.2 Inclinations

In general angles of inclination according to Table 9.1 are to be considered.

1.3 Vibrations

Machinery shall not cause any vibrations which impose unacceptable stresses on other machines, equipment or the hull of the vessel. The amplitudes and accelerations defined in the **TL** Part B, Chapter 4, Section 1,D. are to be complied with.

1.4 Noise

In compliance with the relevant national regulations, care is to be taken to ensure that operation of the vessel is not unacceptably impaired by engine noise. **TL** Part B, chapter 4, Section 1, E.7 is also to be taken in consideration.

1.5 Hazardous Areas

1.5.1 General

Hazardous areas are areas in which an explosive atmosphere is liable to occur owing to local and operating conditions. Machinery which is to be used in such areas is to be designed according to the categorization in 1.5.2

Table 9.1 Inclinations

Installations, components	**Angle of inclination [°] (2)**			
	Athwartship		Fore & aft	
	static	dynamic	static	dynamic
Main and auxiliary machinery	15	22,5 10 s **(5)**	5 **(4)**	7,5
Vessel's safety equipment, e.g. emergency power installations, emergency fire pumps and their drives	22,5 **(3)**	22,5 10 s **(5)**	10	10
Switchgear, electrical and electronic appliance **(1)** and remote control systems				
Machinery of self-elevating units in elevated condition	10	-	10	-

(1) *Up to an angle of inclination of 45° no undesired switching operations or functional changes may occur.*

(2) *Athwartships and fore- and aft - inclinations may occur simultaneously.*

(3) *On vessels for the carriage of liquefied gases and chemicals the emergency power supply shall also remain operational with the vessel flooded to a final athwartships inclination up to a maximum of 30°.*

(4) *Where the length of the ship exceeds 100 m, the fore-and aft static angle of inclination may be taken as 500/**L** degrees.*

(5) *Minimum rolling period*

1.5.2 Subdivision into Zones

Hazardous areas are divided into zones depending on the probability that an explosive atmosphere may occur.

Zone 0 comprises areas in which a dangerous explosive atmosphere is present either permanently or for long periods

Zone 1 comprises areas in which an explosive atmosphere is liable to occur occasionally.

Zone 2 comprises areas in which an dangerous explosive atmosphere is liable to occur only rarely, and then only for a brief period (extended hazardous areas).

2. Environmental Conditions

2.1 Water Temperature

In general the water temperature according to Table 9.2 is to be considered.

Table 9.2 Water temperature

Coolant	Temperature [°C]
Seawater	+ 32 **(1)**
Charge air coolant inlet to charge air cooler	+ 32 **(1)**

(1) *TL may approve lower water temperatures for vessels operating only in special geographic areas*

2.2 Air Temperature

In general the air temperature according to Table 9.3 is to be considered.

Table 9.3 Air temperature at atmospheric pressure=1000 mbar and relative humidity=60%

Installations, components	Location, arrangement	Temperature [°C]
Machinery and electrical installations **(1)**	In enclosed spaces	0 to 45 **(2)**
	On machinery components, boilers	According to special local conditions
	In spaces subject to higher or lower temperatures	
	On the open deck	- 25 to + 45

(1) *Electronic appliances shall be designed and tested to ensure trouble-free operation within switchboards and consoles even at a constant air temperature of + 55 °C.*

(2) *TL may approve lower air temperatures for vessels designed only for service in particular geographical areas.*

2.3 Other Environmental Conditions

2.3.1 Other Environmental Conditions for Machinery Spaces

In general the environmental conditions according to

Table 9.4 are to be considered for machinery spaces.

Table 9.4 Other environmental conditions

Location	Conditions
In all spaces	Ability to withstand oil vapour and salt-laden air **(1)**
	Trouble-free operation within the Temperature ranges stated in Table 9.4, and with a relative humidity up to 100 % at a reference temperature of 45° C
	Tolerance to condensation is assumed
In specially protected control rooms	80 % relative humidity at a reference temperature of 45° C
On the open deck	Ability to withstand temporary flooding with seawater and salt-laden spray

(1) *Does not apply to electric installations*

2.3.2 Temperatures for Electrical Equipment in Areas Other Than Machinery Spaces

2.3.2.1 Where electrical equipment is installed within environmentally controlled spaces the ambient temperature for which the equipment is to be suitable may be reduced from 45 °C and maintained at a value not less than 35 °C provided:

- The equipment is not for use for emergency power supply and is located outside of the machinery space(s)

- Temperature control is achieved by at least two cooling units so arranged that in the event of loss of one cooling unit, for any reason, the remaining unit(s) is capable of satisfactorily maintaining the design temperature

- The equipment is able to be initially set to work safely within a 45 °C ambient temperature until such a time that the lesser ambient temperature may be achieved; the cooling equipment is to be rated for a 45°C ambient temperature

- Audible and visual alarms are provided, at a continually manned control station, to indicate any malfunction of the cooling units

2.3.2.2 In accepting a lesser ambient temperature than 45 °C, it is to be ensured that electrical cables for their entire length are adequately rated for the maximum ambient temperature to which they are exposed along their length.

2.3.2.3 For classifying the equipment used for cooling maintaining the lesser ambient temperature, refer to **TL** Part B, Chapter 5, Section 1, E, 1.5.3.

2.4 Environmental Categories for Electrical Installations

Electrical products are classified according to their applications into the environmental categories as stated in Table 9.5.

2.5 Currents

For the design of the propulsion and manoeuvring arrangement the different factors influencing currents in the operation area and their possible combinations are to be considered. This is to include currents created by storms or special geographic features (e.g. narrow channels).

2.6 Wind

The wind speed has to be considered according to mission of the vessel, the operating area and the time of the year where the services shall be performed.

2.7 Seastates

The seastates up to which the different types of vessel will be operated are to be agreed with **TL.**

2.8 Icing

For icing conditions see Section 22, A.6.

3. Additional Requirements for Specific Vessels and Different Services

The environmental conditions defined in 2. are applicable as for normal seagoing ships. For more severe environmental or ambient conditions the suitability of systems and components shall be demonstrated for the specific application.

B. Reliability Concept

It is recommended to define the reliability requirements for the different services of the Offshore Service Vessel, taking into account operational and special customer requirements. Reliability is understood to mean the ability of a component or system to perform its required function without failure for a specified period of time.

For complex services the reliability requirements should be verified by a Failure Mode and Effects Analysis (FMEA) which may result in a confirmation of the original design or proposals for modification. The analysis should be conducted early in the design to allow for any proposed modification to be implemented.

Table 9.5 Environmental conditions for the environmental categories of electrical installations

Environmental category	Environmental conditions						Comments
	Closed area			Open deck area			
	Temperature	Relative Humidity	Vibrations	Temperature	Relative Humidity	Vibrations	
A	0 °C to + 45 °C	to 100 %	0,7 g				For general applications, Except category B,C,D,F,G,H
B	0 °C to + 45 °C	to 100 %	4 g				For application at higher level of vibration strain, e.g. in steering gear compartment
C	0 °C to + 55 °C	to 100 %	0,7 g				For application at higher degree of heat, e.g. for equipment to be mounted in consoles, housings.
D	0 °C to + 55 °C	to 100 %	4 g				For application at higher degree of heat and higher level of vibrations strain e.g. for equipment to be mounted on combustion engines and compressors.
E	0 °C to + 40 °C	to 80 %	0,7 g				For use in air-conditioned areas. With **TL**'s special consent only.
F				- 25 °C to + 45 °C	to 100 %	0,7 g	For application when Additional influences of salt mist and temporary inundation are to be expected
G				- 25 °C to + 45 °C	to 100 %	2,3 g	For use on masts, with the additional influence of salt mist
H	In accordance with manufacturer's specifications						The provisions contained in the certificates shall be observed

SECTION 10

BASIC REQUIREMENTS for MACHINERY INSTALLATIONS

Page

A. General

1. Scope

This Section summarizes the basic requirements for machinery installations of Offshore Service Vessels. They complement the more detailed requirements for specific services of Offshore Service Vessels defined and described in Sections 5, 13 to 23.

2. Basic Rules

For all types of machinery for Offshore Service Vessels **TL** Part B, Chapter 4 apply.

The requirements defined in this and in the following Sections of this Chapter are to be observed in addition.

B. Definitions

Definitions of terms for machinery installations of Offshore Service Vessels are given in detail in the different Sections of the **TL** Part B, Chapter 4.

C. Documents

1. Documents to be Submitted for Approval

1.1 The general conditions for the submission of documents are given in Section 1, F.

1.2 The drawings and documents to be submitted for machinery installations of Offshore Service Vessels are defined in detail in the different Sections of the **TL** Part C, Chapter 4.

1.3 Additional drawings and documents to be submitted for the different services are summarized in the relevant Sections of this Chapter.

D. Rules and Regulations to be Considered

1. Applicable Rules and Regulations are listed in Section 1, B. This Section should be considered in conjunction with:

- Sections 1 ÷ 8
- Electrical Installations/Section 11
- Automation/Section 12

2. Where requirements in respect of machinery installations are not covered by these **TL** Rules the application of other rules and standards is to be agreed to on a case by case basis.

E. Classification and Certification

The principles for Classification and Certification are defined in Section 1, B.

F. Basic Technical Requirements

1. Design and Construction of Machinery Installations

1.1 Dimensions of Components

1.1.1 All parts are to be capable of withstanding the stresses and loads peculiar to shipboard service, e.g. those due to movements of the vessel, vibrations, intensified corrosive attack, temperature changes and wave impact, and shall be dimensioned in accordance with the requirements set out in the present Chapter.

In the absence of Rules governing the dimensions of parts, the recognized rules of engineering practice are to be applied.

1.1.2 Where connections exist between systems or plants, items which are designed for different forces, pressures and temperatures (stresses), safety devices are to be fitted which prevent the over-stressing of the system or plant item designed for the lower design parameters. To preclude damage, such systems are to be fitted with devices affording protection against excessive pressures and temperatures and/or against overflow.

These Rules apply to ships intended for offshore support and supply, offshore towing, and other specialized offshore services.

1.2 Materials

All components directly involved with the operation of the Offshore Service Vessel as well as related to safety and environmental protection matters shall comply with the **TL** Part A, Chapter 2, as far as applicable.

1.3 Welding

The fabrication of welded components, the approval of companies and the testing of welders are subject to the **TL** Part A, Chapter 3.

1.4 Corrosion Protection

Parts which are exposed to corrosion are to be safeguarded by being manufactured of corrosion-resistant materials or provided with effective corrosion protection.

1.5 Availability of Machinery

1.5.1 Vessel's machinery is to be so arranged and equipped that it can be brought into operation from the "dead ship" condition with the means available on board.

The "dead ship" condition means that the entire machinery installation including the electrical power supply is out of operation and auxiliary sources of energy such as starting air, battery-supplied starting current, etc. are not available for restoring the vessel's electrical system, restarting auxiliary operation and bringing the propulsion installation back into operation.

To overcome the "dead ship" condition use may be made of an emergency generator set provided that it is ensured that the electrical power for emergency services is available at all times.

1.5.2 In case of "dead-ship" condition it is to be ensured that it will be possible for the propulsion system and all necessary auxiliary machinery to be restarted within a period of 30 minutes, see **TL** Part B, Chapter 5, Section 3.

1.6 Control and Regulating

1.6.1 Machinery is to be equipped adequately with governing/control means to assure safe operation within its design features under all service conditions, for which the Offshore Service Vessel is aimed to fulfil its purpose.

1.6.1.1 For the control equipment of main engine and systems essential for operation see **TL** Part B, Chapter 5, Section 9.

1.6.2 In the event of failure or fluctuations of the supply of electrical, pneumatic or hydraulic power to regulating and control systems, or in case of a break in a regulating or control circuit, steps are to be taken to ensure that:

- The appliances remain at their present operational setting or, if necessary, are changed to a setting which will have the minimum adverse effect on operation (fail-safe conditions)

- The power output or engine speed of the machinery being controlled or governed is kept stable or reduced in a controlled manner, whichever leads to the most safe condition

- No unintentional start-up sequences are initiated

1.6.3 Local Operation

Every functionally important, automatically or remote controlled system shall also be capable for local operation.

1.7 Propulsion Plant

1.7.1 Manoeuvring Equipment

Each engine control platform or control panel of propulsion equipment (e.g. gears, CPP units) is to be equipped in such a way that;

- The propulsion plant can be adjusted to any output setting between idling and nominal load

- The direction of thrust can be reversed (pitch, rotational or azimuth direction control)

- The propulsion unit and/or the propeller shaft can be stopped

- Clutches within the power train can be locally disengaged

1.7.2 Remote Controls

The remote control of the propulsion plant is subject to the **TL** Part B, Chapter 4.1.

1.7.3 Multiple-Shaft and Multi-Engine Systems

Steps are to be taken to ensure that in the event of the failure of a propulsion engine, operation can be maintained with the other engines, where appropriate by a simple change-over system. For multiple engines driving one shaft, each engine has to be connected in such a way that it can be mechanically disengaged.

For multiple-shaft systems, each shaft is to be provided with a locking device by means of which unintended rotating of the shaft can be prevented, see **TL** Part B, Chapter 4, Section 5. The locking device is to be designed in such a way, that starting/engaging of the corresponding engine is blocked, when the locking device is active.

1.8 Turning Appliances

1.8.1 Machinery is to be equipped with suitable and adequately dimensioned turning appliances.

1.8.2 The turning appliances are to be of the selflocking type. Electric motors are to be fitted with suitable retaining brakes.

1.8.3 An automatic interlocking device is to be provided to ensure that the propulsion and auxiliary prime movers cannot start up while the turning gear is engaged. In case of manual turning installations warning devices may be provided alternatively.

1.9 Operating and Maintenance Instructions

1.9.1 Manufacturers of machinery, boilers and auxiliary equipment shall supply a sufficient number of operating and maintenance notices and manuals together with the equipment.

1.9.2 In addition, an easily legible board is to be mounted on boiler operating platforms giving the most important operating instructions for boilers and oilfiring equipment.

1.10 Markings, Identification of Machinery Parts

In order to avoid unnecessary operating and switching errors, all parts of the machinery whose function is not immediately apparent are to be adequately marked and labelled.

1.11 Fuels

1.11.1 The flash point **(1)** of liquid fuels for the operation of boilers and diesel engines shall not be lower than 60 °C. For emergency generating sets, however, use may be made of fuels with a flash point of ≥ 43 °C.

1.11.2 In exceptional cases, for vessels intended for operation in limited geographical areas or where special precautions subject to **TL**'s approval are taken, fuels with flash points between 43 °C and 60 °C may also be used. This is conditional upon the requirement that the temperatures of the spaces in which fuels are stored or used shall under all circumstances be 10 °C below the flash point.

1.11.3 For ships using gases or other low-flash point fuels, please refer to **TL**, Part D, Chapter 78.

2. Engine and Boiler Room Equipment

2.1 Operating and Monitoring Equipment

2.1.1 Instruments, warning and indicating systems and operating appliances are to be clearly displayed and conveniently sited. Absence of dazzle, particularly on the bridge, is to be ensured.

(1) *Based, up to 60 °C, on determination of the flash point in a closed crucible (cup test).*

Operating and monitoring equipment is to be grouped in such a way as to facilitate easy supervision and control of all important parts of the installation.
The following requirements are to be observed when installing systems and equipment:

- Protection against humidity and the effects of dirt

- Avoidance of excessive temperature variations

- Adequate ventilation

In consoles and cabinets containing electrical or hydraulic equipment or lines carrying steam or water the electrical gear is to be protected from damage due to leakage.

Redundant ventilation systems are to be provided for air-conditioned machinery and control rooms.

2.1.2 Pressure Gauges

The scales of pressure gauges are to be dimensioned up to the specified test pressure. The maximum permitted operating pressures are to be marked on the pressure gauges for boilers, pressure vessels and in systems protected by safety valves.

Pressure gauges are to be installed in such a way that they can be isolated.

Lines leading to pressure gauges are to be installed in such a way that the readings cannot be affected by liquid heads and hydraulic hammer.

2.2 Accessibility of Machinery and Boilers

2.2.1 Machinery and boiler installations and apparatus are to be accessible for operation and maintenance.

2.2.2 In the layout of machinery spaces (design of foundation structures, location of pipelines and cable conduits, etc.) and the design of machinery and equipment (mountings for filters, coolers, etc.), 2.2.1 is to be complied with.

2.3 Engine Control Rooms

Engine control rooms are to be provided with at least two exits, one of which can also be used as an escape route.

2.4 Lighting

All operating spaces are to be adequately lit to ensure that control and monitoring instruments can be easily read. In this connection see **TL** Part B, Chapter 5, Section 11.

2.5 Bilge Wells/Bilges

2.5.1 Bilge wells and bilges are to be readily accessible, easy to clean and either easily visible or adequately lit.

2.5.2 Bilges beneath electrical machines are to be so designed as to prevent bilge water from penetrating into the machinery at all angles of inclination and movements of the vessel in service.

2.5.3 For the following spaces bilge level monitoring is to be provided and limit values being exceeded are to be indicated at a permanently manned alarm point:

- Unmanned machinery rooms of category "A" are to be equipped with at least 2 indicators for bilge level monitoring.

- Other unmanned machinery rooms, such as bow thruster or steering gear compartments arranged below the load waterline are irrespective of Class Notation **AUT** to be equipped at least with one indicator for bilge level monitoring.

2.6 Ventilation

The machinery ventilation is to be designed under consideration of environmental conditions as defined in Section 9, A.2.

2.7 Noise Abatement

In compliance with the relevant national regulations, care is to be taken to ensure that operation of the vessel is not unacceptably impaired by engine noise.

3. Safety Equipment and Protective Measures

Machinery is to be installed and safeguarded in such a way, that the risk of accidents is largely ruled out. Apart from national regulations particular attention is to be paid to the following:

3.1 Moving parts, flywheels, chain and belt drives, linkages and other components which could constitute an accident hazard for the operating personnel are to be fitted with guards to prevent contact. The same applies to hot machine parts, pipes and walls for which no thermal insulation is provided, e.g. pressure lines to air compressors.

3.2 When using hand cranks for starting internal combustion engines, steps are to be taken to ensure that the crank disengages automatically when the engines start. Dead-Man's circuits are to be provided for rotating equipment.

3.3 Blowdown and drainage facilities are to be designed in such a way that the discharged medium can be safely drained off.

3.4 In operating spaces, anti-skid floor plates and floor-coverings are to be used.

3.5 Service gangways, operating platforms, stairways and other areas open to access during operation are to be safeguarded by guard rails. The outside edges of platforms and floor areas are to be fitted with coamings unless some other means is adopted to prevent persons and objects from sliding off.

3.6 Glass water level gauges for steam boilers are to be equipped with protection devices. Devices for blowing through water level gauges shall be capable of safe operation and observation.

3.7 Safety valves and shut-offs are to be capable of safe operation. Fixed steps, stairs or platforms are to be fitted where necessary.

3.8 Safety valves are to be installed to prevent the occurrence of excessive operating pressures.

3.9 Steam and feedwater lines, exhaust gas ducts, boilers and other equipment and pipelines carrying steam or hot water are to be effectively insulated. Insulating materials are to be incombustible. Points at which combustible liquids or moisture can penetrate into the insulation are to be suitably protected, e.g. by means of shielding.

4. Thrusters

4.1 Definitions

Thrusters for the propulsion and/or steering of Offshore Service Vessels can be distinguished according to Table 10.1.

4.1.1 Thrusters

Thrusters are in general devices producing active thrust for propulsion and/or steering tasks using a propeller to be applied e.g. for Offshore Service Vessels.

Thrusters can be distinguished in auxiliary thrusters serving mainly for steering and dynamic positioning and L- or Z-drives and podded drives for main propulsion and/or main steering instead of rudders.

4.1.2 Auxiliary Thrusters

Auxiliary thrusters may be driven by electric or hydraulic power transmitted from the power plant of the vessel, which is located elsewhere. The following types can be defined:

- Tunnel thrusters, especially used to develop lateral thrust in the bow and stern for steering

- Retractable thrusters, especially for dynamic positioning tasks as a booster, support of manoeuvrability, etc. They may be retracted to protect them from damage when not required.

- Underwater mounted thrusters, often used together with a series of other thrusters at different locations of the underwater hull with the main aim to achieve dynamic positioning of the Offshore Service Vessel with the required precision

Table 10.1 Thrusters for Offshore Service Vessels

<table>
<tr><th colspan="5">Thrusters</th></tr>
<tr><th>Auxiliary propulsion</th><th colspan="4">Main propulsion and/or steering system</th></tr>
<tr><td rowspan="2">Tunnel thrusters
(lateral thrusters in bow and/or stern) (1)

Rectractable thrusters
(mostly below vessel bottom)

Underwater mounted thrusters
(e.g. for dynamic positioning)</td><td colspan="2">L- or Z- drives
(Diesel engine, electric or hydraulic motor in vessel and connected to propeller by gearing)</td><td colspan="2">Podded drives
(Electric or hydraulic motor in pod=gondola)</td></tr>
<tr><td>Fixed drives
(not turnable)</td><td>Turnable drives =
rudder propeller units
(2)</td><td>Fixed podded drives
(not turnable)</td><td>Azimuth drives
(turnable for 360 ° or less)</td></tr>
<tr><td colspan="5">(1) Requirements for Classification are defined in TL Part B, Chapter 4, Section 9 C.
(2) Requirements for Classification are defined in TL Part B, Chapter 4, Section 9 B.</td></tr>
</table>

4.1.3 Thrusters for Main Propulsion

Thrusters for main propulsion which may also be used for steering instead of rudders may be distinguished in L- or Z-drives and podded drives.

4.1.4 L- or Z-Drives

L- or Z-drives are thrusters where the prime mover is situated within the vessel’s hull and coupled via a L- or Z-gear to the propeller. Electric or hydraulic power may be applied for L- or Z-drives, internal combustion engines are in general only to be used with Z-drives. In the gondola under water is only situated a gear stage with 90° direction change of the driving shaft.

L- or Z-drives which can be turned around their vertical axis by a certain angle to starboard and port or even by 360° and are able to produce thrust in various directions are commonly referred to rudder propeller units.

Basic requirements for podded drives as defined from 4.2 to 4.9 may be applied also to L- or Z-drives as far as applicable.

4.1.5 Podded Drives

Podded drives are thrusters, where the driving motor is located in the gondola under water and is directly coupled to the shaft carrying the thrust producing propeller.

4.1.6 Fixed Podded Drives

Podded drives which produce thrust only in longitudinal direction of the vessel are referred to as non-turnable, fixed podded drives.

4.1.7 Azimuth Drives

Podded drives which can be turned around their vertical axis by a certain angle to starboard and port or even by

360° and are able to produce thrust in various directions are referred to as azimuth drives.

For this application azimuth drives have to fulfil both the function of the propulsion and the steering gear. The design requirements for the components of such drives are to be defined in accordance to their specific application.

4.2 Application to Offshore Service Vessels

4.2.1 For main propulsion plants of conventional design e.g. diesel engines or electrical motors driving directly or via a separate gear box a controllable or fixed pitch propeller the design criteria as given in **TL** Part B, Chapter 4 are applicable in full. Redundancy in the propulsion system is required by these rules only in conjunction with an additional Class Notation **RP1**, **RP2** or **RP3**.

4.2.2 The **TL** Part B, Chapter 4, Section 9, B. for Rudder Propeller Units and Section 9, C. for Lateral Thrust Units remain fully applicable, in so far as they are not interpreted in the following taking into account the special requirements of Offshore Service Vessels.

4.2.3 For devices intended to operate in ice the scantlings as prescribed under **TL** Part B, Chapter 4, Section 19 apply additionally.

4.2.4 The following part of this Section therefore describes requirements for podded drives.

4.3 General Performance Requirements for Podded Drives

4.3.1 The requirements listed below are minimum requirements, which have to be fulfilled to obtain unrestricted **TL** Class, even if nothing else has been specified between yard and owner. They are derived by direct application or common interpretation of general relevant requirements for manoeuvrability e.g. SOLAS and MSC.

4.3.2 Basic Design Document

Offshore Service Vessels are regular seagoing vessels which may be expected to operate under conditions that exceed common seaworthiness requirements. In relation to azimuth drives this may impose particular requirements on the systems expected to ensure the manoeuvrability of the vessel.

These particular requirements cannot be covered by general Rules for all ship types. For this reason, and in order to be able to perform drawing approval satisfying the expected operational conditions of Offshore Service Vessels a basic design document shall be additionally submitted, briefly describing the acceptable limitations of the propulsion and steering system. This document will be taken into consideration by **TL** and will become part of the scope of the approval process.

4.3.3 Typically, the commonly required manoeuvrability properties by SOLAS, MSC, etc. are easily met for vessels equipped with azimuth drives. However, extreme manoeuvres such as full rotation during full ahead speed may be rendered possible by the installation, but could exceed the design strength of the azimuth drive and lead to damages.

In this respect, the supplier of the azimuth drives shall describe the operational limits within the basic design document referred to in 4.3.2. The tests and strength calculations will take into account these limits, derived from the design process, provided they exceed the requirements as set out by or are derived from SOLAS, MSC, etc.

It is highly recommended to make this document available to the owner/operator of the vessel, in order to specify clearly the contracted abilities.

4.4 Requirements for the Design

4.4.1 General Requirements

The following general requirements have to be considered for all types of podded drives:

- For main drive of Offshore Service Vessels at least two podded drives are to be installed.

- The failure of one podded drive or its control system shall not cause the failure of other drives.

- The lubrication system shall provide all gear elements, bearings, sealings, etc. with the required amount of oil for lubrication and also cooling duties. For forced lubrication redundancy of the lube oil pumping is required.

- Special consideration has to be spent to sealing of the podded drive against ingress of seawater and also emission of oil to the seawater, compare also Section 23, C.5.

- A bilge system is to be installed for podded drives.

- The internal power transmitting components (esp. gears and bearings but also shafting, couplings, sealings) are sensible to alignment, therefore the stiffness of the drive housing supported by plating, girders, etc. has to be such, that the deformations resulting from external or operating forces are reduced to a tolerable minimum, so far they are transmitted via the bearings to the rotating and power transmitting mechanical components.

- If the Offshore Service Vessel is assigned an ice class additional requirements are defined in Section 22, B.

- Steering control for all podded drives has to be established at the bridge, the machinery control room and immediately at the podded drives. At these positions the thrust direction and the number of propeller revolutions are to be shown.

4.4.2 Special requirements for electrically driven podded drives

In addition to the general requirements of 4.4.1 for podded drives with the electrical motor integrated on the propeller shaft the following requirements have to be considered:

4.4.2.1 Additionally special care has to be taken, in order to avoid any water intrusion through the sealings to the electrical motor. This additional feature can be achieved by bilges between the sealing barriers with adequate alarms and equipped with pumps of adequate capacity for draining.

4.4.2.2 Complementary to the requirements of 4.4.1 for the case of application of one single podded drive a Failure Mode and Effect Analysis (FMEA) has to be provided, which has to take place during the design process of the podded drive itself.

4.4.2.3 Further requirements for the electrical system are defined in Section 11, F.4.

4.4.3 Special Requirements for Azimuth Drives

4.4.3.1 The following is applicable for azimuth drives with a power exceeding 300 kW each, so far no other means are installed to enable the vessel's steering capabilities, as required by SOLAS Chapter II-1, Reg. 29.

4.4.3.2 So far the propulsion and steering capabilities of the vessel are realised by azimuth drives at least two independent devices are to be installed as a rule. The drives may not be identical, but each one has to be capable to navigate the vessel safely and maintain sufficient manoeuvrability under the most adverse weather and sea conditions, anticipated for the vessel's purpose.

A single azimuth drive installation may be accepted on special considerations and provided that the purpose of the vessel will not imply a direct risk for safety and environment in the case of momentarily loss of propulsion. For this purpose SOLAS Reg. II-1/29.4.3 is to be fulfilled, commonly interpreted in the way that for vessels with an installed propulsion power of more than 2500 kW at least two power driven devices (propulsors) for steering purposes are to be installed.

4.4.3.3 Request for redundancy as described under 4.4.3.2 does not interfere and does not cover up the requirements set out to achieve additional Class Notations **RP1**, **RP2**, **RP3**.

4.4.3.4 In order to apply SOLAS in the sense of required manoeuvrability for a vessel the so-called "declared steering angle" **(2)** is introduced.

The maximum angle at which the azimuth drive can be oriented on each side when the vessel navigates at its maximum speed is to be specified by the owner/operator. Such maximum angle is generally to be less than 35° on each side.

In general, orientations greater than this maximum angle may be considered by **TL** for azimuth drives during manoeuvres or dynamic positioning, provided that the orientation values together with the permissible speed values are submitted to **TL** for approval. In any way the propulsion power has to be limited so that the safety of the vessel is not endangered.

4.4.3.5 The azimuth drive shall be power driven in rotational direction, the installed power capacity shall enable a minimum rotational speed corresponding to 65° in 28 sec (0,4 rev/min) - respectively in 20 sec for special Offshore Service Vessel types -, when the vessel is operating at service speed. In deviation to above mentioned minimal required rotational speed, values of not less than 1 rev / min should be aimed or measured under full speed conditions.

4.4.3.6 Any installed azimuth drive, declared as main propulsor with main steering capabilities has to be capable to be rotated in both directions at least by the "declared steering angle". In case that the reverse operation is achieved by rotating the thrusters over the 90° position, reaching of this position shall be feasible under full speed conditions (emergency stop manoeuvre).

Manoeuvres possibly conflicting with design features of the podded drive or the vessel have to be blocked by automatic control.

(2) *Declared steering angle is the helm angle at which the vessel shows a comparable manoeuvring behaviour as it would show, when equipped with a conventional rudder at 35° helm angle with maximum steering force*

4.4.3.7 In general the structural elements and connections of the azimuth drive shall be capable to withstand extreme manoeuvring at full speed, operation at full astern speed and crash stop manoeuvre. Any such manoeuvre may be asked to be demonstrated, so far not electronically blocked or limited in accordance to the design criteria of the manufacturer. In latter case a manufacturer's document as described under 4.3.2 has to be applied.

4.4.3.8 At least two independent drives of the steering gear are to be provided for each azimuth drive. For the case the steering gear is inoperative it shall be possible to lock the azimuth drive in a neutral position.

4.4.3.9 If hydraulic power is used for the steering gear of the azimuth drive it shall not be in direct connection with other hydraulic systems. It shall be possible to change oil cleaning filters without interruption of oil supply. A storage tank for hydraulic oil is to be provided with a capacity to recharge at least one azimuth drive.

4.4.4 Special Requirement for Drives for Dynamic Positioning

- For drives that are part of a dynamic positioning system the additional requirements of Section 16 are to be considered.

- Drives applied for dynamic positioning are to be designed for continuous operation.

- Where wind milling may be occurring during normal operation a shaft brake able to hold the wind milling torque is to be provided respectively lubrication is to be secured also in this operating condition.

4.5 Requirements for the Components

For Classification purposes the components of podded drives have also to meet the requirements of further valid **TL** Rules, such as:

- Gears, couplings: see **TL** Part B, Chapter 4, Section 7

- Shafting: see **TL** Part B, Chapter 4, Section 5
- Propeller: see **TL** Part B, Chapter 4, Section 8
- Turning mechanism: analogous to rudder propeller units, see **TL** Part B, Chapter 4, Section 9, B.
- Hydraulics: see **TL** Part B, Chapter 4, Section 10, A.
- Electrical installation: see **TL** Part B, Chapter 5, Section 13
- Sensor and control system, including excess temperatures, oil levels, leakage indications, impermissible vibrations, etc., see **TL** Part B, Chapter 4.1, Section 8
- Any other relevant requirement in **TL** Rules

In addition the **TL** Part B, Chapter 4, Section 6 for torsional vibrations has to be considered.

4.6 Documents to be Submitted for Podded Drives

The following documentation has to be submitted in addition to the standard documentation for the components defined in 4.5.

- Basic design document (cf. 4.3.2)
- Arrangement drawings of the complete podded drive and definition of forces acting on the hull
- Drawings showing the steel structure of the pod itself
- Drawings for all rotating parts transmitting torque (e.g. shafts, couplings, gears connections, etc.)
- Drawings of sealing devices and bearings including calculations
- Diagrams for cooling lubrication and hydraulic systems including functional descriptions
- Investigation of mechanical vibrations of the drive having impact on the design (e.g. bending vibrations, torsional vibrations)
- Electrical installations (see Section 11, F.4.)
- Definition of overall control system
- Failure Mode and Effects Analysis, if required

4.7 Structural Measures for the Pod

The structure has to observe that podded drives are integrated drives carrying rotating mechanical and electrical components for driving purposes. This leads to the following requirements:

- The casing has to be rigid enough to limit the deflections at the connecting points to the mechanical parts such as a long term reliable operation can be achieved.
- In accordance to the state of the art both, welded or casted designs may be applied. Water tightness has to be proven for casted parts as well as combined welded/casted constructions.

4.8 Testing and Trials

The complete functioning of each podded drive has to be verified during sea trials. If several drives are installed at the vessel their integrated operation has to be tested for all relevant operation conditions.

5. Communication and Signalling Equipment

The requirements for:

- Voice communication
- Engineer alarm
- Engine telegraph systems
- Shaft revolution indicator

- Design of communication and signalling equipment are defined in Section 11, F.5.

G. Tests and Trials

1. General

1.1 Machinery and its substantial components are subject to material, pressure and leakage as well as functional tests. All tests prescribed in the following Sections are to be conducted under the supervision of **TL.**

In the case of parts produced in series, other methods of testing can be agreed with **TL** instead of the tests prescribed, provided that the former are recognized as equivalent by **TL**.

1.2 **TL** reserves the right, where necessary, to increase the scope of the tests and also to subject to testing those parts which are not expressly required to be tested according to these Rules.

1.3 In case of application of components or parts without adequate Certification in accordance to these Rules, **TL** may ask for replacement by certified parts or prove of equivalent quality properties.

1.4 After installation on board of the main and auxiliary machinery, the proper operability of the machinery and associated auxiliary equipment has to be verified. All safety equipment is to be tested, unless adequate testing has already been performed at the manufacturer's works in the presence of **TL**'s Representative. Substantial auxiliary machinery and deck machinery, which could not be tested in the manufacturer's facilities under load conditions, is to be tested on board, the latest during sea trials. Until final successful testing on board, the full Certification of this machinery is pending.

In addition, the entire machinery installation is to be tested and adjusted in accordance to the specifications during sea trials. The sea trials shall be carried out, as far as possible, under intended operational conditions for the special vessel; at least the nominal design loadings/capabilities of the machinery shall be demonstrated.

1.5 For the requirements during sea trials see **TL** Guidelines for Sea Trials of Ships, as far as applicable.

2. Specific Tests

The tests for specific services are defined in Sections 13 to 23.

SECTION 11

BASIC REQUIREMENTS for ELECTRICAL INSTALLATIONS

A. General

1. Scope

This Section summarizes the basic requirements for all the electrical installations of Offshore Service Vessels. They complement the more detailed requirements for specific service of Offshore Service Vessels defined and described in the Sections 13 to 23.

2. Basic Rules

For all types of electrical installations for Offshore Service Vessels the **TL** Part B, Chapter 5 apply. The requirements defined in the following Sections of this Chapter are to be observed in addition.

B. Definitions

Definitions of electrical terms are given in the **TL** Part B, Chapter 5, Section 1, B.

C. Documents

1. Documents to be Submitted for Approval

1.1 The general conditions for the submission of documents are given in Section 1, F.

1.2 The drawings and documents to be submitted for electrical installations of Offshore Service Vessels are summarized in Table 11.1.

1.3 The drawings of switchgear and control systems are to be accompanied by parts lists indicating the manufacturers and characteristics of the electrical components and circuit diagrams together with descriptions, where these constitute a necessary aid to understanding.

D. Rules and Regulations to be Considered

1. Applicable Rules and Regulations are listed in Section 1, H. This Section 11 should be considered in conjunction with **TL** Rules for:

- **TL** Part B, Chapter 4
- **TL** Part B, Chapter 4.1

2. Where requirements in respect of electrical installations are not covered by these **TL** Rules the application of other rules and standards is to be agreed on a case by case basis.

3. The provisions of the "International Convention for Safety of Life at Sea (**SOLAS 74**)" are taken into account in these Rules, insofar as these affect electrical installations.

E. Classification

The principles for Classification are defined in Section 1, B.

F. Basic Technical Requirements

1. General

1.1 All electrical systems and equipment are to be constructed and installed in such a way that they are serviceable and perform satisfactorily under the design conditions specified for the Offshore Service Vessel to minimize the risks for the crew through fire, explosion, electric shock and emission of toxic gases.

1.2 Provision is to be made for maintaining the electrical installations in a normal operating condition without recourse to the emergency power supply.

1.3 Even under emergency conditions, the operation of equipment necessary for the safety of the crew is to be assured.

1.4 Suitable protective measures are to be taken to exclude any electrical hazards to the crew and to other special personnel working on the Offshore Service Vessel.

Table 11.1 Documents subject to approval relating to electrical equipment of offshore service vessels

No	Documents	Basic documents	Additional documents		
		General	HNLS (1)	OIL RECOVERY (2)	CHEMICAL RECOVERY (3)
1.	**Power supply equipment**				
1.1	Electrical plant, power generating and distribution (general layout drawing)	x			
1.2	Generators, UPS units, batteries with maintenance schedule, transformers	x	x	x	x
1.3	Spaces with an explosion hazard with details of installed equipment				
1.4	Short-circuit calculation, where total generators output > 500 kVA	x			
1.5	Electrical power balance (main and emergency supply)	x			
1.6	Protection coordination study with all values > 3000 kVA	x			
1.7	Main switchgear	x			
1.8	Emergency switchgear	x			
1.9	Main distribution boards	x			
1.10	Main cableways for medium-voltage Systems	x			
1.11	Bulkhead/deck penetrations A 60	x **(4)**			
1.12	Cable layout/list	x			
2.	**Manoeuvring equipment**				
2.1	Steering gear drive and control systems	x			
2.2	Rudder propeller and lateral thrust system	x			
2.3	Controllable pitch propeller system	x			
3.	**Lighting**				
3.1	Lighting arrangement	x			
3.2	Emergency lighting arrangement	x			
3.3	Additional emergency lighting arrangement and facilities, if applicable	x			
4.	**Starting, control and monitoring equipment**				
4.1	Monitoring systems for machinery	x			
4.2	Safety devices/safety systems for machinery	x			
4.3	Starting arrangements for auxiliary and main engines	x			
4.4	Controls and adjustments for essential equipment/drive installations	x			

Table 11.1 Documents subject to approval relating to electrical equipment of offshore service vessels *cont.*

No	Documents	Basic documents	Additional documents		
		General	HNLS (1)	OIL RECOVERY (2)	CHEMICAL RECOVERY (3)
5.	**Ship's safety devices**				
5.1	General alarm systems	x			
5.2	Technical officer's alarm system	x			
5.3	Navigation and signalling lights, power supply and monitoring system	x			
5.4	Fire detection and alarm systems	x			
5.5	CO_2 alarm system	x			
5.6	Emergency shut-off facilities	x			
5.7	Tank level indicators, alarms, shutoff facilities		x	x	x
5.8	Gas detector systems		x	x	x
5.9	Fixed water-based local application fire-fighting systems	x			
6.	**Communication systems**				
6.1	Public address system	x			
6.2	Important intercommunication systems	x			
7.	**Computer systems**				
7.1	Power supply concept	x			
7.2	System configuration	x			
7.3	Software version	x			
8.	**Electrical propulsion plants**				
8.1	Propulsion motors	x			
8.2	Static converters	x			
8.3	Control, adjustment, monitoring	x			
8.4	Functional description for Class Notation **RP ..%**	x			
8.5	FMEA	x**(5)**			
8.6	Trial program	x			
9.	**Medium voltage installation**				
9.1	Trial program	x			

Explanation:
(1) *Hazardous and Noxious Substances in Bulk, compare Section 5*
(2) ***TL****, Part C, Chapter 12, Section 18*
(3) ***TL****, Part C, Chapter 24, Section 19*
(4) *For Information*
(5) *Additional FMEA to be submitted for Class Notation* ***RP ..%****, if assigned*

2. Protection Against Electric Shock

2.1 Protection Against Direct Contact

Protection against direct contact comprises all the measures taken to protect persons against the dangers arising from contact with the live parts of electrical facilities. Live parts are conductors and conductive parts of facilities which in normal operating condition are under voltage.

2.1.1 Electrical facilities shall be so designed that, when they are used properly, persons cannot touch, or come dangerously close to live parts. For exceptions, see 2.1.2 and 2.1.3.

2.1.2 In locked electrical service spaces, protection against direct contact is already maintained by the mode of installation. Insulated handrails are to be fitted near live parts.

2.1.3 In systems using safety voltage protection against direct contact may be dispensed with.

2.2 Protection Against Indirect Contact

Electrical facilities shall be made in such a way that persons are protected against dangerous contact voltages in the event of an insulation failure.

For this purpose, the construction of the facilities shall incorporate one of the following protective measures:

- Protective earthing, see 2.3
- Protective insulation (double insulation)
- Electrical facilities are operated at voltages causing no danger even in case of a fault
- In case where special precautions against electric shock will be necessary, the additional usage of residual current protective devices ≤ 30 mA (not for essential equipment)

2.3 Protective Earthing

Touchable conductive parts of equipment which are normally not live, but which may present a dangerous contact voltage in the event of a fault, are to be connected (earthed) to the Offshore Service Vessel's hull.

Where such earthing is not effective by fastening or mounting, protective earthing conductors are to be used.

For the earthing of cable shielding, armouring and braids, see **TL** Part B, Chapter 5, Section 12, D.

2.4 Protective Earthing Conductors

The following points are to be noted with regard to the use of earthing conductors:

- An additional cable or an additional wire with a green/yellow coded core shall be provided as an earthing conductor, or the connection cable shall contain a green/yellow coded core. Cable braids and armouring shall not be used as earthing conductors.
- A conductor normally carrying current shall not be used simultaneously as an earthing conductor, nor may it be connected with the latter to the vessel's hull. The green/yellow coded core shall not be used as a current-carrying conductor.
- The cross-section of the earthing conductor shall at least conform to the values indicated in Table 11.2.
- Machines and devices which are insulated mounted are to be earthed by flexible cables, wires or stranded copper straps.
- The connection of the earthing conductor to the Offshore Service Vessel's hull shall be located at a point where it can easily be checked. Connections of earthing conductors shall be protected against corrosion.

Table 11.2 Cross-sections for protective earthing conductors

<table>
<tr><th rowspan="2">Cross-ection of outer conductor
[mm²]</th><th colspan="3">Minimum cross-section of protective earthing conductor</th></tr>
<tr><th>In insulated cables [mm²]</th><th>Separately Laid [mm²]</th><th>Flexible,mobile cables and wires [mm²]</th></tr>
<tr><td>0,5 to 4</td><td>equal to cross section of outer conductor</td><td>equal to cross-section of outer conductor but not less than 1,5 for stranded and 4 for solid earth conductor</td><td rowspan="2">equal to cross section of outer conductor</td></tr>
<tr><td>> 4 to 16</td><td>equal to cross section of outer conductor</td><td rowspan="3">equal to half the cross section of outer conductor but not less than 4</td></tr>
<tr><td>> 16 to 35</td><td>16</td><td rowspan="3">equal to cross section ofouter conductor but not less than 16</td></tr>
<tr><td>>35 to <120</td><td>equal to half the cross section of outer conductor</td></tr>
<tr><td>≥120</td><td>70</td><td>70</td></tr>
</table>

- Insulated mounted structures and aluminium structures shall be connected to the Offshore Service Vessel's hull by special conductors at several points. The connections shall have a high electrical conductivity and shall be corrosion-resistant. The minimum cross-section is 50 mm^2 per conductor.

3. Explosion Protection

3.1 Hazardous Areas

3.1.1 General

Hazardous areas are areas in which an explosive atmosphere in dangerous quantity (a dangerous explosive atmosphere) is liable to occur owing to local and operating conditions.

Hazardous areas are divided into zones depending on the probability that a dangerous explosive atmosphere may occur.

3.1.2 Subdivision into Zones

Zone 0 comprises areas in which a dangerous explosive atmosphere is present either permanently or for long periods. Zone 1 comprises areas in which a dangerous explosive atmosphere is liable to occur occasionally. Zone 2 comprises areas in which a dangerous explosive atmosphere is liable to occur only rarely, and then only for a brief period (extended hazardous areas).

3.2 Hazardous Areas, Zone 0

3.2.1 These areas include for instance the insides of tanks and piping with a combustible liquid having a flash point ≤ 60 °C, or flammable gases, see also 3.9.

3.2.2 For electrical installations in these areas the permitted equipment that may be fitted is:

- Intrinsically safe circuits Ex ia

- Equipment specially approved for use in zone 0 by a test organisation recognised by **TL**

3.2.3 Cables for above mentioned equipment may be installed and shall be armoured or screened or run inside metal tubes.

3.3 Hazardous Areas, Zone 1

3.3.1 These areas include areas like:

- Paint rooms, kerosene lamp rooms, see also 3.5

- Acetylen and oxygen bottle rooms, see also 3.6

- Battery rooms, see also 3.7

- Areas with machinery, tanks or piping for fuels having a flash point ≤ 60°C, or flammable gases, see also 3.8

- Ventilation ducts belonging to above mentioned Areas

- Insides of tanks, heaters, pipelines, etc. for liquids or fuels having a flash point > 60 °C, if these liquids are heated to a temperature higher than 10 °C below their flash point; see also **TL**, Part B, Chapter 4, Section 16, V.2.

- See also 3.9 to 3.13

3.3.2 The following electrical equipment or certified safe type equipment may be installed:

- Equipment, permitted for zone 0, see 3.2.2
- Intrinsically safe circuits Ex i
- Flameproof enclosure Ex d
- Pressurized Ex p
- Increased safety Ex e
- Special type of protection Ex s
- Oil immersion Ex o
- Encapsulation Ex m
- Sand filled Ex q
- Hermetically enclosed echo-sounders

3.3.3 Cables for above mentioned equipment may be installed and shall be armoured or screened or run inside metal tubes, and cables for echo-sounders and cathodic protection systems, installed in thick-walled steel pipes with gastight joints up to above the main deck.

3.4 Extended Hazardous Areas, Zone 2

3.4.1 These areas include:

- Areas directly adjoining Zone 1 lacking gastight separation from one another are allocated to Zone 2 (Enclosed areas with access to zone 2-areas may be counted as safe areas under the following conditions: if the access door to the room is watertight and fitted with self-closing devices and without holding back arrangements and the area is ventilated from a safe area by an independent natural ventilation system and warning labels are fixed to the outside of the access door, drawing attention to the combustible liquids in this room)
- Areas on open deck 1 m surrounding openings for natural ventilation or 3 m surrounding openings for forced ventilation for rooms, see 3.5, 3.6, 3.7, 3.8
- see also 3.9 to 3.13

3.4.2 The following electrical equipment may be installed:

- Equipment permitted for zone 0, see 3.2.2
- Equipment permitted for zone 1, see 3.3.2
- Equipment of Ex n- type protection
- Facilities which in operation do not cause any sparks and whose surfaces, accessible to the open air, do not attain any unacceptable temperatures
- Equipment with a degree of protection of IP 55 at least and whose surfaces, accessible to the open air, do not attain any unacceptable temperatures

3.5 Electrical Equipment in Paint and Kerosene Lamp Rooms

3.5.1 In the above-mentioned rooms (Zone 1) and in ventilation ducts supplying and exhausting these areas, electrical equipment shall be of certified safe type and comply at least with explosion protection class II B and temperature class T3.

Switches, protective devices and motor switchgear for electrical equipment in these areas shall be of all-poles switchable type and shall preferably be fitted in the safe area.

3.5.2 On the open deck within a radius of 1 m (Zone 2) around natural ventilation openings (in- and outlets) or within a radius of 3 m around forced ventilation outlets (Zone 2) the requirements of 3.4 shall be fulfilled. Care shall be taken to avoid exceeding temperature class T3 or 200 °C.

3.5.3 Enclosed areas with access to paint- and kerosene lamp rooms may be counted as safe areas under the following conditions; if

- The access door to the room is gastight and fitted with self-closing devices and without holding back arrangements. A watertight door may be considered as being gastight; and

- The area is ventilated from a safe area by an independent natural ventilation system; and

- Warning labels are fixed to the outside of the access door, drawing attention to the combustible liquids in this room.

3.6 Electrical Equipment in Acetylene and Oxygen Bottle Rooms

Electrical equipment in acetylen and oxygen bottle room shall be of certified safe type with explosion protection of IIC T2 at least.

3.7 Electrical Equipment in Battery Rooms

Electrical equipment in battery rooms shall be of certified safe type with explosion protection of IIC T1 at least. Arrangements and further requirements, see **TL** Part B, Chapter 5, Section 2, C.

3.8 Electrical Equipment in Fuel Stores, Flash Point ≤ 60 °C

Electrical equipment in fuel stores shall be of certified safe type with explosion protection of IIA T3 at least.

3.9 Explosion Protection on Offshore Service Vessels with Cargo Tanks

Regarding hazardous areas and approved electrical equipment on these vessels see:

- IEC 60092-502

- **TL** Part B, Chapter 5, Section 15

- **TL** Part B, Chapter 10, see also IGC-Code of IMO

- **TL** Part B, Chapter 8, see also IBC-Code of IMO

3.10 Explosion Protection in Pipe Tunnels

All equipment and devices in pipe tunnels containing fuel lines or adjoining fuel tanks shall be permanently installed irrespective of the flash point of the fuels.

Where pipe tunnels directly adjoin tanks containing combustible liquids with a flash point below 60 °C or where pipes inside these tunnels convey combustible liquids with a flash point below 60 °C, all the equipment and devices in pipe tunnels shall be certified explosion-protected in accordance with 3.3.2 (zone 1).

3.11 Permitted Electrical Equipment

3.11.1 Electrical equipment shall not be installed in hazardous areas Zones 0, 1 and 2, unless it is necessary for vessel operation or safety. All electrical equipment, necessary to install in hazardous areas zone 0 and 1 shall be either manufactured according to a recognized standard, such as IEC 60079 and certified by an authority recognised by **TL** or of a simple type belonging to an intrinsically safe circuit. Certificates for electrical equipment installed in zone 2 may be requested by **TL**. Special conditions, mentioned in the Certificates or in their instruction manuals have to be observed.

3.11.2 Where electrical equipment is liable to suffer damage due to characteristics of the cargo, measures shall be taken to protect such equipment.

3.12 Portable Electrical Equipment

Portable electrical equipment, important for aboard operation and used in hazardous areas or stipulated for such use by regulations shall be of a certified safe type.

3.13 Earthing/ Equipotential Bonding/ Static Electricity

3.13.1 All electrical equipment in hazardous areas shall be earthed regardless of the operating voltage.

3.13.2 To prevent static charges, all cargo tanks, processing plants, piping, etc. shall be durably bonded by electrical conductors and/or connected to the hull, unless they are electrically connected to the hull by welds or bolting. Not permanently installed tanks, piping systems and equipment may be connected by bonding straps. Such straps shall be designed and located that they are protected against corrosion and mechanical damages. These connections shall be accessible for inspection and protected against mechanical damage and corrosion.

3.13.3 To prevent the accumulation of static electricity the discharge resistance has to be less than 1 MOhm.

3.14 Aerials / Electromagnetic Radiation

3.14.1 Aerials and their riggings shall be placed outside hazardous areas.

3.14.2 If aerials are to be placed in hazardous areas owing important reasons of vessel construction or radio technology, the level of radiated power or field strength shall be limited to safe values acceptable to the appropriate authority.

4. Special Requirements for Podded Drives

The special requirements for podded drives considering e. g:

- Level of vibration
- Sensors
- Protection of the propulsion motor
- Air humidity
- Motor supply lines
- Slip rings
- Azimuth drives

which are defined in the standard IEC 60092-501, 13 are to be observed.

5. Communication and signalling equipment

5.1 Voice communication

Means of voice communication are to be provided between the vessel's manoeuvring station, the engine room and the steering gear compartment, and these means shall allow fully satisfactory intercommunication independent of the main shipboard power supply under all operating conditions, see also **TL** Part B, Chapter 5, Section 9, C.5.

5.2 Engineer alarm

From the engine room or the engine control room it shall be possible to activate an alarm in the engineers' living quarters, see also **TL** Part B, Chapter 5, Section 9, C.5.3.

5.3 Engine Telegraph Systems

5.3.1 General

At least two mutually independent command transmission units shall be provided for the commands from the bridge to the position in the engine room or machinery control room from which speed and direction of thrust of the propellers is normally controlled.

One of these units shall be an engine telegraph system. In the case of multiple-shaft installations, a telegraph shall be provided for each unit.

The second appropriate means of command transmission shall be independent of the main engine telegraph system.

Suitable means of communication shall be provided from the bridge and the engine room to all other positions from which speed and thrust of the propeller can be varied.

5.3.2 Main engine telegraph system

5.3.2.1 The controls of the transmitters and receivers shall be safeguarded by suitable means (e.g. notching) against inadvertent operation.

5.3.2.2 Engine telegraphs shall be of the two-way systems type in which the signal given by the receiver is also immediately discernible at the transmitter.

5.3.2.3 In the case of installations with several control positions the acknowledged command shall be indicated at all control positions. Where control positions are selected by switching, additionally indication shall be provided of which one is in use.

5.3.2.4 Transmitters and receivers shall be equipped with call-up devices which remain in operation from the start of the command transmission until it is correctly acknowledged. The audible signal shall be hearable at all points in the engine room. If necessary, optical signals shall be provided in addition to the audible signals.

5.3.2.5 Power supply shall be provided from the main source of electrical power.

5.3.3 Emergency engine telegraph system

5.3.3.1 The function of the emergency engine telegraph system shall conform to that of the main system in accordance with 5.3.2.1 and 5.3.2.2.

Power supply shall be provided from the emergency source of electrical power.

5.3.3.2 Instead of the emergency engine telegraph system a telephone system may be fitted.

5.4 Shaft revolution indicator

The speed and direction of rotation of the propeller shafts are to be indicated on the bridge and in the engine room. In the case of small propulsion units, the indicator may be dispensed with.

Barred speed ranges are to be marked on the shaft revolution indicators, see **TL** Part B, Chapter 4, Section 6.

5.5 Design of communication and signaling equipment

Reversing, command transmission and operating controls, etc. are to be grouped together at a convenient point on the control platform.

The current status, "Ahead" or "Astern", of the reversing control is to be clearly indicated on the propulsion plant control platform.

Signalling devices are to be clearly perceptible from all parts of the engine room when the machinery is in full operation.

For details of the design of electrically operated command transmission, signalling and alarm systems, see **TL** Part B, Chapter 5, Section 9 and **TL** Part B, Chapter 4.1.

6. Emergency Power Supply

The design of the capacity of the emergency power supply has to consider also the additional requirements of different services provided by Offshore Service Vessels.

G. Tests and Trials

The tests for specific services are defined in Sections 13 to 23. For sea trials the **TL** Additional Rules for Sea Trials of Motor Vessels are to be applied.

SECTION 12

BASIC REQUIREMENTS for AUTOMATION

A. General

1. Scope

This Section summarizes the basic requirements for all the automation systems of Offshore Service Vessels. They complement the more detailed requirements for specific services of Offshore Service Vessels defined and described in the Sections 13 to 23.

2. Basic Rules

For all types of automation systems for Offshore Service Vessels **TL** Part B, Chapter 4.1 4.1 apply. The requirements defined in the following Sections of this Chapter are to be observed in addition.

B. Definitions

1. Alarms

An alarm gives optical and acoustical warning of abnormal operating conditions.

2. Protective Devices

Protective devices detect actual values, activate alarms in the event of limit-value violation and prevent machinery and equipment being endangered. They automatically initiate curative measures or call for appropriate ones.

3. Safety Devices

Safety devices detect critical limit-value violations and prevent any immediate danger to persons, vessel or machinery.

4. Safety Systems

A combination of several safety-devices and/or protective devices is forming a functional unit.

5. Systems

Systems contain all equipment necessary for monitoring, control and safety including the in- and output devices. Systems cover defined functions including behaviour under varying operation conditions, cycles and operation.

C. Documents

1. Documents to be Submitted for Approval

1.1 The general conditions for the submission of documents are given in Section 1, F.

1.2 For each of the systems listed in **TL** Part B, Chapter 5, Section 2, depending on the chosen Class Notation for automation **AUT, AUT-nh** and **AUT-C**, the following documents are to be submitted:

- General plan
- Wiring diagrams
- Power supply plan
- Description of functional relationships
- General arrangement
- Functional description

For integrated automation systems F.5. is to be observed additionally.

1.3 The list of measuring points is to be submitted for the monitoring system.

1.4 Safety programmes giving details of limit values which result in shutdown or reduction are to be submitted for the main propulsion plant and also for other equipment where necessary.

D. Rules and Regulations to be Considered

1. Applicable Rules and Regulations are listed in Section 1, H. This Section should be considered in conjunction with **TL** Rules:

- Part B, Chapter 4
- Part B, Chapter 5

2. Where requirements in respect of automated machinery systems are not covered by these **TL** Rules the application of other rules and standards is to be agreed on a case by case basis.

3. Allowance is made in substance in these **TL** Rules for the provisions of the "International Convention for the Safety of Life at Sea" (**SOLAS**) where these relate to unattended machinery spaces.

E. Classification

1. General

General requirements for Classification and Certification are defined in Section 1, B.

2. Class Notations

Machinery installations which comply with the **TL** Rules for automated and/or remotely controlled systems are given the following Class Notations:

2.1 AUT

The machinery installation has been designed to operate in an unattended machinery space so that no control and maintenance operations are required for at least 24 hours.

2.2 AUT-nh

This denotes the period during which no control and maintenance operations are necessary, whereby nh means that the machinery installation may be left unattended for n hours (h).

2.3 AUT-C

This is the Class Notation for machinery systems on Offshore Service Vessels with a permanently attended machinery control room for centralized control, remote control of the propulsion plant from the bridge or facilities for manoeuvring the vessel from the machinery control room.

F. Basic Technical Requirements

1. Design and Performance

1.1 The requirements laid down for each unit and system depend on their intended use and the process-technological conditions. The **TL** Rules stipulate the minimum requirements for these.

1.2 In all circumstances the operation of the Offshore Service Vessel using automated machinery installations shall be at least as safe as operation with a manned machinery installation.

1.3 If special operating conditions call for a particular system design, **TL** reserves the right to impose additional requirements depending on the operational and system-specific considerations.

1.4 Systems have to be intelligible and userfriendly and have to follow ergonomic principles.

1.5 The potential risk in case of failure shall be limited to a reasonable level of residual risk by safety measures, open and closed loop controls as well as protection and monitoring equipment.

1.6 As far as required, the following basic requirements shall be observed:

– Compatibility with the environmental and operating conditions

- Compliance with accuracy requirements

- Recognizability and constancy of the parameter settings, limiting- and actual values

- Compatibility of the measuring, open and closed loop controls and monitoring systems with the process and its special requirements

- Immunity of system elements to reactive effects in overall system operation

- Non-critical behaviour in the event of power failure, restoration and of faults

- Unambiguous operation

- Maintainability, the ability to recognise faults and test capability

- Reproducibility of values

1.7 Systems have to operate with sufficient speed to allow automatic open and closed loop controls to be carried out promptly in all operating conditions, to provide the user with accurate information in time and to allow commands given by the user to be executed at the right time.

1.8 Redundant systems shall be individually protected against short circuit and overload and selectively supplied with power.

1.9 The required drain facilities are either to be automated or of a type which requires no intervention during the period in which the machinery spaces are to be left unmanned in line with their Class Notation.

1.10 Automatic interventions shall be provided where damage cannot be avoided by manual intervention.

1.11 Machinery alarm systems, protection and safety systems, together with open and closed loop control systems for essential equipment shall be constructed in such a way that faults and malfunctions affect only the directly involved function. This also applies to measuring facilities.

1.12 For machinery and systems which are controlled remotely or automatically, control and monitoring facilities have to be provided to permit manual operation.

1.12.1 The actual control mode shall be discernible at the concerned control stations.

1.12.2 The manual operation facilities shall have provisions to override the automated or remote controls. Failure of any part of the automatic or remote control system shall not prevent the manual operation.

1.12.3 At manual operation influence of the automated or remote mode shall be prevented by technical measures.

1.13 If danger to persons or the safety of the Offshore Service Vessel arising from normal operation or from faults or malfunctions in machinery or plant, or in control, monitoring and measuring systems, cannot be ruled out, safety devices or safety measures are required.

1.14 If danger to machinery and systems arising from faults or malfunctions in control, monitoring and measuring systems cannot be ruled out, protective devices or protective measures are required.

1.15 Where mechanical systems or equipment are either completely or partly replaced by electric/ electronic equipment, the requirements relating to mechanical systems and equipment according to **TL** Part B, Chapter 4 shall be met accordingly.

1.16 To avoid unnecessary interruption of the operation the response of stand-by functions, alarm systems and safety systems shall occur in this sequence.

1.17 Disturbed units which are automatically shut down shall be restarted only directly at the unit after a manual release.

1.18 Where approved systems are modified, the proper functioning of the system as a whole is to be demonstrated.

2. Computer Systems

Where computer systems are used for automation systems, the requirements relating to hardware and software in accordance with **TL** Part B, Chapter 5, Section 10 shall be fulfilled.

3. Input and Output Units

3.1 Controls shall correspond to the system being controlled with regard to their position and direction of operation.

3.2 It shall be possible to control the essential equipment at or near the equipment concerned.

3.3 Input units located on the bridge shall be individually illuminated where the general lighting is not adequate. The lighting has to be adapted non-glare.

3.4 It shall be possible to adapt the brightness of output units in order to suit the ambient conditions in each case.

3.5 The use of monochrome displays is permitted if a clear recognition of the signals can be guaranteed.

3.6 With regard to the use of colour in optical signal equipment, reference is made to **TL** Part B, Chapter 5, Section 1, I.

4. Open / Closed Loop Control Equipment

4.1 Open Loop Control Equipment

4.1.1 Main engines and essential equipment shall be provided with effective means for the control of their operation. All controls for essential equipment shall be independent or designed such that failure of one system does not degrade the performance of other systems.

4.1.2 Protection measures shall be provided where incorrect operation would result in serious damage or the loss of essential functions.

4.1.3 The consequences of control commands shall be indicated at the respective control station.

4.1.4 Where controls are possible from several control stations, the following shall be observed:

4.1.4.1 Competitive commands shall be prevented by suitable interlocks. The control station in operation shall be recognizable as such.

4.1.4.2 Taking over of command shall only be possible with the authorization of the user of the control station which is in operation. See also F.1.12.

4.1.4.3 Precautions shall be taken to prevent changes to desired values due to a change-over in command station.

4.2 Closed Loop Control Equipment

4.2.1 Closed loop control equipment shall keep the process variables within the limits specified, under normal conditions.

4.2.2 Closed loop controls have to show the specified reaction over the full control range. Anticipated variations of the parameters are to be considered during the planning.

4.2.3 Defects in one control loop shall not impair the function of other control loops for essential equipment.

4.2.4 The power supply of operationally essential control loops is to be monitored and power failure shall be signalled by an alarm.

5. Integration of Systems for Essential Equipment

5.1 For the definition of essential equipment see **TL** Part B, Chapter 5, Section 1, B.2.

5.2 The integration of functions of independent equipment shall not decrease the reliability of the single equipment.

5.3 The required independence of conventional alarm, control and safety functions shall be secured by other sufficient measures where two or more of those functions are integrated in one system.

These measures have to be documented and suitable proofs have to be furnished.

5.4 A defect in one of the sub-systems (individual module, unit or sub-system) of the integrated system shall not affect the function of other subsystems.

5.5 The interruption of the transfer of data between connected autarkic subsystems shall not impair their independent functions.

5.6 Operation of essential equipment shall be possible independently of integrated systems.

5.7 Networks shall be designed according to international standard.

5.8 The creation and configuration of a network with regard to the use of

- Transmission media
- Topologies
- Access methods
- Access speeds
- Network systems
- Interfaces
- Any redundancy which may be required

shall comply with the system requirement in each case.

5.9 Standard interfaces shall be used to ensure the exchange of data between different systems.

6. Electrical Propulsion Plants

Engines driving the generators for the electrical propulsion plant are to be considered as main engines. Therefore, sensors are to be provided according to **TL** Part B, Chapter 4.1, Section 8, B., Table 8.1 (for medium and high speed engines).

Electric motors driving the propeller shaft are propulsion motors.

7. Air Compressors

In the event of failure of the pressurized lubrication system of an air compressor, independently driven air compressors have to shut down automatically. A suitable automatic drain facility is to be provided for the cooler and water traps (where appropriate also during operation).

If in case of a diving support or an underwater equipment support vessel the compressor is part of the breathing gas system, the automatic shut-down has to be delayed until a redundant compressor has already started its operation.

G. Tests and Trials

Requirements for

- General aspects of tests
- Mandatory type approvals
- Tests conducted at the manufacturer's works
- Tests on board including de-briefing

are defined in the **TL** Part B, Chapter 4.1, Section 7. Additional requirements are defined in Sections 13 -23.

For sea trials see also **TL** Addinional Rules for Sea Trials of Motor Vessels.

SECTION 13

TOWING and ESCORTING

Page

A. General

1. Scope

1.1 Towing

The requirements of this Section apply to Offshore Service Vessels primarily designed for towing and/or pushing operations or assisting other vessels or floating offshore objects in manoeuvring.

1.2 Escorting

The requirements defined in C. apply to Offshore Service Vessels specially intended to provide the service of active escort towing.

1.3 Special designs not covered by the following rules will be considered from case to case.

2. Definitions

2.1 Towing

Towing is the function of an Offshore Service Vessel if another ship or floating object is towed and/or pushed respectively assisted in manoeuvring. Relevant, full functioning equipment and good practice of seamanship is necessary to accomplish the mission. Proper preparations have to be made also for emergency conditions.

2.2 Escorting

Active escorting of offshore units or vessels involved in the offshore business includes steering, braking and otherwise controlling such units or vessels in restricted waters during speeds of up to 10 knots by means of a permanent towline connection with the stern of the escorted vessel, see Figure 13.1.

3. Documents for Approval

In addition to the documents listed in the Rules mentioned under 4, the following design documentation shall be submitted for approval and/or information:

- General arrangement of the towing gear including winch(es), if provided
- Description of the towing winch(es) including the safety devices
- Design drawings and material specifications of the towing winch including winch drum and drives, brakes and fastening elements
- Description of electrical and hydraulic systems including circuit diagrams
- Required bollard pull (design criterion)
- Towrope specification
- In special cases, intended tow configuration(s)

Especially for active escorting:

- Preliminary calculation of the maximum towrope pull T_E [kN], see Figure 13.1

4. Reference to Further Rules

4.1 TL Rules

The following Rules and sections shall also be considered:

- For further aspects see Section 6
- For gears of towing winches see **TL** Part B, Chapter 4, Section 7
- For instructions regarding towing operations in general see the **TL** . Part D, Chapter 58
- For active escorting see Section 6, H

4.2 Other Rules and Regulations

- MSC/Circ.884 Guidelines for Safe Ocean Towing, issued 21 December 1998

5. Classification, Notations

5.1 Offshore Service Vessels built in accordance with the requirements of this Section will be assigned the Notation **TOW** in addition to **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification

5.2 If an Offshore Service Vessel meets the requirements for escorting defined in C. a respective entry in the Technical File of the Class Certificate can be made on request by the owner/operator.

B. Towing Winches

1. Definition of Loads

1.1 The design force T corresponds to the towrope pull (or the bollard pull, if the towrope pull is not defined) stipulated by the owner. The design force may be verified by a bollard pull test, see Rules defined in A.4.

1.2 The test force PL is used for dimensioning as well as for testing the towing hook and connected elements. The test force is related to the design force as shown in Table 13.1.

Table 13.1 Design force T and test force PL

Design force T [kN]	Test force PL [kN]
up to 500	2 T
from 500 to 1500	T + 500
above 1500	1,33 T

1.3 The minimum breaking force F_{min} of the towrope is based on the design force. It is to be calculated on the basis of the design force T and a utility factor K, as follows:

$$F_{min} = K \cdot T$$

K = 2,5 for T ≤ 200 kN and

= 2,0 for T ≥ 1000 kN

For T between 200 and 1000 kN, K may be interpolated linearly.

1.4 The winch holding capacity shall be based on the minimum breaking force F_{min}, see 3.3. The rated winch force is the hauling capacity of the winch drive when winding up the towrope, see G.1.2.3.

2. Materials and Components

The following Certificates according to **TL**, Part A, Chapter 2, are required for the applied materials and components:

2.1 TL Material Certificate

TL Material Certificates will generally be required for:

- Main shaft, e.g. drum shaft, shaft stubs for rope drums
- Drum pipe including braking rim
- Brake components, e.g. brake cylinder, brake straps, bolts
- Hydraulic hoses for drum brakes

2.2 Manufacturers Inspection Certificate

If the manufacturer is recognized by **TL**, Manufacturer Inspection Certificates are sufficient for:

- Winch frame
- Gear casing, gear cover
- Rings and round material for spur wheels
- Couplings
- Emergency bolt, if existing
- Force measuring bolt, if existing
- Round material for driving shafts, intermediate shafts
- Stiffening webs, e.g. for rope drums, braking circle
- Chain sprocket
- Standard components

3. Arrangement and Control

3.1 General

3.1.1 The towing winch, including towrope guiding equipment, has to be arranged such as to assure safe guiding of the towrope in all suitable directions.

3.1.2 For winch control see E.1.7.

3.2 Winch Drum

3.2.1 The towrope shall be fastened on the winch drum by a breaking link.

3.2.2 The winch drum shall be capable of being declutched from the drive.

3.2.3 The diameter of the winch drum is to be not less than 14 times the towrope diameter.

3.2.4 The length of the winch drum is to be such that at least 50 m of the towrope can be wound up in the first layer.

3.2.5 To ensure security of the rope end fastening, at least 3 dead turns shall remain on the drum.

3.2.6 At the ends, drums shall have disc sheaves whose outer edges shall surmount the top layer of the rope at least by 2,5 rope diameters, if no other means is provided to prevent the rope from slipping off the drum.

3.2.7 If a multi-drum winch is used, then each winch drum shall be capable of independent operation.

3.2.8 Each towing winch drum shall have sufficient capacity to stow the length of the provided towrope.

3.2.3 to 3.2.5 are not applicable for towropes of austenitic steels and fibre ropes. In case these towrope materials are utilized, dimensioning of the wind drum is to be specially approved by **TL.**

3.3 Holding Capacity / Dimensioning

3.3.1 The holding capacity of the towing winch (towrope in the first layer) shall correspond to 80 % of the minimum breaking load F_{min} of the towrope.

3.3.2 When dimensioning the towing winch components, which - with the brake engaged - are exposed to the pull of the towrope (rope drum, drum shaft, brakes, foundation frame and its fastening to the deck), a design tractive force equal to the holding capacity is to be assumed. When calculating the drum shaft the dynamic stopping forces of the brakes have to be considered. The drum brake shall not give way under this load.

3.4 Brakes

3.4.1 If the drum brakes are power-operated, manual operation of the brake shall be provided additionally.

3.4.2 Towing winch brakes shall not be released automatically in case of power failure.

3.4.3 For control of the brakes see E.1.6.

3.5 Tricing Winches

3.5.1 Control stands for the tricing winches have to be located at a safe distance from the sweep area of the towing gear. Apart from the control stands on deck, at least one other control stand shall be available on the bridge.

3.5.2 Tricing winches have to be suitably dimensioned depending on F_{min} of the tricing rope. For operation of the tricing winch, perfect transmission of orders has to be safeguarded.

C. Escorting

1. General

The following requirements are not mandatory for the Class Notation **TOW** but may be introduced in addition if escort duties have to be provided by specialized Offshore Service Vessels. The typical working mode is shown in Figure 13.1.

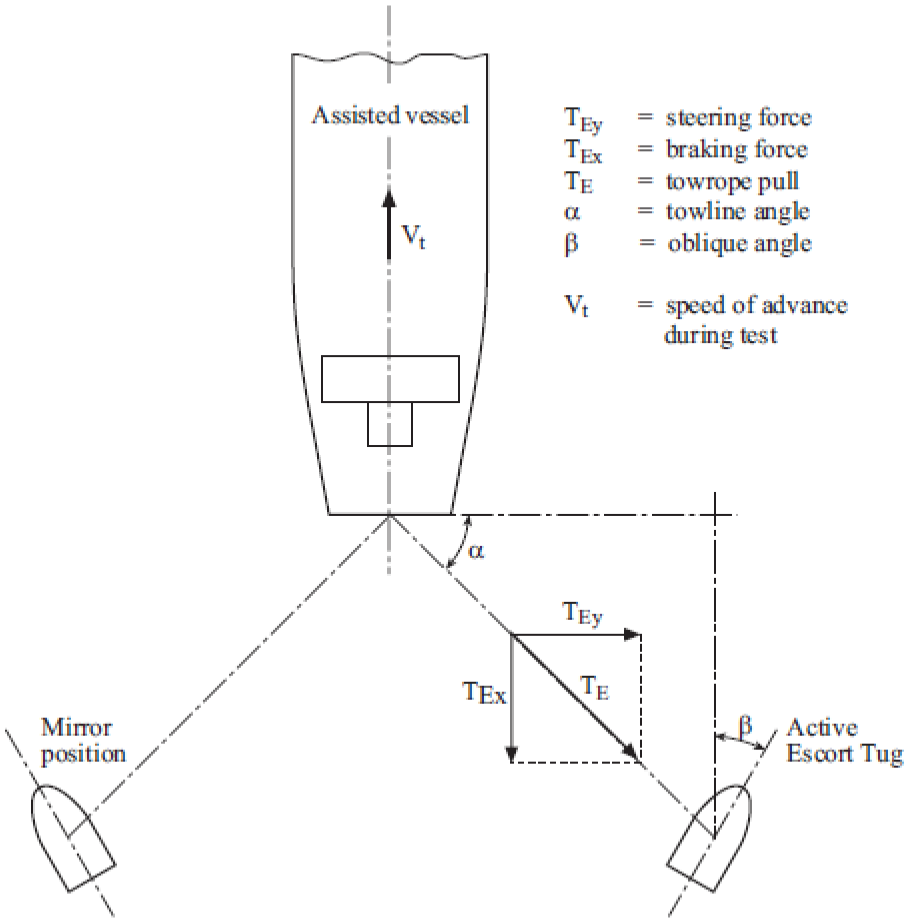


Figure 13.1 Typical working mode during active escorting

2. Propulsion

In case of loss of propulsion of the escorting vessel during active escorting the remaining forces are to be so balanced that the resulting turning moment will turn the Active Escort Service Vessel to a safer position with reduced heel.

3. Towing Winch

3.1 The requirements for towing winches defined in Section 14, B. of these Rules are forming the basis also for the winches of active escorting as far as applicable.

3.2 Equipment for measuring the pulling force in the towrope is to be provided.

3.3 Towing winches are to be fitted with a load damping system which prevents overload caused by dynamic impacts in the towrope.

The towing winch shall pay out the towrope in a controlled manner when the towrope pull exceeds 50 % of the minimum breaking force F_{min} of the towrope (see B.1.3). Active escort towing is always carried out via the towing winch, without using the brake on the towing winch's rope drum.

3.4 The towing winch shall automatically spool a slack towrope. The requirement of B.3.2.4 may be waived, if an impeccable spooling of the towrope under load is guaranteed by design measures (e.g. spooling device).

D. Steering Gear / Steering Arrangement

The following is required for Offshore Service Vessels for towing services:

1. Rudder Forces

Rudder forces shall be calculated for vessel speeds not less than 10 kn.

2. Steering Gear

The steering gear shall be capable of changing the rudder angle from 35° on one side to 30° on the other side in 20 s with the vessel underway at maximum service speed.

3. Special Steering Units

Steering units and arrangements not explicitly covered by the existing **TL** Rules and combinations of such units with conventional rudders will be considered from case to case.

E. Electrical Installations

1. Winches

1.1 Enclosures

The degree of protection for motors and switchgear shall be selected in accordance with the **TL** Part B, Chapter 5, Section 1.

1.2 Emergency Shut Down

The winches shall be equipped at minimum with an emergency OFF switch which allows the motor to be stopped immediately in case of a control device failure.

1.3 Motor Rating

Motor design and construction are to conform to **TL** Part B, Chapter 5, Section 15, A. Winches are to be rated in accordance with the proposed application and shall be capable of delivering twice the rated torque for 2 minutes without dangerous overheating.

1.4 Overload Protection

An electrical overload protective device is to be provided to prevent excessive overloading of the motors and as far as possible, of the winches.

1.5 Power Supply

1.5.1 Winch motors and their control systems shall be supplied directly from the switchboard of the main electrical power source.

1.5.2 If, during normal operating conditions, the power for the towing winch is supplied by a main engine shaft generator, another generator shall be available to provide power for the towing winch in case of main engine or shaft generator failure.

1.6 Brakes

1.6.1 The electromagnetic operating elements of brakes shall conform to **TL** Part B, Chapter 5, Section 20.

1.6.2 The operating levers for the brakes are to be secured against unintentional operation.

1.6.3 Drum brakes shall be capable of being quickly released from the control stand on the bridge, as well as from any other control stand. The quick release shall be possible under all working conditions, including failure of the power drive.

Following activation of the quick release device, normal operation of the brakes shall be restored immediately.

Following activation of the quick release device, the winch driving motor shall not start again automatically.

1.7 Winch Controls

1.7.1 From the winch control stands it shall be possible to observe the operation of each winch, including fairleads, lines and towed units or vessels.

1.7.2 The winch shall be capable of being safely operated from all control stands. Apart from the control stand on the bridge, at least one additional control stand has to be provided on deck. From each control stand the winch drum shall be freely visible; where this is not ensured, the winch shall be provided with a self-rendering device.

1.7.3 Each control stand has to be equipped with suitable operating and control elements. The arrangement and the working direction of the operating elements have to be analogous to the direction of motion of the towrope.

Operating levers shall, when released, return into the stop position automatically. They shall be capable of being secured in the stop position.

1.7.4 Individual control shall be provided for each winch. Any failure in the control systems of one winch shall not affect the operation of the controls of other winches.

1.7.5 The respective control stand shall be equipped with at least the following facilities for each winch in addition to the emergency OFF switch mentioned in 1.2.

- Wattmeter or ammeter
- Device for monitoring and indicating the pull on the tow rope
- Devices showing the length of paid-out chain or wire

The power supply to the above mentioned devices shall be independent of the power supply to the winch control system. The operative state of the system is to be indicated.

1.7.6 Circuits shall be arranged for automatic transfer in the event of failure of the normal control power supply, but need not be exclusive to the supply of the towrope operation control power.

Operation of transfer arrangements shall not cause a power supply failure mode to be initiated.

2. Communication

There shall be an adequate means of communication between the winch control station(s) and the engine control station(s) and the bridge of the Offshore Service Vessel.

3. Searchlight

A searchlight that can be directed from the Offshore Service Vessel's main steering station is to be provided to assist the tasks of the Offshore Service Vessel.

F. Hydraulic Systems

1. General

1.1 If the main towing and/or auxiliary winches are hydraulically driven the following requirements have to be considered.

1.2 For the dimensional design of pressure vessels see **TL** Part B, Chapter 4, Section 14; for the dimensions of pipes and hose assemblies see **TL** Part B, Chapter 4, Section 16.

2. Materials

The requirements for materials are defined in Section 14, D.2

3. Hydraulic Operating Equipment for Towing

3.1 Design

3.1.1 Winches may be supplied either by a common hydraulic power station or individually by several hydraulic power stations for each single winch. Where a common power station is used, at least two pump units of equal size are to be fitted. Where the systems are supplied individually, change-over valves or fittings are required, so that operation can be maintained should one pump unit fail.

3.1.2 The movement of winches is not to be initiated merely by starting the pumps. The movement of winches is to be controlled from special operating stations. The controls are to be so arranged that, as soon as they are released, the movement of the winch ceases immediately.

3.1.3 Local controls, inaccessible to unauthorized persons, are to be fitted. The movement of winches normally is to be visible from the control stands. If the movement cannot be observed, audible and/or visual warning devices are to be fitted. In addition, the control stands are then to be equipped with indicators for monitoring the movement of the winch.

3.2 Pipes

3.2.1 Pipes are to be installed and secured in such a way as to protect them from damage while enabling them to be properly maintained from outside. Pipes may be led through tanks in pipe tunnels only.

The laying of such pipes through cargo spaces is to be restricted to the essential minimum. The piping system is to be fitted with relief valves to limit the pressure to the maximum allowable working pressure.

3.2.2 The piping system is to be fitted with filters for cleaning the hydraulic fluid.

Equipment is to be provided to enable the hydraulic system to be vented.

3.2.3 The accumulator space of the hydraulic accumulator is to have permanent access to the relief valve of the connected system. The gas chamber of the accumulator may be filled only with inert gases. Gas and operating medium are to be separated by accumulator bags, diaphragms or similar.

3.2.4 Connection between the hydraulic system used for towing winches and other hydraulic systems is permitted only with the consent of **TL**.

3.2.5 The hydraulic fluids have to be suitable for the intended ambient and service temperatures.

3.3 Oil Level Indicators, Filters

3.3.1 Tanks within the hydraulic system are to be equipped with oil level indicators.

3.3.2 The lowest permissible oil level is to be monitored. Audible and visual alarms are to be provided for the navigating bridge and in the machinery space or machinery control room. The alarm on the navigating bridge is to be an individual alarm.

3.3.3 Arrangements are to be provided to maintain the cleanliness of the hydraulic fluid taking into consideration the type and design of the hydraulic system.

3.4 Hose Assemblies

The construction of hose assemblies is to conform to **TL** Part B, Chapter 4, Section 16, U.

G. Tests and Trials

1. Testing of Towing Winches

1.1 Standard Items

Manufacturer Inspection Certificates may be accepted for standard items, if the manufacturer is recognized by **TL.**

1.2 Workshop Testing of Towing Winches

1.2.1 The winch power unit has to be subjected to a test bed trial at the manufacturer's workshop. A Manufacturer Inspection Certificate has to be presented on the occasion of the final inspection of the winch.

1.2.2 Components exposed to hydraulic pressure are to be pressure-tested to a test pressure p_p [bar] of:

$$P_p = 1,5 \,.\, p_{e,\,müs}$$

$p_{e,\,müs}$ = Maximum allowable working pressure [bar]

= Opening pressure of the safety valves

However, with working pressures exceeding 200 [bar], the test pressure need not be higher than $p_{e,\,müs}$ + 100 [bar].

Tightness tests are to be carried out for the relevant components.

1.2.3 Upon completion, towing winches have to be subjected to a final inspection and an operational test at the rated load. The hauling speed has to be determined during an endurance test under the rated tractive force. During these trials, in particular the braking and safety equipment shall be tested and adjusted.

The brake has to be tested to a test load equal to the rated holding capacity, but at least equal to the bollard pull.

If manufacturers do not have at their disposal the equipment required, a test confirming the design winch capacity, and including adjustment of the overload protection device, may be carried out after installation on board.

In that case only the operational trials without applying the prescribed loads will be carried out at the manufacturers.

1.3 Test of Towing Winches on Board

After installation on board, the safe operation of the winch(es) from all control stands has to be checked; it has to be proved that in both cases, with the drum braked and during hauling and releasing, the respective quick-release mechanism for the drum operates well. These checks may be combined with the bollard pull test.

2. Testing of the Complete Towing System

2.1 General

The complete towing system has to be tested during the bollard pull test and the sea trials.

The towing winch has to be subjected to a trial during the bollard pull test to a test load corresponding to the holding power of the winch.

3. Escorting Capability

3.1 Full scale tests or alternatives to full scale tests for escorting capability are to be made according **TL**, Part C, Chapter 13, Section 1, H or I respectively.

SECTION 14

ANCHOR HANDLING

Page

A. General

1. Scope

1.1 The following requirements apply to the special equipment on board of Offshore Service Vessels designated for handling of big anchors for positional mooring on a fixed position or on a predetermined track of big floating offshore units and structures.

1.2 Special designs not covered by the following requirements will be considered from case to case.

2. Definitions

2.1 Anchor Handling

Anchor handling consists of the operations of deploying anchor(s) from an offshore unit or structure, release it at an exact location, move it up later on and store it on deck of the Offshore Service Vessel for the transport to the next mooring position, release the anchor at the new position, and so on.

3. Documents to be Submitted for Approval

The following documents shall be submitted for approval and/or information:

- General arrangement of the anchor handling equipment including winches
- Report on maximum pulling forces for intended anchor handling operations
- Description of the anchor handling winches including the safety devices
- Design drawings and material specifications of the anchor handling winches including winch drum and drives, brakes and fastening elements
- Description of the electrical system including circuit diagrams
- Diagram of the hydraulic system together with drawings of the motors and cylinders containing all the data necessary for assessing the system, e.g. operating data, descriptions, materials used, etc.
- Description and detailed drawings for special equipment (like stern roller, retractable pins, shark jaws, A-frame, etc.) to facilitate the handling of the anchor
- Specification of ropes and small gears for anchor handling
- Description of measures to secure the handled anchors on the working deck
- Anchor Handling Manual describing all procedures and safety measures to be applied, for information

Note:
If anchor handling equipment is part of the towing winch, documents can be submitted in connection with towing winch approval.

4. Reference to Further Rules

The actual issue of following Rules shall also be considered:

- For shipbuilding aspects see Section 6.
- For gears of towing winches see **TL** Part B, Chapter 4, Sections 7, 14 and 16.

5. Classification, Notations

Offshore Service Vessels built in accordance with the requirements of this Section will be assigned the Class Notation **AH** in addition to **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification.

B. Technical Requirements

1. System Arrangement

Offshore Service Vessels for anchor handling are normally arranged with an open stern to allow for decking of the anchors. The anchor is lowered or lifted over the stern with a pennant line operated by the anchor handling winch mostly situated at the fore end of the working deck. The deck between the stern and the winch is to be kept clear for handling of lines and anchors. Devices for securing the anchors on the deck and to position stowed lines, buoys, etc. have to be provided.

2. Stern Equipment

2.1 Anti-friction Support

2.1.1 To avoid wear of the deck and to facilitate the pulling of the anchor over the stern with the necessary tension force in the pennant line at least a curved chafing plate is to be provided.

2.1.2 Stern rollers or rope sheaves are suitable antifriction supports for the pennant line. If a roller is used, it should be of double tapered shape with a larger radius of the curvature at the ends than in the centre section, to assist the aligning of wires to the vessel's longitudinal axis. Alternatively a groove in the middle of the roller may be provided. To feed stray lines towards the stern roller, the stern part of the deck next to the roller should also be curved.

If lubrication of the bearings of the roller is required, adequate access to them or other lubrication measures are to be provided.

2.1.3 If there is the requirement to operate two independent winch lines with different diameters and loads over the stern of the Offshore Service Vessel, increased friction and possible damage of the less heavily loaded line is to be avoided. A division plate fitted between two rollers, which are completely independent from each other, is recommended.

2.2 Stern Gate

For the times when no anchor handling operations are performed, it is recommended to close the stern by a gate or a removable railing, a suitable net, etc. to increase the safety of the crew on the working deck.

During towing operations the stern shall be clear of the gate, etc. to allow unobstructed movement of the tow rope.

2.3 Guiding Devices

To limit the amount of side movement of the pennant wire immediately before the stern roller at least two retractable cylindrical pins, hydraulically operated and remotely controlled, are recommended. Their status is to be shown at the central control console. When lowered, the pins have to be flush with the deck, when raised the pennant line shall be able to run between them. To avoid friction the exposed parts are to be able to rotate about the vertical pin axis.

If hydraulic power fails, the pins shall remain in their actual position, prior to the failure. See also D.3.1.4.

The pin seals shall prevent penetration of water into the space below the working deck, where drives of the pins and fixing devices are normally located.

2.4 Fixing Devices

If it is necessary to unshackle lengths of lines on deck, while continuing to carry a loaded line over the Offshore Service Vessel's stern, hydraulically driven and remotely controlled shark jaws may be used. Such jaws shall comprise a cylindrical unit, which can be retracted flush to the deck, when not used or raised to the working position. The cylindrical unit has to be forked at the top to contain two different pairs of hydraulically operated jaws, one for wire and the other for chain. It shall be possible to change the different pairs of jaws quickly. In the working position the wire or chain shall be supported clear of the deck.

Further mechanical or, preferably, hydraulic and remotely operated tools for fixing different wires and chains as well as buoys and anchors to the deck surface are to be provided, as far as necessary.

For all remotely operated tools a clear indication of their status is to be shown at the central control console overlooking the complete deck.

2.5 Special Equipment

2.5.1 Tilting Stern Ramp

If a tilting ramp is provided at the stern it shall be equipped with sheaves at the forward and aft edge to lead the pennant line. The anchor is pulled up with the ramp in the vertical position until the anchor is next to the ramp. Then the ramp with the anchor shall be able to be tilted to the horizontal position. The tilting operation from horizontal to vertical position of the ramp and vice versa shall be established by at least two hydraulic cylinders. In case of failure of one cylinder, the other one shall be able to tilt the ramp at reduced speed. The horizontal and the vertical position of the ramp have to be mechanically locked.

2.5.2 Auxiliary Revolving Jib Cranes

If revolving jib cranes for assistance during anchor handling, e.g. for lassoing the buoy, are installed at the cargo rails on each side of the deck, it has to be ensured that they are secured for any movement of the vessel in the seaway. The central control console for controlling their movements has to have clear view over the whole operating range of the cranes. For the design, refer Section 15, C.

2.5.3 A-frame

An A-frame which is positioned at the stern of the Offshore Service Vessel may - besides for other services - also be used to facilitate anchor handling if it can be equipped with rope sheaves. This application is similar to launch and recovery systems described in Section 19, F. Technical requirements for this type of lifting appliance are defined in Section 15, C. and D.

2.5.4 Bridge crane

If a bridge crane is positioned transversely at a height of at least the length of the biggest anchor over the deck which has anti-friction supports for the pennant wire in form of idler rollers or rope sheaves, the forces on the winch line for pulling the anchor over the stern can be reduced.

If the crane is able to travel longitudinally on cargo rails to deposit the anchor on deck, suitable stops are to be provided for the bridge crane at the end of the tracks.

If the bridge crane shall also be used for carrying or dragging equipment between locations on deck, additional requirements have to be considered according to the actual use. The design details have to follow the requirements defined in Section 15.

3. Winches

3.1 The design principles for the winches are mainly analogous to towing winches and are defined in detail in Section 13, B.

3.2 If there is the requirement to operate two independent pennant lines with different diameters and loads over the stern of the Offshore Service Vessel from a single winch a split winch drum is to be arranged. Each half of the drum shall be arranged to rotate in its own bearings on a spindle. The diameter of the spindle has to be chosen to take the high bending loads without excessive deflection.

3.3 Guidance measures for correctly spooling the wires on the winch drum(s) are to be provided. If a fixed special spooling gear would have negative influence on some aspects of anchor handling (during fast pay out and recovery), the two tricing winches equipped with sliding rings at the end of their wire may also be used for this duty.

3.4 On either side of the winch drum(s) chain handling sprockets (preferably of two different sizes) may be fitted and rotate with the drum. If they are being used, the work wire has to be fully spooled up and secured on the drum.

It is recommended to arrange chain lockers of adequate size below the sprockets, see **TL** Part A, Chapter 1, Section 17, E.

3.5 Large winches normally impose heavy loads on the Offshore Service Vessel's structure and care has to be taken to distribute these loads into the Section 6.B.

4. Quick anchor release

For winches and mechanical fixing devices a quick, controlled release to reduce undesired tension in the pennant wire is to be provided. This shall not be instantaneous releases, but shall allow fast payout of the winch line.

The quick anchor release shall be operable from the bridge or other manned central control console in direct communication with the bridge.

5. Central control stand

A central control stand for the anchor handling operations shall be provided. It shall be situated where the best view of the winches and the complete working deck is available. Normally this would be a place aft of the bridge.

It will be of advantage to provide in this anchor handling control stand, a second control console for vessel navigation

6. Propulsion

6.1 The anchor handling vessel has to have sufficient power to drag the paid out anchor lines from the offshore unit or structure to the planned anchor position.

6.2 The steering gear shall be capable of changing the rudder angle from 35° on one side to 30° on the other side in 20 seconds with the vessel underway at maximum service speed.

6.3 To keep the Offshore Service Vessel in seaway, currents, etc. on the required anchoring position during anchor handling, a propulsion system with the ability of dynamic positioning at least according to Class Notation **DK 2** is recommended. For this Class Notation a loss of position may not occur in the event of a single fault in any active component or subsystem of the propulsion system. For details see Section 16 – Positioning.

7. Anchor Handling Manual

An Anchor Handling Manual describing the different anchor handling procedures and their safe execution is to be submitted to **TL**, see A.3.

8. Foundation and Supports

Foundation and supports have to be safely designed. Please refer to Sec.6, B for minimum requriements for supports and foundations.

C. Electrical Installations

1. External communication to the offshore unit to be anchored and the other Offshore Service Vessels engaged has to be established.

2. Internal communication between the bridge, the anchor handling control console and the crew on the anchor handling deck is to be provided.

3. Other aspects of electrical installations shall follow the requirements in Section 13, E., as far as applicable.

D. Hydraulic Systems

1. General

1.1 Scope

The requirements apply to hydraulic systems used to operate anchor handling equipment. For winches the requirements in Section 13 are to be applied.

1.2 Dimensional Design

Refer to **TL** Part B, Chapter 4, Section 14 for the design of pressure vessels; **TL** Part B, Chapter 4, Section 16 for the dimensions of pipes and hose assemblies.

2. Materials

2.1 Approved Materials

2.1.1 Components fulfilling a major function in the power transmission system normally are to be made of steel or cast steel in accordance with the **TL** Part A, Chapter 2. The use of other materials is subject to special agreement with **TL.**

Cylinders are preferably to be made of steel, cast steel or nodular cast iron (with a predominantly ferritic matrix).

2.1.2 Pipes are to be made of seamless or longitudinally welded steel tubes.

2.1.3 The pressure-loaded walls of valves, fittings, pumps, motors, etc. are subject to the requirements of **TL** Part B, Chapter 4, Section 16, B.

2.2 Testing of Materials

The following components are to be tested under supervision of **TL** in accordance with the **TL** Part B, Chapter 2

a) Pressure pipes with DN > 50, see **TL** Part B, Chapter 4, Section 16, Table 16.5

b) Cylinders, where the product of the pressure times the diameter:

$p_{e,müs} \cdot D_i > 20000$

$p_{e,müs}$ = Maximum allowable working pressure [bar]

D_i = Inside diameter of tube [mm]

c) For testing the materials of hydraulic accumulators, see **TL** Part B, Chapter 4, Section 14, B.

3. Hydraulic Operating Equipment for Anchor Handling

3.1 Design

3.1.1 Hydraulic operating equipment for anchor handling may be served either by one common power station for all elements or by several power stations individually assigned to a single element. Where a common power station is used, at least two pump units of equal size are to be fitted. Where the systems are supplied individually, change-over valves or fittings are required so that operation can be maintained should one pump unit fail.

3.1.2 Movement of anchor handling equipment is not to be initiated merely by the starting of the pumps. Special control stands are to be provided for controlling the anchor handling equipment. The controls are to be so designed that, as soon as they are released, movement of the equipment stops immediately.

3.1.3 Local controls, inaccessible to unauthorized persons, are to be fitted. The movement of winches normally is to be visible from the control stands. If the movement cannot be observed, audible and/or visual warning devices are to be fitted. In addition, the control stands are then to be equipped with indicators for monitoring the movement of the equipment.

3.1.4 Suitable equipment is to be fitted in, or immediately adjacent to, each power unit (cylinder or similar) used to enable the pins, etc. to be operated slowly in the event of a power failure, respectively due to a pipe rupture.

3.2 Pipes

3.2.1 Pipes are to be installed and secured in such a way as to protect them from damage while enabling them to be properly maintained from outside.

Pipes may be led through tanks in pipe tunnels only. The laying of such pipes through cargo spaces is to be restricted to the essential minimum. The piping system is to be fitted with relief valves to limit the pressure to the maximum allowable working pressure.

3.2.2 The piping system is to be fitted with filters for cleaning the hydraulic fluid.

Equipment is to be provided to remove the air in the hydraulic system.

3.2.3 The accumulator space of the hydraulic accumulator is to have permanent access to the relief valve of the connected system. The gas chamber of the accumulator may be filled only with inert gases. Gas and operating medium are to be separated by accumulator bags, diaphragms or similar.

3.2.4 Connection between the hydraulic system, used for anchor handling equipment and other hydraulic systems is permitted only with the consent of **TL.**

3.2.5 The hydraulic fluids have to be suitable for the intended ambient and service temperatures.

3.3 Oil Level Indicators, Filters

3.3.1 Tanks within the hydraulic system are to be equipped with oil level indicators.

3.3.2 The lowest permissible oil level is to be monitored. Audible and visual alarms are to be provided for the bridge and in the machinery space or machinery control room. The alarm on the bridge is to be an individual alarm.

3.3.3 Arrangements are to be provided to maintain the cleanliness of the hydraulic fluid taking into consideration the type and design of the hydraulic system.

3.4 Hose Assemblies

The construction of hose assemblies is to conform to **TL** Part B, Chapter 4, Section 16, U.

3.5 Emergency Operation

It is recommended that devices be fitted which are independent of the main system and which enable anchor handling operations to be completed or be brought into a safe condition in the event of failure of the main system.

E. Tests and Trials

1. Tests in the Manufacturer's Works

1.1 Testing of Power Units

The power units are required to undergo testing on a test bed. Manufacturer Test Reports for this testing are to be presented at the final inspection of the hydraulic system.

1.2 Pressure and Tightness Tests

Pressure components are to undergo a pressure test. The test pressure is p_p [bar]:

$$p_p = 1{,}5 \cdot p_{e,\,mus}$$

$p_{e,\,mus}$ = Maximum allowable working pressure [bar]

= Opening pressure of the safety valves

For pressure testing, see **TL** Part B, Chapter 4, Section 16, B.4 (pipes, valves and fittings) and U.5. (hose assemblies and compensators).

Tightness tests are to be performed on components where this is appropriate.

2. Testing of Winches

The workshop testing and testing on board shall be analogously to the requirements defined for towing winches in Section 13, G.

3. Testing of the Complete Anchor Handling System

The complete anchor handling system has to be tested first in harbour and then during the sea trials and all procedures defined in the Anchor Handling Manual have to be executed.

The anchor handling winch has to be subjected to a trial with a test load corresponding to the holding power of the winch.

SECTION 15

SPECIAL LIFTING and/or TRANSPORTATION EQUIPMENT

A. General

1. Scope

1.1 Special Lifting Capability

1.1.1 The following requirements apply to special lifting appliances on board of Offshore Service Vessels working at sea. Mainly shipboard cranes with jib, knuckle and extendable boom as well as A-frames and expandable outriggers are considered as lifting appliances. They are to be used up to a specified sea state and should be fitted with devices for reducing the dynamic loads during the loading/unloading operations.

1.1.2 Basic Rules

The basis for the requirements defined in this Section for all kinds of lifting appliances on board Offshore Service Vessels is the latest issue of the following **TL** Rules:

- **TL** Part D, Chapter 50
- **TL** Part D, Chapter 52
- **TL** Part D, Chapter 53
- For unmanned underwater vehicles and machines: **TL** Part D, Chapter 54

1.2 Transport Capability

The requirements defined in I. also apply to the stowage and transport of containers, bulky objects and materials on the supply deck of Offshore Service Vessels.

1.3 Special Designs

Special designs not covered by the following requirements will be considered from case to case.

2. Definitions

2.1 Offshore Cranes

Offshore cranes are cranes installed on fixed offshore installations or on column stabilized mobile offshore units for loading and unloading of Offshore Service vessels, barges and other offshore floating systems. This crane type is not subject of this Section.

2.2 Floating Cranes

Floating cranes are lifting appliances, regardless of type, safe working load or purpose, which are mounted on a floating body whose purpose is to enable the lifting appliances to be transported by water and to work at sea.

This crane type is not subject of this Section.

2.3 Shipboard Lifting Appliances Working at Specified Sea State

Shipboard lifting appliances installed on Offshore Service Vessels and working at specified sea state comprise of cranes, gantry cranes, A-frames and extendable outriggers. They are exposed to offshore environmental conditions and handle cargo as well as manned/unmanned vehicles in the open sea. Thus, in the sea states, the load will be unfavourably superimposed/ amplified by the motions of the Offshore Service Vessel itself and also by the motions of the vessel or offshore unit from where it is lifted. This results in increased dynamic stresses on the lifting appliance and has to be specially considered in calculations and design.

2.4 Shipboard Cranes

For Offshore Service Vessels shipboard cranes with revolving jibs, knuckle booms (to reduce the stowage length) and extendable jibs may be installed. These cranes may also travel as support girder cranes along the bulwark on both sides of the working and supply deck.

2.5 Gantry Cranes

Gantry cranes are those with a bridge structure at a suitable height above the working and supply deck of Offshore Service Vessels which are able to travel in longitudinal direction on rails installed on the bulwark at the deck sides. For special applications, like anchor handling, they may travel on cantilevers over the vessel's stern.

2.6 A-Frame

An A-frame is a lifting appliance which can be tilted overboard from a resting position at the stern or the side of the Offshore Service Vessel to launch and recover anchors, scientific and industrial underwater equipment, diving equipment etc. The tilting movement is, typically, actuated by hydraulic cylinders.

2.7 Extendable Booms

Extendable booms consist in general of several girders which can be moved into and out of each other and extended to their maximum outreach. Such extendable booms may especially be installed for launching and recovery of underwater equipment if there is not enough space for the required size of crane at the vessel's side.

2.8 Safe Working Load (SWL)

The safe working load SWL of a lifting appliance is the static load which may be directly applied to the supporting element (e.g. cargo hook) of the lifting appliance. The dead load imposed by loose gear forms part of the SWL.

2.9 Loose Gear

Loose gear comprises all gear by means of which a load can be attached to a lifting appliance but which does not form part either of the lifting appliance or of the load like slings, lifting beams or spreaders.

2.10 Interchangeable Components

Interchangeable components comprise all parts such as: chains, rings, hooks, shackles, swivels, blocks, etc. It is regardless whether they form part of lifting appliances or loose gear.

3. Documents to be Submitted for Approval

3.1 General Requirements

For general requirements see Section 9, C.

3.2 Documents for Approval of Newly Manufactured Lifting Appliances

The following lists for newly manufactured loading gear are not exhaustive and are only applicable within the respective scope.

3.2.1 Structural Parts

- Masts, posts, fittings, foundations of all kinds
- Traverses, crane booms, crane housings, excentric platforms, crane columns, supporting structures
- Crane bridges, trolleys, gantries, boogies, runways, runway supports
- Stoppers, derailment guards, devices to prevent overturning
- Sea lashings, crane boom supports
- Design and fixing of cabin

Additional for lifting appliances with Class Notation **CRANE:**

- Control stands or cabins, if any

3.2.2 Mechanical Parts

- Winch drums and their bearings
- Slew rings, with bolting system and limit load diagrams
- Other rotary bearings such as king pins and rollers
- Cylinders, pipe fracture valves
- Racks, spindles
- Winch drives and brakes
- Slewing and swinging mechanisms, with drives and brakes

- Dismantling devices for slew rings
- Shock absorbers in luffing and hoisting systems
- Swell compensator systems

Additional for lifting appliances with Class Notation **CRANE**:

- Slewing, swinging, luffing and running gear
- All drives and brakes, including the prime mover
- Valves, control equipment
- Pipes and hoses
- Tanks
- Cooling, ventilation equipment

3.2.3 Electrical Installations

– Details of the rated characteristics and types of
Enclosure of the drive motors employed

- Details of all safety devices
- Wiring diagrams
- Emergency power supply
- Alarms

– Lighting diagrams

Additional for lifting appliances with Class Notation **CRANE**:

- Circuit diagrams
- Control equipment

3.2.4 Other Documents

- Circuit diagrams (hydraulic/pneumatic)
- Material specifications
- Welding and testing schedules
- Details of ropes, rope-end connections, rope sheaves
- Details of interchangeable components
- Access ways, ladders, platforms
- Fire protection plans
- Test and trial programs
- Drawings of cabins resp. control stands

Additional for lifting appliances with Class Notation **CRANE**:

- Design data, energy balance
- Layout plans
- Specifications
- Corrosion protection
- Spare parts list

3.3 Documents for Information

These are calculations and back-up documentation such as:

3.3.1 Strength Calculations (steel structure/machinery)

- General stress analysis
- Proof of stability (crippling, tilting, buckling)
- Proof of fatigue strength

3.3.2 Other Calculations

- Proof of rope drives
- Proof of safety against overturning

- Proof of safety against drifting off by wind

3.3.3 Other Documents

- Functional descriptions, where necessary
- Certificates for loose gear, interchangeable components and ropes
- Details of type tests

3.4 Particulars for Documentation

3.4.1 Minimum Extent

- General arrangement drawings (showing overall layout)
- Load radius diagram, where necessary
- Operating instructions

Additional for lifting appliances with Class Notation **CRANE**:

- Maintenance instruction

3.5 Documents for Approval of Existing Lifting Appliances and Loose Gear

For the special requirements for the approval of documents for existing lifting appliances see **TL** Part D, Chapter 50.

3.6 Stowage and Deck Transport

- Plans with description of the transport, the stowage and the lashing measures including parts lists of the lashing gear used
- Description of the electrical measures
- Description of the fire protection measures
- Description of the explosion protection measures

4. Reference to Further Rules

4.1 TL Rules

The latest issue of the following **TL** Rules has to be complied with:

- For shipbuilding aspects see **TL** Part A, Chapter 1
- The basic **TL** Rules defined in A.1.1.2
- **TL** Part D, Chapter 51.

4.2 Other Rules and Regulations

- The relevant standards of TS, DIN, EN, API as far as applicable
- IMO Resolution A.714(17), as amended: Code of the Safe Practice for Cargo Stowage and Securing

5. Certification and Classification, Notations

5.1 Certification

If the systems contained in this Section fulfil the defined requirements and are constructed and tested under **TL** survey, a Certificate for the system can be issued and a Register Book can be opened. The latter's purpose is to provide information about the as-built general data plus the test, examination and maintenance status.

Details on this are defined in **TL** Part D, Chapter 50.

5.2 Classification

5.2.1 General Notes

5.2.1.1 Classification of lifting appliances on Offshore Service Vessels is optional in principle. But on request, lifting gear on Offshore Service Vessels can be classified by **TL**.

5.2.1.2 For this classification, tests, examinations and scope of attestation will be extended beyond those required for Certification, on some electrical and on further machinery components.

5.2.1.3 Classification is concluded by issuing the Class Certificate. For confirmation and renewal of certified lifting appliances, the requirements of 5.1 apply.

5.2.1.4 The requirements of this Section refer to new lifting appliances. For existing lifting appliances, **TL**'s Head Office determines the scope of tests and examinations for Classification case by case.

5.2.2 Conditions for Classification

Classification requires Certification as well as additional measures, as described in 5.2.1.2.

5.2.3 Class Certificate

After successful completion of Certification of lifting appliances by a **TL** Surveyor and all tests and examinations prescribed in this Section for Classification, the owner receives a **TL** "Certificate of Class for Lifting Appliances" from **TL**'s Head Office.

Subsequently Offshore Service Vessels will then be assigned the Class Notation **CRANE** in addition to **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification.

B. Basic Requirements

1. General

1.1 Sea State

The lifting appliance shall be capable of safely handling the safe working load SWL at the sea state conditions defined by the owner or designer, refer also Section 9, A.2.7.

1.2 Access

Unobstructed access to all essential components of the lifting appliance shall be ensured for maintenance and repair purposes by means of suitable accesses, platforms, ladders and standing spaces.

1.3 Control Stands

Control stands and controls shall be designed in such a way that the driver has an unobstructed view of the load itself, or at least of the person guiding him.

Control stands shall be designed and arranged in such a way, and be of such a size, that they are easily accessible regardless of the position of the loading gear.

1.4 Stability

Offshore Service Vessels with lifting appliance for heavy lifting operations are to be checked for stability in lifting conditions.

2. Materials

Provisions for the

- Selection of materials
- Steel for welded components
- Forgings
- Steel castings
- Bolts and nuts

are defined in the **TL** Part D, Chapter 50.

3. Components

For the following components of lifting appliances detailed requirements are defined in the **TL**, Part D, Chapter 50:

- Rope and chain hoists
- Loose gear and interchangeable components
- Ropes and rope accessories
- Welding of components

C. Cranes

For shipboard cranes working on Offshore Service Vessels at specified sea state, the following shall be considered:

1. Types of Cranes

According to their type of construction the following cranes are in general fitted on Offshore Service Vessels:

- Slewing cranes with a fixed pedestal on the deck or superstructure of the Offshore Service Vessel and different forms and lengths of the boom.

- Monorail cranes capable of travelling along one side of the working and supply deck.

- Gantry cranes with a portal at a suitable height over the deck and travel mostly on the bulwark at vessel's sides. The portal has to use steel wheels supported by roller bearins to travel along the guide rails and a rack and pinion system for advancing.

  Clamps and/or slider shoes on the sets of wheels have to fit around the rails without actually touching them to prevent the gantry from tipping over.

  During voyage of the Offshore Service Vessel it is recommended, to lift the gantry free from the rails in order to avoid damages to the wheel's ball bearings and rails, by the vessel's vibrations.

- For all crane types a special parking or stowage position where seaworthy lashing can be achieved is to be provided.

2. Category of Service

The cranes can be categorized according to their range of operation and their purpose of use as follows:

- Service and store cranes

  for loading and/or unloading of cargo from time to time mainly at the cargo deck in the rear area of the vessel for supporting diving and underwater equipment operations for supporting anchor handling, etc.

- Installation and construction cranes or installation, maintenance or repair duties e.g. at offshore wind turbine farms. The duty class of the crane is depending on the number of load cycles experienced during its life time.

3. Design and Calculation Principles

3.1 General

In the following provisions of general validity governing the design and calculation of lifting appliances on Offshore Service Vessels are addressed.

3.2 Design Criteria

3.2.1 Note

The determination and specification of the operating conditions on which the design is based are principally the responsibility of the owner and the manufacturer. For this, the building yard is also to be consulted. The specifications decided upon are of considerable importance to the reliable operation and the expected service life.

The planned missions of Offshore Service Vessels and lifting appliances, the voyage and operating area, high vessel speeds and the form of the vessel hull are to be considered as far as necessary.

3.2.2 Working Conditions

Essential criteria for the working condition ("in operation") are:

- Frequency of loading or use, i.e. the number of load cycles within the expected service life

- The loading condition, i.e. the relative or percentage frequency at which the safe working load is reached in all the expected loading cycles

- Type of service, e.g. operation as offshore service crane or as offshore installation crane, etc.

Essential criteria for the design of the not working condition ("out of operation") are increased vessel inclinations as well wind and ice loads, as applicable and vessel accelerations. In special cases vibration stress caused by ship machinery or seaway is to be considered. See also **TL** Part A, Chapter 1.

For the case of changing the working conditions of existing lifting appliances, **TL** may, on request, check and if necessary redefine the safe working load SWL.

3.2.3 Special Provisions for Vessel's Lifting Appliances

3.2.3.1 Notes

The design, dimensioning and construction of lifting appliances have to take account of the special considerations stated in the following.

3.2.3.2 Inclinations of the Vessel

The design of lifting appliances has to consider the static inclinations of the Offshore Service Vessel (compare Section 9, A.) and the agreed sea state up to which lifting operations shall take place.

Normally for the calculations it is assumed that the angle of engagement of the load strength member may be 12° off perpendicular in any direction.

3.2.3.3 Wind Loads

Regardless of the higher wind speed used for design purposes, lifting appliances may in general be used up to a wind speed of about 18 m/s corresponding to 7 Bft. At higher wind speeds, lifting appliances shall normally be taken out of operation and stowed.

3.2.3.4 Sea Lashings

Provision has to be made for securely lashing all the moving parts of the lifting appliances, e.g. derricks, jibs, trolleys, gantries, etc. The lashings have to be designed in accordance with loading condition C.

3.2.3.5 Design Temperature

The design temperature has to be at least -10 °C. If the specified design temperature is below -10 °C, this has to be expressly noted in the documentation submitted to **TL**.

3.2.3.6 Environment Conditions

Special attention is to be given to the operation area, weather conditions, humidity, dust, aggressive media, vibrations, etc. See also the environmental conditions for the vessel in Section 9, A.2.

3.2.3.7 Corrosion Protection

Allowances for rusting are not normally required, but the wall thickness of load-bearing parts of corrodible materials has to be above certain minimum thicknesses.

Special requirements are defined for eye plates, spring washers and wire ropes exposed to weather.

3.2.3.8 Handling

Special cargo hooks and shackles are to be used. For fibre ropes minimum diameters are to be kept.

3.2.3.9 Dimensioning of Ropes and Interchangeable Components

The dimensioning of ropes (minimum breaking load) and the ascertaining of the nominal sizes of interchangeable components has to be in accordance with the Tables in Annex A of the **TL** Part D, Chapter 50 and is to be based on dead loads and SWL at rest, i.e. purely static load.

3.2.3.10 Conveyance of Persons

For the special requirements for conveyance of persons see **TL** Part D, Chapter 50.

The permitted safe working load SWL of a lifting appliance for the conveyance of persons has to be at least twice as high as the weight and the permissible safe working load of the loose gear used for persons or for the manned equipment, like submersibles, etc.

3.2.3.11 Lifting of Underwater Equipment and Submersibles

For the special requirements for lifting of diving equipment, submersibles and underwater working machines see **TL** Rules for such lifting tasks defined in A.1.1.2. For lifting of manned equipment the requirements of 3.2.3.10 have to be considered additionally.

The values for the hoist load coefficient ψ = 1,8 and the dead load coefficient φ = 1,2 are to be applied in these Rules under the assumption that an employment in a seaway is restricted to significant wave heights up to 2 m.

Where it is proposed that launch or recovery operations should be performed in even more unfavourable conditions, previous agreement with **TL** is necessary.

3.2.4 Equivalence

If the safety of lifting appliances can be ensured in an equivalent way, requirements different from the requirements defined above may be agreed with **TL.**

3.3 Design Loads

3.3.1 Types of Loads

The loads on the components of lifting appliances are to be distinguished as follows:

- Principal loads
- Additional loads
- Special loads

Where necessary, loads resp. load assumptions which are not mentioned or specified in these Rules can be determined by reference to DIN 15018 or any equivalent standard, upon agreement with **TL** or **TL**, additional Rules, Finite Element Method and Applications in Shipbuilding, Section 1.

3.3.2 Principal Loads

As principal loads the following loads are to be considered according to **TL** Part D, Chapter 50:

- Dead loads, which are the weights exerted by all fixed and mobile structural members and of the loose gear.
  The safe working load SWL is the part of the hoist load which can be directly applied to the cargo hook or load attachment.

- The hoist load comprises the safe working load SWL and the dead loads of all the lifting appliance components carrying the SWL

- Horizontal forces generated by inclinations of the vessel

- The vertical dynamic forces due to the acceleration or movement of lifting appliances are considered in calculation by the dead load coefficient φ and the hoist load coefficient ψ, by which the static loads are to be multiplied.

  The weights of movable components of the lifting appliance, e.g. booms, etc. are to be multiplied by the dead load coefficient defined in **TL** Part D, Chapter 50.

  For determination of the hoist load coefficient see 4.

- Horizontal and other dynamic forces

- Dynamic forces due to motions of the vessel in operation and out of operation

3.3.3 Additional Loads

- Wind loads on structural members of lifting appliances

- Wind loads acting on the SWL

- Lateral forces when the crane is moving

- Loads on stairways, platforms and railings

3.3.4 Special Loads

Special loads are buffer forces of travelling gantry cranes or the static and dynamic test loads, see also I.

3.3.5 Load Conditions

For the purposes of strength calculation, the loads described in 3.3.1 to 3.3.4 are to be applied to load conditions A to C. in the manner defined in the following.

3.3.5.1 Load Condition A (principal loads)

This load condition relates to the planned operating conditions without taking into account of additional loads, e.g. wind loads.

3.3.5.2 Load Condition B (principal and additional loads)

This load condition relates to the planned conditions in and out of operation, with taking in account of additional loads, e.g. the wind load.

3.3.5.3 Load Condition C (principal and special loads)

This load condition relates to extraordinary stresses. Calculations are to be based on:

- Lifting appliance in operation (dead and hoist loads, buffer forces, if applicable)

- Lifting appliance out of operation (minimum dynamic inclinations, dead loads, dynamic forces due to vessel motions, wind load)

- Lifting appliance under dynamic test load (including dead loads x dead load coefficient φ)

- Alternatively lifting appliance under dynamic test load (dead loads and test load x hoist load coefficient ψ)

- Interchangeable components under static test load

3.4 Strength Computation

3.4.1 Basic Proofs

For the load conditions stated in 3.3.5, at least the first, and where necessary all three, of the following proofs are to be performed:

- Proof against reaching the yield point (general stress analysis)

- Proof against failure due to instability, e.g. crippling, tilting and buckling (proof of stability)

- Proof against fracture as a result of frequently repeated stresses variable with time for load condition A (proof of fatigue strength)

Detailed requirements for these proofs are contained in **TL** Part D, Chapter 50.

3.4.2 Proof of Bolt Forces

Detailed procedures for the proof of bolt forces for circular or rectangular bolt connections are defined in **TL** Part D, Chapter 50.

3.4.3 Permissible Stresses

3.4.3.1 The permissible stresses for structural members and welds for the general stress analysis and proof of stability are to be calculated by the following formula:

$$\sigma_{all} / \tau_{all} / \sigma_{vall} = 23{,}5 / (k * v) = (0{,}8 * R_{eH} + 4{,}8) / v \qquad [kN/cm^2]$$

$\sigma_{müs}$ = permissible normal stress

$\tau_{müs}$ = permissible shear stress

$\sigma_{vmüs}$ = permissible combined stress

v = safety factor for structural members as defined in **TL** Part D, Chapter 50

k = material factor = 29,5 / (R_{eH} + 60)

R_{eH} = yield point of material [kN/cm^2]

3.4.3.2 If accurate stress analyses according to recognized calculation procedures, e.g. using the finite element method, or proof based on measured data are provided, **TL** may, according to circumstances agree to the permissible stresses stated in 3.4.3.1 being increased by up to 10 %.

3.5 Special Proofs

The following proofs are to be provided as far as applicable

- In case of cargo gear whose cargo runner is reeved between the boom head and the mast a greater number of times than between the load and the boom head and which are topped by ropes, proof shall be provided that jack-knifing of the crane boom cannot occur.

- The head of booms which are held by luffing cylinders and operate on the cantilever principle shall generally show no greater deflection than 1 % of the boom length under SWL.

- Proof of safety against overturning is a measure of its resistance to overturning, which is influenced by a great number of factors. It should be noted that the danger of overturning arising from inexpert or incorrect operation cannot be precluded, no matter how stringent the conditions in the proof were.

- Vertical and horizontal forces due to ship motions at expected sea state shold be considered..

- Increase of load radius by permissible inclination of the Offshore Service Vessel's hull.

Details for these special proofs are contained in the **TL,** Part D, Chapter 50.

4. Determination of the Hoist Load Coefficient ψ

4.1 Basic Hoist Load Coefficient

4.1.1 The hoist loads or the stresses arising there from shall be multiplied by a hoist load coefficient. If a crane has several hoisting equipments, these may have differing hoist load coefficients.

For the determination of the basic hoist load coefficient ψ see **TL,** Part D, Chapter 50.

4.1.2 For dimensioning of launch and recovery systems for underwater equipment (like submersibles, diving bells and underwater working machines) a hoist load coefficient of ψ, which will be determined in **TL,** Part D, Chapter 50, has to be applied, see also 3.2.3.11.

4.2 Conversion of the SWL for Shipboard Cranes Working at Sea State

In relation to the operation in still water or on fixed offshore platforms the working at sea state from board of an Offshore Service Vessel results in a increased dynamic stressing for the crane which is defined by the hoist load coefficient ψ_{see}.

Therefore the nominal load of a crane working at sea state on an Offshore Service Vessel SWL_{sea} is to be reduced in relation to a crane working in calm water SWL because of the influences described in 4.4 and 4.5.

$SWL \,.\, \psi = SWL_{see} \,.\, \psi_{see}$

The reduced SWL_{see} shall be determined for various significant wave heights for the entire load radius range. This can be done using simplified methods or shall be established on the basis of a motion response analysis.

4.3 Simplified Methods for Calculation of ψ_{see}

Simplified methods for the calculation of ψ_{see} shall include:

- Basic formula depending on crane stiffness

- Relative speed between load and hook

– Corrections to crane stiffness according to position of hook, etc.

- Deviation angle of hoist rope

- Value of transverse tow

- Speed of hook

For crane works between different Offshore Service Vessels or between Offshore Service Vessels and offshore installations/ units the speed of the hook, which is resulting from lifting and luffing speeds of the crane as well as from the motion of the Offshore Service Vessel, has to be high enough, to secure that a renewed contact of the load with the cargo deck of the other vessel or unit does not result in a damage of the crane or the load.

4.4 Calculation of the Hoist Loads Coefficient ψ_{see} From a Motion Response Analysis

An improved approach to the actual sea state conditions in relation to the simplified methods described in 4.3 can be reached with the help of stochastic data about the sea state and hydrodynamic calculation methods. This may lead to a reduced value of the hoist load coefficient (and also the dead load coefficient) to be considered in the calculation of the lifting appliance

.

The calculation has to include the following influences, as far as applicable:

- Vertical movement of the deck with the cargo

- Horizontal movement of the deck with the cargo (longitudinal, transverse)

- Carrying structure of the crane

- Motion behaviour of the Offshore Service Vessel on which the crane is installed

- Hydrodynamic characteristics of a floating or dived cargo

- Influence of the positioning/mooring systems of the Offshore Service Vessel

- Agreed wind speeds

5. Mechanical Parts

5.1 General

5.1.1 Complementary or more comprehensive requirements, in particular for mechanical parts not covered hereafter can be taken from the following:

- **TL** Part B, Chapter 4

- Recognized standards and regulations where applicable to loading gear, unless contrary to the requirements of this Section

5.1.2 **TL** reserves the right to impose additional requirements for all kinds of mechanical parts, should this be necessary on account of new findings or operational experience.

5.2 Design Criteria

5.2.1 General Regulations

Mechanical parts of lifting appliances and loose gear shall be designed for the environmental conditions agreed on or prescribed, and be capable of being operated without problem under these conditions.

The effects of deformation of the supporting structure on machinery and equipment are to be observed.

Mechanical parts are to be designed in such a way that repairs and regular maintenance are easy to perform using on-board tools.

Lifting appliances are to be provided with a device which in the event of a power failure allows a suspended load to be set down safely.

5.2.2 Dimensioning

Mechanical parts shall be dimensioned as to provide adequate strength in respect of dynamic stress peaks plus adequate fatigue strength in the light of the loading and the service life.

With respect to dimensioning attention is to be paid particularly to the stress peaks arising during acceleration and retardation, and if applicable, the dynamic influences resulting from high rope speeds.

5.2.3 Vibration Effects

Machinery and equipment shall not cause any vibrations and shocks which may unduly stress other components or the structure of the lifting appliance and the loose gear. The permissible amplitudes and accelerations are stated in the **TL** Part B, Chapter 4, Section 1.

5.2.4 Lubrication

Lubrication of the moving parts of lifting appliances and loose gear shall be guaranteed under all operating conditions.

Each grease-lubricated bearing shall be provided with its own proven type of grease nipple. Accessibility to manual greasing points shall be ensured.

5.2.5 Corrosion Protection

Components at risk of corrosion are to be given suitable corrosion protection.

5.3 Components

For the following parts of mechanical equipment detailed requirements are defined in **TL** Part D, Chapter 50:

- Power drives
- Slewing gears, slewing rings including bolting
- Winches with rope drums, brakes, drives, couplings, gearing and controls and marking
- Protection devices.

6. Crane Sea Lashing Systems

6.1 All moving parts of the different crane types shall be capable of seaworthy lashing.

6.2 Cranes in their stowed position and their stowage/lashing equipment shall be designed to withstand the combination of motions and/or wind forces applicable to the design of the Offshore Service Vessel on which the crane is installed.

7. Crane Support Structures

The requirements for crane support structures, like

- Crane pedestals
- Crane foundations
- Boom stowages

are defined in Section 2.

D. A-Frames

1. Pivoted A-frames may be installed at the stern of the vessel (symmetrical or unsymmetrical) or on one side of the Offshore Service Vessel. The influence of the A-frame on heel, trim and stability of the vessel is to be investigated. The end positions of the A-frame are to be limited by electric limit switches or by mechanical strong backs of robust design if a hydraulic drive is provided. The design of the strong backs has to consider the pressure in the hydraulic system if the A-frame is tilted by hydraulic means.

2. A-frames are to be equipped with two hydraulic cylinders which are to be so designed and arranged that each is fully capable of safely performing the lifting operations under load. In addition, they are to be connected to the hydraulic system in such a way that a single fault in the hydraulic system cannot lead to the failure of both hydraulic cylinders.

3. An overload protection is to be provided, e.g. by a load measuring element at the very end of the hoisting rope or by a load measuring axle for a significant hoisting rope pulley.

4. For the detailed design and dimensioning the requirements defined for cranes in C. have to be applied in a similar way and as far as applicable.

E. Extendable Booms

1. Design

1.1 The end positions of the different expansions of the girder units are to be limited by mechanical stoppers and the maximum permissible SWL for each outreach is to be restricted by an automatic load limiting device.

1.2 During moving out and in of the expansions, it is strongly recommended that the length of the hoisting ropes be adjusted automatically by means of rope reeving or other control systems.

1.3 The movement of the different expansions has to be established by hydraulic cylinder(s) or sophisticated rope reeving system.

1.4 Special care is to be given to the local area of the force transition between the different expansions.

1.5 For the detailed design and dimensioning the requirements defined for cranes in C. have to be applied in analogous way and as far as applicable.

2. Calculation

The calculation of stresses has to consider:

- Transfer of loads from the different extensions
- Buckling of extensions in axial direction caused by the forces in the hoisting rope considering eccentricities because of clearances between the expansions
- Shear forces at the force transmission planes between the extensions
- Additional forces caused by inclined pull of the load

F. Hydraulic Systems

1. General Requirements

1.1 The dimensions and design of hydraulic systems shall conform to the established rules of engineering practice. Safe operation under all envisaged service conditions shall be ensured by suitable measures (e.g. filters, coolers, control devices and primary pressure control) and by selecting an appropriate hydraulic fluid.

1.2 Instead of pipes, high pressure hoses may be used. These shall comply with the requirements of DIN 20066 or an equivalent standard.

The hoses shall be suitable for the proposed operating fluids, pressures, temperatures, operating and environmental conditions and be appropriately laid.

The hose screw-joints shall be of an approved design.

1.3 For hydraulically powered winches, a standstill brake to prevent slip is required if necessary for the intended purpose of the winch. Any slip occurring if the brake is not fully activated shall generally not exceed the equivalent of one revolution of the drum or 1 m hook lowering per minute whichever is smaller.

1.4 Connection between the hydraulic system used for lifting appliances and other hydraulic systems is permitted only with the consent of **TL**. In this case a second pump unit and the provision of suitable shutoff valves are recommended.

2. Hydraulic Cylinders

2.1 Hydraulic cylinders which are critical to the overall safety of the lifting appliance are to be equipped with load holding or overcenter valves valves immediately adjacent to the cylinder.

2.2 The hydraulic cylinders are to be connected in such a way that no unacceptable external bending moments can be transmitted to the piston rod.

G. Electrical Installations

1. General Notes

1.1 Additional or more comprehensive requirements, e.g. for switch cabinets and for electrical equipment not covered hereafter can be taken from the following:

- **TL** Part B, Chapter 5
- Recognized standards and regulations where applicable to lifting appliances, unless contrary to the requirements of this Section

1.2 Electrical equipment developed on the basis of novel technical concepts requires special approval by **TL.**

1.3 **TL** reserves the right to impose additional requirements for all kinds of electrical equipment, should this be necessary on account of new findings or operational experience.

2. Design Criteria and Operational Requirements

2.1 The electrical control and switch gear, as well as the motors, shall be designed or arranged in such a way that necessary maintenance of contacts, contactors, collectors, slip rings, brakes, etc. can be carried out with means available on board.

2.2 Switch and control cabinets as well as motors are to be provided with adequate heating for the standstill condition, if sufficient internal space is available.

2.3 When choosing electrical equipment, the expected environmental conditions such as humidity, heat, cold and vibrations shall receive special consideration. In addition the following applies:

2.3.1 In general acceleration of 0,7 g in the frequency range from 13 to 100 Hz shall also be taken into account as regards design and mounting.

2.3.2 Plug-in cards with electronic controls shall have extra fastenings.

2.4 Where special circuits for lighting, standstill heating, etc. are fed through separate power supply switches so that they can also be operated when the main supply to the loading gear is switched off, special measures shall be taken in the switchgear to prevent direct contact with live parts. A double feed is to be indicated by labels.

2.5 Power supply or control via contact lines or bus bars with collectors is not permitted or rather may only be approved, on application, for specially protected areas, and with special protective measures being observed.

2.6 For supply lines to shipborne lifting appliances, including the external fixing cabling, marine type cable is to be used, as per **TL** Part B, Chapter 5, Section 1, 4 to 17.

2.7 An adequate power supply is to be provided on board.

2.8 Undesirable electrostatic discharges shall be avoided by earthing and interconnecting all the metallic components of electrical and non-electrical equipment.

2.9 Between the control position for the lifting appliances, if separately arranged, and the bridge of the Offshore Service Vessel a communication facility is to be established.

2.10 Means shall be provided to prevent permanent damage to the primary components of the lifting appliance from lightning strike.

3. Heave Compensation/Rope Tensioning Systems

To ease and simplify the lifting operations heave compensation/tension systems may be installed. These systems shall be of the following types:

3.1 Active Heave Compensation System (AHC)

Active heave compensation systems are systems, which keep the distance of the load in relation to the working reference plane constant and use for that purpose, the power of the hoisting system.

Activation of the heave compensation system(s) shall be protected against inadvertent use.

If a lifting appliance is equipped with such a system, the decisive coefficients for the layout of such a lifting appliance may be reduced in agreement with **TL.**

3.2 Passive Heave Compensation System (PHC)

Passive heave compensation systems are systems which keep the position of the load within pre-defined limits, using stored power such as hydraulic accumulators.

Activation of the heave compensation system(s) shall be protected against inadvertent use.

3.3 Active Rope Tensioning System (ART)

An active rope tensioning system shall, when activated and the control lever for hoisting is in the position for full hoisting, provide a tension in the hoisting wire rope to a set point value, both in downward and upward vessel motion. This system uses the power of the hoisting system.

Activation of any rope tensioning system shall only be possible when the hoisting system is not loaded.

3.4 Passive Rope Tensioning System (PRT)

A passive rope tensioning system shall, when activated, keep the tension in the hoisting wire within predefined limits using stored power.

3.5 General Requirements

The activation switch for heave compensation/rope tensioning systems shall be clearly and durably marked. When the systems are deactivated, the lifting appliance shall smoothly return to normal operation.

4. Safety Devices

4.1 Overload Protection

Lifting appliances shall have overload protection devices which shall become effective when the SWL is exceeded in general by not more than 10 % and for certain hydraulic drives by not more than 15 %. In case of friction effected overload protections, the safety setting is subject to individual agreement with **TL.**

Where lifting appliances have variable nominal loads, the overload protection device shall adjust automatically to the actual load radius and a load moment limitation device is also required.

After an overload protection device has responded, crane movements to reduce the load/load moment shall still be possible.

4.2 Motion Llimitation

The end positions of all motions which can be performed by lifting appliances or their mobile components shall be limited in an appropriate and safe way. For rotary motions, this is only applicable if they are restricted by local circumstances.

4.3 Emergency Switches/Keys

At the place of control or inside the cabin an emergency stop switch or emergency cut-out with mechanical locking device is to be provided. In hydraulic drives the emergency switch has also to act on the electric drive of the hydraulic pump.

Return to service shall be restricted to the zero position of the respective control elements or operating instruments.

4.4 Warning Devices

Outside the crane operator's cabin, a signal horn is to be provided with which the crane driver can activate audible warnings which are well perceptible within the operating range of the crane.

5. Components

For the following components of electrical equipment detailed requirements are defined in **TL** Part D, Chapter 50:

- Safety devices
- Drives and brakes
- Cables and lines
- Switches.

H. Stowage and Deck Transport

1. General

1.1 Stowage and deck transport is to be understood as the transfer of containers, bulky objects and materials recovered by the loading gear to a safe deposit location on the work deck, in hatches or substructures. The deposit location is to be protected as far as possible against environmental influences, especially if maintenance and repair work has to be done. The objects are to be safely stowed and lashed for all possible vessel movements.

1.2 If adequate proof of suitability e.g. by test stamps, test marks, etc. for this equipment does not exist and **TL** is appointed to establish such a proof by the manufacturer or operator, the following requirements are to be complied with.

2. Principles for Design and Equipment

The requirements of the IMO Code A.714(17), as amended: Code of Safe Practice for Cargo Stowage and Securing and of the **TL** Part D, Chapter 51 are to be considered.

2.1 Mechanical Requirements

2.1.1 Cargo Securing Elements

Aboard of the Offshore Service Vessel and under consideration of maximum vessel movements, sufficiently dimensioned measures, like cargo securing elements are to be provided for:

- Complete transportation

- Storage of bulky objects and materials

- Lashing on deck or within the hatches/superstructures

2.1.2 Stowage of containers on weather deck without lashing or buttressing

2.1.2.1 When stowing containers without lashing or buttressing, the transverse loads occurring will have to be absorbed by the transverse framework of the containers. This racking load occurring in the container transverse framework owing to the motion of the vessel shall not exceed 150 kN, and locking devices as to 2.1.2.2 through 2.1.2.4 are to be used.

The load applied to the upper corner casting of the container may not exceed 848 KN (20' and 40'), 942 kN according to ISO amendment 2005. The limit for the stowage systems is 848 kN.

2.1.2.2 Containers in One Layer

The containers shall be secured against tilting and shifting by locking devices at their lower corner fittings. Where not all of the lower corner fittings of a block of containers are accessible, locking the two outer containers at least at three corner fittings will do, provided that bridge fittings are arranged.

2.1.2.3 Containers Arranged in Several Layers

The containers located in the lowermost layer shall be locked at their lower corner fittings. Cone locks shall be arranged between the container layers.

2.1.2.4 Dunnage

Placing containers on dunnage without lashing them is only permissible where effective securing means preventing their shifting and tilting (see 2.1.2.2) can be arranged.

2.1.3 Lashing of Containers on Weather Deck

2.1.3.1 The lashings shall be arranged in such a way that 150 kN racking load will not be exceeded in the container transverse framework when taking as basis the load assumptions contained in **TL** Part D, Chapter 51, Section 3, A.

Always both container ends are to be lashed. Both ends have to be lashed in the same way.

In a stowage system all front-ends respectively all door-ends must be stowed principally in one section. The door- or front-ends can be arranged forward or backwards. If these requirements are not kept, the stack in question has to be examined separately.

2.1.3.2 Lashed containers shall be secured against horizontal displacement by cones, locking devices or alignment steps arranged on the hatch covers and/or on deck.

2.1.3.3 Containers in One Layer

Lashing is required only where there are no locking devices at the lower corner fittings of the containers. The lashings shall be arranged vertically.

2.2 Electrical Requirements

2.2.1 At the superstructures of the Offshore Service Vessel a connecting possibility in the form of a connecting plate with a stay bolt preferably M12 is to be provided at an easily accessible position, on which, if applicable, the earthing conductor of the object to be transported can be connected without using tools.

2.2.2 Areas for transport and stowage are to sufficiently iluminated.

2.3 Fire and Explosion Protection

The stowage location for the object to be transported is to be equipped with suitable fire extinguishing systems. In general this system will be a part of the fire extinguishing system of the Offshore Service Vessel.

Explosion protection measures for transport areas with explosion danger are to be provided.

I. Tests and Trials

1. Lifting Appliances

1.1 Components

1.1.1 Loose Gear

Before being put into use and after every major modification or repair to load-bearing parts, loose gear shall be subjected to a functional and load test in the presence of a **TL** Surveyor.

Static tests are to be performed with the test loads defined in Table 15.1.

Table 15.1 Static loads for loose gear

Safe working load SWL of loose gear	Test load PL_{stat}
Up to 10 t	2 x SWL
Over 10 t up to 160 t	(1,04 x SWL) + 9,6 t
Over 160 t	1,1 x SWL

Loose gear with a SWL of more than 10 t, which is intended for lifting appliances of the same construction, may be dynamically tested together with the lifting appliance. The test loads are given in Table 15.2.

Table 15.2 Dynamic test loads for loose gear with SWL > 10 t

SWL of lifting appliance	Test load PL_{dyn}
Up to 20 t	SWL + 25%
Between 20 t and 50 t	SWL + 5 t
Over 50 t	SWL + 10 t

1.1.2 Interchangeable Components

Before being assembled or put into use, interchangeable components in the unpainted and ungalvanized condition are to be subjected, in presence of a **TL** Surveyor, to a static load test performed on a calibrated and approved testing machine using the test loads according to Table 15.3.

Table 15.3 Static test load for interchangeable components

Interchangeable components	Working load limit WLL (1)	Static test load PL_{stat}
Chains, rings, hooks, shackles, swivels, etc.	Up to 25 t	2 x WLL
	Over 25 t	(1,22 x WLL) + 20 t
Multi-sheaved blocks	Up to 25 t	2 x WLL
	Over 25 t up to 160 t	(0,933 x WLL) + 27 t
	Over 160 t	1,1 x WLL
Single-sheaved blocks without becket	Up to 12,5 t	4 x WLL
	Over 12,5 t	(2,44 x WLL) + 20 t
Single-sheaved blocks with becket	Up to 8 t	6 x WLL
	Over 8 t	(3,66 x WLL) + 20 t

(1) *With multi-sheaved blocks, the working load limit is equal to the permissible load on the suspension.*
With single-sheaved blocks without becket, ***WLL*** *is equal to half the permissible load on the suspension. If the two parts of the rope led over the block sheave run parallel to each other, WLL is equal to the rope tension.*
With single-sheaved blocks with becket, ***WLL*** *is equal to one third of the permissible load on the suspension. If the three parts of the rope led over the sheave and fastened to the block becket are parallel to each other,* ***WLL*** *is equal to the rope tension.*

1.1.3 Hydraulic Systems

1.1.3.1 Pressure Test

Hydraulic pressure components are to undergo a pressure test.

The test pressure is p_p.

$p_p = 1,5 \cdot p_c$

p_c = Design pressure for which a component or piping system is designed with its mechanical characteristics [bar]. For pressures above 200 bar the test pressure need not exceed p + 100 bar.

For pressure testing of pipes, their valves and fittings, see **TL** Part B, Chapter 4, Section 16.

1.1.3.2 Tightness Test

Tightness tests are to be performed on components to which this is appropriate.

1.1.4 Electrical Equipment

Electrical equipment shall at least undergo the following tests:

- Heating-up run test
- Overload and overspeed test
- Winding test (high voltage test)
- Insulation measurement
- Testing of switch gear (function test, high voltage test, insulation measurement)

1.2 Final Test and Examination at the Manufacturers

1.2.1 Final testing and examination at the manufacturers is required even if the lifting appliance is not assembled completely there.

1.2.2 New-design lifting appliances or the first appliance in every delivery has to be test-run in the presence of the **TL** Surveyor according to a programme approved by **TL**. If possible this should take place at the manufacturers, but with **TL**'s consent it may also take place elsewhere or on board.

1.2.3 If the lifting appliance is also used to lift persons and/or manned equipment, a static load test has to be conducted. The test load shall be equal to 2,2 times the safe working load SWL.

1.2.4 For further details see **TL** Part D, Chapter 50.

1.3 Initial Test and Examination of Lifting Appliances

1.3.1 General

Prior to putting into use, an initial test and examination with the scope defined in the following at the place of operation is required.

If a test run in accordance with 1.2 has been carried out, the test on board consists of a function test plus a load test together with a thorough examination.

During practical testing of lifting appliances dependent on power supply from the Offshore Service Vessel, care is to be taken to ensure that the test is carried out using the type of power supply envisaged from the vessel's mains.

1.3.2 Function Test

This test serves to provide proof of the good working order of all components, installed systems and safety devices. The test procedure is at the **TL** Surveyors discretion.

The function test furthermore serves to verify whether parts of the vessel's structure or the vessel's equipment restrict the working range or impede the working process.

The function test carried out for the **TL** Surveyor does not normally serve to check whether all possible operations wanted by the Operator/Owner can be effected. Proving this is the responsibility of the manufacturer or supplier.

With the exception of the test on the overload protection devices, the function test may be carried out with any given load.

1.3.3 Load Test

Each lifting appliance with a defined SWL shall undergo a load test with weights prior to being put in service. The test shall be carried out at the place of operation, in order that their respective foundations or driveways are included in the test.

Lifting appliances on Offshore Service Vessels are to be subjected to a dynamic load test. The size of the test load shall be taken from Table 15.4

Table 15.4 Dynamic test loads for lifting appliances

SWL of lifting appliance	Test load PL_{dyn}
Up to 20 t	SWL + 25%
Between 20 t and 50 t	SWL + 5 t
Over 50 t	SWL + 10 t

For the dynamic load test the test load is to be lifted slowly, slewed and if possible also luffed. They are to run the full travelling distance or at maximum load radius cover the full swinging or slewing range. Additionally the minimum load radius is to be tested and in case of radius dependant SWL also an intermediate value.

For further conditions see **TL** Part D, Chapter 50.

1.3.4 Examination After the Load Test

Following performance of the load test, all parts of the lifting appliance, insofar as they are covered by the **TL** testing/survey order, shall be thoroughly examined.

The scope of the examination to be carried out, lies within the discretion of the **TL** Surveyor.

For the examination, if necessary individual parts shall be unrigged and dismantled. All parts then found not to be in unobjectionable condition shall be repaired or replaced. The **TL** Surveyor is entitled to require a repetition of the load test if he considers this necessary.

1.4 Further Requirements

Further requirement in relation to tests and trials, concerning:

- Supervision of construction
- Stamping after the initial tests
- Certification
- Marking
- Periodic tests and examinations
- Wear, damage repair
- Documentation.

are defined in **TL** Part D, Chapter 50,

2. Stowage and Deck Transport

Before use of the stowage and transport system an acceptance test with the following single tests is to be performed:

- Check that proofs are available for all exchangeable single parts
- Check, that proofs are available for the rupture strength of the used ropes
- Check that the transport of containers, bulky objects and materials in normal and emergency operation is safe and relatively smooth
- Functional test including check of the safety devices.

SECTION 16

POSITIONING

A. General

1. Scope

Special position keeping services for the Offshore Service Vessel may become necessary to support the operation of non-autonomous submersibles, ROVs and working machines as well as diving operations and other tasks, etc.

This gets special importance if underwater equipment and diving bells are connected to the Offshore Service Vessel via lifting cables and/or umbilicals or if well stimulation is done via risers connected to the bottom of the sea.

For position keeping of Offshore Service Vessels the following possibilities are envisaged:

- Positional mooring with cables and anchors
- Dynamic positioning by thrusters on the vessel
- Combination of mooring and dynamic positioning

This Section describes the requirements for these types of positioning.

2. Definitions

Control Mode

Possible control modes of a control system for dynamic positioning may be:

- Automatic mode (automatic position and heading control)
- Joystick mode (manual position control with selectable automatic or manual heading control)

Dynamic Positioning

Dynamic positioning means that the Offshore Service Vessel automatically maintains its position (fixed location or predetermined track) exclusively by means of controlled thrust.

Dynamic positioning system (DK system)

A DK system consists of components and systems acting together to achieve sufficiently reliable position keeping capability. The complete installation necessary for dynamically positioning a vessel comprises:

- Power system
- Thruster system
- DK control system

Positional Mooring

Positional mooring means that the Offshore Service Vessel maintains its position exclusively by a system of anchors, anchor lines and mooring winches.

Position Keeping

Position keeping means maintaining a desired position and heading or following a predefined track within the critical excursions or other excursions as specified in the DK Operation Manual of the DK system and under defined environmental conditions.

Single Failure Concept

The single failure concept assumes that only one (single) failure is the initiating event for an undesired occurrence. The simultaneous occurrence of independent failures is not considered. However, common mode failures are to be examined.

3. Rules to be Considered

3.1 TL Rules

The latest issue of following **TL** Rules shall be considered:

- **TL** Part A, Chapter 1
- **TL** Part B, Capter 4
- **TL** Part B, Chapter 4.1
- **TL** Part B, Chapter 5
- **TL** Part C, Chapter 22

3.2 International Conventions and Codes

The following Codes are to be considered:

- IMO MSC.1/Circ.1580: Guidelines for Vessels with Dynamic Positioning Systems

4. Documents to be Submitted for Approval

The following documents are to be submitted electronically or in paper form in triplicate. Operating manuals shall be submitted in a single set for information only.

4.1 Positional Mooring

4.1.1 Plans showing the arrangement and complete details of the anchoring system, including anchors, shackles, anchor line components, wires, together with details of fairleads, windlasses, winches, controls and instrumentation, as well as any other components of the anchoring system and its foundations, are to be submitted to **TL** for approval.

4.1.2 An analysis of the anchoring arrangements expected to be utilised during the vessel's operation is to be submitted to **TL**. Among items to be addressed are:

- Design environmental conditions: waves, wind, currents, tides, and ranges of water depth
- Anchor holding capacities for various seabed soil conditions
- Air and sea water temperature
- Ice conditions, if applicable
- Description of analysis method

4.1.3 An arrangement drawing for the mooring system has to be submitted. Mooring forces and permissible mooring directions are to be defined.

4.1.4 For each type of mooring winch

- General and sectional drawings
- Circuit diagrams of the hydraulic and electrical systems
- Detail drawings of the frame, main shaft, drum couplings and brakes.Strength calculations for main shaft, shaft bearings, drum, gearbox torque transmitting components (not required if gearbox is a standard product of a specialist manufacturer), components of service and holding brake
- Description of the mooring winch including the control and safety devices
- Strength calculation for bolts, chocks and stoppers securing the mooring winch to the deck

4.1.5 In the drawings for the hull structure the foundations for the mooring winches and the fairleads have to be shown.

4.1.6 The following aspects have to be included in the Operations Manual:

- Principal functioning and co-operation/ interaction of the different elements of the system
- Procedure for the start of the task (e.g. deploying divers into the water, launching of submersibles)
- Stopping or finishing the task
- Procedure for a limited change of the position
- Procedures in the event of failure of the systems
- Procedure in emergency situations

4.2 Dynamic Positioning

4.2.1 General Documentation

- Operation description (type of Offshore Service Vessel)
- Specification of environmental conditions (wind

and sea) for DK operation

- DK capability analysis
- DK operation manual (for information only)
- Test program for Factory Acceptance Test (FAT)
- Test program for DK control trial and FMEA proving trial, if applicable acc. to E.2.2
- For **DK 3** the local distribution of all DK relevant systems and components in a different coloured arrangement description/drawing for the related systems
- For **DK 2** and **DK 3** the following DK operation related information has to be provided:
  - Redundancy concept document (FMEA of basic design) with worst case failure design intent, including:
    - General arrangement
    - Percentage of remaining power after one failure
    - Power plant configuration for DK operation
    - Permissible number of failed thrusters
    - Required power sources for DK operation and permissible loss of power sources after one failure
    - Definition of time period for safely terminating a DK operation after a single failure

4.2.2 Documentation for Control, Safety and Alarm Systems

- Functional block diagram(s) of the control system(s)
- Functional block diagram(s) of the position reference system(s) and the environmental sensor(s)
- Wiring diagrams
- Drawings showing the electrical power supply of all units and the internal power distribution
- For **DK 3** the cableways for the different systems have to be identified in different colours
- Drawings and descriptions of monitoring functions of control, sensor and reference systems
- General bridge arrangement drawings, e.g. control panels, control consoles, location of control station
- List of installed equipment

4.2.3 Thruster Documentation

- Documentation according to the relevant **TL** Rules

4.2.4 Electric Power System Documentation

- Documentation according to the relevant **TL** Rules
- A power balance with the following information shall be provided:
- Power demand of the DK system under the specified environmental conditions (wind, wave, current) and under worst case failure
- Power demand for the supply of the Offshore Service Vessel (basic load)

4.2.5 Failure Mode and Effects Analyses (FMEA)

A Failure Mode and Effects Analysis (FMEA) concerning availability of the DK system after a single failure shall be provided for the Class Notations **DK 2** and **DK 3**.

The DK FMEA shall be performed, based on IMCA

M166, 178, IEC 60812 or equivalent, according to common DK FMEA industrial requirements.

The results of the FMEA shall be verified during FMEA proving trials.

The relevant test program for the FMEA proving trial has to be provided for approval.

5. Classification, Notations

5.1 Positional Mooring

Offshore Service Vessels provided with positional mooring equipment in accordance with the requirements of this Section will be assigned the Class Notation **POSMOOR** in addition to the Notation **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification.

5.2 Dynamic Positioning

5.2.1 Offshore Service Vessels equipped with dynamic positioning systems in accordance with the requirements of this Section will be assigned the following Class Notations **DK 1, DK 2, DK 3** in addition to the Notation **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification.

5.2.2 For Offshore Service Vessels which allow different DK operating configurations a Class Notation **DK 3** is possible. Thereby all respective requirements in C. have to be fulfilled and documented independently for both Class Notations.

5.2.3 If the DK control system is tested with a special "hardware in the loop" test (during FAT and on board) a respective entry in the Technical File of the Class Certificate is possible.

5.2.4 If the DK system with Notation **DK 2** is equipped with means to increase availability a respective entry in the Technical File of the Class Certificate is possible.

5.3 Combination

The combination of positional mooring and dynamic positioning may be favourable in some cases, compare D. Details are to be agreed case by case with **TL.**

In this case, Class Notation assigned would be:

POSMOOR DK x x = 1, 2, 3

B. Positional Mooring

1. Design Parameters

The following parameters have to be considered for the design of a positioning system:

- Task of the Offshore Service Vessel (like diving support, submersible operation,etc.)
- Hull characteristics of the Offshore Service Vessel, equipment number
- Maximum and minimum water depth in the area of operations
- Limit of environmental conditions (like wind, seaway, ice, currents, etc.) up to which system shall work
- Required accuracy of positioning
- Necessity for change of position

2. System Elements

A positional mooring system consists of:

- Heavy anchors belonging to the Offshore Service Vessel which may be laid by the vessel itself before taking the operating position or changed in position by anchor handling tugs
- Safe stowage of the anchors on the Offshore Service Vessel and appliances to hand them over to the tugs
- Anchor cables as wire ropes or chain cables from the anchors to fairleads and winches on the Offshore Service Vessel including accessories like shackles, quick relase

devices, wire rope terminations, etc.

- Awinch or windlass for each anchor cable including tension control and measuring of cable length paid out

- Central control of all winches to keep position and allow forward movement of the Offshore Service Vessel on the planned track

3. Calculation

3.1 Redundancy

The anchoring system shall be designed such that a sudden failure of any single anchor line will not cause progressive failure of the remaining lines.

3.2 Loads

Anchoring system components shall be designed utilizing adequate safety factors and a design methodology suitable to identify the most severe loading condition for each component. In particular, sufficient numbers of heading angles together with the most severe combination of wind, current, and waves are to be considered, usually from the same direction, to determine the maximum tension in each mooring line.

When a particular site is being considered, any applicable cross sea conditions are also to be taken into account in the event that they might induce higher mooring loads.

3.3 Quasi Static Methods

When the Quasi static method is applied, the tension in each anchor line is to be calculated at the maximum excursion for each design condition defined in 3.4, combining the following steady state and dynamic responses of the vessel:

a) Steady mean offset due to the defined wind, current, and steady wave forces.

b) Most probable maximum wave induced motions of the moored vessel due to wave excitation.

For relatively deep water, the effect from damping and inertia forces in the anchor lines is to be considered in the analysis.

3.4 Factors of Safety

When the Quasi Static Method outlined in 3.3 is applied, the minimum factors of safety at the maximum excursion of the vessel for a range of headings should be considered according to Table 16.1.

Safety factor = P_B / T_{max}

T_{max} = Characteristic tension in the anchor line, equal to the maximum value obtained according to 3.2 and 3.3

P_B = Minimum rated breaking strength of the anchor line

3.5 Dynamic Analysis

When a dynamic analysis is employed, other safety factors may be considered to the satisfaction of **TL**.

The defined operating and severe storm conditions are to be the same as those identified for the design of the Offshore Service Vessel, unless **TL** is satisfied that lesser conditions may be applicable to specific sites.

Table 16.1 Minimum factors of safety

Design condition	**Safety factor**
Normal operation **(1)**	2,7
Severe storm **(1)**	1,8
Operating - one line failed **(2)**	1,8
Severe storm - one line failed **(2)**	1,25

(1) *Most severe environmental condition defined by the owner or designer*
(2) *Situation following failure of any one mooring line in operating condition*
(3) *Situation following failure of any one mooring line in severe storm condition*

3.6 Model Tests

In general, the maximum wave induced motions of the moored Offshore Service Vessel about the steady mean offset should be obtained by means of model tests. **TL** may accept analytical calculations provided that the proposed method is based on a sound methodology which has been validated by model tests.

The results of wind tunnel tests, as well as other recognized criteria, may be considered.

3.7 Other Analysis Methods

TL may accept different analysis methods provided that a level of safety equivalent to the one obtained by 3.3 and 3.4 is ensured.

3.8 Foundations

The acting forces on the foundations are to be calculated for 100 % of the nominal breaking load of the mooring cables. For the supporting structure under this equipment 100 % of the minimum yield stress R_{eH} is to be observed as acceptance criterion in the calculation.

4. Equipment

4.1 Anchors

4.1.1 Type/design, materials, manufacture and testing of anchors used for position mooring shall comply with the Appendix 1 to this Section, if Certification by **TL** is requested.

4.1.2 Anchors used as positional anchors, which are to be specially laid the right way up or which require flukes and profile to be adjusted to meet sea bed conditions, will not normally be approved for temporary mooring purposes.

4.1.3 Anchors shall be subjected to load tests in approved testing installations, see Appendix 2 to this Section.

4.1.4 Anchors are to be securely stowed on board to prevent movement during transit.

4.2 Anchor Lines

4.2.1 **TL** is to be ensured that the anchor lines are of a type/composition that will satisfy the design conditions of the anchoring system. In general anchor cables may be of wire, rope, chain or any combination thereof.

4.2.2 For mooring chain cables see Appendix 3 to this Section.

4.2.3 Where wire ropes are fitted in lieu of chain cables, the following applies:

- The length of ropes is to be equal to 1,5 times the corresponding tabular chain cable length.

- The ropes' breaking strength is not to be less than the breaking strength of the tabular Grade K 1 chain cable. Strength according to Grade K 2 chains is recommended.

- A short length of chain cable is to be fitted between anchor and wire rope. Wire rope winches are to be fitted which comply with the rules for windlasses, see 4.3.

4.2.4 For accessories like anchor shackles, forerunners, etc. see Appendix 3 to this Section.

4.2.5 Means are to be provided to enable the anchor lines to be released from the Offshore Service Vessel after loss of main power.

4.2.6 Means are to be provided for measuring anchor line tensions.

4.2.7 Anchor lines are to be of adequate length to prevent uplift of the anchors under the maximum design load condition for the anticipated area(s) of operation.

4.3 Winch System

For the design of winches for positional mooring see Appendix 4 to this Section.

4.4 Quality Control

Details of the quality control of the manufacturing process of individual anchoring system components are to be submitted. Components shall be designed, manufactured, and tested in accordance with recognized standards and, if included in the Classification procedure according to A.5. also in accordance with **TL** Rules. Equipment so tested shall, insofar as practical, be legibly and permanently marked with **TL**'s stamp and delivered with documentation which records the results of the tests.

C. Dynamic Positioning

1. Design Parameters

The following parameters have to be considered for the design of a dynamic positioning system:

- Task of the Offshore Service Vessel (like diving support, submersible operation, etc.)

- Hull characteristics of the Offshore Service Vessel, equipment number

- Limit of environmental conditions (like wind, seaway, ice, currents, etc.) up to which system shall work

- Operational modes for the DK operation

- Required accuracy of positioning

- Period for terminating safely a DK operation after a single failure

2. System Elements

A dynamic positioning system consists of the following sub-systems:

2.1 Power System

This sub-system includes all components and systems necessary to supply the DK system with power:

- Prime movers or main and auxiliary engines with necessary auxiliary systems (e.g. fuel, lubricating oil, cooling water, control air systems) including piping

- Generators

- Switchboards

- Distributing system (cabling and cable routing)

- UPS

- Power management for **DK 2** and **DK 3**

2.2 Thruster System

This sub-system includes all components and systems necessary to supply the DK system with thrust force and thrust direction:

- Thrusters with prime movers and necessary auxiliary systems including piping (e.g. lateral thrust systems, rudder propeller)

- Main propellers and rudders if these are under the control of the DK control system

- Thruster control electronics

- Manual thruster controls

- Associated cabling and cable routing

2.3 DK Control System

This sub-system includes all control components and systems, hardware and software necessary to dynamically position the Offshore Service Vessel:

- Computer system / joystick system

- Sensor system (e.g. motion reference unit, gyro, anemometer)

- Display system (operator panels)

- Position reference system

- Associated cabling and cable routing

3. Characteristics for the Different Class Notations

For the different Class Notations the following basic characteristics can be defined:

3.1 For Class Notation **DK 1**, loss of position may occur in the event of a single fault. The redundancy requirements according to Table 16.2 are to be fulfilled.

3.2 For Class Notation **DK 2**, a loss of position may not to occur in the event of a single fault in any active component or system. Static components will not be considered to fail where adequate protection from damage is demonstrated and reliability is deemed acceptable by **TL**.

3.3 For Class Notation **DK 3**, a loss of position may not occur in the event of a single fault in any active or static component or system. This applies also for the total failure of one compartment due to fire or flooding.

3.4 For Class Notations **DK 2** and **DK 3**, a single inadvertent action shall be considered as a single fault, if such an action is reasonable probable.

4. Functional Requirements

4.1 Offshore Service Vessels with Class Notation **DK 1** are able to keep their position at least in automatic mode and joystick mode.

4.2 Offshore Service Vessels with Class Notation **DK 2** fulfil the requirements of **DK 1** and are able to keep their position after a single failure (see A.2.) in an active component.

Static components will not be considered to fail where adequate protection from damage is demonstrated and reliability is to the satisfaction of **TL.**

4.2.1 Redundant components and systems shall be available with such capacity that the DK operation can be continued for such a period that the work in progress can be terminated safely.

4.2.2 The transfer to the redundant component or system shall be automatic and within acceptable limits of the DK operation.

4.3 Offshore Service Vessels with class notation DK 3 fulfil the requirements of **DK 2** and are able to keep their position after a single failure (see A.2.) in an active or static component. This applies also for the total loss of the equipment in one compartment due to fire or flooding.

4.3.1 Requirements for space separation

Class divisions between spaces for redundant components have to withstand a fire related to the fire load in the respective spaces. The minimum class divisions are A-0 and with fire load A-60.

4.3.2 If the spaces are below the operational waterline, the separation shall also be watertight.

4.3.3 DK systems shall be arranged in such a way that in the event of damage to one system by fire or flooding the systems intended to provide redundancy will not be affected.

4.4 In order to meet the single failure criteria given in A.2., redundancy of components will normally be necessary as follows:

- For Class Notation **DK 2**, redundancy of all active components.

- For Class Notation **DK 3**, redundancy of all active and static components and physical separation of DK relevant systems.

4.5 The failure of redundant components shall be revealed by alarms and where this is not possible periodic testing may be accepted. (e.g. DK redundancy reduced)

4.6 The possibility of hidden failures shall be minimized (e.g. periodical testing).

4.7 The transfer of failures between redundant sub-systems shall be prevented by physical separation or protective functions.

4.8 An operational DK system is one that is able to reliably keep a vessel in position when working up to the defined environmental conditions, such that the maximum excursion from the vessel motions (surge, sway and yaw) and the position control system accuracy is equal to, or less than, half the critical excursion for the work being carried out. (stand-by redundancy)

5. System Arrangement

5.1 General

The requirements for the DK system arrangement for the different Class Notations are shown in Table 16.2.

Table 16.2 Minimum requirements for class notation DK 1 to DK 3

<table>
<tr><th colspan="2" rowspan="2">Subsystem or component</th><th colspan="4">Minimum requirements for class notation</th></tr>
<tr><th>DK 1</th><th>DK 2</th><th colspan="2">DK 3</th></tr>
<tr><td rowspan="6">Power system</td><td>Generator and prime movers</td><td>-</td><td>Redundant</td><td colspan="2">Redundant, separate compartments</td></tr>
<tr><td>Main switchboard</td><td>1</td><td>2</td><td colspan="2">2 in separate compartments</td></tr>
<tr><td>Bus-tie breaker</td><td>-</td><td>2 N.O. (1)</td><td colspan="2">2 N.O.</td></tr>
<tr><td>Distribution system</td><td>-</td><td>Redundant</td><td colspan="2">Redundant, through separate compartments</td></tr>
<tr><td>Power management</td><td>-</td><td>Redundant</td><td colspan="2">Redundant, separate compartments</td></tr>
<tr><td>UPS for DK control system</td><td>1</td><td>2</td><td colspan="2">2 + 1 in separate compartments</td></tr>
<tr><td>Thruster system</td><td>Arrangement of thrusters</td><td>-</td><td>Redundant</td><td colspan="2">Redundant, separate compartments, provided WCF is not exceeded</td></tr>
<tr><td colspan="2">DK-relevant auxiliary system</td><td>-</td><td>Redundant (2)</td><td colspan="2">Redundant, separate compartments</td></tr>
<tr><td rowspan="2">DK control system</td><td>No. of computer systems</td><td>1</td><td>2</td><td colspan="2">2 + 1 in separate compartments</td></tr>
<tr><td>Independent joystick with auto heading</td><td>1</td><td>1</td><td colspan="2">1</td></tr>
<tr><td rowspan="4">Sensors</td><td>Position reference systems</td><td>2</td><td>3</td><td colspan="2">3 whereof 1 connected to back-up control system</td></tr>
<tr><td>Vessel's Sensor Wind</td><td>1</td><td>2</td><td>2</td><td rowspan="3">One of each connected to backup control system</td></tr>
<tr><td>VRS</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Gyro</td><td>1</td><td>3</td><td>3</td></tr>
<tr><td colspan="2">Essential non-DK systems (3)</td><td>-</td><td>Redundant</td><td colspan="2">Redundant, separate compartments</td></tr>
<tr><td colspan="2">Printer</td><td>Yes</td><td>Yes</td><td colspan="2">Yes</td></tr>
<tr><td colspan="6">(1) NC bus-tie breakers may be accepted depending on the findings of the FMEA and additional testing (N.O. = normally open, N.C. = normally closed)
(2) When active components are used
(3) See C.5.4</td></tr>
</table>

5.2 Specific Requirements

Specific requirements for the sub-systems and components, like

- Power system

- Thruster system

- DK relevant auxiliary systems for **DK 2** and **DK 3**

- DK control system (including computer systems, position reference systems, sensor systems, DK alert system)

and all further details about dynamic positioning systems are defined in the **TL** Part C, Chapter 22.

5.3 Important Voice Communication

A means of communication shall be provided between the DK control positions, the navigational bridge, the engine control room and other for the DK operation important control positions. (e.g. diver control, ROV control).

5.4 Requirements for Essential non-DK Systems

For Class Notations **DK 2** and **DK 3**, systems not directly part of the DK system, but which in the event of failure could cause failure of the DK system (e.g. common fire suppression systems, engine ventilation systems, shut-down systems, crane and drilling power systems), shall also comply with the worst case failure design intent.

D. Combination of Positional Mooring with Dynamic Positioning

1. Also a combination of the positional mooring system according to B. with a dynamic positioning system according to C. may be established, if it is of advantage for special tasks, like:

- operation in strong currents

- operation in restricted waterways, etc.

2. It is to be secured that all elements of the combined system are operated from one control station overlooking the Offshore Service Vessel and the mooring area.

3. A dynamic analysis has to be submitted to **TL**, which has to consider:

- Arrangement of positional mooring system considering elasticity of cables, if applicable

- Function of dynamic positioning system

- Influence of the diving system, the underwater equipment, etc.

- Influence of seastate, wind and current conditions

4. Further detailed requirements for such a combination will be defined case by case.

E. Tests and Trials

1. Positional Mooring

1.1 Testing of Winches in the Manufacturer's Works

1.1.1 Testing of Power Units

The winch power unit has to be subjected to a test bed trial at the manufacturer's works with its rated performance.

1.1.2 Pressure and Tightness Testing

Pressure components are to undergo a pressure test.

The test pressure is p_C:

$$p_C = 1{,}5 \cdot p$$

p = The maximum allowable working pressure [bar]

= Pressure at which the relief valves open. However, for working pressures above 200 bar the test pressure need not exceed p + 100 bar.

Tightness tests are to be performed on components to which this is appropriate.

1.1.3 Material Certificates

TL Material Certificates according **TL**, Part A, Chapter 2, Section 1.F, will generally be required for:

- Frame, drum, shaft(s), couplings, brakes, gear(s)

- Mooring rope(s), including Certification of breaking load, rope fixing parts like shckles sockets e.t.c..

Manufacturer Inspection Certificates according to the **TL** Rules defined above may be accepted for standard items, if the manufacturer is recognized by **TL**. These Certificates have to be presented on the occasion of the final inspection of the winch.

1.1.4 Final Inspection and Operational Testing

Upon completion, winches have to be subjected to a final inspection and an operational test to the rated load. The hauling speed has to be determined during an endurance test under the rated tractive force.

During these trials, in particular the braking and safety equipment shall be tested and adjusted.

The brake has to be tested to a test load equal to the rated holding capacity.

1.1.5 If manufacturers do not have at their disposal the equipment required, a test confirming the design winch capacity, and including adjustment of the overload protection device, may be carried out after installation on board.

In that case only the operational trials without applying the prescribed loads will be carried out at the manufacturers.

1.2 Sea Trials

1.2.1 A schedule for the proposed tests of the positioning systems has to be submitted for approval to **TL** Head Office in due time before the sea trials.

1.2.2 If the mooring winch could not be tested at the manufacturer's works with the rated performance, these tests shall be done during sea trials.

1.2.3 The interaction of the different mooring winches has to be tested in a realistic way as much similar as possible to the operation in service.

1.2.4 All procedures defined in the Operating Manual have to be tested as far as practicable in this stadium.

1.2.5 The trials have to be executed in presence of a **TL** Surveyor who will sign a detailed trials protocol to be prepared by the builder, if the tests are successful. The duplicate of this protocol has to be sent to **TL** Head Office for final approval.

2. Dynamic Positioning

2.1 Testing in the Manufacturer's Works

Before a new installation is surveyed and tested as specified in 2.2 factory acceptance tests (FAT) shall be carried out at the manufacturer's works. These tests are to be based on the approved test program as required in A.4.2.1 shall demonstrate compliance with the redundancy concept, if applicable. **TL** may require, pending on the DK Class Notation, full integration tests of all hardware components, including fault simulation. For Class Notation **DK 2** / **DK 3** this is required for power management systems, drive control systems, DK control systems, etc.

2.2 Sea Trials

Sea trials shall include a complete survey of the dynamic positioning system to ensure full compliance with the applicable parts of the Rules:

This survey includes a complete test of all DK relevant systems and components (DK control trial).

Tests of the installations according to the requirements of **TL** Rules including:

- Testing of the alarm system and switching logic of the DK control measuring system (sensor, peripheral equipment and reference system)

- Functional tests of control and alarm systems of each thruster in the DK control system

- Tests of the complete DK system (all operational modes, back-up system, joystick system, alarm system and manual override)

- Manual override shall be demonstrated during normal operation and failure conditions

- Testing of UPS battery capacity (30 min.)

- Positioning shall be performed on all possible combinations of position reference systems and on each reference system as a single system

- Accuracy verification of position reference systems (offset)

An endurance trial shall be conducted with full system operation for at least 4 hours without significant alarms of the DK system. The environmental conditions shall be such that the function of the DK system under load conditions can be demonstrated.

For all thruster systems under DK control a heat run test shall be carried out until steady state temperatures have been reached.

Redundancy and independence of the DK system (for Class Notations **DK 2** and **DK 3**) have to be verified with a FMEA proving trial. This trial shall be based on the approved program as required in A.4.2.5.

TL reserves the right to add further tests for the verification of FMEA.

APPENDIX 1

TYPE/DESIGN, MATERIALS, MANUFACTURE and TESTING of ANCHORS USED for POSITION MOORING

1. General

1.1 Temporary mooring equipment is to be designed for quick and safe operation in all foreseeable service conditions and for holding the vessel at anchor.

Note:

1. *Temporary mooring equipment is, therefore, not intended to hold a unit off fully exposed coasts in rough weather or to stop a unit which is moving or drifting. In this condition, the loads on the mooring equipment increase to such a degree that its components may be damaged or lost owing to the high energy forces generated, particularly for large units.*

2. *In good holding ground the temporary mooring equipment required by this Section is intended to hold a unit in conditions such as to avoid dragging of the anchor. In poor holding ground, the holding power of the anchors will be significantly reduced.*

3. *The Equipment Numeral formula for the temporary mooring equipment required in this Appendix is based on an assumed current speed of 2,5 m/sec, a wind speed of 25 m/sec, and a scope of chain cable between 6 and 10, the scope being the ratio between length of chain paid out and water depth.*

1.2 The temporary mooring equipment shall consist of anchors, chain cables, windlass or winches, chain stoppers, chain lockers (if chains are fitted) and wire ropes.

The equipment of anchors and chain cables is to be determined from Table 16A1.1.

1.3 The anchors are to be effectively stowed and secured to prevent any movement at sea. If the anchors are stowed at the shell, the shell plating is to be increased in thickness and the framing may have to be strengthened.

1.4 The arrangements are to be such as to provide an easy lead of chain cable/wire rope from the anchor to the windlass/winch and to ensure that the anchor can be dropped by its own weight without assistance.

1.5 Dimensioning

1.5.1 For the supporting structure under windlasses, chain stoppers, fairleads, sheaves and any other items of equipment subjected to loads from the anchor cables as determined in accordance with the provisions of 1.5.2 or 1.5.3, the following permissible stresses are to be observed:

− Axial, bending stress: $\sigma_b \leq 0{,}8 \,.\, R_{eH}$

− Shear stress: $\tau \leq 0{,}5 \,.\, R_{eH}$

− Equivalent stress: $\sigma_{eq} = \sqrt{\sigma_b^2 + 3 \,.\, \tau^2} \leq R_{eH}$

1.5.2 Where chain cables are led through hawse pipes, the acting forces are to be taken as 80 % or 45 % of the rated breaking load of the chain cable, i.e.

− for chain stoppers: 80 %

− for windlasses: 80 % where no chain stoppers are fitted

− for windlasses: 45 % where chain stoppers are fitted

1.5.3 Where hawse pipes are not installed and the chain cables are guided by fairleads and sheaves, the acting forces are to be taken as 100 % or 50 % of the rated braking load of the chain cable, i.e.

− for chain stoppers: 100 %

− for windlasses: 100 % where no chain stoppers are fitted

− for windlasses: 50 % where chain stoppers are fitted

2. Equipment Numeral

The equipment numeral Z is to be calculated as follows:

$$Z = D^{2/3} + f_W$$

D = Moulded displacement [t] in seawater having a density of 1,025 t/m³ when at anchor

f_W = Projected area of all surfaces above the water line [m²] perpendicular to the wind direction when at anchor

The masking effect of structures located behind each other is normally not to be taken into account.

However, upon case-by-case consideration a reduced projected area of leeward structures may be accepted. Reduction factors on account of the particular shape of structures are normally not to be applied.

3. Anchors

3.1 Number

Two rule power anchors according to Table 16A1.1 are to be connected to their chain cables and positioned on board ready for use. It is to be ensured that each anchor can be stowed in the hawse and hawse pipe in such a way that it remains firmly secured in seagoing conditions.

3.2 Construction

3.2.1 The anchors are to be made of materials and are to be tested as required in accordance with the **TL** Part A, Chapter 2.

3.2.2 The anchors must be of approved design. The mass of the heads of patent anchors (stockless anchors), including pins and fittings, must comprise not less than 60 % of the total mass of the anchor.

3.2.3 In case of stock anchors, the total mass of the anchor including the stock must comply with the values given in Table 16A1.1. The weight of the stock should be approximately 20 % of this total mass.

3.2.4 The mass of each individual anchor may deviate from the tabular mass by up to 7 % as long as the total mass of the anchors fitted and attached to the chain cables is not less then twice the tabular mass of one anchor.

3.3 High Holding Power Anchors

3.3.1 Where anchors with increased holding power are intended to be used, a special approval procedure is required, as described in 3.4. The following reduced masses may be admitted:

- for ‘High Holding Power’ (HHP) anchors:
  75 % of the tabular mass
- for ‘Very High Holding Power’ (VHHP) anchors:

  50 % of the tabular mass

3.3.2 The dimensions of the chain cable and windlass are to be based on the tabular anchor mass as given in Table 16A1.1.

3.4 Approval Procedure

3.4.1 For approval as a "High Holding Power Anchor", satisfactory tests are to be made on various types of bottom and the anchor is to have a holding power at least twice that of a patent anchor ("Admiralty Standard Stockless") of the same mass. The mass of anchors to be tested should be representative of the full range of sizes intended to be manufactured. The tests are to be carried out on at least two sizes of anchors in association with the chain cables appropriate to the weight. The anchors to be tested and the standard stockless anchors should be of approx. the same mass.

3.4.2 The chain length used in the tests should be approx. 6 to 10 times the depth of water.

3.4.3 The tests are normally to be carried out from a tug, however, alternative shore based tests (e.g. with suitable winches) may be accepted.

Three tests are to be carried out for each anchor and type of bottom. The pull shall be measured by means of a dynamometer or recorded by a recording instrument. Measurements of pull based on rpm/bollard pull curve of the tug may be accepted. Testing by comparison with a previously approved HHP anchor may be accepted as a basis for approval.

Table 16A1.1 Definition of anchors and chain cables

Number for Reg.	Equipment numeral Z	2 stockless bower anchors	Stud link chain cables			
		Mass per anchor	Total length	Diameter		
				d_1 (1)	d_2	d_3
[-]	[-]	[kg]	[m]	[mm]	[mm]	[mm]
120	720-780	2280	467,5	48	42	36
121	780-840	2460	467,5	50	44	38
122	840-910	2640	467,5	52	46	40
123	910-980	2830	495	54	48	42
124	980-1060	3060	495	56	50	44
125	1060-1140	3300	495	58	50	46
126	1140-1220	3540	522,5	60	52	46
127	1220-1300	3780	522,5	62	54	48
128	1300-1390	4050	522,5	64	56	50
129	1390-1480	4320	550	66	58	50
130	1480-1570	4590	550	68	60	52
131	1570-1670	4890	550	70	62	54
132	1670-1790	5450	577,5	73	64	56
133	1790-1930	5610	577,5	76	66	58
134	1930-2080	6000	577,5	78	68	60
135	2080-2230	6450	605	81	70	62
136	2230-2380	6900	605	84	73	64
137	2380-2530	7350	605	87	76	66
138	2530-2700	7800	632,5	90	78	68
139	2700-2870	8300	632,5	92	81	70
140	2870-3040	8700	632,5	95	84	73
141	3040-3210	9300	660	97	84	76
142	3210-3400	9900	660	100	87	78
143	3499-3600	10500	660	102	90	78
144	3600-3800	11100	687,5	105	92	81
145	3800-4000	11700	687,5	107	95	84
146	4000-4200	12300	687,5	111	97	87
147	4200-4400	12900	715	114	100	87
148	4400-4600	13500	715	117	102	90
149	4600-4800	14100	715	120	105	92
150	4800-5000	14700	742,5	122	107	95
151	5000-5200	15400	742,5	124	111	97
152	5200-5500	16100	742,5	127	111	97
153	5500-5800	16900	742,5	130	114	100
154	5800-6100	17800	742,5	132	117	102
155	6100-6500	18800	742,5		120	107

Table 16A1.1 Definition of anchors and chain cables (cont.)

Number for Reg.	Equipment numeral Z	2 stockless bower anchors	Stud link chain cables			
		Mass per anchor	Total length	Diameter		
				d_1 (1)	d_2	d_3
[-]	[-]	[kg]	[m]	[mm]	[mm]	[mm]
156	6500-6900	20000	770		124	111
157	6900-7400	21500	770		127	114
158	7400-7900	23000	770		132	117
159	7900-8400	24500	770		137	122
160	8400-8900	26000	770		142	127
161	8900-9400	27500	770		147	132
162	9400-10000	29000	770		152	132
163	10000-10700	31000	770			137
164	10700-11500	33000	770			142
165	11500-12400	35500	770			147
166	12400-13400	38500	770			152
167	13400-14600	42000	770			157
168	14600-1600	46000	770			162

d_1 = chain diameter Grade K1 (ordinary quality)
d_2 = chain diameter Grade K2 (special quality)
d_3 = chain diameter Grade K3 (extra quality)

(1) *Not recommended for offshore use*

3.4.4 The maximum mass of an anchor thus approved may be 10 times the mass of the largest size of anchor tested.

3.5 Positional Anchors

Anchors used as positional anchors which must be specially laid the right way up or which require flukes and profile to be adjusted to meet sea bed conditions, will not normally be approved for temporary mooring purposes.

4. Mooring Chain Cables and Accessories

4.1 The chain cable diameters given in Table 16A1.1 apply to chains complying with the requirements of **TL** Part A, Chapter 2, where

- Grade K 1 (ordinary quality)
- Grade K 2 (special quality)
- Grade K 3 (extra special quality)

are defined.

4.2 Grade K1 chain cable should not be used for offshore applications. Where the installation of offshore quality mooring chains is intended, the provisions of Appendix 3. apply.

4.3 Grade K 2 and K 3 chain cables must be post production quenched and tempered and shall be purchased only from recognized manufacturers.

4.4 Chain cables or wire ropes, if fitted, are to be made of materials and tested in accordance with the **TL** Rules mentioned under 4.1.

4.5 Where the total mass of anchors is divided into three or four anchors, see 3.1, the chain cable diameter and lengths are to be determined from Table 16A1.1 for the mass of the anchor actually fitted. The chain cable length is to be determined by dividing the tabular length by two and then multiplying by the number of anchors actually fitted, unless specified otherwise by the Owner/Operator.

4.6 Accessories

4.6.1 Anchor shackles shall be of an approved type and the material(s) shall conform to the TL Rules mentioned under 4.1. Kenter-type shackles are recommended.

4.6.2 A forerunner with swivel is to be fitted between anchor and chain cable. In lieu of a forerunner with swivel, an approved swivel shackle may be fitted. However, swivel shackles are not to be connected directly to the anchor shank unless specially approved.

4.6.3 Where a spare anchor is fitted, see 3.1, a sufficient number of suitable spare shackles is to be kept on board to facilitate fitting of the spare anchor at any time.

4.7 Attachment of Cable Ends

4.7.1 The inboard ends of the chain cables are to be secured to the structure. The attachment is to be able to withstand a force not less than 15 % nor more than 30 % of the rated breaking load of the chain cable.

4.7.2 The attachment of the inboard ends of the chain cables to the unit's structure is to be provided with suitable means to permit, in case of emergency, an easy slipping of the chain cables to sea from an accessible position outside the chain locker.

4.8 Wire Ropes

Where wire ropes are fitted in lieu of chain cables, the following applies:

- The length of ropes is to be equal to 1,5 times the corresponding tabular chain cable length.
- The ropes' breaking strength is not to be less than the breaking strength of the tabular Grade K 1 chain cable. Strength according to Grade K 2 chains is recommended.
- A short length of chain cable is to be fitted between anchor and wire rope.

5. Chain Locker

5.1 The chain locker is to be of adequate capacity and depth to facilitate an easy direct lead of the cables through the chain pipes and to permit self-stowing of the cables. The chain locker is to be provided with internal divisions so that the chain cables may be fully and separately stowed.

The minimum required stowage capacity without mud box for the two bower anchor chains is as follows:

$$S = 1{,}1 \cdot d^2 \cdot \ell / 100.000 \qquad [m^3]$$

d = Chain diameter [mm] according to Table 16A1.1

ℓ = Total length of stud link chain cable according to Table 16A1.1

The total stowage capacity is to be distributed on two chain lockers of equal size for the port and starboard chain cables. The shape of the base areas shall as far as possible be quadratic with a maximum edge length of 33. d. As an alternative, circular base areas may be selected, the diameter of which shall not exceed (30 - 35). d.

Above the stowage of each chain locker in addition a free depth of

$$H = 1500 \text{ [mm]}$$

is to be provided.

5.2 The chain locker boundaries and their access openings are to be watertight to prevent flooding of adjacent spaces, where essential installations or equipment are arranged, in order to not affect the proper operation of the unit after accidental flooding of the chain locker.

5.3 Where the chain locker boundaries are also tank bulkheads, the scantlings of plating and stiffeners are to be determined as for tanks.

5.4 Special Requirements to Minimize the Ingress of Water

5.4.1 Spurling pipes and cable lockers are to be watertight up to the weather deck.

5.4.2 Where means of access is provided, it is to be closed by a substantial cover and secured by closely spaced bolts.

5.4.3 Spurling pipes through which anchor cables are led are to be of suitable diameter and shall be provided with permanently attached closing appliances to minimize water ingress.

5.5 Adequate drainage facilities are to be provided.

APPENDIX 2

LOAD TESTING for ANCHORS

1. Testing

Anchors shall be subjected to load tests according to the Rule requirements, in approved testing installations. After application of the test load, it must be shown that the anchor is free of any defects/ deformations resulting from testing, and fully operable.

Test loads are shown in Table 16A2.1. For anchors with increased holding capacity, the following test loads have to be applied:

HHP anchors: A load corresponding to 1,33 × mass of anchor.

VHHP anchors: A load corresponding to 2 × mass of anchor.

Table 16A2.1 Test loads for anchors (1)

Mass [kg]	Test load [kN]	Mass [kg]	Test load [kN]
2200	367	7800	861
2300	388	8000	877
2400	401	8200	892
2500	414	8400	908
2600	427	8600	922
2700	438	8800	936
2800	450	9000	949
2900	462	9200	961
3000	474	9400	975
3100	484	9600	987
3200	495	9800	998
3300	506	10000	1010
3400	517	10500	1040
3500	528	11000	1070
3600	537	11500	1090
3700	547	12000	1110
3800	557	12500	1130
3900	567	13000	1160
4000	577	13500	1180
4100	586	14000	1210
4200	595	14500	1230
4300	604	15000	1260
4400	613	15500	1270
4500	622	16000	1300
4600	631	16500	1330
4700	638	17000	1360

Table 16A2.1 Test loads for anchors (1) (cont.)

Mass [kg]	Test load [kN]	Mass [kg]	Test load [kN]
4800	645	17500	1390
4900	653	18000	1410
5000	661	18500	1440
5100	669	19000	1470
5200	677	19500	1490
5300	685	20000	1520
5400	691	21000	1570
5500	699	22000	1620
5600	706	23000	1670
5700	713	24000	1720
5800	721	25000	1770
5900	728	26000	1800
6000	735	27000	1850
6100	740	28000	1900
6200	747	29000	1940
6300	754	30000	1990
6400	760	31000	2030
6500	767	32000	2070
6600	773	34000	2160
6700	779	36000	2250
6800	786	38000	2330
6900	794	40000	2410
7000	804	42000	2490
7200	818	44000	2570
7400	832	46000	2650
7600	845	48000	2730

(1) *Intermediate values can be determined by linear interpolation*

APPENDIX 3

ANCHOR LINES

1. Anchor Lines (mooring chain cables)

1.1 General Requirements

1.1.1 **TL** is to be ensured that the anchor lines are of a type/composition that will satisfy the design conditions of the anchoring system. In general anchor cables may be of wire, rope, chain or any combination thereof.

1.1.2 Means are to be provided to enable the anchor lines to be released from the unit after loss of main power.

1.1.3 Means are to be provided for measuring anchor line tensions.

1.1.4 Anchor lines are to be of adequate length to prevent uplift of the anchors under the maximum design load condition for the anticipated area(s) of operation.

1.2 Offshore Mooring Chain Cables - Material Requirements

1.2.1 General Requirements

1.2.1.1 Scope

These Rules apply to the materials, design, manufacture and testing of offshore mooring chains and accessories intended to be used for applications such as: mooring of mobile offshore units, mooring of floating production units, mooring of offshore loading systems and mooring of gravity based structures during fabrication.

Mooring equipment covered are common links, connection common links (splice links), enlarged links, end links, detachable connecting links (shackles), and shackles, swivels and swivel shackles.

1.2.1.2 Chain Cable Grades

Depending on the nominal tensile strength of the steels used for manufacture, chain cables are to be subdivided into three grades, i.e.: TL-R3, TL-R3S, TL-R4.

1.2.1.3 Approval of Chain Cable Manufacturers

1.2.1.3.1 Offshore mooring chain cables are to be manufactured only by works approved by **TL**. For this purpose approval tests are to be carried out, the scope of which is to include proof and breaking load tests, measurements and mechanical tests including fracture mechanics tests.

1.2.1.3.2 Manufacturers are to submit for review and approval the sequence of operations from receiving inspection to shipment, and details of the following manufacturing processes:

a) Bar heating and bending including method, temperature control and recording.

b) Flash welding including current, force, time and dimensional variables as well as control and recording of parameters.

c) Flash removal including method and inspection

d) Stud insertion method.

e) Heat treatment including furnace types, means of specifying, controlling and recording of temperature and chain speed and allowable limits, quenching bath and agitation, cooling method after exit.

f) Proof and break loading including method/ machine, means of horizontal support, if applicable, method of measurement recording.

g) Non-destructive examination procedures.

1.2.1.3.3 Calibration of furnaces shall be verified by measurement and recording of actual link temperature (surface and internal).

1.2.1.4 Approval of Quality System at Chain Cable Manufacturers

Chain cable manufacturers are to have a documented and effective quality system approved by **TL,** e.g. according to ISO 9001.

1.2.1.5 Approval of Steel Mills for Rolled Bars

1.2.1.5.1 Bar material intended for chain and accessories are to be manufactured only by works approved by **TL.** The approval is limited to a nominated supplier of bar material. If a chain cable manufacturer wishes to use material from a number of suppliers, separate approval tests must be carried out for each supplier.

Approval will be given only after successful testing of the completed chain cable. The approval will normally be limited to a thickness equal to that of the bars tested.

1.2.1.5.2 The steel maker is to submit a specification of the chemical composition of the bar material, which must be approved by **TL** and by the chain cable manufacturer.

For Grade TL-R4 chain cables the steel should contain a minimum of 0,20 per cent molybdenum.

1.2.1.5.3 A heat treatment sensitivity study simulating chain cable production conditions shall be applied in order to verify mechanical properties and establish limits for temperature and time combinations.

1.2.1.5.4 The bar manufacturer is to provide evidence that the material is resistant to strain ageing, temper embrittlement and hydrogen embrittlement.

1.2.1.6 Approval of Forges and Foundries for Accessories

1.2.1.6.1 Forges and foundries intending to supply finished or semifinished accessories are to be approved by **TL**. The scope of approval is to be agreed with **TL**.

1.2.1.6.2 Manufacturers intending to supply accessories in machined condition (e.g. Kenter type shackles) are to submit detailed drawings for approval.

1.2.2 Materials

1.2.2.1 Scope

These requirements apply to rolled steels, forgings and castings used for the manufacture of offshore mooring chain cables and accessories.

1.2.2.2 Rolled Steel Bars

1.2.2.2.1 Steel Manufacture

The steels are to be manufactured by basic oxygen, electric furnace or such other process as may be specially approved. All steels are to be killed and fine grain treated.

1.2.2.2.2 Chemical Composition

For acceptance tests, the chemical composition of ladle samples of each heat is to be determined by the steel maker and is to comply with the approved specification.

1.2.2.2.3 Mechanical Tests

.1 Bars of the same nominal diameter are to be presented for test in batches of 50 tonnes or a fraction thereof from the same heat. Test specimens are to be taken from material heat treated in the same manner as intended for the finished chain.

.2 Each heat of Grade TL-R3S and TL-R4 steel bars is to be tested for hydrogen embrittlement. In case of continuous casting, test samples representing the beginning and the end of the charge shall be taken. In case of ingot casting, test samples representing two different ingots shall be taken.

Two (2) tensile test specimens shall be taken from the central region of bar material which have been simulated heat treated. The specimens shall preferably have a diameter of 20 mm, alternatively 14 mm. One specimen is to be tested within max. 3 hours after machining. For a 14 mm diameter specimen, the time limit is 1,5 hours. Alternatively, the specimen may be cooled to - 60 °C immediately after machining and kept at that temperature for a period of max. 5 days. The other specimen is to be tested after baking at 250 °C for 4 hours, alternatively 2 hours for 14 mm diameter specimen.

A slow strain ≤ 0,0003 s^{-1} must be used during the entire test, until fracture occurs. This means approx. 10 minutes for a 20 mm diameter specimen.

Tensile strength, elongation and reduction of area are to be reported. The requirement for the test is:

$Z_1 / Z_2 \geq 0,85$

Z_1 = reduction of area without baking

Z_2 = reduction of area after baking

If the requirement $Z_1 / Z_2 \geq 0,85$ is not met, the bar material may be subjected to a hydrogen degassing treatment after agreement with **TL.** New tests shall be performed after degassing.

.3 For all grades, one tensile and three Charpy V-notch specimens are to be taken from each sample selected. The test specimens are to be taken at approximately one-third radius below the surface, as shown in Figure 16A3.1.

The results of all tests are to be in accordance with the appropriate requirements of Table 16A3.1.

.4 If the tensile test requirements are not achieved, a retest of two further specimens selected from the same sample shall be permissible. Failure to meet the specified requirements of either or both of the additional tests will result in rejection of the batch represented, unless it can be clearly attributed to improper simulated heat treatment.

1.2.2.2.4 Dimensional Tolerances

The diameter and roundness shall be within the tolerances specified in Table 16A3.2, unless otherwise agreed.

1.2.2.2.5 Non-destructive Examination and Repair

The bars shall be free from pipe, cracks and flakes. Bar material is to be subjected to ultrasonic examination at an appropriate stage of the manufacture.

One hundred percent of the bar material is to be examined by magnetic particle or eddy current methods. The bars shall be free of injurious surface imperfections such as seams, laps and rolled-in mill scale. Provided that their depth is not greater than 1 % of the bar diameter, longitudinal discontinuities may be removed by grinding and blending to a smooth contour. The frequency of non-destructive examinations may be reduced at the discretion of **TL** provided it is verified by statistical means that the required quality is consistently achieved.

1.2.2.2.6 Marking

Each bar is to be stamped with the steel grade designation and the charge number (or a code indicating the charge number) on one of the end surfaces. Other marking methods may be accepted subject to agreement.

1.2.2.3 Forged Steels

1.2.2.3.1 Forged steels used for the manufacture of accessories must be in compliance with specifications submitted and approved.

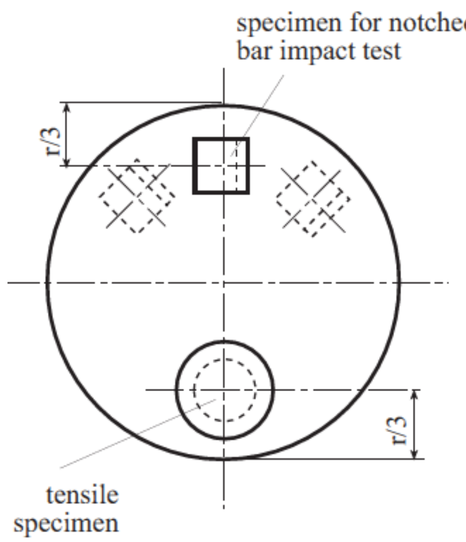


Figure 16A3.1 Location of test specimens

Table 16A3.1 Mechanical properties of offshore mooring chain cables

Grade	Yield stress	Tensile strength	Elongation	Reduction of area (3)	Charpy V-notch impact tests		
					Test temperature	Average energy	Average energy flash weld
	[N/mm^2] minimum	[N/mm^2] minimum	[%] minimum	[%] minimum	[°C] (2)	[J] minimum	[J] minimum
TL-R3	410	690	17	50	0 -20	60 40	50 30
TL-R3S	490	770	15	50	0 -20	65 45	53 33
TL-R4	580	860	12	50	-20	50	36

(1) *Aim value of yield to tensile ratio: 0,92 max*

(2) *At the option of Society the impact test of Grade TL-R3 and TL-R3S may be carried out at either 0 °C or minus 20 °C.*

(3) *Reduction of area of cast steel is to be:*

- for grades R3 and R3S: min. 40 %

- for grades R4: min 35 %

Table 16A3.2 Dimensional tolerances of bar stock material

Nominal diameter [mm]	Tolerance on diameter [mm]	Tolerance on roundness (d_{max} - d_{min}) [mm]
Below 25	-0 +1,0	0,60
25-35	-0 +1,2	0,80
36-50	-0 + 1,6	1,10
51-80	-0 + 2,0	1,50
81-100	-0 + 2,0	1,95
101-120	-0 + 3,0	2,25
121-160	-0 + 4,0	3,00

1.2.2.3.2 Chemical Composition

1.2.2.2.2 applies.

1.2.2.3.3 Heat Treatment

Finished forgings are to be properly heat treated in compliance with specifications submitted and approved.

1.2.2.3.4 Mechanical Properties

The forgings must comply with the mechanical properties given in Table16A3.1 when properly heat treated.

1.2.2.3.5 Mechanical Tests

For test sampling, forgings of similar dimensions, that means that diameters do not differ by more than 25 mm, originating from the same heat treatment charge and the same heat of steel are to be combined into one test unit. From each test unit one tensile and three impact test specimens are to be taken and tested. For the location of the test specimens see Figure 16A3.1.

1.2.2.3.6 Ultrasonic Examination

The forgings are to be subjected to ultrasonic examination at an appropriate stage of manufacture and in compliance with the standard submitted and approved.

1.2.2.3.7 Marking

Marking is to be similar to that specified in 1.2.2.2.6.

1.2.2.4 Cast Steels

1.2.2.4.1 Cast steels used for the manufacture of accessories must be in compliance with specifications submitted and approved.

1.2.2.4.2 Chemical Composition

1.2.2.2.2 applies.

1.2.2.4.3 Heat Treatment

All castings are to be properly heat treated in compliance with specifications submitted and approved.

1.2.2.4.4 Mechanical Properties

The castings must comply with the mechanical properties given in Table 16A3.1.

1.2.2.4.5 Mechanical Tests

For test sampling, castings of similar dimensions originating from the same heat treatment charge and the same heat of steel are to be combined into one test unit. From each test unit one tensile and three impact test specimens are to be taken and tested. For the location of the test specimens see Figure 16A3.1.

1.2.2.4.6 Ultrasonic Examination

The castings are to be subjected to ultrasonic examination in compliance with the standard submitted and approved.

1.2.2.4.7 Marking

1.2.2.3.7 applies.

1.2.2.5 Materials for Studs

The studs are to be made of steel corresponding to that of the chain or in compliance with specifications submitted and approved. In general, the carbon content should not exceed 0,25 per cent if the studs are to be welded in place.

1.2.3 Design and Chain Cable Manufacture

1.2.3.1 Design

Drawings giving detailed design of chain cables and accessories made by or supplied through the chain cable manufacturer are to be submitted for approval.
Typical designs are given in ISO 1704:1991.
In addition, drawings showing the detailed design of the stud shall be submitted for information. The stud shall give an impression in the chain link which is sufficiently deep to secure the position of the stud, but the combined effect of shape and depth of the impression shall not cause any harmful notch effect or stress concentration in the chain link.

Machining of Kenter shackles shall result in fillet radius min. 3 % of nominal diameter.

1.2.3.2 Manufacturing Process

Offshore mooring chain cables shall be manufactured in continuous lengths by flash butt welding and are to be heat treated in a continuous furnace; batch heat treatment is not permitted.

The use of joining shackles to replace defective links is subject to the written approval of the end purchaser in terms of the number and type permitted. The use of connecting common links is restricted to 3 links in each 100 m of chain cable.

1.2.3.3 Manufacturing Process Records

1.2.3.3.1 Documentation

Records of bar heating, flash welding and heat treatment shall be made available for inspection by the Surveyor.

1.2.3.3.2 Bar Heating

For electric resistance heating, the heating phase shall be controlled by an optical heat sensor. The controller shall be checked at least once every 8 hours and records made.

For furnace heating, the temperature shall be controlled and continuously recorded using thermocouples in close proximity to the bars. The controls shall be checked at least one every 8 hours and records made.

1.2.3.3.3 Flash Welding

The following welding parameters shall be controlled during welding of each link:

a) Platen motion.

b) Current as a function of time.

c) Hydraulic pressure.

The controls shall be checked at least every 4 hours and records made.

1.2.3.3.4 Heat Treatment

Chain cables shall be austenitized above the upper transformation temperature, at a combination of temperature and time within the limits established.

When applicable, chain cables shall be tempered at a combination of temperature and time within the limits established.

Temperature and time or temperature and chain speed shall be controlled and continuously recorded.

1.2.3.4 Mechanical Properties

The mechanical properties of finished chain cables and accessories are to be in accordance with Table 16A3.1. For the location of test specimens see Figures. 16A3.1 and 16A3.2.

1.2.3.5 Proof and Break Load Tests

Chain cables and accessories are to withstand the proof and breaking load tests given in Table 16A3.3

1.2.3.6 Freedom From Defects

All chain cables are to have a workmanship like finish consistent with the method of manufacture and be free from defects. Each link is to be examined in accordance with 1.2.4.5 using approved procedures.

1.2.3.7 Dimensions and Dimensional Tolerances

1.2.3.7.1 The shape and proportion of links and accessories must conform to ISO 1704:1991 or to the designs specially approved.

1.2.3.7.2 The following tolerances are applicable to links:

a) Nominal diameter measured at the crown:
up to 40 mm nominal diameter: - 1 mm
over 40 up to 84 mm nominal diameter: - 2 mm
over 84 up to 122 mm nominal diameter: - 3 mm
over 122 mm nominal diameter: - 4 mm

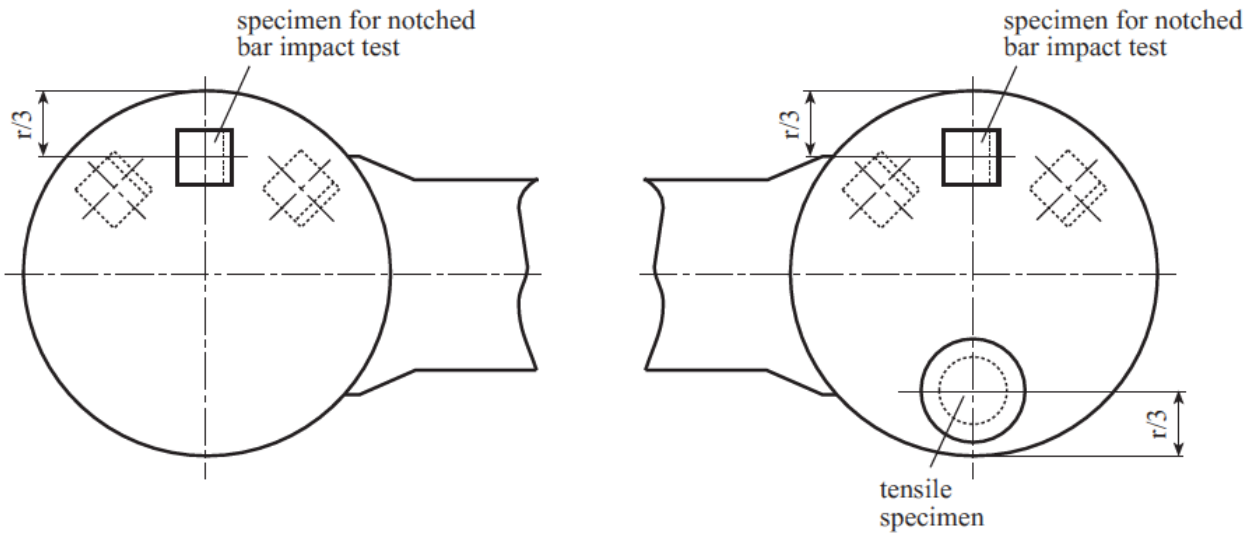


Figure 16A3.2 Location of test specimens

Table 16A3.3 Formulas for proof and breaking load tests, weight and length over 5 links

	Grade TL-R3	**Grade TL-R3S**	**Grade TL-R4**
Proof test load [kN] Break test load [kN]	0,0148 d^2 (44-0,08 d) 0,0223 d^2 (44-0,08 d)	0,0180 d^2 (44-0,08 d) 0,0249 d^2 (44-0,08 d)	0,0216 d^2 (44-0,08 d) 0,0274 d^2 (44-0,08 d)
Chain weight [kg/m]	0,0219 d^2		
Length over 5 links Min. [mm] Max. [mm]	22 d 22,55 d		

The plus tolerance may be up to 5 % of the nominal diameter. The cross sectional area at the crown shall have no negative tolerance.

b) Diameters measured at locations other than the crown: The diameter is to have no negative tolerance. The plus tolerance may be up to 5 % of the nominal diameter. The approved manufacturer specification is applicable to the plus tolerance of the flash butt weld.

c) The allowable manufacturing tolerance on a length of five links is + 2,5 %, but may not be negative.

d) All other dimensions are subject to a manufacturing tolerance of ± 2,5 %, provided always that all parts fit together properly.

e) Studs must be located in the links centrally and at right angles to the sides of the link. The following tolerances are acceptable provided that the stud fits snugly and its ends lie flush against the inside of the link:

Maximum off-centre distance "X" is 10 % of the nominal diameter, Maximum deviation α from the 90°- position is 4°. The tolerances are to be measured in accordance with Figure 16A3.3.

1.2.3.7.3 The following tolerances are applicable to accessories:

a) Nominal diameter: + 5,0 %, - 0 %

b) Other diameters: ± 2,5 %

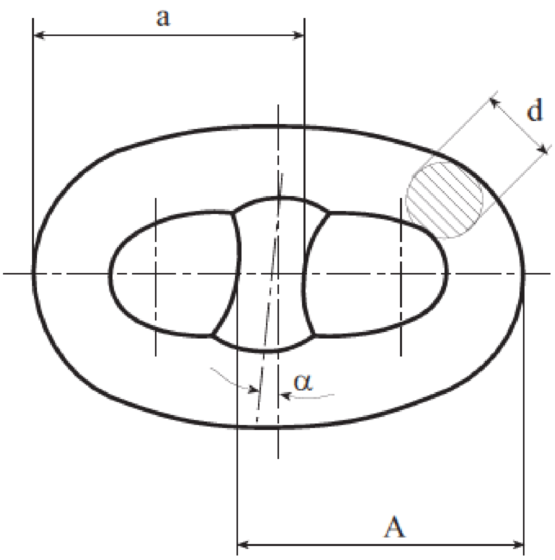
1.2.3.8 Welding of Studs

1.2.3.8.1 A welded stud may be accepted for grade TL-R3 and TL-R3S chains. Welding of studs in grade TL-R4 chains is not permitted unless specially approved.

1.2.3.8.2 Where studs are welded into the links this is to be completed before the chain is heat treated.

1.2.3.8.3 The stud ends must have a good fit inside the link and the weld is to be confined to the stud end opposite to the flash butt weld. The full periphery of the stud end is to be welded unless otherwise approved.

1.2.3.8.4 Welding of studs at both ends is not permitted unless specially approved.



off-centre distance:

$$X = \frac{A - a}{2}$$

Figure 16A3.3 Tolerances for stud position

1.2.3.8.5 The welds are to be made by qualified welders using an approved procedure and low-hydrogen approved consumables.

1.2.3.8.6 The size of the fillet weld shall as a minimum be as per API specification 2F.

1.2.3.8.7 The welds are to be of good quality and free from defects such as cracks, lack of fusion, gross porosity and undercuts exceeding 1 mm.

1.2.3.8.8 All stud welds shall be visually examined. At least 10 per cent of all stud welds within each length of chain shall be examined by dye penetrant or magnetic particle after proof load testing. If cracks or lack of fusion are found, all stud welds in that length are to be examined.

1.2.3.9 Connecting Common Links

1.2.3.9.1 Single links to substitute for test links or defective links without the necessity for re-heat treatment of the whole length are to be made in accordance with an approved procedure. Separate approvals are required for each grade of chain cables and the tests are to be made on the maximum size of chain cables for which approval is sought.

1.2.3.9.2 Manufacture and heat treatment of connecting common links is not to affect the properties of the adjoining links. The temperature reached by these links is nowhere to exceed 80 % of the tempering temperature.

1.2.3.9.3 Each link is to be subjected to the appropriate proof load and non-destructive examination as detailed in Table 16A3.3 and 1.2.4.5. A second link shall be made identical to the connecting common link; the link shall be tested and inspected according to 1.2.4.4. and 1.2.4.5.

1.2.3.9.4 Each connecting common link is to be marked on the stud in accordance with 1.2.4.7 plus an unique number for the link. The adjoining links are also to be marked on the studs.

1.2.4 Testing and Inspection of Finished Chain Cables

1.2.4.1 General

All chain cables are to be subjected to proof load tests, breaking load tests and mechanical tests after final heat treatment in the presence of a **TL** Surveyor. Where the manufacturer has a procedure to record proof loads and the Surveyor is satisfied with the adequacy of the recording system, he needs not witness all proof load tests. The Surveyor is to satisfy himself that the testing machines are calibrated and maintained in a satisfactory condition.

Prior to test and inspection the chain cable is to be free from scale, paint or other coating. The chain cable shall be sand or shot blasted to meet this requirement.

1.2.4.2 Proof and Breaking Load Tests

1.2.4.2.1 The entire length of chain cable shall withstand the proof load specified in Table 16A3.3 without fracture and shall not crack in the flash weld. The load applied shall not exceed the proof load by more than 10 % when stretching the chain cable. Where plastic straining is used to set studs, the applied load is not to be greater than that qualified in approval tests.

1.2.4.2.2 A breaking load test specimen consisting of at least 3 links is to be either taken from the chain or produced at the same time and in the same manner as the chain. The test frequency is to be based on tests at sampling intervals according to Table 16A3.4 provided that every cast is represented. Each specimen shall be capable of withstanding the break load specified without fracture and shall not crack in the flash weld. It shall be considered acceptable if the specimen is loaded to the specified value and maintained at that load for 30 seconds.

If the loading capacity of the testing machine is insufficient, another equivalent method shall be agreed with **TL.**

1.2.4.3 Dimensions and Dimensional Tolerances

1.2.4.3.1 After proof load testing measurements are to be taken on at least 5 per cent of the links in accordance with 1.2.3.7.

1.2.4.3.2 The entire chain cable is to be checked for the length, five links at a time. By the five link check the first five links shall be measured. From the next set of five links, at least two links from the previous five links set shall be included. This procedure is to be followed for the entire chain cable length. The measurements are to be taken preferably while the chain cable is loaded to 5 - 10 % of the minimum proof load. The links held in the end blocks may be excluded from this measurement.

Table 16A3.4 Frequency of breaking load and mechanical tests

Nominal chain diamete [mm]	**Maximum sampling interval [m]**
Min.- 48	91
49 - 60	110
61 - 73	131
74 - 85	152
86 - 98	175
99 - 111	198
112 - 124	222

1.2.4.4 Mechanical Tests

Links of samples detached from finished, heat treated chain shall be sectioned for determination of mechanical properties. A test unit shall consist of one tensile and nine impact specimens. The tensile specimen shall be taken at the side opposite the flash weld. Three impact specimens shall be taken across the flash weld with the notch centred in the middle. Three impact specimens shall be taken across the unwelded side and three impact specimens shall be taken from the bend region.

The test frequency is to be based on tests at sampling intervals according to Table 16A3.4 provided that every cast is represented. Mechanical properties shall be as specified in Table 16A3.1.

The frequency of impact testing in the bend may be reduced at the discretion of **TL** provided it is verified by statistical means that the required toughness is consistently achieved.

1.2.4.5 Non-destructive Examination

1.2.4.5.1 After proof load testing, all surfaces of every link shall be visually examined. Burrs, irregularities and rough edges shall be contour ground. Links shall be free from mill defects, surface cracks, dents and cuts, especially in the vicinity where gripped by clamping dies during flash welding. Studs shall be securely fastened**.**

1.2.4.5.2 Magnetic particle procedures shall be employed to examine the flash welded area including the area gripped by the clamping dies. Procedures and equipment in accordance with those approved shall be used. The frequency of examination shall be every link. Link surface at the flash weld shall be free from cracks, lack of fusion and gross porosity.

1.2.4.5.3 Ultrasonic procedures shall be employed to examine the flash weld fusion. Procedures and equipment in accordance with those approved shall be used. On-site calibration standards for chain cable configurations shall be approved.

The frequency of examination shall be every link.
The flash weld shall be free from defects causing ultrasonic back reflections equal to or greater than the calibration standard.

1.2.4.6 Retest, Rejection and Repair Criteria

1.2.4.6.1 If the length over 5 links is short, the chain cable may be stretched by loading above the proof test load specified provided that the applied load is not greater than that approved and that only random lengths of the chain cable need stretching.

If the length exceeds the specified tolerance, the over length chain cable links shall be cut out and 1.2.4.6.2 shall apply.

1.2.4.6.2 If single links are found to be defective or do not meet other applicable requirements, defective links may be cut out and a connecting common link inserted in their place. The individual heat treatment and inspection procedure of connecting common links is subjected to the **TL** Surveyor’s approval. Other methods for repair are subject to the written approval of **TL** and the end purchaser.

1.2.4.6.3 If a crack, cut or defect in the flash weld is found by visual or magnetic particle examination, it shall be ground down no more than 5 % of the link diameter in depth and streamlined to provide smooth contours. The final dimensions must still conform to the agreed standard.

1.2.4.6.4 If indications of interior flash weld defects in reference to the accepted calibration standards are detected during ultrasonic examination, 1.2.4.6.2 shall apply.

1.2.4.6.5 If link diameter, length, width and stud alignment do not conform to the required dimensions, these shall be compared to the dimensions of 40 more links, 20 on each side of the affected links. If a single particular dimension fails to meet the required dimensional tolerance in more than 2 of the sample links, all links shall be examined, 1.2.4.6.2 shall apply.

1.2.4.6.6 If a breaking load test fails a thorough examination, with the Surveyor informed in a timely manner, is to be carried out to identify the cause of failure. Two additional breaking test specimens representing the same sampling length of chain cable are to be subjected to the breaking load test. Based upon satisfactory results of the additional tests and the results of the failure investigation, it will be decided what lengths of chain cable can be accepted. Failure of either or both of the additional tests will result in rejection of the sampling length of chain represented, and 1.2.4.6.2 shall apply.

1.2.4.6.7 If a link fails during proof load testing, a thorough examination, with the Surveyor informed in a timely manner, is to be carried out to identify the probable cause of failure of the proof load test. In the event that two or more links in the proof loaded length fail, that length is to be rejected.

The above failure investigation is to be carried out, especially with regard to the presence in other lengths, of factors or conditions thought to be causal to failure.

In addition to the above failure investigation, a breaking load test specimen is to be taken from each side of the one failed link, and subjected to the breaking load test. Based upon satisfactory results of both breaking load tests and the results of the failure investigation, it will be decided what length of chain can be considered for acceptance. Failure of either or both of the breaking load tests will result in rejection of the proof loaded length.

Replacement of defective links is to be in accordance with 1.2.4.6.2.

1.2.4.6.8 If the tensile test fails to meet the requirements, a retest of two further specimens selected from the same sample shall be permissible. Failure to meet the specified requirements of either or both of the additional tests will result in rejection of the sampling length of chain cable represented, and 1.2.4.6.2 shall apply.

1.2.4.6.9 If the impact test requirements are not achieved, a retest of three further specimens selected from the same sample shall be permissible. The results shall be added to those previously obtained to form a new average. The new average shall comply with the requirements. Not more than two individual results are to be lower than the required average and not more than one result is to be below 70 per cent of the specified average value.

Failure to meet the requirements will result in rejection of the sampling length represented, and 1.2.4.6.2 shall apply.

1.2.4.7 Marking

1.2.4.7.1 The chain cable shall be marked at the following places:

- At each end
- At intervals not exceeding 100 m
- On links next to shackles or connecting common links

All marked links shall be stated on the Certificate, and the marking shall make it possible to recognise leading and tail end of the chain. In addition to the above required marking, the first and last common link of each individual charge used in the continuous length shall be adequately and traceably marked.

The marking shall be permanent and legible throughout the expected lifetime of the chain.

The chain cable shall be marked on the link as follows, compare Figure 16A3.4:

- Chain cable grade
- Test Certificate No.
- **TL** Surveyor's stamp
- Month and year of test

The Certificate number may be exchanged against an abbreviation or equivalent. If so, this shall be stated in the Certificate.

The chain cable Certificate shall contain information on number and location of connecting common links. The Certificate number and replacement link number may be exchanged against an abbreviation or equivalent. If so, this shall be stated in the Certificate.

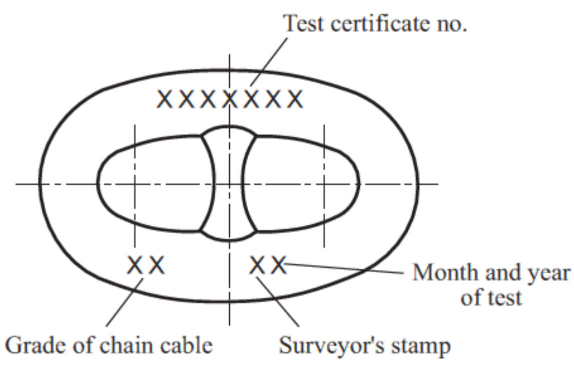


Figure 16A3.4 Stamping of chain cables

1.2.4.8 Documentation

A complete Chain Cable Inspection and Testing Report in booklet form shall be provided by the chain cable manufacturer for each continuous chain cable length. This booklet shall include all dimensional checks, test and inspection reports, NDT reports, process records, photographs as well as details of any non-conformity, corrective action and repair work.

Individual Certificates are to be issued for each continuous single length of chain cable.

All accompanying documents, appendices and reports shall carry reference to the original Certificate number.

The manufacturer will be responsible for storing, in a safe and retrievable manner, all documentation established for a period of at least 10 years.

1.2.5 Testing and Inspection of Accessories

1.2.5.1 General

All accessories are to be subjected to proof load tests, breaking load tests and mechanical tests after final heat treatment in the presence of a Surveyor. Where the manufacturer has a procedure to record proof loads and the Surveyor is satisfied with the adequacy of the recording system, he need not witness all proof load tests. The Surveyor is to satisfy himself that the testing machines are calibrated and maintained in a satisfactory condition.

Prior to test and inspection the chain cable accessories are to be free from scale, paint or other coating.

1.2.5.2 Proof and Breaking Load Tests

1.2.5.2.1 All accessories are to be subjected to the proof load specified for the corresponding chain.

1.2.5.2.2 Chain cable accessories are to be tested to the breaking test loads prescribed for the grade and size of chain cable for which they are intended. At least one accessory out of every batch or every 25 accessories, whichever is less, is to be tested.

For individually produced accessories or accessories produced in small batches, alternative testing will be subject to special consideration. Accessories which have been subjected to a breaking load test are to be scrapped.

1.2.5.3 Dimensions and Dimensional Tolerances

At least one accessory (of the same type, size and nominal strength) out of 25 is to be checked for dimensions after proof load testing. The manufacturer is to provide a statement indicating compliance with the purchaser's requirements.

1.2.5.4 Mechanical Tests

Accessories are to be subjected to mechanical testing as described in 1.2.2.3 and 1.2.2.4. For individually produced accessories or accessories produced in small batches, alternative testing will be subjected to special consideration.

1.2.5.5 Non-destructive Examination

After proof load testing all chain cable accessories are to be subjected to a close visual examination. Special attention is to be paid to machined surfaces and high stress regions. All non-machined surfaces are to be sand or shot blasted to permit a thorough examination. All accessories are to be checked by magnetic particle or dye penetration methods.

The manufacturer is to provide a statement that non-destructive examination has been carried out with satisfactory results. This statement should include a brief reference to the techniques and to the Operator's qualification.

1.2.5.6 Test Failures

In the event of a failure of any test the entire batch represented is to be rejected unless the cause of failure has been determined and it can be demonstrated to the Surveyor's satisfaction that the condition causing the failure is not present in any of the remaining accessories.

1.2.5.7 Marking

Each accessory is to be marked as follows:

- Chain cable grade
- Test Certificate No.

- **TL** Surveyor's stamp

- Month and year of test

All detachable component parts shall be stamped with a serial number to avoid mixing of components. The Certificate number may be exchanged against an abbreviation or equivalent. If so, this shall be stated in the Certificate.

1.2.5.8 Documentation

A complete Inspection and Testing Report in booklet form shall be provided by the manufacturer for each order. This booklet shall include all dimensional checks, test and inspection reports, NDT reports, process records as well as any non-conformity, corrective action and repair work.

Each type of accessory shall be covered by separate Certificates.

All accompanying documents, appendices and reports shall carry reference to the original Certificate number.

The manufacturer will be responsible for storing, in a safe and retrievable manner, all documentation established for a period of at least 10 years.

APPENDIX 4

WINCHES for POSITIONAL MOORING

1. General

1.1 Scope

General requirements for mooring winches are also dealt with in ISO Standard 3730 and 7825.

1.2 Documents for Approval

1.2.1 For each type of mooring winch general and sectional drawings, circuit diagrams of the hydraulic and electrical systems and detail drawings of the frame, main shaft, torque transmitting components in the gearbox, couplings, drum and brake are to be submitted in triplicate for approval.

1.2.2 One copy of the description of the mooring winch including the safety devices is to be submitted.

1.2.3 One copy of the strength calculation for bolts, chocks and stoppers securing the mooring winch to the deck are to be submitted.

1.2.4 If several mooring winches have to work together as a positional mooring system, an operating and maintenance manual including the interaction in the system is to be submitted.

2. Materials

2.1 Approved Materials

2.1.1 The provisions contained in **TL** Part A, Chapter 2 are to be applied as appropriate to the choice of materials.

2.2 Testing of Materials

2.2.1 The materials for forged, rolled and cast parts which are stressed by the pull of the mooring rope (main shaft, drum, brake bands, brake spindles, brake bolts, tension straps) are to be tested under supervision of **TL** in accordance with the **TL** Part A, Chapter 2.

2.2.2 In case of hydraulic systems, the materials used for pipes and pressure vessels are also to be tested.

2.3 Certificates

2.3.1 **TL** Material Certificates according to **TL** Part A, Chapter 2 will generally be required for:

- frame, drum, shaft(s), couplings, brakes, gear(s)

- mooring rope(s), including Certification of breaking load

2.3.2 Manufacturer Inspection Certificates according to the **TL** Rules defined in 2.3.1 may be accepted for standard items, if the manufacturer is recognized by **TL**.

3. Design of Equipment

3.1 Type of Drive

3.1.1 The drive of the winch shall be hydraulic or electric, a drive using steam would only be recommendable if the main propulsion system uses steam.

3.2 Winch Drums

3.2.1 If constant brake holding capacity and heaving forces are to be maintained, split drums with a tension section and a storage section should be provided. The tension section shall be wide enough for ten turns of mooring line to reach a very low load at the transfer point to the storage drum.

3.2.2 To ensure security of the rope end fastening at least 3 dead turns shall remain on the drum.

3.2.3 If an undivided drum is used, special attention is to be given to properly spooling of the mooring line to avoid line damage. If no special spooling device is provided the winch should be placed symmetrically and with a sufficient distance to the fairlead.

3.2.4 If a multi-drum winch is used, each winch drum shall be capable of independent operation.

3.2.5 The drum diameter shall be at least 16 times the wire rope diameter. The drum capacity shall be capable of storing the total length of the mooring line. For synthetic ropes the drum diameter shall be chosen according to ISO 3730.

3.2.6 If band brakes are used at the drum, mooring lines shall be spooled onto the drum on the correct direction, since band brakes are designed to work in one direction only.

3.3 Braking Equipment

3.3.1 Each mooring winch is to be provided with two independent power operated brakes, and each brake is to be capable of holding against a static load in the mooring line of at least 50 % of its breaking strength. Where agreed by **TL**, one of the brakes may be replaced by a manually operated brake.

3.3.2 On loss of power to the winch, the alternative power operated braking system shall be automatically applied and be capable of holding against 50 % of the anchor line breaking strength.

Winch brakes shall be of the fail safe spring applied type.

3.3.3 It is recommended to use disc brakes also for drum brakes instead of band brakes because disc brakes are less sensitive to friction changes.

3.3.4 Multiple drum winches require a brake for each drum.

3.3.5 Special attention shall be given to the strength of the connection of the brake band to the unit's structure.

3.3.6 Regardless of the brake type periodic brake testing is essential to assure a safe mooring. Testing provisions should be already incorporated in the winch design. A test program is to be submitted to **TL**.

3.4 Winch Control

3.4.1 A manned central control station shall be provided for the operation of the complete positional mooring system. Each winch shall be equipped with devices for measuring the mooring forces and the speed of the mooring rope. These values shall be monitored also at the central control station together with the wind speed and direction.

3.4.2 Each windlass shall be capable of being controlled from a position which provides a good view of the operation. Means are to be provided at the local windlass control position to monitor anchor line tension, speed and windlass power load and to indicate the amount of anchor line paid out.

3.4.3 Automatic tension mooring winches should only be used in the manual mode of operation. Otherwise the mooring position could be changed by automatically heave-in whenever the line tension falls on one line and pay out of the opposite line when the tension exceeds a pre-set value.

3.4.4 Reliable means are to be provided to communicate between all locations critical to the positional mooring operations.

4. Power and Design

4.1 Power and speed to be provided as well as design characteristics have to be agreed with **TL**.

4.2 The design of the mooring winch is to provide for adequate dynamic breaking capacity to control normal combinations of loads from the anchor, anchor chain cable, mooring line and anchor handling vessel during deployment of the anchors at maximum design payout speed of the winch.

4.3 Winches shall be clearly marked with the breaking strength of the mooring line for which they are designed.

4.4 For constructional details see also **TL** Part D, Chapter 50.

4.5 The attachment of the mooring winch to the hull structure is to be designed to withstand a force corresponding to the breaking strength of the mooring line.

5. Tests in the Manufacturer's Works

5.1 Testing of Power Units

The winch power unit has to be subjected to a test bed trial at the manufacturer's works with its rated performance.

A Manufacturer Test Certificate according to the **TL** Rules defined in 2.3.1 has to be presented on the occasion of the final inspection of the winch.

5.2 Pressure and Tightness Testing

Pressure components are to undergo a pressure test.

The test pressure is p_C:

$p_C = 1{,}5 \cdot p$

p = the maximum allowable working pressure [bar] = the pressure at which the relief valves open. However, for working pressures above 200 bar the test pressure need not exceed p + 100 bar.

Tightness tests are to be performed on components to which this is appropriate.

5.3 Final Inspection and Operational Testing

5.3.1 Upon completion, winches have to be subjected to a final inspection and an operational test to the rated load. The hauling speed has to be determined during an endurance test under the rated tractive force. During these trials, in particular the braking and safety equipment shall be tested and adjusted.

The brake has to be tested to a test load equal to the rated holding capacity.

5.3.2 If manufacturers do not have at their disposal the equipment required, a test confirming the design winch capacity, and including adjustment of the overload protection device, may be carried out after installation on board, see 6.

In that case only the operational trials without applying the prescribed loads will be carried out at the manufacturers.

6. Sea Trials

6.1 If the mooring winch could not be tested at the manufacturer's works with the rated performance, these tests shall be done during sea trials.

6.2 The interaction of the different mooring winches has to be tested in a realistic way as much similar as possible to the operation in service.

SECTION 17

FIRE FIGHTING

Page

A. General

1. Scope

1.1 The requirements of this Section apply to equipment on Offshore Service Vessels for fire fighting for all types of offshore installations and units.

1.2 The range of the equipment is determined by the type of duty for which the Offshore Service Vessels is intended and is denoted by a Notation affixed to the Character of Classification of the machinery in accordance with 5.

2. Definitions

Fire Fighting Vessel

Offshore Service Vessel which is designed and specially equipped to assist fixed offshore installations or mobile offshore units in fighting fires and related rescue operations in addition to their own fire fighting systems. This service can be combined with other services defined in these Rules.

3. Documents for Approval

3.1 Basic Documentation

Each of the following documents is to be submitted in triplicate respectively as single document in the case of electronic transmission for approval:

- Plan showing the arrangement of all fire extinguishing equipment required by this Section and giving details of type and performance of pumps and monitors

- Arrangement showing the location and design of the sea connections and sea chests for the fire fighting system

- Drawing showing the seating of the water monitors and giving details of their fastening method

- Arrangement of the remote operation equipment for the water and foam monitors

- Remote control equipment for water and foam monitors, if of electrical type

- Details of the location of fireman's outfits and of the compressor for refilling of breathing air cylinders details of the manufacturer, type, electrical power, protection degree and location of the searchlights

- Proof that the Offshore Service Vessels's propulsion plant and thrusters are capable of holding it (in calm waters) and in the required direction against the resultant forces of the monitors

- Documentation showing the stability in all fire fighting operating conditions based on the results of an approved inclining test (lightweight survey) and including the proof of the maximum heeling moment corresponding to the maximum output of all monitors in any direction

- Load balance calculation including required consumers in the case of fire fighting for simultaneous operation of fire pumps, thrusters, active rudders, water spray system, lighting, etc.

- Details on structural fire protection

- Torsional vibration calculation for engine driven monitor pumps having a power > 200 kW

3.2 Additional Documentation

According to the Notation affixed to the Character of Classification concerned, the following documents are also to be submitted in triplicate respectively as single document in the case of electronic transmission.

3.2.1 For FF1

- Diagram of the water spray system and the disposition of the nozzles, pumps and valves together with the capacity calculation of the water spray system

3.2.2 For FF2

- Details of the type and performance of the portable foam generator, foam concentrate calculation and location of the foam concentrate storage tanks

3.2.3 For FF3

- Details of the type and performance of the portable foam generator, foam concentrate calculation and location of the foam concentrate storage tanks

- Drawing of the fixed installed foam system including the storage tanks, mixing unit, monitors and pipelines as well as capacity calculation

4. Reference to Further Rules

4.1 The essential requirements of this Section are also defined in the **TL** Part C, Chapter 11.

4.2 In addition to these Guidelines the **TL,** Part B, Chapter 4, Part B, Chapter 4.1 and **TL**, Part B, Chapter 5 are also applicable.

4.3 For design, material and testing of the pumps the **TL,** Additional Rule, Design, Construction and Testing of Pumps shall be observed.

5. Classification, Notations

Fire fighting services will, depending on the size and purpose of the equipment provided, have in addition to the Notation **OFFSHORE SERVICE VESSEL** one of the following Notations affixed to their Character of Classification for the machinery installation:

FF1 Equipment for fighting fires in the initial stage and performing rescue operations in the immediate vicinity of the installation on fire.

FF2 Equipment for sustained fighting of large fires and for cooling parts of the installation on fire.

FF3 Corresponding to **FF2**, but with greater fire extinguishing capacity and additional fire extinguishing equipment.

FF1/2 or FF1/3 Equipment is corresponding to **FF2** or **FF3** and additionally suited for rescue operations as per **FF1**.

B. Basic Requirements

1. Manual for Operating, Testing and Maintenance

1.1 A manual for operating, testing and maintenance shall be carried on board.

1.2 The first part of the manual shall contain the description of the vessel's fire fighting systems and equipment together with the relevant instructions for operation, testing and maintenance. The second part shall contain instructions for the operation of the Offshore Service Vessels when in operation.

2. Manoeuvrability

2.1 In calm water the main propulsion plant, the thrusters and the steering gear shall enable the Offshore Service Vessel to maintain its position for all possible directions of the monitors. The relevant tests shall be carried out during sea trials.

2.2 In order to maintain full manoeuvrability, suitable control devices and interlocks are to be used to prevent overloading of the vessel's mains.

2.3 When the consumption of electrical power exceeds 90 % of the available capacity, a visual and audible alarm shall be provided on the bridge.

2.4 A control system for thrust and thrust direction, e.g. joystick system, shall be installed.

2.5 The steering gear shall be capable of changing the rudder angel from 35° on one side to 30°on the other side in 20 s with the vessel under way at maximum service speed.

3. Stability

The Offshore Service Vessel shall be able to withstand the maximum heeling moment resulting from the operation of all the monitors.

4. Lighting

4.1 For operation in the dark, at least 2 fixed installed searchlights are to be provided which are to be fitted with maintenance-free lamps and are capable of orientation in any direction.

4.2 The capacity of the searchlights shall be such as to produce a luminous intensity of 50 lux over an area of at least 11 m in diameter at a distance of 250 m in good visibility.

C. Fire Protection and Extinguishing Equipment

1. Range of Appliances and Equipment

1.1 The required items of equipment corresponding to the various Notations affixed to the Character of Classification are shown in Table 17.1.

1.2 For pumps involved in 'FF-service' a performance test is to be carried out in manufacturer's workshop under **TL** supervision.

2. Water Spray System

2.1 The water spray system is to be capable of protecting all the vertical external surfaces of the Offshore Service Vessel's hull exposed in the light-load condition, all vertical surfaces of superstructures and deckhouses, the mounting platforms of the monitors and deck areas above engine rooms and spaces in which combustible materials may be stored.

2.2 The capacity of the water spray system is to be calculated on the basis of 10 l/min per m^2 of area to be protected.

2.3 For areas protected by A-60 insulation (insulation inside), the water spray capacity may be reduced down to 5 l/min per m^2.

2.4 The water spray system is to be divided in such a way that sections which are not exposed to radiant heat or fire can be shut off.

2.5 The nozzles are to be so arranged that uniform distribution over the whole protected area can be achieved. Provision is to be made to ensure adequate visibility from the bridge.

2.6 Monitor supply water pumps may be used to operate the water spray system, provided that the capacity of the relevant pump(s) is increased by the amount of the additional demand.

2.7 If, besides the Offshore Service Vessel's emergency fire pump, two further fire pumps are available for the vessel's fire main, one of these pumps may be used for the water spray system provided that the total capacity of the fire pumps is sufficient to supply water at the required pressure simultaneously to the water spray system and the required number of hose connections according to 6.1.

2.8 The pipes of the fixed installed water spray system are to be effectively protected against corrosion, e.g. by hot-dip galvanizing or other equivalent means.

3. Water Monitor System

3.1 Design and Location of Water Monitors

3.1.1 Monitors shall be of approved type.

3.1.2 Monitors shall deliver a concentrated jet of water when operated at the required output.

3.1.3 At least two of the monitors are to be equipped with a permanently fitted control enabling either a solid or a spray jet to be delivered as required.

3.1.4 For the fastening of the monitors, the loads due to recoil action and sea condition are to be taken into account.

Table 17.1 Required equipment for the different notations

<table>
<tr><th rowspan="2">Equipment parameters</th><th colspan="4">Notation affixed to the character of classification</th></tr>
<tr><th>FF 1</th><th colspan="2">FF 2</th><th>FF 3</th></tr>
<tr><td>Water monitors :</td><td>2</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>Output [m^3/h] per monitor</td><td>1200</td><td>2400</td><td>1800</td><td>2400</td></tr>
<tr><td>Length of throw [m] (1)</td><td>120</td><td colspan="2">150</td><td>150</td></tr>
<tr><td>Height of throw [m] (2)</td><td>45</td><td colspan="2">70</td><td>70</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Pumps :</td><td>2</td><td colspan="2">2-4</td><td>2-4</td></tr>
<tr><td>Total pump capacity [m^3/h]</td><td>2400</td><td colspan="2">7200</td><td>9600</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Foam monitors :</td><td>-</td><td colspan="2">-</td><td>2</td></tr>
<tr><td>Duration of supply of foam concentrate for foam monitors [min]</td><td>-</td><td colspan="2">-</td><td>30 (3)</td></tr>
<tr><td>Foam capacity per monitor [litre/min]</td><td>-</td><td colspan="2">-</td><td>5000</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Portable foam generator :</td><td>-</td><td colspan="2">1</td><td>1</td></tr>
<tr><td>Duration of supply of foam concentrate for portable foam generator [min]</td><td>-</td><td colspan="2">30 (3)</td><td>30 (3)</td></tr>
<tr><td>High-expansion foam output of portable foam generator [m^3/h]</td><td>-</td><td colspan="2">100</td><td>100</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Water spray system</td><td>1</td><td colspan="2">- (4)</td><td>- (4)</td></tr>
<tr><td>Number of fire hydrants on each side of service vessel (hose connection)</td><td>4</td><td colspan="2">8</td><td>8</td></tr>
<tr><td>Fireman’s outfit (total numbers)</td><td>4</td><td colspan="2">8</td><td>8</td></tr>
<tr><td>Fuel supply [h] (5)</td><td>24</td><td colspan="2">96</td><td>96</td></tr>
</table>

(1) *Horizontal distance from monitor outlet to centre of impact area*

(2) *Vertical distance from surface of water to centre of impact area at a distance of at least 70 m from the closest portion of the vessel*

(3) *Duration (in minutes) of uninterrupted foam production with generator operating at rated output*

(4) *A water spray system is to be installed in the case of the combined Notations affixed to the Character of Classification **FF1/2** or **FF1/3***

(5) *With all monitors in uninterrupted operation*

3.1.5 Monitors are to be made of seawater resistant material.

3.1.6 Monitors shall be directed either forward or aft and shall be capable of being traversed horizontally through an angle of 45° with respect to each side of the Offshore Service Vessel.The angle of elevation is determined by the required height of throw. Within the required fields of traverse and elevation, the jet of water delivered bythe monitors shall not be obstructed by superstructures, masts, funnels, etc

3.2 Control of Water Monitors

3.2.1 Monitors and the associated valves shall be of remote operated type.

3.2.2 The handling of the remote operation shall be located in a safe area.

3.2.3 Local operation of the monitors and associated valves shall be provided as well.

3.2.4 Control systems shall be protected against external damages.

3.2.5 Hydraulic or pneumatic control systems are to be capable of being supplied from two mutually independent energy sources, e.g. main supply and emergency supply by generator set or battery.

3.2.6 Electrical control circuits shall be independent from each other. In electrical control systems an independent circuit is to be provided for each individual control unit.

4. Foam Monitor System

4.1 Capacity

4.1.1 Foam monitors shall be of approved type.

4.1.2 The capacity of permanently installed foam monitors is to be at least 5000 l/min of foam solution each.

4.1.3 With both monitors operating simultaneously the length of throw shall be at least 70 m.

4.1.4 The monitors shall be mounted at a level designed to achieve a maximum height of throw.

4.2 Foam Concentrate

The low-expansion foam concentrate shall be of approved alcohol resistant type suitable for oil and chemical fires.

4.3 Foam Generator

The foam generating plant including the associated pipework is to be permanently installed.

4.4 Control of Foam Monitors

For control of foam monitors 3.2 applies analogously.

5. Pumps, Sea Connections and Pipelines

5.1 Pumps

The pumps supplying water to the fire fighting and water spray systems together with their motors are to be installed in such a way that their operation and accessibility are not impaired by fumes or radiant heat during fire fighting.

5.2 Sea Connections and Sea Chests

5.2.1 Sea connections and sea chests are to be provided on both sides of the vessel for supplying the fire fighting systems. Sea chests are to be arranged as low as practicable in the vessel's structure to avoid icing or ingress of oil from the surface of the sea.

5.2.2 Sea chests openings are to be equipped with strum plates having a free section equal to at least twice the free section of the seawater intake pipe.

5.2.3 Sea connections and sea chests are to be designed and arranged so as to provide an adequate and uniform supply of water free from interference by movements of the vessel or current set up by thrusters and propellers.

5.2.4 The supply of water to other major systems shall not be affected by fire fighting operations.

5.2.5 Each sea connection is to be fitted with a remote operated shut-off valve.

5.2.6 Each monitor supply pump is to be connected to at least one sea chest/sea connection dedicated for fire fighting purposes.

5.3 Pipelines

5.3.1 Pipelines for fire fighting purposes (monitor supply, foam, water spray, etc.) on open deck shall be effectively protected against corrosion.

5.3.2 The wall thickness shall be in accordance with Tables 16.6 and 16.7 of **TL** Part C, Chapter 4, Section 16, C.

5.3.3 The velocity inside suction pipes shall normally not exceed 2 m/s and inside delivery pipes not exceed 4 m/s.

6. Portable Fire Fighting Equipment

6.1 Hose Connections and Hose Boxes

6.1.1 At least half the hose connections prescribed in these Rules are to be located on the open deck.

6.1.2 Hose boxes are to be provided for at least every second hose connection/hydrant.

6.1.3 Each hose box is to be equipped with two approved fire hoses, each 20 m long, one approved multi-purpose spray/jet nozzle and one hose wrench.

6.1.4 It is to be ensured that at least half the required hose connections can be operated simultaneously with a pressure of 5 bar at the nozzle outlet.

6.1.5 Where water is supplied to the hose connections by the pumps of the water monitors, a separate piping system is to be provided for this purpose. Where necessary, the pressure is to be reduced, e.g. by pressure-reducing valves, to the point where nozzles can be managed by one person each.

6.2 Portable Foam Generator

6.2.1 The portable foam generator required as per Table 17.1 shall be designed to produce at least 100 m^3 of high-expansion foam per minute.

6.2.2 The high-expansion foam concentrate shall be of approved type suitable for fires in machinery spaces and similar fire hazard areas.

6.2.3 The concentrate is to be stored in a readily accessible place in portable containers of approximately 20 l capacity each.

7. Fireman's Outfit

7.1 Scope of Fireman's Outfit Required

7.1.1 Fireman's outfit shall conform to **SOLAS 74**, as amended, Chapter II-2, Regulation 10, 10.

7.1.2 Self-contained compressed air breathing apparatuses are to be provided. 3600 l of breathing air (including spare cylinders) are to be provided for each breathing apparatus.

7.1.3 In addition to above, the number of fireman's outfits required by the flag state are to be supplied, one of which may be set against the equipment called for in Table 17.1.

7.2 Storage of Fireman's Outfits

7.2.1 The fireman's outfits are to be stored in a special room.

7.2.2 The room is to be clearly marked and accessible from the open deck.

7.2.3 The room shall be so arranged that the items of equipment can be stored in an orderly manner ready for immediate use.

7.2.4 Adequate ventilation and heating shall be provided in the storage room.

7.3 Compressor for Refilling of Breathing Air Cylinders

7.3.1 A breathing air compressor with a capacity of at least 300 l/min and equipped with all accessories necessary for filling simultaneously at least 4 breathing air cylinders is to be installed at a suitable position on the vessel.

7.3.2 Breathing air compressors are to be of approved type.

D. Tests and Trials

After completion, an operational test is to be carried out including verification of the equipment performance.

The heeling angle of the Offshore Service Vessel with the monitors in operation is to be determined on the basis of the most unfavourable conditions.

SECTION 18

DIVING SUPPORT

A. General

1. Scope

1.1 Diving Support

1.1.1 Definition

Offshore Service Vessels for diving support are designed to take on board complete fixed or mobile diving systems and to protect and support their operation by providing all auxiliary functions necessary for the diving system, like e.g. electrical or hydraulic power, elements of fire protection, etc.

1.1.2 Supporting services of the diving support vessel

For the safe and proper operation of the carried diving system the following supporting services are to be provided by the diving support vessel:

- Adequate foundations for all components, considering the loads from the diving system
- Structural measures on the vessel's hull, like arrangement of moon pools, see **TL** Part A, Chapter 1.
- Possibilities for arrangement of diving systems, see B.
- Electrical supply, see C.
- Hydraulic supply, see D.
- Gas supply, see E.
- Control and communication, see F.
- Positioning of the vessel (dynamic positioning or positional mooring), if it is required to keep the exact diving position, see F. and Section 16
- Active and passive hull stabilization, if applicable, see F.
- Fire protection, see G.
- Launch, recovery and transfer, at least partly, if already on board, see H.
- Preparation for hyperbaric evacuation, if applicable, see I.

The interfaces between the support vessel and the diving system are to be defined under consideration of applicable **TL** Rules.

1.1.3 Regarding the requirements for the acceptance tests and trials at the end of manufacture and installation on board see J.

1.2 Diving System

1.2.1 Definition

A diving system is a system for the support of diving operations especially in greater depths with following main components: decompression chamber, diving bell, hyperbaric evacuation system, launch, recovery and transfer system and installations for storage and filling of gases.

A further type of diving system is a diver launch system, which consists of a wet bell respectively a diver basket and the belonging launch and recovery system.

Diving systems which are designed, to be assembled and operated for a limited time period from different diving support vessels are called mobile diving systems.

1.2.2 Components of Diving Systems

In detail diving systems may consist of the following components:

- Decompression chambers
- Diving bells
- Wet bells
- Diver baskets
- Permanently installed gas containers

- Pressure vessels
- Pipes, valves, fittings and hoses.
- Umbilicals
- Breathing gas systems
- Life support systems
- Diver heating systems
- Sanitary systems
- Communication systems
- Electrical systems and equipment
- Automation, communication and locating equipment
- Gas analyzing systems
- Fire prevention, fire detection and extinguishing equipment
- Compressors
- Gas mixers
- Helium reclaim system
- Launching, recovery, transfer and mating systems
- Hyperbaric evacuation system

2. Definitions

For the purpose of these Rules the terms used have the meanings defined in the following unless expressly provided otherwise:

Decompression Chamber

A pressure vessel for occupancy of divers before or after missions aboard of a support vessel with means of controlling and monitoring the internal pressure within the chamber.

Diver Basket

A simple, completely open basket like a wet bell, but with no arrangement for a gas pocket at the upper part.

Diving Bell

A submersible pressure chamber, including its ancillary equipment, for transfer of divers under pressure between the work location and the decompression chamber.

Gas Cylinders

Bottles for storage and transport of gases under pressure.

Gas Storage

In the open or in spaces fixed installed containers with pressurized gas, where the breathing and working gases for the operation are stored.

Hyperbaric Evacuation System

An emergency system whereby divers under pressure can be safely evacuated from the support vessel to a location where decompression can be carried out.

Launch, Recovery and Transfer System

The plant and equipment necessary for launching, recovering and transfer of the diving bell between the work location and the decompression chamber.

Launch, recovery and transfer systems may be applied also for hyperbaric evacuation systems, compare I. and for wet bells.

Mating Device

Necessary equipment for the connection of a diving bell to a decompression chamber.

Nominal Diving Pressure

The nominal diving pressure NDP [bar] is the pressure which corresponds to the nominal diving depth NDD [m] for unrestricted diving operation of the diving system.

Pressure Chamber

Pressure vessel for human occupancy (PVHO) at higher than atmospheric pressure, normally equipped with means of controlling and monitoring.

Umbilical

Connection between support vessel and diving bell/wet bell respectively between diver and the adjacent supply arrangement, which might contain monitoring, communication and power supply cables, breathing gas and hot water hoses. The lifting cable for lifting and lowering the diving bell/wet bell may be part of the umbilical.

Wet Bell

Open submersible device, including accessories, for the carriage of divers at the ambient pressure with a gas pocket in the upper part prevailing between support vessel and the underwater site.

3. Documents to be Submitted for Approval

The following documents concerning the supply and assisting services for the diving system are to be submitted:

3.1 Total system

- Main dimensions and parameters, general arrangement drawings of the diving system
- Foundation drawings showing fixed and free points
- Further installation drawings
- Drawings of supply and disposal systems

3.2 Electrical equipment

- A general arrangement drawing of the electrical equipment containing at least the following information:
  - Voltage rating of systems
  - Power or current ratings of electrical consumers
  - Switchgear, indicating settings for shortcircuit and overload protection; fuses with details of current ratings
  - Cable types and cross-sections
- Energy balance of the main and emergency power supply systems
- Drawings of switchgear and distribution equipment
- Battery installation drawing with details of battery types, chargers and battery room ventilation.

3.3 Hydraulic supply

- Diagram of the hydraulic system
- All the data necessary for assessing the system, e.g. operating data, descriptions, etc.

3.4 Gas supply

- Piping diagrams, block diagrams and descriptions are to be furnished for the entire gas supply system (breathing gases as well as compressed air)
- Description of compressors and their drives with definition of essential design and operating data

3.5 Control and communications

- General arrangement drawings/block diagrams of control equipment
- Description of alarms to be integrated in the diving support vessel
- General arrangement drawings and description of communications systems and signaling equipment

- Arrangement drawing and description of the video system

3.6 Fire protection

- A description of the preventive fire protection measures

- Description of the fire load in the diving system

- Drawings and descriptions of fire detection system, fire alarm equipment, fire extinguishing system(s)

3.7 Launching, recovery, transfer and mating systems

3.7.1 Launch and recovery system

- General arrangement and description of the system

- Data about installation and connecting conditions including control stand

- Substructures of launch and recovery systems, coil-up/coil-off mechanism for umbilicals

- Substructures of handling gear and winches

- Connecting data of the hydraulic or pneumatic systems

- Information about nominal data and type of protection of electrical installations

3.7.2 Installation for stowage and deck transport

- Plans with description of the transport, the stowage and the lashing measures including parts list of the lashing material required

- Description of the electrical measures

- Description of the fire protection measures

- Description of the explosion protection measures

4. Rules to be Considered

4.1 TL Rules

The latest issue of following **TL** Rules is to be considered:

- Part A, Chapter 1

- Part D, Chapter 52

4.2 International conventions and codes

The following IMO Resolutions have to be considered:

- IMO Resolution A.831(19) as amended by MSC 185(79): "Code of Safety for Diving Systems", 1995

- IMO Resolution A.692(17): "Guidelines and Specifications for Hyperbaric Evacuation Systems", 1991

- IMO Resolution A.714(17): "Code of the Safe Practice for Cargo Stowage and Securing", as amended

5. Classification, Notations

5.1 Diving support vessel

5.1.1 A support vessel that fulfils the requirements of this Section and which has on board systems for supporting diver operations as well as at least a fixed installed diver pressure chamber and does not need a diving bell to perform diving operations is assigned the Class Notation **DSV 1** in addition to the Notation **OFFSHORE SERVICE VESSEL.**

5.1.2 A support vessel that fulfils the requirements of this Section and which has on board a fixed installed diving system which needs for its operation a diving bell, the vessel is assigned the Class Notation **DSV 2** in addition to the Notation **OFFSHORE SERVICE VESSEL**.

5.2 Diving systems

5.2.1 The Classification of diving systems comprising the components defined in A.1.2.2 is to be performed according to the requirements of **TL** Part D, Chapter 52.
The character of Classification for diving systems is:

TAZ

5.2.2 Diving systems, which shall not be classified by **TL**, but which shall be constructed and tested according to the Rules and under survey of **TL**, may receive an adequate System Certificate from **TL**, see also **TL TL** Part D, Chapter 52.

6. Marking

The marking of:

- Valves, fittings, indicating and warning devices

- Pressure vessels and gas cylinders

- Compressors

- Launch and recovery system

is defined in **TL** Part D, Chapter 52.

B. Arrangement of Diving Systems

1. General

1.1 Diving systems on diving support vessels may only be located and operated in areas not subject to an explosion hazard. In exceptional cases, installation subject to special conditions may be permitted in the highest explosion protection (or lowest explosion potential) zone.

1.2 As far as possible, the area in which the diving system is installed is to be kept free of combustible materials. In addition, only those electrical cables needed to operate the diving system shall be routed through this area.

1.3 It is not permitted to locate diving systems and breathing gas storage facilities in engine rooms unless the engine plant is connected to the diving system.

1.4 Diving systems and breathing gas storage facilities are to be located in spaces which can be adequately ventilated and provided with suitable electric lighting.

1.5 Where parts of the diving system are located on the open deck, these are to be protected against influences caused by seaway and against damage due to other shipboard activities.

2. Filling Stations for Breathing Gases

2.1 Filling stations are to be arranged that operating, surveillance and maintenance personnel or other persons nearby are not endangered.

2.2 Filling stations for breathing gases are not to be installed in areas where internal combustion engines or boilers are in operation.

2.3 Filling stations for breathing gases are to be arranged with sufficient space for operation, maintenance and cleaning, escape and rescue corridors as well as for fire extinguishing.

2.4 Pipe connections between filling stations for compressed air for production of breathing gases and other compressed air systems on board are only be established with special approval of **TL** and under consideration of additional protection measures.

2.5 Oxygen pipes are to be routed separately from oil pipes. Pipelines carrying oxygen under high pressure shall not be routed through accommodation spaces, engine rooms or similar compartments.

2.6 Gas under pressure, which is discharged by the safety devices, is to be drawn off in a suitable way.

2.7 Oxygen compressors are to be installed in separate spaces which have adequate ventilation

2.8 Closed spaces for filling stations are to be provided with mechanical ventilation of at least 8 air changes per hour. The air is to be sucked from an area which is not endangered by explosion.

2.9 Spaces where breathing gas systems for oxygen and/or nitrox are installed have to be provided with fire warning devices. Floor drainage has to be avoided.

3. Storage for Breathing Gases

3.1 For each diving system a permanently installed gas storage facility or a suitable location for the storage of portable gas cylinders is to be provided on board.

3.2 Oxygen bottles are to be placed in well ventilated positions and may not be stored close to combustible materials.

3.3 Spaces in which oxygen is stored are to be separated from the adjoining spaces by bulkheads and decks of Type "A-60" and are to be arranged to facilitate speedy exit in case of danger.

3.4 Spaces into which oxygen can penetrate are to be equipped with oxygen indicating and alarm devices. The oxygen sensor is to be installed near the floor. A monitored suction of space air near the floor may be provided as an alternative.

4. Mobile Diving Systems

4.1 The requirements defined in 1. to 3. for permanently installed diving systems are also valid for mobile diving systems.

4.2 To allow the installation of the different elements of mobile diving systems suitable foundations and fixing points are to be provided on the main deck of the diving support vessel.

4.3 It shall be possible to lift the diving system on board by using a crane - which may not be a part of the diving support vessel - and then to shift the different elements on prepared foundations to their final place and secure them to the fixing points.

4.4 The piping systems, the electrical power cables and the control lines between the different elements and to the supply stations of the vessel are to be protected against any kind of damage.

C. Electrical Supply

1. General

For general requirements of the electrical supply system of the Offshore Service Vessel see Section 11.

2. Supply Systems

2.1 Approved supply systems are:

- Direct current and single-phase alternating current: 2 conductors insulated from vessel's hull

- Rotary current (three-phase alternating current): 3 conductors insulated from vessel's hull

2.2 The use of the diving system, the vessel's hull or parts thereof for the return of electrical current is not permitted.

2.3 Earth networks for the electrical supply system are not permitted.

Exceptions may be allowed in the case of subsystems using isolating transformers and high-resistance systems earthing.

3. Protective Measures

3.1 All electrical equipment is to be protected in accordance with the requirements defined in Section 11, F.

3.2 To protect divers against excessive contact voltages and electric shock, additional safety measures are to be taken to avoid or restrict dangerous fault currents. These measures are to be agreed with **TL** in each single case.

3.3 The connection of the protective conductor to the hull of the support vessel shall be located at a point where it can easily be checked.

4. Earthing and Potential Equalization

For earthing is to be considered:

a) Diving systems are to be equipped with an earthing and potential equalizing system. Connections for external earthing are to be provided at all pressure chambers, also in gas storage and filling stations, etc.

b) All metal parts of electrical installations - with the exception of live (active) components - are to be connected for potential equalization.

c) The connections of the potential equalization at the diving bell/wet bell shall be installed where it can easily be checked.

In an easily accessible position of the superstructure of the support vessel and on the diving bell/wet bell a connection point in the form of a connecting plate with preferably M12 stud bolts is to be provided to which protective conductors can be connected without tools. This connection serves for the compensation of the potential between the diving system and the support vessel.

d) The connections between the earthing conductor and the decompression chambers to the support vessel's earth are to be made with corrosion resistant screw connections effectively safeguarded against accidental loosening. The screw connections are to be dimensioned according to the requisite cross-sections of the earth conductor to be connected and may not be used for other purposes.

e) Earth connections are to be accessible for maintenance and inspection. They are to be marked. Earthing conductors in cables are to be marked green and yellow, at least at the terminals.

f) Earthing conductors are to be provided with corrosion protection compatible with their place of installation.

g) Cable sheaths and armouring are not to be used as earthing conductors.

5. Power Supply

5.1 Principles

5.1.1 All electrical equipment essential to the safety of divers and diving operations is to be connected independently to the main and an emergency power supply.

5.1.2 Where provision is made for automatic switching from the main to the emergency power supply, each such switching operation has to actuate in the central control position of the diving system a (visual and audible) signal requiring acknowledgement. An indicator has to show which supply is connected.

5.1.3 The main power supply to the diving system can be taken directly from the main switchboard of the support vessel respectively from the main power source of the diving system, if applicable.

5.1.4 Wherever necessary, an uninterruptable power supply (UPS) with sufficient capacity has to be provided.

5.2 Main power supply

5.2.1 A power balance is to be prepared to prove that units for the generation, storage and conversion of electric power are adequately rated. This balance shall take account of the full power consumption of those consumers which are permanently required in service.

5.2.2 The power consumption of consumers which are connected for limited periods may be determined by applying a simultaneity factor.

5.2.3 To meet the power requirements during brief peak loads, e.g. when motors are started automatically, a reserve capacity is to be shown.

5.2.4 The generating equipment of the main power supply is to be so designed that the voltage and frequency variations allowed by the **TL** Part B, Chapter

5, Section 1 are not exceeded.

5.3 Emergency power supply

5.3.1 Emergency power supply from support vessel

If the emergency power supply is part of the support vessel, the following requirements are to be considered:

5.3.1.1 The capacities of the diving system and the support vessel have to be adapted to each other. The emergency power supply shall be able to meet the emergency power requirements for the saturation diving system for a period of at least 48 hours respectively for diver pressure chambers for a period of at least 5 hours.

5.3.1.2 The emergency power supply shall be able to meet simultaneously in addition to the emergency consumers of the support vessel the requirements of at least the following items of equipment:

- Emergency lighting systems in decompression chambers and diving bells as well as in the spaces required for operation

- Emergency communication systems

- Life support systems required for emergency

- Launch, recovery and transfer systems required for emergency

- Central control position as well as required surveillance and alarm systems

5.3.1.3 In the design of the emergency power supply system, appropriate reserve capacity is to be provided to meet peak loads (e.g. caused by the starting of electric motors).

In determining the necessary battery capacity, allowance is also to be made for the cut-off voltage and voltage drop of batteries.

5.3.2 Emergency power supply independent from the support vessel

If an independent emergency power supply as part of the diving system will be provided, the following is to be considered in addition to 5.3.1:

5.3.2.1 The emergency power source for the diving system is to be installed in a space separated from the main power source and the main switchboard so that it also remains operational in case of a fire or other major damage affecting the main power supply.

5.3.2.2 If the emergency power supply is temporarily installed, plug-in connections are normally to be omitted. If they cannot be avoided, measures against misuse have to be agreed with **TL**.

Cables and connections are to be protected against mechanical damages (see also B.4.4).

6. Power Distribution

6.1 Electrical distribution systems are to be so designed that a fault or failure in one circuit cannot impair the operation of other circuits or the power supply.

6.2 The following consumers are to be supplied at least via individual circuits equipped with all necessary safety devices and switchgear from a distribution panel supplied directly from the main switchboard of the support vessel:

- Launch, recovery and transfer systems of the support vessel for the diving bell/wet bell

- Lighting system for decompression chambers and diving bells

- The electrical consumers of the life support systems

- Communication systems

6.3 In normal operation the emergency power distribution system of the diving system may be supplied via a transfer line from the main power distribution system.

7. Lighting

7.1 Service and work spaces, safety and control stations are to be equipped with normal and emergency lighting.

7.2 The lighting is to be so designed and arranged that all important instruments and markings can be read and any necessary operations can be safely performed. As far as possible the interior lighting shall be arranged glare-free.

7.3 The emergency lighting is to be independent from the main lighting. This concerns the power generation as well as the distribution and cable network. Emergency lights are to be marked as such to facilitate easy identification.

The emergency lighting has to be automatically switched on in case of failure of the main lighting. Switches for switching-off the emergency lighting are to be arranged only locally, e.g. at the control stand.

7.4 All lighting fixtures shall be so mounted that combustible parts are not ignited by the generated heat, and they themselves are not exposed to damage.

D. Hydraulic Supply

1. Needed Capacity

The needed capacity of hydraulic fluids (volume, pressure range, medium) is to be defined by the manufacturer or operator of the diving system and has to be made available at any time by the support vessel. The additional demand for eventual working devices of the divers is to be considered, (compare **TL** Part D, Chapter 54).

2. General Requirements

As far as applicable, the requirements defined in **TL** Part B, Chapter 4, Section 10 are valid.

3. Additional Requirements

The following requirements are to be considered additionally:

- If a dangerous condition for the consumers may arrive if the main supply fails, special measures are to be provided in accordance with **TL.**

- The permissible deviations of volume and pressure are to be in accordance with the data of the manufacturer of the diving system and shall not be exceeded resp. shall not fall short of.

- The hydraulic oil is to be suitable for the operational conditions and especially for the environmental conditions under water (see Section 9, A.).

- When selecting the hydraulic oil, allowance is to be made not only for the service conditions but also for the temperatures occurring during the commissioning or repair.

- Hydraulic systems are to be fitted with filters to keep hydraulic fluid clean. In addition, provision is to be made for venting and dewatering the system. Hydraulic fluid tanks are to be fitted with level indicators. Wherever necessary, hydraulic systems are to be equipped with means of cooling the hydraulic fluid.

- Hydraulic lines should not be routed close to oxygen systems.

- Wherever necessary, the possibility of a pressure rise due to the penetration of seawater into the system is to be considered.

- To protect the hydraulic system from over pressurization, a closed circuit safety valve shall be fitted and the discharged oil shall be returned into the system.

- Hydraulic systems are to be equipped with all the indicating devices necessary for the operation of the system.

E. Gas Supply

1. Supply of Breathing Gases

1.1 The arrangement of the filling station and of the storage for breathing gas is defined in B.2. and B.3.

1.2 The following requirements are to be considered additionally:

- The supply pressure is to be indicated at the central control position.

- If the supply pressure falls short an alarm is to be triggered at the central control position.

- An emergency supply is to be established for the time to safely finish the operation of the divers resp. to surface in a safe way.

- Measures are to be taken to hinder the entrance of seawater in the systems as far as possible.

2. Supply of Compressed Air

2.1 For the calculation, choice of materials and manufacturing of the compressed air supply system for the diving system on the Offshore Service Vessel the **TL** Part B, Chapter 5, Section 11 are to be recognized.

2.2 The following requirements are to be considered additionally:

- The demand of compressed air (volume, pressure range) defined by the manufacturer or operator of the diving system has to be made available by the support vessel at any time. The additional demand for eventual working devices is to be considered, compare **TL** Part D, Chapter 53 and **TL** Part D, Chapter 54.

- If a dangerous condition for the consumers may arrive in case of the main supply fails, special measures are to be provided in accordance with **TL**.

- If necessary, the emergency supply shall be able to provide during operations the defined demand of compressed air until a safe condition of the diving system is reached.

- The permissible deviations of volume and pressure are to be in accordance with the data of the manufacturer or operator of the diving system and shall not be exceeded resp. shall not fall short of.

- Between the supply system for underwater operations and the compressed air system for the operation of the Offshore Service Vessel a safe separation is to be provided.

F. Systems for Control and Communication

1. General

Systems for control of the diving support on board of the support vessel are:

- Central control position

- Communication between the different operating areas on the support vessel

- Video surveillance, if applicable

- Positioning system, if applicable

- Active and passive hull stabilization of the support vessel, if applicable

2. Central Control Position

In case of permanently installed diving systems on board of the Offshore Service Vessel the following is to be considered:

2.1 The central control position of the diving system has to have sufficient protection against other operation spaces (noise protection, visual protection, no access/passing to other operating spaces).

2.2 This central control position is to be so equipped with a separate ventilation and exhausting system to achieve optimum conditions for personnel and equipment. The intake of the air is to be routed from an area not subject to explosion hazard.

2.3 This central control position is to be monitored concerning fire protection and the possibility of effective fire fighting herein is to be provided without endangering the safe operation of the diving system.

3. Voice Communication Systems

3.1 Offshore Service Vessels for diving support are to be equipped with a suitable communication system providing direct voice communication between the central control position and:

- Divers in water
- Diving bell/wet bell
- Each compartment of the decompression chambers
- Control stand for launch, recovery and transfer systems
- Mating system
- Control stand for dynamic positioning of the Offshore Supply Vessel, if applicable
- Bridge of the support vessel and necessary operating rooms

3.2 A telephone link independent of the main power supply is to be provided in addition to the communication system specified in 3.1.

3.3 Electrically powered voice communication systems shall be provided with a reliable power supply. This normally means that the equipment shall be supplied from a storage battery with a parallel connected mains unit and battery charger supplied with energy in accordance with C.

4. Video Surveillance

4.1 If necessary for the safe operation of the diving system, the number, location and visual angle of the video cameras are to be chosen in a way that, as far as possible, the complete working area or room to be monitored is covered.

4.2 A sufficient number of video monitors is to be provided at the central control position respectively on the bridge. On each monitor it shall be possible to definitely recognize which area or room is shown at the moment.

5. Positioning of the Vessel

5.1 For keeping a position or a predetermined track during a diving operation, the Offshore Service Vessel is in general to be equipped with a positioning system. This will become especially necessary for diving systems with guide wires for the diving bell and an umbilical connection to the support vessel.

5.2 For positioning of the Offshore Service Vessel the following options may be considered:

- Positional mooring with cables and anchors
- Dynamic positioning by a greater number of thrusters
- Combination of mooring and dynamic positioning

5.3 All requirements for Classification of the different positioning systems are defined in Section 16.

5.4 For the case of loosing the position, the possibility to trigger an alarm is to be provided.

6. Active and Passive Hull Stabilization

To facilitate the diving operations at the diving station active or passive roll reduction systems are recommended, refer to Section 20.

G. Fire Protection

1. Structural Fire Protection

1.1 For the Offshore Service Vessel on which the diving system is installed, the fire protection rules of **TL**

respectively the relevant regulations of the International Convention for the Safety of Life at Sea (**SOLAS**) of 1974, as amended are to be met.

1.2 In the area of installation of the diving system, the gas storage facility and the central control position, sources of ignition and fire loads are to be reduced to a minimum. As far as possible, materials which are at least flame-retardant are to be used. Heat insulation is to be made of incombustible materials.

1.3 Diving systems on Offshore Service Vessels are only to be installed and operated in areas not subject to explosion hazard.

1.4 Where diving systems or parts thereof are installed in closed spaces, these spaces including the central control position are to be separated from the deck and the rest of the vessel by partitions of type "A-60".

1.5 Enclosed spaces or parts thereof are to be provided with a forced ventilation system capable of effecting at least 8 changes of air per hour. The air is to be drawn from an area not subject to explosion hazard.

2. Fire Detection System

2.1 Interior spaces containing parts of the diving system, such as decompression chambers, diving bells, filling stations, compressors and control positions are to be monitored by a fire detection system.

2.2 The detected fire is to be signalled visually and audibly in the permanently manned central control position and on the bridge of the vessel.

2.3 The fire alarm may be actuated manually from the permanently manned central control position or may be automatically activated by the fire detection system.

2.4 Fire detection systems including central fire detection station, fire detectors and wiring of the detection loops require the approval of **TL**.

2.5 Fire detection systems are to be so constructed that any fault, as e.g. supply failure, shortcircuit or wire breakage in the detection loops, or the removal of a detector from its base, triggers a visual and audible signal at the fire detection station in the central control position.

2.6 For the design and arrangement of fire detection and alarm systems the **TL** Part B, Chapter 5 and **TL** Part B, Chapter 4.1 are to be observed.

3. Fire Extinguishing Systems

3.1 Every support vessel on which a diving system is installed is to be equipped with a general water fire extinguishing system consisting of hydrants as well as portable and mobile fire extinguishers and extinguishing equipment according to the **TL** Part B, Chapter 4, Section 18.

3.2 Where pressure chambers are situated in enclosed spaces, a permanently installed water spray system having an application rate of at least 10 ℓ/m^2 and per minute related to the horizontal projected area is to be provided for cooling in the event of fire. These water spray systems may be manually activated and operated.

3.3 For pressure chambers installed on the open deck, cooling by means of fire hoses connected to the general fire extinguishing system is permitted.

3.4 Interior spaces containing diving systems or parts thereof are to be additionally equipped with approved manual fire extinguishers. One of the portable fire extinguishers shall in every case be situated close to the entrance to the space concerned.

3.5 The central control position of the diving system is to be equipped with at least one independent compressed air respirator of approved design having an operating capability of at least 30 minutes and fitted with equipment for voice communication with the divers.

H. Launch, Recovery and Transfer System

1. Launch and Recovery System

The requirements for the launch and recovery system for diving bells, wet bells and diver baskets can be taken in analogous way from Section 19, F.

2. Stowage and Deck Transport on Board

2.1 The deck transport is the transfer of the diving bell/wet bell/diver basket recovered by the launch and recovery system to a deposit location aboard. The deposit location is to be protected normally against environmental influences, especially if maintenance and repair work has to be done. The diving bell/wet bell/diver basket is to be safely transferred, stowed and lashed for all thinkable vessel movements

Note

The requirements of the IMO Code A.714(17), as amended: "Code of the Safe Practice for Cargo Stowage and Securing" are to be considered.

2.2 At the superstructures of the support vessel a connecting possibility in form of a connecting plate with stay bolt preferably M12 is to be provided at an easily accessible position, on which the protective conductor of the diving bell/wet bell can be connected without using tools.

2.3 For the stay of the diving bell/wet bell on deck of the support vessel the measures defined in 2.2 are to be so arranged, that an uninterrupted equalization of the potential is possible.

2.4 Areas for transport and stowage are to sufficiently illuminated, see also C.7.

2.5 The stowage location for the diving bell/wet bell/diver basket on the support vessel is to be equipped with suitable fire extinguishing systems. This system may be a part of the fire extinguishing system of the support vessel, see also G.

2.6 Explosion protection measures for areas with explosion hazards, from which the diving bell/wet bell/diver basket shall undergo missions, are to be provided.

I. Hyperbaric Evacuation System

1. General

1.1 An emergency system is to be provided to evacuate the divers under pressure, in the case that the support vessel has to be abandoned, see **TL** Part C, Chapter 52.

2. Possible Evacuation Systems

Depending on the local, geographical and other service conditions, different kinds of evacuation systems are conceivable, including:

- hyperbaric self-propelled lifeboats
- towable hyperbaric evacuation units
- hyperbaric evacuation units, which may be towable, suitable for offloading onto an attendant vessel
- transfer of the diving bell to another ship
- transfer of the divers from one diving bell to another when in the water and under pressure
- negatively buoyant unit with inherent reserves of buoyancy, stability and life support capable of returning to the surface after a certain time to await independent recovery.

If the life boats of the Offshore Service Vessel are designed as fire-protected life boats, their requirements are also to be applied to hyperbaric evacuation systems.

3. Launching of the Evacuation System

3.1 The launching system shall be able to bring the hyperbaric evacuation system safely to water and where required to take it up and mate again. If the system is floating in water, attention is to be paid especially to easy and rapid separation from the suspension considering that not always an experienced crew will be available.

3.2 Disconnection and launching shall also be possible if the Offshore Service Vessel's power fails.

3.3 The design and testing of the launching system shall conform to the relevant national and international regulations.

J. Tests and Trials

The requirements for the acceptance tests and trials at the end of manufacture and installation on board are defined in the following. Even if parts of the complete diving system form not an integrated part of the support vessel, also these parts have to be tested together with the support vessel before start of diving operations. The surveys for maintenance of Class during the Class period of the diving support vessel have to be performed according to **TL** Rules for Classification and Surveys.

1. General

1.1 The systems and components assisting and supplying diving systems on board of diving support vessels are subject to constructional and material tests as well as to pressure, load and tightness tests and trials. As a minimum requirement, this shall include verification of compliance with the approved documents, inspection of workmanship, the verification of materials and checking of dimensional tolerances. All the tests prescribed in the following are to be performed and documented, wherever applicable. About the presence of **TL** Surveyors at these tests and trials **TL** will decide in each individual case.

1.2 For series-manufactured parts, test procedures other than those prescribed may be agreed with **TL** provided that they are recognized as equivalent by **TL**.

1.3 **TL** reserves the right to extend the scope of the tests where necessary and also to subject to test those parts for which testing is not expressly prescribed in the Rules.

1.4 The test Certificates for the applied materials, reports on non-destructive testing of welds and, if applicable, the results of inspections of workmanship and evidence of heat treatments performed are to be presented.

1.5 Gas storage systems including piping systems are to be subjected to a tightness test with the adequate breathing gas or a gas mixture with similar properties at maximum allowable working pressure. As maximum permissible leakage rate 1 % pressure drop within 24 hours for the whole compression chamber system is valid.

1.6 After the components of the diving system have been installed on board, the diving system together with its ancillary plant is to be subjected to functional tests. All items of safety equipment are to be tested except where a sufficient trial has already been performed on the manufacturer's premises in the presence of **TL**.

1.7 Parts subject to replacement are to be replaced with tested parts. The same also applies to spare parts.

2. Electrical Equipment

2.1 Electrical machines, components and cables are to be tested in the manufacturer's works in accordance with the **TL** Part B, Chapter 5.

2.2 The electrical systems and equipment of the support vessel are to be inspected and tested before the diving system is put into service.

2.3 Electrical protective devices and especially the measures for earthing of the diving system to the support vessel are to be checked.

3. Hydraulic Equipment

3.1 The power units are required to undergo testing on a test bed.

3.2 Pressure components are to undergo a pressure test.

The test pressure is p_p.

$p_p = 1{,}5 \cdot p_c$

p_c = Design pressure for which a component or piping system is designed with its mechanical characteristics [bar]. For pressures above 200 bar the test pressure need not exceed p + 100 bar.

3.3 Tightness tests are to be performed on components to which this is appropriate.

3.4 Subsequently a complete functional test for normal and emergency operation is to be performed.

4. Compressors

4.1 Compressor components subjected to pressure are to undergo a hydraulic pressure test at a test pressure equal to 1,5 times the delivery pressure of the compressor stage concerned.

4.2 On completion, compressors are to be subjected to a tightness test at their maximum allowable working pressure. In addition, a function and performance test is to be carried out in which the final moisture content and any possible contamination of the compressed gas are to be determined. The control, monitoring and safety devices are to be checked.

5. Piping Systems

5.1 On completion of manufacture but before insulation or painting, all piping systems under internal pressure are to undergo a hydraulic pressure test at 1,5 times the design pressure. Piping systems under external diving pressure are to be tested in addition with 1,3 times nominal diving pressure NDP (depending on the load case from outside or inside).

5.2 Wherever possible, all butt welds in piping systems for life support systems are to be subjected to 100 % X-ray test.

5.3 Piping systems for breathing gas and oxygen are to be subjected to a purity test.

6. Control and Communication Equipment

6.1 Indicating and monitoring instruments are to be tested for the accuracy of their readings and their limit value settings.

6.2 Automatic control systems are to be checked for satisfactory performance under service conditions.

6.3 Normal and emergency communications equipment is to be subjected to a functional test.

6.4 Proof is required for the autonomy of the safety systems.

7. Fire Protection

Fire alarm, detection and extinguishing appliances are to be subjected to a functional test.

8. Launch, Recovery, Transfer and Mating Systems

8.1 Launch and Recovery System

Before putting into operation of the launch and recovery system as well as the coil-up/coil-off mechanism for umbilicals an acceptance test with the following single tests is to be performed:

- Check that for all single parts the required proofs are existing.

- The breaking strength of the used ropes is to be proven by a total rupture test and to be certified.

- Static test of the system at the manufacturer with a test load equal to 2,2 times the safe working load SWL.

- Dynamic test (brake test) aboard with 1,25 times the safe working load SWL (up to 20 t).

- For an A-frame operated by two hydraulic cylinders an additional test with SWL and use of only one cylinder is to be performed.

- Check of minimum lifting speed

- Test that the procedure of transfer and launch resp. recovery of the diving chamber/wet bell is performed in normal and emergency operation safely and without jerk. The test in normal operation is to be performed down to nominal diving depth NDD.

- Test of function including safety and alarm systems.

8.2 Stowage and Deck Transport Systems

Before use of the stowage and transport systems an acceptance test with the following single tests is to be performed:

- Check that proofs are available for all exchangeable single parts

- Check, that proofs are available for the rupture strength of the used ropes

- Check that the transport of the diving chamber resp. the wet bell in normal and emergency operation is safe and without jerk

- Functional test including check of the safety devices

8.3 Mating System

- The mating procedure is to be tested. For power drives the main drives as well as the auxiliary drives are to be checked for correct function.

- It is to be checked that release of the mating system and transfer of the diving chamber can only take place, when the connecting trunk is not under pressure.

9. Hyperbaric Evacuation System

By a functional test it is to be demonstrated that the hyperbaric rescue system is able to convey divers under pressure from aboard to a safe position where they can be monitored and supplied.

10. Fixing Points

Foundations and fixing points for chambers, containerized equipment, winches, launch- and recovery systems are to be checked for suitability, especially for mobile diving systems.

SECTION 19

UNDERWATER EQUIPMENT SUPPORT

A. General

1. Scope

1.1 Underwater Equipment Support

1.1.1 Definition

The following Rules are valid for services performed by Offshore Service Vessels to support the operation of underwater equipment. The actual scope and character of such services depend on the type and purpose of the operation of the underwater equipment.

1.1.2 Supporting Services of the Offshore Service Vessel

For the safe and proper operation of the underwater equipment carried by the Offshore Service Vessel the following supporting services are to be provided:

- Adequate foundations, as necessary, for components considering the loads from the underwater equipment
- Structural arrangements on the vessel's hull, like arrangement of a moon pool on the vessel, see **TL** Part A, Chapter 1
- Arrangement of supporting systems, see B.
- Hangar or protected area for parking of submersibles, ROVs or underwater working machines see B.
- Control station, see C.2.
- Communication and data transfer, see C.3.
- Video surveillance, see C.4.
- Positioning of the vessel (dynamic positioning or mooring), if it is required to keep the exact operating position, see C.5. and Section 16
- Active and passive hull stabilization, if applicable, see C.6.
- Electrical supply, see D.2.
- Hydraulic supply, see D.3.
- Air supply, see D.4. and D.5.
- Fire protection, see E.
- Launch and recovery, see F.
- Stowage and deck transport, see G.
- Mating, see H.
- Decompression chamber (s) for operation of manned submersibles with diver lock-out, see **TL** Part D, Chapter 52.
- Hyperbaric evacuation for divers from a decompression chamber, if applicable, see **TL** Part D, Chapter 52.

Regarding the requirements for the acceptance tests and trials at the end of manufacture and installation on board see I.

1.3 Underwater Equipment

1.3.1 Definition

Underwater equipment are those designed to perform reconnaissance and other operations in seas underwater, for a wide variety of branches of the offshore industry. This equipment can be manned or unmanned and may also transport divers to their underwater working place.

1.3.2 Elements of Underwater Equipment

Underwater equipment includes the following types:

- Manned submersibles (non-autonomous, autonomous)
- Unmanned, remotely operated submersibles (ROV)
- Unmanned autonomous submersibles (AUV)
- Underwater working machines.

2. **Definitions**

For the purpose of these Rules the terms used have the meanings defined in the following unless expressly provided otherwise:

Autonomous submersible (AUV)

Submersible which is not physically connected to the Offshore Service Vessel during operation (e.g. by an umbilical) and which is able to perform pre-defined missions with the aid of EDP-programming and active and/or passive sensors. Further on they are recovered by the Offshore Service Vessel, supplied, maintained and transferred to the location of the next mission.

Submersible (manned)

Manned submersible which is physically (nonautonomous) or not physically (autonomous) connected to the Offshore Service Vessel during operation (e.g. by an umbilical) but has enough stored power to operate under the control of the crew. After the mission it has to be recovered by the Offshore Service Vessel and transferred to the location of the next mission.

Control station

Central control position at which all essential indicators, controls, regulating devices, monitoring devices as well as communication/data transfer systems of the submersible or the working machine are arranged.

Decompression chamber

Chamber for accommodation of persons at more than atmospheric pressure.

Diver's lock-out

A compression chamber including exit hatch in a manned submersible for the entry, egress and accommodation of divers at diving pressure.

Launch and recovery system

The plant and equipment necessary for launching and recovering a submersible or underwater working machine.

Mating device

The equipment necessary for the connection of a manned submersible with diver's lockout resp. rescue chamber to a decompression chamber or another submersible.

Remotely operated submersible (ROV)

Unmanned submersible which is during the mission physically connected to the related Offshore Service Vessel by an umbilical and is controlled from there. As an exception also wireless remote control is possible.

Safe working load of the launching and recovery system SWL

The safe working load SWL is the load which may be loaded directly to the launching and recovery system. The dead load of lifting tackles which are not fixed to the launch and recovery system, but are used as connection between load and lifting appliance, is part of the safe working load SWL.

Supply systems

Systems aboard of the Offshore Service Vessel which are supplying manned non-autonomous and autonomous submersibles, unmanned AUVs and ROVs and working machines with the supply goods necessary for operation, like e.g. electrical power, hydraulic liquid, breathing/compressed air as well as communication and monitoring data.

Umbilical/supply line

Connection between Offshore Service Vessel and nonautonomous submersible, ROV, underwater working machine, which might contain hose lines for gas and liquid transport and control, communication/data transfer and energy supply cables as well as, if applicable, a lifting cable.

Working device (underwater)

Devices, e.g. manipulator, sample container and tools, which are fixed to a submersible or working machine and which are designated to the performance of underwater tasks and the reception of e.g. samples.

Working machine (underwater)

Machines, e.g. grab, driver, bucket and their combination, which are normally used directly from an Offshore Service Vessel to perform underwater tasks.

3. Documents to be Submitted for Approval

The following documents concerning the supply and assisting functions for underwater equipment are to be submitted:

3.1 Total System

- Main dimensions and parameters
- General arrangement drawings of the underwater equipment
- Foundation drawings showing fixed and free points
- Installation drawings
- Drawings of supply and disposal systems
- Drawings of consoles showing controls and instrument displays

3.2 Control and Communication Systems

- Plans and descriptions of the control station and its feeding are to be submitted for the areas relevant here
- Description of the complete instrumentation layout of the control station
- Description of the safety and alarm systems
- Arrangement drawings/block diagrams of monitoring systems including lists of measuring points
- Documentation for electronic components such as instrument amplifiers, computers and peripheral units
- General diagrams and equipment lists for the communication systems and signalling equipment of the underwater equipment
- General diagram and description of the TV system
- Plans and descriptions of the communication systems of the Offshore Service Vessel are to be submitted for the areas relevant here

3.3 Electrical Equipment

- General arrangement drawings of the electrical supply system containing at least the following information:
    - voltage rating of the systems
    - power or current ratings of electrical consumers
    - switchgear and safety devices with indicating settings for short-circuit and overload protection; fuses with details of current ratings
    - cable types and cross-sections
- Energy balance of the main and emergency power supply systems
- Drawings of switchgear and distribution equipment with parts lists
- Complete documentation for electric motor drives with details of control, measuring and monitoring systems
- Battery installation drawing with details of battery types, chargers and battery room ventilation
- Diagrams showing arrangement of emergency light fittings
- For the operation in explosive endangered

areas the required explosion classes are to be proven.

3.4 Hydraulic Supply

- Plans and descriptions of the hydraulic system of the Offshore Service Vessel

- All the data necessary for assessing the system, e.g. operating data, materials used, etc.

- Drawings of the cylinders

3.5 Air Supply

- Exact definition of the separated supply systems for breathing air and compressed (working) air

- Schematic diagrams of all piping systems including details of:

  - materials

  - maximum allowable working pressure

  - allowable working temperature

  - dimensions (diameter, wall thickness)

  - type of valves and connections used and their operational parameter

  - type of hose lines

- Description of compressors and their drives together with all important design and operating data.

3.6 Fire Protection

- A description of the fire preventive measures

- Description of the combustibles in the underwater equipment

- Drawings and descriptions of fire detection system, fire alarm equipment, fire extinguishing systems(s)

3.7 Launch and Recovery System

- Description of the system with definition of the mission conditions and technical data including recovery and launching speed

- Data about installation and connection conditions including operating platform

- Design drawings of:

  - launch and recovery systems

  - coil-up and coil-off mechanism for umbilicals

  - substructure for gears and winches

- Detailed drawings of exchangeable single lifting parts and fittings or definition of the standards where they are based on

- Drawings of the machinery equipment like e.g. winches, drives, etc.

- Connection diagram of the hydraulic and pneumatic systems

- Control scheme and description of the safety systems

- Information about nominal data and type of protection of the electrical installation

- Data for lifting cables/umbilicals

3.8 Stowage and Deck Transport

- Plans with description of the transport, the stowage and the lashing measures including parts lists with the lashing material used

- Description with the electrical measures

- Description of the fire protection measures

- Description of the explosion protection measures

3.9 Mating Equipment

- Description of system with data about operating conditions
- Data concerning installation and connecting conditions including control station
- Design drawings of the mating equipment
- Control scheme and description of the safety equipment

4. Rules to be Considered

4.1 TL Rules

The latest issues of the following **TL** Rules are to be considered:

- **TL** Part A, Chapter 1
- **TL** Part D, Chapter 53
- **TL** Part D, Chapter 54

4.2 International Conventions and Codes

The following codes are to be considered:

- IMO Code A.714 (17), as amended: "Code of the Safe Practice for Cargo Stowage and Securing"

5. Classification, Notations

5.1 Offshore Service Vessels

An Offshore Service Vessel that fulfils the requirements of this Section to handle underwater equipment of up to 5 t is assigned the Class Notation **UES 1** in addition to the Notation **OFFSHORE SERVICE VESSEL**.

An Offshore Service Vessel that fulfils the requirements of this Section to handle underwater equipment of up to 20 t is assigned the Class Notation **UES 2** in addition to the Notation **OFFSHORE SERVICE VESSEL**.

An Offshore Service Vessel that fulfils the requirements of this Section to handle underwater equipment of up to 80 t is assigned the Class Notation **UES 3** in addition to the Notation **OFFSHORE SERVICE VESSEL**.

An Offshore Service Vessel that fulfils the requirements of this Section to handle underwater equipment of more than 80 t is assigned the Class Notation **UES 4** in addition to the Notation **OFFSHORE SERVICE VESSEL.**

These Notations may be used also for other types of ships than Offshore Service Vessels if applied for and agreed by **TL.**

5.2 Underwater Equipment

The underwater equipment meeting the requirements of C.2., C.3. and D.4. for submersibles and of C.2. and C.3. for other underwater equipment has to be classified or certified according to **TL** Part D, Chapter 53 and **TL** Part D, Chapter 54, as applicable, or according to the Rules of another recognized Classification Society.

6. Marking

The marking of the following elements is defined in **TL** Part D, Chapter 53:

- Valves, fittings, indicating and warning devices (Section 2, H.1.)
- Pressure vessels, gas cylinders and pipe systems (Section 2, H.2.)
- Launch and recovery system (Section 17, E.8.)

B. Arrangement

1. General

1.1 Underwater support equipment on Offshore Service Vessels may only be located and operated in areas not subject to an explosion hazard. In exceptional cases, installation subject to special conditions may be permitted in the lowest hazardous zone.

1.2 As far as possible, the area in which underwater support equipment is installed or underwater equipment is stowed is to be kept free of combustible materials. In addition, only those electrical cables needed to operate the underwater equipment shall be routed through this area.

1.3 It is not permitted to locate underwater support equipment in engine rooms unless the engine plant is connected to the support of underwater equipment.

1.4 Components of the underwater support equipment are to be located in spaces which can be adequately ventilated and provided with suitable electric lighting.

1.5 If a hangar for the safe parking of submersibles, ROVs, AUVs or underwater working machines is provided within the superstructure of the Offshore Service Vessel, a suitable fire protection of surrounding walls and decks of this hangar to other spaces within the superstructure, especially to accommodation, is to be provided.

1.6 Where parts of the underwater equipment are located on the open deck, these are to be protected against influences caused by seaway and against damage due to other shipboard activities.

2. Mobile Underwater Support Equipment

2.1 The requirements defined in 1. , for permanently installed underwater support equipment are also valid for mobile underwater support equipment.

2.2 To allow the installation of the different elements of mobile underwater support equipment suitable foundations and fixing points are to be provided on the main deck of the Offshore Service Vessel.

2.3 It shall be possible to lift the underwater support equipment on board by using a crane - which may not be a part of the Offshore Service Vessel - and then to shift the different elements on prepared foundations to their final place and secure them to the fixing points.

2.4 The piping systems, the electrical power cables and the control lines between the different elements and to the supply stations of the vessel are to be protected against any kind of damage.

C. Systems for Control and Communication

1. General

1.1 Systems for control and communication cover the control station, the communication/data transfer systems to the underwater equipment, video surveillance, the positioning system and hull stabilization of the Offshore Service Vessel, if applicable.

1.2 Proof of suitability for control station and data transfer has to be established by **TL** Classification or a Submersible / ROV / AUV / Underwater Working Machine Certificate. In both cases the following requirements are to be considered:

2. Control Station

2.1 All systems aboard of the Offshore Service Vessel which are serving for the support of underwater equipment are to be summarized in a control station.
Special emphasize is to be given to the control stand for non-autonomous submersibles, ROVs and underwater working machines.

2.2 As far as applicable, the requirements defined in **TL** Part D, Chapter 53 are valid for a control station aboard of the Offshore Service Vessel in analogous and evident way.

2.3 The following requirements are to be considered additionally:

- The needed energy to be defined by the manufacturer of the underwater equipment has to be made available.

- The feeding of the control station for nonautonomous submersibles, ROVs and working machines shall be established by two power circuits independent from each other which can be switched over, i.e. by direct feeding from the main and emergency switchboard.

- An emergency stopping device for unmanned underwater equipment is to be installed at the control station. This is to be provided in a way that unintentional actuation is excluded.

- In the vicinity of the control station no systems or plants are to be installed which impair the function of the control station.

2.4 For the operation of autonomous manned submersibles a control station is only required for communication during the mission and the renewed supply between the missions.

2.5 2.1 to 2.3 are only to be applied to the control station of an AUV, if the control station is required for the save operation of the AUV, like control of the position during the missions.

3. Communication and Data Transfer Systems

3.1 Communication on the Offshore Service Vessel

When several areas not situated nearby are required on board the Offshore Service Vessel for the safe performance of the services, these are to be connected to each other by a suitable communication system, like:

- If the control station with the communication/ data transfer systems is not located directly on the bridge, a communication system between these two locations is to be provided.

- Between the control station and the control stand for the supply systems according to D. (e.g. control room for ship machinery) a communication system is to be established.

- further communications on the Offshore Service Vessel see 5.4 and F.1.4

3.2 Communication with the Underwater Equipment

3.2.1 Vocal communication from and to the Offshore Service Vessel has to be established only for manned on-autonomous and autonomous submersibles. Data transfer is necessary for all types of underwater equipment.

3.2.2 As far as applicable, the requirements according to **TL** Part D, Chapter 53 are valid for the communication and data transfer systems on board of the Offshore Service Vessel. Communication and data transfer shall be performed from the central control station according to 2.

3.2.3 The energy supply for the communication and data transfer system to the underwater equipment is to be provided in analogous way to 2.3.

3.2.4 3.2.3 is only to be applied to the communication system relating to an autonomous manned submersible if the communication is required for a save operation.

4. Video Surveillance

4.1 If necessary for the safe operation of the underwater equipment, the number, location and visual angle of the video cameras are to be chosen in a way that, as far as possible, the complete working area or room to be monitored is covered.

4.2 A sufficient number of video monitors are to be provided at the central control station on the bridge.On each monitor, it shall be possible to readily recognize which area or room is shown at the moment.

5. Positioning of the Offshore Service Vessel

5.1 If an exact position or a predetermined track of the Offshore Service Vessel is required to be maintained during an underwater mission, the Offshore Service Vessel is to be equipped with a positioning system. This will become especially necessary for non-autonomous submersibles with an umbilical connection to the Offshore Service Vessel.

5.2 For positioning of the Offshore Service Vessel the following possibilities may be established:

- Positional mooring with cables and anchors

- Dynamic positioning by thrusters

- Combination of mooring and dynamic positioning

5.3 All requirements for Classification of the different positioning systems are defined in Section 16.

TL may assign the Class Notations

- **POSMOOR** for positional mooring and/or- **DK 2** or **DK 3** according to the degree of redundancy for dynamic positioning in addition to the Notation **OFFSHORE SERVICE VESSEL.**

5.4 Between the control stand for positioning of the Offshore Service Vessel and the control station according to 2. Suitable communication systems are to be established. An alarm is to be provided to indicate loss of position.

6. Active and Passive Hull Stabilization

For the measures for active or passive stabilization of the hull against rolling and pitching as well as heave compensation of seaway sensitive systems see Section 23.

D. Supply Systems

1. General

1.1 Systems of the Offshore Service Vessel, which provide energy in form of electrical power, hydraulic oil and breathing or compressed air are supply systems. For nonautonomous submersibles, ROVs and working machines the supply is necessary for the preparation of the mission as well as continuously during the mission for AUVs- only between missions.

1.2 The proof of the suitability of these systems can be provided by a Class Certificate of the Offshore Service Vessel or by a Certificate of a recognized institution, see A.5. For both cases the following requirements are to be considered.

The supply of breathing air for submersibles according to 4., is as a life support system part of Classification or Certification of non-autonomous manned submersibles.

2. Electrical Supply

2.1 Needed Capacity

The needed capacity of electric power (voltage ranges, performance) of underwater equipment including connected working devices is to be defined by the manufacturer or operator and has to be made available at any time by the Offshore Service Vessel.

2.2 General Requirements

As far as applicable, the requirements defined in the **TL** Part B, Chapter 5 are valid.

2.3 Additional Requirements

2.3.1 The following requirements are to be considered additionally:

- If a dangerous condition for the consumer may arrive if the main supply fails, special measures are to be provided in accordance with **TL** Rules.

- The emergency energy supply on the Offshore Service Vessel of non-autonomous submersibles, ROVs and working machines shall be able to provide the energy demand until a safe condition of the mission is reached.

- The permissible deviations of voltage and frequency according to **TL** Part B, Chapter 5, Section 1 shall not be exceeded.

2.4 Besides the essential consumers listed in the **TL** Part B, Chapter 5, Section 1, B. the following items of electrical equipment on the Offshore Service Vessel also count as essential consumers:

- Emergency lighting of the areas essential for the operation of the underwater equipment

- Power supply of the central control station for non-autonomous submersibles, ROVs and working machines as well as AUVs and autonomous submersibles

- Supply system, e.g. breathing air compressor, power supply, etc.

- Launch, recovery, stowage, transport and mating equipment

2.5 Lighting

2.5.1 Service and work spaces, safety and control stations are to be equipped with normal and emergency lighting.

2.5.2 The lighting is to be so designed and arranged that all important instruments and markings can be read and any necessary operations can be safely performed. As far as possible the interior lighting shall be arranged glare-free.

2.5.3 The emergency lighting is to be independent from the main lighting. This concerns the power generation as well as the distribution and cable network. Emergency lights are to be marked as such to facilitate easy identification.

The emergency lighting has to be automatically switched on in case of failure of the main lighting. Switches are to be arranged only locally, e.g. for switching-off at the control stand.

2.5.4 All lighting fixtures shall be so mounted that combustible parts are not ignited by the generated heat, and they themselves are not exposed to damage.

3. Hydraulic Supply

3.1 Needed Capacity

The needed capacity of hydraulic systems (volume, pressure range, medium) of underwater equipment including connected working devices is to be defined by the manufacturer or operator and has to be made available at any time by the Offshore Service Vessel.

3.2 General Requirements

As far as applicable, the requirements defined in **TL** Part B, Chapter 4, Section 10 are valid.

3.3 Additional Requirements

The following requirements are to be considered additionally:

- If necessary, the emergency supply at missions of non-autonomous submersibles / ROVs / working machines shall be able to provide the defined oil demand for a safe finishing of the underwater mission.

- If a dangerous condition for the consumers may arrive if the main supply fails, special measures are to be provided in accordance with **TL.**

- The permissible deviations of volume and pressure are to be in accordance with the data of the manufacturer of the underwater equipment and shall not be exceeded resp. shall not fall short of.

- The hydraulic oil is to be suitable for the operational conditions and especially for the environmental conditions above and under water (see Section 1, F.).

- When selecting the hydraulic oil, allowance is to be made not only for the service conditions above and under water, but also for the temperatures occurring during the commissioning or repair.

- Hydraulic systems are to be fitted with filters to keep hydraulic fluid clean. In addition, provision is to be made for venting and dewatering the system. Hydraulic fluid tanks are to be fitted with level indicators. Wherever necessary, hydraulic systems are to be equipped with means of cooling the hydraulic fluid.

- Hydraulic lines shall not be routed close to oxygen systems.

- Wherever necessary, the possibility of a pressure rise due to the penetration of seawater into the system is to be observed.

- To protect the hydraulic system from over pressurization, a closed circuit safety valve shall be fitted and the discharged oil shall be returned into the system.

- Hydraulic systems are to be equipped with all the indicating devices necessary to the operation of the system.

4. Supply of Breathing Air

4.1 Needed Capacity

The needed capacity of breathing air (volume, pressure range, temperature) is to be defined by the manufacturer or operator of the manned submersibles and has to be made available at any time by the Offshore Service Vessel.

4.2 General Requirements

The requirements for breathing air supply for manned submersibles defined in the **TL** Part D, Chapter 53 are valid in analogous way also for breathing air supply systems on the Offshore Service Vessel.

4.3 Additional Requirements

The following requirements are to be considered additionally:

- The supply pressure is to be indicated at the control station.

- If the supply pressure falls short an alarm is to be triggered at the control station.

- An emergency supply is to be established for the time to safely finish the mission resp. to surface.

- Between the supply system for breathing air and the compressed air system for the operations on the Offshore Service Vessel a safe separation is to be provided.

- Measures are to be taken to hinder the entrance of seawater in the systems as far as possible.

5. Supply of Compressed Air

5.1 Needed Capacity

The needed capacity of compressed air (volume, pressure range, temperature) is to be defined by the manufacturer or operator of the underwater equipment and has to be made available at any time by the Offshore Service Vessel.

5.2 General Requirements

The requirements for calculation, choice of materials and manufacturing of the compressed air supply system for all types of underwater equipment on the Offshore Service Vessel are defined in the **TL**Part B, Chapter 4, Section 16.

5.3 Additional Requirements

The following requirements are to be considered additionally:

- If a dangerous condition for the consumer may arrive in case of the main supply fails, special measures are to be provided in accordance with **TL.**

- If necessary, the emergency supply shall be able to provide during missions the defined demand of compressed air until a safe condition of the underwater equipment is reached.

- The permissible deviations of volume and pressure are to be in accordance with the data of the manufacturer of the underwater equipment and shall not be exceeded resp. shall not fall short of.

- Between the supply system for underwater missions and the compressed air system for the operation of the Offshore Service Vessel a safe separation is to be provided.

- Measures are to be taken to prevent the entrance of seawater in the systems as far as possible.

E. Fire Protection

1. Structural Fire Protection

1.1 For the Offshore Service Vessel from which the underwater equipment is operating, the fire protection rules of **TL** respectively the relevant regulations of the International Convention for the Safety of Life at Sea (**SOLAS**) of 1974, as amended are to be met.

1.2 In the area of the stowage of the underwater equipment and the installation of the control station sources of ignition and combustible materials are to be reduced to a minimum. As far as possible, materials which are at least flame-retardant are to be used. Heat insulation is to be made of incombustible materials.

1.3 Where supply systems or parts of underwater equipment are installed in closed spaces, these spaces including the central control station are to be separated from the deck and the rest of the vessel by partitions of type "A-60".

1.4 Enclosed spaces or parts thereof are to be provided with a forced ventilation system capable of effecting at least 8 changes of air per hour. The air is to be drawn from an area not subject to explosion hazard.

2. Fire Detection System

2.1 Interior spaces containing underwater equipment or parts thereof, such as submersibles, ROVs, AUVs, working machines, compressors and control stations and also decompression chambers are to be monitored by a fire detection system.

2.2 The detected fire is to be signalled visually and audibly in the permanently manned central control station.

2.3 The fire alarm may be actuated manually from the permanently manned central control station or may be automatically activated by the fire detection system.

2.4 Fire detection systems including central fire detection station, fire detectors and wiring of the detection loops require the approval of **TL.**

2.5 Fire detection systems are to be so constructed that any fault, as e.g. supply failure, shortcircuit or wire breakage in the detection loops, or the removal of a detector from its base, triggers a visual and audible signal at the fire detection station in the central control station.

2.6 For the design and arrangement of fire detection and alarm systems the **TL** Part B, Chapter 5 and **TL** Part B, Chapter 4.1 are to be observed

3. Fire Extinguishing Systems

3.1 Every Offshore Service Vessel from which underwater equipment is operating is to be equipped with a general water fire extinguishing system consisting of hydrants as well as portable and mobile fire extinguishers and extinguishing equipment according to the **TL** Part B, Chapter 4, Section 18.

3.2 Where decompression chambers are situated in enclosed spaces, a permanently installed water spray system having an application rate of at least 10 ℓ/m^2 and per minute related to the horizontal protected area is to be provided for cooling in the event of fire. These water spray systems may be manually activated and operated.

3.3 For decompression chambers installed on the open deck, cooling by means of fire hoses connected to the general fire extinguishing system is permitted.

3.4 Interior spaces containing underwater equipment or parts thereof are to be additionally equipped with approved manual fire extinguishers. One of the portable fire extinguishers shall in every case be situated close to the entrance to the space concerned.

3.5 The central control station for the underwater equipment is to be equipped with at least one independent compressed air respirator of approved design having an operating capability of at least 30 minutes and fitted with equipment for voice communication with the manned submersibles respectively data transfer to the unmanned submersibles and working machines.

F. Launch and Recovery System

1. General

1.1 The following requirements are valid for all systems and plants for launch and recovery as well as for coil-up/coil-off mechanism for umbilicals to be certified by **TL**.

1.2 If the systems contained in this Section fulfil the defined requirements and are constructed and tested under **TL** surveillance, a Certificate for the system can be issued and a Register of launching appliances can be opened. The latter has the purpose to provide information about the actual situation with regard to general data plus the test, examination and maintenance status.

Details for this are defined in the defined in Section 15.

1.3 Besides of the launch and recovery system an emergency recovery system is to be provided that allows the underwater equipment to be lifted to the surface and towed away in an emergency.

1.4 Between the launch and recovery system and the coil-up/coil-off mechanism for umbilicals, if separately arranged, a communication facility with the control station according to C.2. is to be established.

2. Principles for Design

2.1 General Principles

2.1.1 The launch and recovery equipment shall be capable of safely launch and recover the underwater equipment in the seaway conditions which are agreed with **TL**.

2.1.2 The launch and recovery equipment should be fitted with devices for reducing the dynamic loads during launch and recovery operations in a seaway.

2.1.3 In case the underwater equipment is not directly hanging on the lifting cable a coupling system is to be provided to enable the underwater equipment to be safely and efficiently coupled to, and uncoupled from the launch and recovery system.

2.1.4 Devices are to be provided to stabilize the underwater equipment during launch and recovery.

2.1.5 Launch and recovery equipment for submersibles with a diver's lockout shall in addition conform to the requirements set out in the **TL** Part D, Chapter 52.

2.1.6 Unless otherwise specified in the following, the mechanical equipment of launch and recovery systems is to conform to the requirements of the **TL** Rules defined in Section 15.

2.2 Power Supply, Mechanical Drives

2.2.1 The launch and recovery system is to be provided with at least two mutually independent power sources, each of which shall be capable of supplying all the power needed to launch and recover the underwater equipment. For hydraulic drives two power pumping sets independent from each other are to be provided.

2.2.2 The power sources, together with their feed lines and switchgear, are to be so arranged that a failure or burn-out of one system cannot lead to the failure of the standby system.

2.2.3 The launch and recovery system is to be equipped with auxiliary drives enabling a launch or recovery manoeuvre which has already been started to be safely concluded should the winches or hydraulic pumps fail.

2.2.4 Launch and recovery systems using an A-Frame are to be equipped with two hydraulic cylinders which are to be so designed and arranged that each is fully capable of safely performing the launch and recovery operation under load. In addition, they are to be connected to the hydraulic system in such a way that a single fault in the hydraulic system cannot lead to the failure of both hydraulic cylinders. See also Section 15, D.

2.3 Control Equipment

2.3.1 Launch and recovery systems are to be fitted with control equipment enabling the system to be operated intermittently with smooth accelerations. In addition, the controls are to be designed and arranged in such a way that the operator has the underwater equipment in view throughout complete launch and recovery and is fully able to perform all the necessary actions safely.

2.3.2 The controls are to be fitted with blocking devices which ensure that only those commands can be performed simultaneously which do not produce a dangerous or unintended condition.

2.3.3 Control systems are to be provided with EMERGENCY SHUT OFF buttons.

2.3.4 Wherever possible, control units are to operate on the fail-safe principle.

2.3.5 Control units with remote control are to be additionally equipped with a direct control override. In the event of failure or malfunction of the remote control, all operating sequences which have been initiated shall be automatically STOPPED.

2.3.6 All control units are to be clearly and permanently marked and shall be adequately illuminated.

2.3.7 An operating platform with good view over the complete launch and recovery system is to be provided.

3. Calculation

3.1 Design Loads

3.1.1 The "safe working load SWL" of the launch and recovery system summarizes as follows:

- Weight of the submersible or working machine, including its equipment, ballast weights, etc.

- Weight of the working devices

- Payload NL of the submersible or working machine

- Total weight of the crew with 75 kg each and fully equipped divers with 150 kg each, if applicable

- Weight of the load transmitting devices which are not connected in a fixed way with the launch and recovery system

- Resulting loads of the umbilical according to 5.3 if this is existing and it is transferred via the launch and recovery system

Additional requirement:

The finally permitted safe working load SWL of a lifting appliance for the conveyance of persons has to be at least twice as high as the weight and the permissible safe working load of the loose gear used for persons resp. of the manned equipment.

3.1.2 Calculations are normally to be based on the assumption that the angle of engagement of the load strength member may be 12° off perpendicular in any direction.

3.1.3 For the calculation also possible external loads, which may occur during operation (e.g. dynamics, wind loads, ice accretion, etc.) are to be considered.

3.1.4 Finally also the forces from maximum vessel motions and green seas, wind, ice, etc. have to be checked for the launching and recovery system in resting position and stowed on the Offshore Service Vessel. A proof of strength considering the seaway and wind conditions according to Section 9, F. and 2.1.1 is to be submitted.

3.1.5 Further on the minimum recovery speed is to be specified by the manufacturer and to be agreed by **TL.**

3.1.6 The driving machine of the winch has to be designed in a way, that a maximum torque according to a maximum pull of 1,5 times the nominal pull of the winch can be developed at reduced speed for at least 5 minutes. In analogy the hydraulic cylinders are to be laid out for 1,5 times the nominal cylinder force. For both a calculational proof is to be provided.

3.2 Materials

3.2.1 For the manufacture, processing and testing of materials the **TL** Part A, Chapter 2 are valid.

3.2.2 Other materials as defined in 3.2.1 are to be manufactured and processed according to recognized standards resp. according to specifications of the material manufacturer checked and approved by **TL**.

3.3 Calculation Procedure

3.3.1 The calculation of the launch and recovery system as well as of the coil-up/coil-off mechanism for umbilicals is to be performed according to the principles defined in Section 15. For this calculation the system is to be considered as shipboard crane working at sea state.

If the system is equipped with shock absorbers or swell compensators approved by **TL**, a reduction of the working load SWL may be dispensed with totally or partially if agreed by **TL.**

3.3.2 For the values of hoist load coefficient ψ and dead load coefficient φ see Section 15, C.3.2.3.11.

4. Equipment

4.1 Where cranes are used for launch and recovery, measures are to be taken to prevent the uncontrolled turning or slewing of the crane in a seaway. The turning or slewing gear has to be capable of holding the crane in any position. The gear is also to be designed to ensure that all movements are initiated and arrested smoothly.

4.2 Launch and recovery systems are to be equipped to prevent excessive turning of the underwater equipment during recovery (e.g. by the use of nonspin ropes and additional pendants).

4.3 Measures are to be provided to prevent the underwater equipment from striking against the vessel's hull or against the launch and recovery gear.

4.4 Winches are to be equipped with two independent brakes. One of the brakes is to be energy independent and shall be activated in case of power failure. Deviations to be agreed by **TL**.

4.5 The capacity of the brakes has to be sufficient to safely hold the dynamic test loads specified in I.9.

4.6 The final positions of the launch and recovery system, like upper and lower hook and jib position as well as the slewing range, are to be monitored. The starting and breaking velocities are to be controlled.

4.7 All interchangeable single components such as blocks, hooks, shackles, etc. are to conform to recognized standards, shall have a safety of 8 against fracture related to the safe working load SWL and are to be marked with their safe working load.

4.8 The maximum static tensile stress imposed on steel wire ropes by the safe working load may not exceed 1/8 of the proven rupture strength.

4.9 The use of ropes made of fibres is only permissible with special consent of **TL**. For the use of natural or synthetic fibres the maximum static tensile stress imposed by the safe working load may not exceed 1/10 of the proven rupture strength.

5. Coil-up/Coil-off Mechanism for Umbilicals

5.1 Coil-up and coil-off mechanism for umbilicals are necessary for non-autonomous manned submersibles, ROVs and working machines. In the following the requirements for the complete equipment for handling of the umbilical on the Offshore Service Vessel is defined. The mechanisms may be of different types, but often an umbilical winch is an integrated part of such a system.

5.2 An adequate coil-up and coil-off mechanism is to be provided for the umbilical, which is tracking the umbilical without restriction of the freedom to move and without additional mechanical loads to the underwater equipment.

If a control for deployment of umbilicals is provided for the mechanism, the requirements according to **TL** Part D, Chapter 52, Annex E, B.2.2 are to be considered.

5.3 The following requirements are to be considered for the design of coil-up and coil-off mechanism for umbilicals:

- Specified operating conditions, e.g. wave height and type of Offshore Service Vessel

- Safe working load SWL of the coil-up and coil-off mechanism for umbilicals considering the weight of the umbilical, its buoyancy in water (filled and empty) as well as the friction in water and dynamic effects, e.g. by the seaway

- The radius of the umbilical in the coil-up and coil-off mechanism is not to be less than the specified bending radius of the umbilical.

- The most unfavourable arrangement of the umbilical in relation to the coil-up and coil-off mechanism (e.g. coil-up angle, position of the winch drum, application of guide pulleys, etc.) is to be considered.

- The material Certificates have to be in accordance to the **TL** Part D, Chapter 50.

- The coil-up and coil-off mechanism have to have a power source which is in the condition to safely coil-up and coil-off the umbilical under the specified conditions.

- The coil-up and coil-off mechanism is to be equipped with auxiliary drives to be able to finish an already started coil-up and coil-off procedure in a safe way if the main drive respectively the hydraulic pump are failing.

- To avoid overstressing of umbilical and the coil-up and coil-off mechanism measuring of the tension force is to be provided at a suitable position of the system, which triggers an alarm at the control stand in case of exceeding the safe working load SWL.

G. Stowage and Deck Transport

1. General

1.1 As stowage and deck transport the transfer of the underwater equipment recovered by the launch and recovery system to a deposit location is to be understood.

The deposit location is to be protected normally against environmental influences, especially if maintenance and repair work has to be done. The underwater equipment is to be safely stowed and lashed for all thinkable vessel movements.

If requested in addition, the transport of a manned submersible with divers lock-out to the decompression chamber resp. to its mating equipment is to be enabled.

1.2 If no adequate proof of suitability by, e.g. test stamps, test marks, etc. for this equipment is existing and **TL** is appointed to establish such a proof by the manufacturer or operator, the following requirements are to be recognized.

2. Principles for Design and Equipment

The requirements of the IMO Code A.714 (17), as amended: "Code of the Safe Practice for Cargo Stowage and Securing" are to be considered.

2.1 Mechanical Requirements

Aboard of the Offshore Service Vessel and under consideration of maximum vessel movements, sufficiently dimensioned measures, like cargo securing elements are to be provided for:

- Complete transport way

- Storage of the underwater equipment

- Lashing on deck or within the containers/hatches

- Lashing of containers with equipment

2.2 Electrical Requirements

2.2.1 At the superstructures of the Offshore Service Vessel a connecting possibility in form of a connecting plate with stay bolt preferably M12 is to be provided at an easily accessible position, on which the protective conductor of the underwater equipment can be connected without using tools.

2.2.2 For the stay of the underwater equipment on deck of the Offshore Service Vessel the measures defined in 2.2.1 are to be so arranged, that an uninterrupted equalization of the potential is possible.

2.2.3 Areas for transport and stowage are to sufficiently illuminated.

2.3 Fire and Explosion Protection

The stowage location for the underwater equipment on the Offshore Service Vessel is to be equipped with suitable fire extinguishing systems. This system may be a part of the fire extinguishing system of the Offshore Service Vessel.

Explosion protection measures for areas with explosion danger, from which the underwater equipment shall undergo missions, are to be provided.

H. Mating Equipment

1. If divers are to be transferred under pressure with help of a submersible with diver's lock-out to the decompression chamber on board of the Offshore Service Vessel, a suitable mating equipment is to be provided for the chamber. The same is valid for the pre-compression of divers to their working conditions under water.

2. Between the mating equipment and the control station according to C.2., a communication system is to be established.

3. For further requirements see **TL** Part D, Chapter 52.

I. Tests and Trials

The requirements for the acceptance tests and trials at the end of manufacture and installation on board are defined in the following. Even if parts of the complete system form an integrated part of the underwater equipment, also these parts have to be tested together with the supporting services of the Offshore Service Vessel before start of underwater operations.

The surveys for maintenance of Class during the Class period of the Offshore Service Vessel have to be performed according to **TL** Rules for Classification and Surveys.

1. General

1.1 The systems and components assisting and supplying underwater equipment on board of Offshore Service Vessels are subject to constructional and material tests as well as to pressure and tightness tests and trials. As a minimum requirement, this shall include verification of compliance with the approved documents, inspection of workmanship, the verification of materials and checking of dimensional tolerances. All the tests prescribed in the following are to be performed and documented, wherever applicable. About the presence of **TL** Surveyors at these tests and trials **TL** will decide in each individual case.

1.2 For series-manufactured parts, test procedures other than those prescribed may be agreed with **TL** provided that they are recognized as equivalent by **TL.**

1.3 **TL** reserves the right to extend the scope of the tests where necessary and also to subject to test those parts for which testing is not expressly prescribed in the Rules.

1.4 The material test Certificates for the applied materials, reports on non-destructive testing of welds and, if applicable, the results of inspections of workmanship and evidence of heat treatments performed are to be presented.

1.5 Tightness tests for decompression chambers, if applicable, have to be performed. As maximum permissible leakage rate, at 1 % pressure drop within 24 hours for the whole decompression chamber system, is acceptable.

1.6 After the systems to service the underwater equipment have been installed on board, these systems together with their ancillary elements are to be subjected to functional tests. All items of safety equipment are to be tested except where a sufficient trial has already been performed on the manufacturer's premises in the presence of **TL**.

1.7 Parts subject to replacement are to be replaced with tested parts. The same also applies to spare parts.

2. Control and Communication Equipment

2.1 Indicating and monitoring instruments are to be tested for the accuracy of their readings and their limit value settings.

2.2 Automatic control systems are to be checked for satisfactory performance under service conditions.

2.3 Normal and emergency communications equipment is to be subjected to a functional test.

2.4 Proof is required for the autonomy of the safety systems.

2.5 Adjustment of camera positions and directions and tests of the system together with the monitors.

2.6 Test of positioning system of the Offshore Service Vessel according to Section 16.

2.7 Test of active and passive hull stabilization according to Section 20.

3. Electrical Equipment

3.1 Electrical machines, components and cables are to be tested in the manufacturer's works in acco rdancewith the **TL** Part B, Chapter 5.

3.2 The electrical systems and equipment of the Offshore Service Vessel are to be inspected and tested before putting them into service.

3.3 Electrical protective devices and especially the measures for earthing of the underwater equipment to the Offshore Service Vessel are to be checked.

4. Hydraulic Equipment

4.1 The power units are required to undergo testing on a test bed.

4.2 Pressure components are to undergo a pressure test.

The test pressure is p_p.

P_p = 1,5 . p_c

p_c = Design pressure for which a component or piping system is designed with its mechanical characteristics [bar]. For pressures above 200 bar the test pressure need not exceed p + 100 bar.

4.3 Tightness tests are to be performed on components to which this is appropriate.

4.4 Subsequently a complete functional test for normal and emergency operation is to be performed.

5. Breathing Air

- A functional test is to be carried out to verify the satisfactory functioning of the breathing air system under normal and emergency conditions.

- Especially humidity and temperature control are to be checked.

6. Compressors

6.1 Compressor components subjected to pressure are to undergo a hydraulic pressure test at a test pressure equal to 1,5 times the delivery pressure of the compressor stage concerned.

6.2 On completion, compressors are to be subjected to a tightness test at their maximum allowable working pressure. In addition, a function and performance test is to be carried out in which the final moisture content and any possible contamination of the compressed air are to be determined. The control, monitoring and safety devices are to be checked.

7. Piping Systems

7.1 On completion of manufacture but before insulation or painting, all piping systems under internal pressure are to undergo a hydraulic pressure test at 1,5 times the design pressure.

7.2 Wherever possible, all butt welds in piping systems for breathing air systems are to be subjected to 100 % X-ray test.

7.3 Piping systems for breathing gas are to be subjected to a purity test.

8. Fire Protection

Fire alarm, detection and extinguishing appliances are to be subjected to a functional test.

9. Launch and Recovery System

Before putting into operation of the launch and recovery system as well as the coil-up/coil-off mechanism for umbilicals an acceptance test with the following single tests is to be performed:

- Check that for all single parts the required proofs are existing.

- The breaking strength of the used ropes is to be proven by a total rupture test and to be certified.

- Static test of the system at the manufacturer with a test load equal to 1,8 times the safe working load SWL.

- Dynamic test (brake test) aboard with 1,25 times the safe working load SWL (up to 20 t, for other loads see Table 22.1)

Table 22.1 Dynamic test loads for lifting appliances

Nominal loads SWL of loading gear	Dynamic test load PL_{dyn}
Up to 20 t	SWL + 25 %
20 t to 50 t	SWL + 5 t
Above 50 t	SWL + 10 %

- For an A-frame operated by two hydraulic cylinders an additional test with SWL and use of only one cylinder is to be performed.

- Check of minimum lifting speed

- Test that the procedure of transfer and launch resp. recovery of the underwater equipment is performed in normal and emergency operation safely and without jerk. The test in normal operation is to be performed down to nominal diving depth NDD

- Test of function including safety and alarm Systems

10. Stowage and Deck Transport Systems

Before use of the stowage and transport systems an acceptance test with the following single tests is to be performed:

- Check that proofs are available for all exchangeable single parts

- Check, that proofs are available for the rupture strength of the used ropes

- Check that the transport of the submersible/ ROV/ AUV/ underwater working machine in normal and emergency operation is safe and without jerk

- Functional test including check of the safety devices

11. Mating System

- The mating procedure is to be tested. For power drives, the main drives as well as the auxiliary drive are to be checked for correct function.

- It is to be checked that release of the mating system and transfer of the submersible can only take place when the connecting trunk is not under pressure.

12. Fixing Points

Foundations and fixing points for submersibles, ROVs, AUVs or underwater working machines, containerized equipment and other elements belonging to the underwater equipment are to be checked for suitability and functionality.

SECTION 20

STABILIZATION IN THE SEAWAY

Page

A. General

1. Scope

Offshore Service Vessels have principally to fulfil also their missions at a maximum seastate defined by the owner/operator. To execute the necessary tasks of different vessel types a reduction or nearly full compensation of the vessel movements in the seaway may be a necessary requirement.

For Offshore Service Vessels transporting considerable loads or with cranes of considerable capacity a static reduction of heel or trim of the hull (especially if 2° inclination will be exceeded) by compensating the lifted load with trimmed ballast water may be needed during operations.

2. Stabilization Methods

The following methods for stabilization in the seaway may be applied:

- Manipulating the rudder
- Using cycloidal propellers
- Ballast shifting
- Servo-controlled anti-roll stabilizing fins
- Anti-roll gyro installation

3. Documents for Approval

The following documents are to be submitted:

3.1 General

- General arrangement drawings of the system
- Diagrammatic plans of all piping systems forming part of the stabilizing systems, including all the necessary details for approval (e.g. lists of valves, fittings and pipes)
- Schematic electric circuit diagrams. If stabilization systems are required for the intended ship services in Sections 13 to 23, then additional drawings may be requested.
- Description of systems
- Operating and maintenance manuals

3.2 Static Heel and Trim Compensation Resp. Reduction

- Details about the identification of heel and trim
- Details of the tank venting system
- Description of the pipe and pumping arrangements for filling and discharging, etc.

3.3 Roll Stabilization with Ballast Shifting

- Description of the functioning principles of the system
- Details of the valves controlling the shifting of water between the different tanks
- Details about the identification of the vessel motion and the control program working with this input
- Description of the measures to avoid negative influences on the stability of the damaged vessel

3.4 Fin Stabilizers

- General arrangement and assembly drawings
- If fin stabilizers are required for the intended ship services in Sections 13 to 23, drawings and strength calculations for the main load-bearing components
- Diagrams of the hydraulic and electrical equipment containing all the data necessary

3.5 Stabilizing Elements on the Vessel

- General arrangement drawings including safety measures

- Documentation about the different drives and their power supply from the vessel systems

- Description of the joint drive control with definition of limits of stabilizing

4. Reference to Further Rules

The latest issue of the following **TL** Rules is to be considered:

- **TL** Part A, Chapter 1, Section 1.

- **TL** Part B, Chapter 4, Sections 1, 10 and 16

- **TL** Part B, Chapter 5, Sections 7, 9 and 10

5. Classification, Notations

Besides the Class Notation **OFFSHORE SERVICE VESSEL** no further Notation for Stabilization in the Seaway will be assigned to Offshore Service Vessels. If the vessel is equipped with a stabilization system defined in this Section, a respective entry in the Technical File of the Class Certificate can be made on request of the owner/operator.

B. Heel, Trim and Roll Reduction of the Vessel

1. General

1.1 Importance

The importance of a reduction of heel and/or trim as well as rolling motions has to be investigated for the specific operations of the Offshore Service Vessel. In complex cases performing of a Failure Mode and Effects Analysis (FMEA) might be necessary.

The influence of the stabilization systems on the damage stability is to be investigated, for the condition when the vessel is statically heeling because of damage beyond the stabilization system. The maximum heeling moment due to damage of compartments and stabilization system has to be considered.

Based on the results, a stabilization philosophy should be created and adequate measures are to be provided for the vessel. Especially the degree of redundancy for the installed stabilization systems has to be defined.

1.2 Methods for Roll Stabilization

The methods of roll stabilization are defined in A.2, and the following methods are recognized in this Section:

- Manipulating the ruder at speed

- Ballast shifting system for static heel, stationary position and at speed

- Stabilizing fins at stationary position and at speed

2. Reduction of Static Heel or Trim

2.1 Tanks for Anti-heeling Devices

2.1.1 If tanks are used as anti-heeling devices, effects of maximum possible tank moments on intact stability are to be checked. Investigations have to be carried out for several draughts and taking maximum allowable centres of gravity resulting from the stability limit curve as a basis. In general the heeling angle shall not be more than 2°.

2.1.2 The free water surface in the tanks shall be kept to the necessary minimum to avoid significant negative influences on the Offshore Service Vessel's stability.

2.2 Anti-heeling Arrangements

Anti-heeling arrangements are to be designed as follows:

- A shut-off device is to be provided in the cross channel between the tanks destined for this purpose before and after the anti-heeling pump.

- These shut-off devices and the pump are to be remotely operated. The control devices are to be arranged in one control stand.

- At least one of the arranged remote controlled shut-off devices has automatically to shut down in the case of power supply failure (fail safe position).

- The 'closed' position of the shut-off devices is to be indicated on the control stand by type approved end position indicators.

2.3 Reduction of Trim

For the measures to reduce the trim of the Offshore Service Vessel, the measures defined in 2.1 and 2.2 are to be applied in an analogous way.

3. Roll Reduction in Stationary Position

3.1 General

It has to be proven that the stability of the Offshore Service Vessel is not dependent on the roll stabilization system.

3.2 Tank Stabilisation System

3.2.1 The requirements of 2.1.1 and 2.1.2 for antiheeling tanks are also valid for roll stabilization tanks.

3.2.2 In general the system will contain the following main elements:

- A pair of water tanks at the vessel sides (media heavier than water may be used and agreed for special cases)

- Duct connection between the starboard and portside tank at the tank bottom

- Several air pipes between the top of the tanks which can be opened or closed by control valves; each of these control valves has to be controlled as single item with the aim to adjust the roll period of the tank system, if the roll period of the vessel is longer than the roll period of the tank system

- Electric, hydraulic or pneumatic energy as control power for the different valves

- Control system to determine the roll period of the vessel and the tank system to control the condition of the air valves

3.2.3 Depending on the stabilization philosophy created according to 1.1 the number of tank pairs and the different components of the stabilization system, like pipes, valves, controls, etc., have to be provided in a redundant way.

3.2.4 The following mechanical and electrical requirements have to be met as a minimum:

- The water duct between the two tanks shall not be blocked; for vessels with ice class notations, anti-freezing measures are required

- Supply of compressed air and supply of hydraulic power shall be possible from two different sources

- Electric supply shall be from two different connections to the main switchboard. A connection to the emergency source of electrical power is to be established if the stabilization philosophy requires it, see 1.1

- The air control valves shall reach the "fail safe" condition, if power fails

- For pneumatic systems a compressed air accumulator to prevent the system from a sudden pressure loss, if the supply fails, is to be provided

- Pneumatic systems are to be protected from oil and solid articles by filters, which have to be maintained regularly

- Each tank is to be provided with venting lines which may be combined with filling lines and are to be closed in case of stabilizing operation

- Each tank is to be provided with a safety valve of sufficient capacity to restrict the tank pressure

3.2.5 The following control and alarm requirements have to be met as a minimum:

- Each tank is to be equipped with high level, low level and service level sensors for the water level; the relevant alarms are to be triggered at the control panel

- If the air or oil filters are blocked, an alarm is to be triggered at the control panel

- At least two roll sensors with a self check of signal equivalence are to be provided; as an alternative a main sensor and a control sensor may be installed; if their signals deviate from each other a signal is to be triggered at the control panel

- If stabilization philosophy requires, additional roll sensors are to be provided

- If the control system fails, an alarm is to be triggered

- Emergency shut-down facility has to be provided

- The availability of control power (electric, pneumatic, hydraulic) has to be monitored and the loss of the control power has to be alarmed

3.2.6 A test mode to check the correct functioning of the system as far as possible before starting the stabilization operation is to be established.

3.3 Stabilizing Fins

Detailed documentation is to be submitted to **TL** for the designs of stabilizing fins. These documents shall especially contain the moving characteristics of the fins, relevant calculations of the developed forces and results of test or installations already in use.

4. Roll Reduction at Speed

4.1 Manipulating the Rudder

4.1.1 Roll stabilization by manipulating the rudder shall not cause any hazardous conditions for the Offshore Service Vessel.

4.1.2 For the necessary fast movements of the rudder to create stabilization forces the maximum rudder angle shall be limited.

4.1.3 Despite of the very fast movements superimposed on the rudder, it has to be guaranteed that the general steering function of the rudder is not impaired.

4.1.4 If the roll stabilization stops working because of failure, the normal rudder function has to be fully maintained.

4.1.5 Additional fatigue considerations have to be demonstrated to **TL** for construction of rudder body and rudder drive system.

4.1.6 To meet the high and fluctuating demand of hydraulic medium for the rudder drive a storage unit is recommended in addition to the two required hydraulic power sets.

4.2 Tank Stabilisation Systems

The requirements for stabilization in stationary position as defined in 3.2 are also valid at speed.

4.3 Fin Stabilizers

4.3.1 Scope

The requirements contained herein are necessary for the operation and safety of the Offshore Service Vessel and apply to stabilizer drive units.

4.3.2 Design

4.3.2.1 For retractable stabilizer fins the actual position has to be indicated at the bridge and at the machinery control room, see G.3.

4.3.2.2 When non-retractable fins are not in use, the fins are to be kept in neutral position by hydraulic or preferably mechanical locking. Retractable fins shall be retracted in the neutral position into the hull compartment inside the hull to prevent any damages. It shall not be possible to activate retractable fins before they are completely extended out of the hull.

4.3.2.3 The bearing system, the inboard gland and the drive unit are to be located within a watertight space of moderate size at the ship's side or bottom. The watertight space has to be provided with openings for inspection and maintenance purposes which are normally closed. The sealing arrangement at the penetration of the fin shaft through the vessel's shell into the watertight space has to be either type approved or the appropriate drawings have to be submitted for approval. The watertight space is to be provided with a water ingress alarm and an indication on the bridge.

As an alternative to fitting, a watertight compartment of moderate size in compliance with SOLAS II-1, Reg. 15, paragraph 8.4 may be demonstrated.

4.3.2.4 If single fin operation in addition to the standard twin fin operation is provided for low speeds and/or vessel motions, details about these operating modes are to be provided.

4.3.2.5 The hydraulic pipes of fin stabilizers are to be made of seamless or longitudinally welded steel tubes. The use of cold-drawn, unannealed tubes is not permitted. At points where they are exposed to damage, copper pipes for control lines are to be provided with protective shielding and are to be safeguarded against hardening due to vibration, by the use of suitable fastenings.

4.3.2.6 High-pressure hose assemblies may be used for short pipe connections subject to compliance with **TL** Part B, Chapter 4, Section 16, U, if this is necessary due to vibrations or flexibly mounted units.

4.3.2.7 The materials used for pressurized components including the seals are to be suitable for the hydraulic oil in use.

4.4 Combined Systems

If tank stabilizing and fin stabilizers are applied in a combined way, both systems are to be controlled from a combined control panel or two panels besides each other. It has to be indicated which system is in operation and which is not in operation.

C. Heave Compensation of the Vessel

Although heave compensation is routinely applied to lifting appliances (see E.) and special platforms (see D.), efforts should be made to select hull forms that give minimum heave under specified working conditions.

D. Stabilized Elements on the Vessel

1. Heave Compensated Platform

1.1 General

Heave becomes an important matter if some types of equipment are to be handled from the Offshore Service Vessel. This is, e.g. the case if drilling operations are to be performed through a moon pool and the drilling equipment is installed on a heave compensated platform, to stay always in contact with the borehole bottom.

In addition the drilling equipment may be provided with a twin cardan-type joint system against buckling of the drill string because of roll and pitch movements of the vessel, but this equipment is not subject to Classification.

1.2 Safety Aspects

1.2.1 The following safety aspects have to be considered:

- The vertical movement has to be mechanically limited including damping measures at the end positions
- Within the mechanically limited heave range, limit switches are to be provided, one for reducing speed of movement, one for stopping of the movement
- The complete range where the platform is moving has to be secured against unintentional access of persons or equipment
- Modes of operation have to be defined in analogous way to 2.2.2

1.2.2 For power supply and control position 2.2.3 and 2.2.4 have to be applied analogously.

2. Motion Compensated Work Platform

2.1 General

An active motion compensating work platform which compensates 3 degrees of freedom, namely roll, pitch and heave movement of the Offshore Service Vessel may be very favourable in transferring materials (especially during repair and maintenance missions) from such a platform to fixed offshore structures, like e.g. offshore windmills. The operation can be further facilitated if the handling crane is also installed on the work platform.

The maximum heaving way and the maximum tilting angles in longitudinal and transverse directions are to be defined by the owner/shipyard according to the vessel's behaviour and the size of seaway to be compensated. The SWL (Safe Working Load) of the platform and the required velocities of the movements together form the decisive design parameters.

2.2 Safety Aspects

The following safety aspects have to be considered:

2.2.1 General

Over the full range of the platform's movement, the area underneath and besides the platform has to be blocked for traffic of personnel, storage of materials, etc.

2.2.2 Modes of Operation

The following modes of operation have to be established:

- Locked mode: The platform is mechanically locked to the hull structure or superstructure of the vessel and the control panel is secured against unintentional use.

- Maintenance mode: The platform can be moved manually (preferably with a joystick from the control panel) in all directions.

- Motion compensating mode: The platform is automatically fully compensating the measured vessel movements to its defined limits. An acoustic warning has to be triggered before start and stop of this mode. During this mode a yellow flashlight overlooking the platform and its surrounding area is to be activated.

- Emergency mode: If the control system is failing, it has to be possible to stop the motions immediately and to bring the platform down to locked mode by manually operating local controls of the moving devices.

2.2.3 Power Supply

During the motion compensating mode the platform is to be connected with two independent power supply lines from the vessel's main switchboard. If a hydraulic system is integrated it has to be equipped with an accumulator under full pressure with a sufficient capacity to bring the platform from the motion compensating mode to locked mode in case of power failure. Alternatively a second hydraulic unit may be provided and kept ready for immediate start if the first unit fails.

2.2.4 Control Position

The operation of the platform shall be managed from a control panel overlooking the complete platform and its surrounding area on the vessel. The maximum seaway and the equivalent significant wave heights to be compensated have to be indicated at the panel. The panel has to be equipped with a key switch to avoid unintentional use of the complete system.

The different operation modes and necessary fault messages have to be indicated on the panel.

3. Helicopter Deck

3.1 An active motion compensating helicopter deck which compensates all or a part of the degrees of freedom, namely roll, pitch and heave movement of the Offshore Service Vessel, suitable to the conditions to the planned size of seaway, may be very favourable in extending landing and starting conditions.

Because of the considerable weight of a helicopter platform it has to be investigated for actual cases if only a part of the above movements or other movements, e.g. travelling of the complete platform in transverse direction to compensate the roll induced transverse sway of the vessel.

The maximum heaving way and the maximum tilting angles in longitudinal and transverse directions are to be defined by the owner/helicopter operator/shipyard according to the vessel's behaviour and the size of seaway to be compensated. The SWL (Safe Working Load) of the helicopter deck and the required velocities of the movements, together form the decisive design parameters.

3.2 The following safety aspects have to be considered for a stabilized helicopter deck:

3.2.1 General

The safety aspects are the same as defined in 2, for working platforms.

3.2.2 Further requirements

In addition the following is to be considered:

- An agreed light signal shall be provided which shows the helicopter pilot that the helicopter deck is already operating correctly in the compensating mode and ready to receive the helicopter.

- An additional verbal communication line is to be established to the helicopter pilot and vice versa.

E. Lifting Appliances

1. Definition

Cranes with jib, knuckle and expandable boom as well as A-frames and expandable outriggers are, mainly, to be considered as lifting appliances for Offshore Service Vessels. The detailed requirements for these systems are defined in Section 15 - Special Lifting and/or Transportation Capability.

2. Active Heave Compensation System (AHC)

Active heave compensation systems are systems, which keep the distance of the load in relation to the working plane constant using external power.

Activation of the heave compensation system(s) shall be protected against inadvertent use.

3. Passive Heave Compensation System (PHC)

Passive heave compensation systems are systems, which keep the position of the load between predefined Limits, using stored power.

4. General

The activation switch for heave compensation systems shall be clearly and durably marked.

When the systems are deactivated, the crane shall smoothly return to normal operation.

F. Hydraulic Installations

1. General

1.1 For hydraulically driven stabilization systems, the following requirements have to be considered.

1.2 For the dimensional design of pressure vessels see **TL** Part B, Chapter 4, Section 14; for the dimensions of pipes and hose assemblies see Section 16.

2. Materials

The requirements for materials are defined in Section 14, D.2.

3. Hydraulic Operating Equipment

3.1 Design

3.1.1 Stabilization systems may be supplied either by a common hydraulic power source or individually by several hydraulic power units for each drive. For stabilization systems that are required for the intended ship services in Sections 13 to 23, sufficient pump capacity is to be provided that in the event of a failure of one pump, the unimpaired operation of the stabilization system is maintained. Where the systems are supplied individually, change-over valves or fittings are to be provided.

3.1.2 The movement of stabilization systems is not to be initiated merely by starting the pumps. The movement of drives is to be controlled from special operating stations. The controls are to be so arranged that, as soon as they are released, the movement of the system ceases immediately.

3.1.3 Local controls, inaccessible to unauthorized persons, are to be fitted. If the movement of the system cannot be observed, audible and/or visual warning devices are to be fitted. In addition, the control stands are to be equipped with indicators for monitoring the movement of the system.

3.2 Pipes

3.2.1 Pipes are to be installed and secured in such a way as to protect them from damage while enabling them to be properly maintained from outside.

Pipes may be led through tanks in pipe tunnels only. The laying of such pipes through cargo spaces is to be restricted to the essential minimum. The piping system is to be fitted with relief valves to limit the pressure to the maximum allowable working pressure.

3.2.2 Equipment is to be provided to to remove the air in the hydraulic system.

3.2.3 The accumulator space of the hydraulic accumulator has to have permanent access to the relief valve of the connected system. The gas chamber of the accumulator may be filled only with inert gases. Gas and operating medium are to be separated by accumulator bags, diaphragms or similar.

3.2.4 Connection between the hydraulic systems used for stabilization and other hydraulic systems is permitted only with the consent of **TL.**

3.2.5 The hydraulic fluids have to be suitable for the intended ambient and service temperatures.

3.3 Oil Level Indicators, Filters

3.3.1 Tanks within the hydraulic system are to be equipped with oil level indicators.

3.3.2 The lowest permissible oil level is to be monitored. Audible and visual alarms are to be provided in the navigating bridge and in the machinery space or machinery control room. The alarm on the navigating bridge is to be an individual alarm.

3.3.3 Arrangements are to be provided to maintain the cleanliness of the hydraulic fluid taking into consideration the type and design of the hydraulic system

3.4 Hose Assemblies

The construction of hose assemblies is to conform to **TL** Part B, Chapter 4, Section 16, U.

G. Electrical Installations

1. Basic Rules

Basic Rule is the latest issue of the **TL** Rules

– Part B, Chapter 5

2. Heel-Compensating Systems

2.1 The heel compensating system shall be centrally controlled and monitored. The following facilities are to be provided:

- Indicator showing whether the system is in operation

- Optical/audible fault indication

- Inclination angle indicator

2.2 The control console shall be provided with a manual emergency OFF switch for Offshore Service Vessels which are operated only under supervision.

2.3 Systems which are also operated without supervision shall be provided with a manual emergency OFF switch and an automatic stop device which shuts down the system independently of the control when the maximum permitted angle of inclination is reached.

2.4 Automatic stop devices and control units for heel compensation systems are subject to mandatory type approval.

3. Stabilizing Fin Systems

3.1 A central control panel shall be installed at the bridge. The following facilities are to be provided:

- For retractable fins indication if fully retracted
- Indication showing whether the system is ready for operation
- Indication if the system is in operation
- Indication of actual operation mode, if applicable
- Optical/audible fault indication

The above indications shall also be shown, as necessary, at the local control panel at the fin driving station.

Provision shall be available to lock the panels to ensure that the stabilizers are not started unintentionally.

3.3 In case of failure of electric power during stabilizer operation the fin units are to be automatically brought into a safe position for further operation of the vessel, e.g. either forceless (neutral) position or zero position. This has to be performed without any external power supply.

3.3 For the purposes of inspections or any immediate maintenance shut-off switches are to be provided locally at the fin units, to definitely avoid any danger to the crew.

H. Tests and Trials

1. General

As far as possible all stabilizing systems have to be tested at the manufacturer's works.

2. Hydraulic Systems

2.1 Pressure Test

For pressure testing of pipes, their valves and fittings see **TL** Part B, Chapter 4, Section 16.B and U.

2.2 Tightness Test

Tightness tests are to be performed on components as appropriate.

3. Electrical Systems

3.1 Electrical machines, components, cables and lines are to be tested in the manufacturer's works in accordance with the **TL** Part B, Chapter 5.

3.2 The electrical systems and equipment of the Offshore Service Vessel are to be inspected and tested before stabilization systems are put into service.

3.3 The different test and operating modes are to be checked as far as possible.

4. Shipboard Trials

4.1 The functioning of the safety measures defined above for the different stabilizing systems have to be tested after installation on board and before start of the sea trials.

4.2 If all safety measures are functioning correctly, the operational efficiency of the stabilizing systems is to be demonstrated in the seaway during the sea trials.

SECTION 21

HELICOPTER SUPPORTING INFRASTRUCTURE

A. General

1. Scope

1.1 The following rules are applicable for services performed by Offshore Service Vessels to enable flight operations with helicopters including winching, landing, parking and refuelling on the vessel. A helicopter hangar on Offshore Service Vessels is not subject of these Rules.

These rules cover the requirements for arrangement and lighting of the helicopter deck, storage of and refuelling with aviation fuel, fire protection and other safety measures.

1.2 Helicopter Specification

The types of helicopters to operate on the Offshore Service Vessel have to be specified by the operator. The following information is primarily needed:

- Types of helicopters
- Geometrical main dimensions, especially length of fuselage, number and diameters of rotors, etc.
- Largest overall dimension of helicopter when the rotors are turning (D-value)
- Weight, weight distribution and wheel or skid configuration
- Highest vertical rate of descent on the helicopter deck
- Data for winching operations, if applicable
- Lashing systems
- Fuel used and type and capacity of refueling equipment
- Starting equipment, if applicable

1.3 Flight Operations

Additional requirements for helicopter operations, like special lighting systems, communication between Offshore Service Vessel and helicopter, electronic take-off and landing aids, flight control, etc. are not subject of Classification by **TL** and have to be agreed directly between operator and shipyard.

2. Definition

D-value

The D-value is the largest overall dimension of the helicopter when rotors are turning. This dimension will normally be measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane (or the most rearward extension of the fuselage in case of Fenestron or Notar tails).

3. Documents to be Submitted for Approval

3.1 The general conditions for the submission of documents are defined in Section 1, F.1. The following documents are to be submitted:

3.2 Specification of helicopters to be operated and calculations for the relevant loading conditions.

3.3 For the helicopter landing deck, if applicable:

- Arrangement plan to show the location on the Offshore Service Vessel, the overall size of the helicopter deck and the designated landing area

3.4 For the winching area, if applicable:

- Arrangement plan to show the location on the Offshore Service Vessel and overall size of the area

3.5 Technical documentation for equipment, lighting, fire extinguishing, aviation fuel system, lighting, electrical protection, etc.

4. Reference to Further Rules

4.1 TL Rules

The latest issue of following **TL** Rules is to be considered:

- Part A, Chapter 1, Sec. 7.D
- Part B, Chapter 4, Sec. 16.V

4.2 Other Rules

Reference is made to:

- "Guide to Helicopter/Ship Operations" published by the International Chamber of Shipping (ICS)
- Offshore Helicopter Landing Areas - Guidance to Standards CAP 437 (Civil Aviation Authority)
- Offshore Helideck Design Guidelines, Health and Safety Executive
- Guidelines for the Management of Offshore Helideck Operations, UK Offshore Operators Association

5. Classification, Notations

5.1 Offshore Service Vessels meeting the requirements for winching areas according to A. and B. of this Section will be assigned the Class Notation **HELIW** (Equipped for Helicopter Winching Operations) in addition to **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification.

5.2 Offshore Service Vessels meeting the requirements for helicopter landing areas according to A., C., D., E. (partly) and G. to I. (partly). of this Section will be assigned the Class Notation **HELIL** (Equipped with Helicopter Landing Deck) in addition to **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification

5.3 Offshore Service Vessels meeting the requirements for helicopter landing areas and helicopter refuelling acc ording to 5.2 and F. of this Section will be assigned the Class Notation **HELILF** (Equipped with Helicopter Landing Deck and Refuelling Capabilities) in addition to **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification.

B. Requirements for Helicopter Winching

1. Winching Operations

1.1 For any Offshore Service Vessel for which helicopters are a normal mode of transport of personnel, a helicopter landing area should be provided. Winching should not be adopted as a normal method of transfer.

1.2 If a regular delivery of supplies, like provisions, spare parts, etc., is planned, measures for a convenient material flow from the winching area has to be provided.

1.3 If winching operations are required, they shall be conducted in accordance with procedures agreed between the helicopter operator, the owner/ operator of the Offshore Service Vessel and **TL** and shall be contained in an Operating Manual.

2. Winching Areas

2.1 A winching area should, for operational effectiveness and safety, be located at the side or one end of the Offshore Service Vessel so that a large part of the manoeuvring zone can extend outside the vessel. The position of the operating area shall enable the pilot of the helicopter hovering over the winching area to have an unobstructed view of the vessel and to be in a position which will minimize the effect of air turbulence and flue gases.

The area shall, as far as possible, be positioned clear of accommodation spaces, provide an adequate deck area for material and provide for safe access to the area from different directions.

2.2 In selecting a winching area the desirability of keeping the winching height to a minimum shall also be borne in mind. In routine operations a winching height greater than 12 m shall be avoided.

2.3 A winching area shall provide a “manoeuvring zone” in which a clear zone shall be centred. The sizes of these areas are to be defined by the state of location or flag state of the Offshore Service Vessel.

3. Winching Above Accommodation Areas

Some Offshore Service Vessels may only be able to provide winching areas which are situated above accommodation spaces. Due to the constraints of operating above such an area only twin-engined helicopters shall be used for such operations and the following procedures adhered to:

- Personnel shall be cleared from all spaces immediately below the helicopter operating area and from those spaces where the only means of escape is through the area immediately below the operating area

- Safe means of access to and escape from the operating area shall be provided by at least two independent routes

- All doors, ports, skylights, etc. in the vicinity of the helicopter operating area shall be closed. This also applies to deck levels below the operating area.

- Fire and rescue parties shall be deployed in a ready state but sheltered from the helicopter operating area.

4. Strength of Winching Areas

4.1 Loads

The following loads are to be considered:

- Vertical load p_e = 2,0 kN/m^2 evenly distributed over the entire winching area for taking into account snow or other environmental loads.

- Vertical load pw evenly distributed over a reasonable part of the winching area for taking into account of the maximum load the biggest permissible helicopter may carry

4.2 Strength Check

A strength check of the deck intended as winching area using the loads of 4.1 shall be performed in accordance to the procedures of the **TL** Part A, Chapter 1, Section 7 and 8.

C. Structure of the Helicopter Landing Deck

1. General

The following provisions shall in principle apply to landing areas on special, pillar-supported landing decks or on the upper deck, superstructure deck or deckhouse of an Offshore Service Vessel.

2. Structure

In general 4 load cases LC 1 to LC 4 are to be investigated. Stresses and forces in the structure are to be evaluated by means of direct calculations. For definition of loads and dimensioning see **TL** Part A, Chapter 1, Section 7 and 8.

D. Helicopter Deck Equipment

1. Equipment as Hull Outfit

The requirements for helicopter deck equipment, such as

- Deck sheathing
- Rope netting
- Helicopter lashing points
- Marking
- Wind direction indicator
- Means of escape
- Safety net and railings
- Drainage

are defined in **TL** Part A, Chapter 1, Section 7.D .

2. Helicopter Operations Support Equipment

Provision shall be made for equipment needed for use in connection with helicopter operations including:

- Chocks and lashing strops/ropes (strops are preferable)

- Heavy-duty, calibrated, accurate scales for passenger baggage and freight weighing

- A suitable power source for starting helicopters if helicopter shut-down is seen as an operational requirement

- Equipment for clearing the helicopter landing area of snow and ice, if applicable, and other contaminants

E. Fire Extinguishing

In close proximity to the helicopter landing deck the following shall be provided and stored near the means of access to that deck:

1. Helicopter Facilities With No Refuelling Capabilities

1.1 At least two nozzles of dual-purpose type and hoses sufficient to reach any part of the helicopter deck.

1.2 At least two dry powder extinguishers having a total capacity of not less than 45 kg.

1.3 CO_2-extinguishers of a total capacity of not less than 18 kg or equivalent. One of these extinguishers shall be so equipped as to enable it to reach the engine area of any helicopter using the deck.

2. Helicopter Facilities With Refuelling Capabilities

2.1 Fire fighting equipment as defined in 1., and so arranged as to adequately protect both the helicopter deck and fuel storage areas. The operation of the fire main is not to interfere with the simultaneous operation of the foam system.

2.2 A fixed low expansion foam system with monitors or foam making branch pipes capable of delivering foam to all parts of the helicopter deck in all weather conditions in which helicopters can operate. The system shall be capable of delivering a discharge rate of not less than 6 ℓ/m^2 for at least 5 minutes for each square metre of the area contained within a circle of diameter D. D is the D-value defined in A.2. The foam agent shall meet the performance standards of ICAO **(1)** and be suitable for use with salt water.

TL may accept other fire-fighting systems which provide a fire-extinguishing capability at least as effective as the required foam application system.

3. Additional Equipment

3.1 Two fireman's outfits with breathing apparatus in addition to those required by national regulations.

3.2 At least the following equipment, stored in a manner that provides for immediate use and protection from the environment:

- Adjustable wrench
- Blanket, fire resistant
- Cutters bolt 600 mm
- Hook, grab or salving
- Hacksaw, heavy duty complete with 6 spare blades
- Ladder
- Life line 5 mm diameter and 15 m in length
- Pliers, side cutting
- Set of assorted screwdrivers
- Harness knife complete with sheath
- Rescue axe, large (non wedge or aircraft type)
- Crowbar, large
- Gloves, fire resistant

Sizes of this equipment shall be appropriate for the types of helicopter on which the design is based.

(1) *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" foam.*

F. Aviation Fuel System

1. General

These Rules apply to aviation fuel with a flash point above or equal and below 60° C.

2. Storage

2.1 General

2.1.1 For the storage of aviation fuel the general safety measures for fuel tanks are to be applied analogously, compare **TL** Part B, Chapter 4, Section 16. V.

2.1.2 The aviation fuel has to be stored in separate dedicated tank(s). Fuel storage tanks are to be of approved metallic construction. Special attention is to be given to the design, mounting and securing arrangements and electrical earthing of the tank.

2.2 Arrangement of Tanks

The arrangement of aviation fuel tanks has to comply with the following requirements:

- Tanks have to be located as far as practicable from accommodation spaces, escape routes, embarkation stations and machinery spaces

- Tanks have to be isolated by cofferdams from areas containing sources of vapour ignition

- Tanks and associated equipment shall be protected against physical damage and from a fire in an adjacent space or area

- No fuel tanks are to be arranged forward of the collision bulkhead (up to main deck)

- Aviation fuel tanks may not be arranged directly at the shell or directly besides other tanks

- The fuel storage area shall be provided with arrangements whereby fuel spillage may be collected and drained to a safe location

- The storage and handling area is to be permanently marked

2.3 Tank Equipment

2.3.1 The filling and outlet pipes, the sounding equipment, the mounting of devices and fittings as well as the venting and overflow equipment has to be provided in accordance with TL Part B, Chapter 4, Section 16, V.

2.3.2 If the flash point of the fuel is below 60 °C the following requirements have to be complied with:

- Venting pipes have to be provided with pressure vacuum valves and flame arrestors of approved type. The location of the openings in relation to any source of ignition has to be approved according to the area classification, compare Section 11, F.3 .

- Electrical equipment has to be explosion protected, compare H.

2.4 Where portable fuel storage tanks are used, special attention shall be given to:

- Design of the tank for the intended purpose

- Mounting and securing arrangements

- Electrical earthing

- Inspection procedures

3. Fuel Transfer System

3.1 General

3.1.1 For the handling of aviation fuel on the Offshore Service Vessel, separate piping systems are to be provided, which are not connected to other fuel systems. For these Rules it is assumed that the refueling is done on the helicopter landing deck.

3.1.2 The following functions are required:

- Filling of the aviation fuel tank(s) of the Offshore Service Vessel

- Discharging from any of the tanks via the connections, with the fuel transfer pump

- Transfer of fuel between any of the aviation fuel tanks, using the transfer pump, if applicable

- Refuelling of the helicopter from the aviation fuel tank, using the refuelling pump

- Flushing of the refuelling hoses to the aviation fuel tank

3.2 Piping and Pumping Arrangements

3.2.1 Electrical fuel pumping units and associated control equipment shall be of a type suitable for the location and potential hazard.

3.2.2 The tank outlet valve has to be directly at the tank. It has to be a quick-closing valve capable of being closed remote-controlled.

3.2.3 The fuel pumping unit shall be connected to one tank at a time and the piping between the tank and the pumping unit shall be of steel or equivalent material, as short as possible and protected against damage. Piping connections have to be of approved type.

3.2.4 Compensators and hoses have to be of steel or have to be flame-resistant and have to be of approved type.

3.2.5 Piping and pumping arrangements have to be firmly connected to the hull structure.

3.2.6 The pump has to be able to be controlled from the refuelling station. Fuel pumps shall be provided with means which permit shutdown from a safe remote location in the event of a fire. Where a gravity-fed fuelling system is installed, equivalent closing arrangements shall be provided.

3.2.7 A relief device has to be provided which prevents over-pressure in the refuelling hose.

3.2.8 The following items have to be provided in the system:

- Fuel metering

- Fuel sampling

- Filters

- Water traps

4. Requirements for the Room Containing the Pump and Filter Unit (Pump Room)

The following requirements have to be met:

- The bulkheads and decks have to be of steel and have to be insulated to "A 60" standard towards adjoining spaces.

- Access to the room is only permitted from the open deck. There is no access permitted to other spaces from this room.

- The room has to be provided with a fire detection system and a fixed fire extinguishing system which can be released from outside this room.

- The room has to be provided with a mechanical ventilation of the extraction type which is separate from any other ventilation system. The fans have to be of non-sparking design. The capacity of the ventilation has to be sufficient for 20 air changes per hour, based on the gross volume of the room.

- Inside the room only explosion protected equipment is permitted (IIA, T3).

- Up to a distance of 3 m from openings to the room, possible sources of ignition and openings to other rooms containing possible sources of ignition are not permitted.

- An emergency shutdown of the pumps and release of the quick-closing valves have to be provided from a position located outside the pump room close to the refuelling station.

- Drip trays have to be provided below components where leakage can occur.

5. No Smoking

"NO SMOKING" signs are to be displayed at appropriate locations.

6. Procedures and Precautions

The procedures and precautions during refueling operations shall be in accordance with good recognized practice.

G. Lighting

1. General

The lighting arrangements for landing areas are to be so designed that they also comply with current national regulations. The following facilities are normally to be provided:

- perimeter lighting of the landing area
- floodlighting of the landing area
- obstruction lights for marking elevated superstructures
- visual warning system

2. Perimeter Lighting

2.1 The perimeter lighting depends on the current national regulations, compare A.4.

2.2 Normally shall the helicopter deck be fitted with omni-directional lights in order to enable the landing area to be easily identified at night. The colour of the lights shall meet the requirement of the relevant Authority. These lights shall be uniformly positioned along the perimeter of the helicopter deck and not more than 3 m apart.

An intensity of at least 25 candelas is recommended.

2.3 The lights shall not project more than 25 cm above the plane of the landing area. Use of flush fitting lights or electro-luminescent panels in the obstruction free approach sector perimeter would provide adequate illumination whilst affording minimum obstruction to personnel and equipment movement.

3. Floodlighting of the Landing Area

3.1 The landing area shall also be floodlit, if intended for night use. The arrangements and aiming of floodlights shall be such that the markings are illuminated and the shadows are kept to a minimum. They shall be arranged so as not to dazzle the pilot and, if elevated and located off the landing area, the system shall not present a hazard to helicopters landing or taking off. Such floodlights shall be capable of being switched on and off at the pilot's request.

The average illumination intensity is recommended to be at least 10 Lux with a uniform ratio (average to minimum) of not more than 8 to 1.

3.2 It may be necessary to enhance the lighting to improve depth perception, possibly by using discrete floodlighting to the main structure or legs of Offshore Service Vessels with jack up capability.

3.3 The wind direction indicator is to be illuminated.

3.4 Undirected and therefore unnecessary light from other parts of the Offshore Service Vessels shall be avoided at the helicopter deck area. Adequate shielding of helicopter deck "polluting" light sources shall already be considered in the early design stage or shall also be minimized on existing Offshore Service Vessels. Temporary working lights which pollute the helicopter deck lighting environment should be switched off for helicopter operations.

It is also important to confine the helicopter deck lighting to the landing area, since any light overspill may cause reflections from the sea.

4. Obstruction Lights

4.1 For the guidance of helicopter pilots, obstructions such as elevated superstructures, drilling towers, crane booms, tops of legs, etc. are to be marked with red obstruction lights.

Objects which are more than 15 m higher than the landing area shall be fitted with intermediate red lights of the same intensity spaced at 10 metre intervals down to the level of the landing area (except such lights would be obscured by other objects).

4.2 Lights should be used which conform to the recommendations of the International Civil Aviation Organization (ICAO).

4.3 The lights are to be assigned to more than one circuit so that not all the lights are simultaneously extinguished in the event of a fault.

5. Visual Warning System

5.1 If a condition can exist on an Offshore Service Vessel which may be hazardous for the helicopter or its occupants, a visual warning system should be installed according to national regulations.

This system (status lights) may be a flashing red light which is visible to the pilot from any direction of approach and on any landing heading.

5.2 The system shall be automatically initiated at the appropriate hazard level, e.g. gas alarm, crane travel, etc., as well as being capable of manual activation.

6. Feeding and Control

6.1 The lighting systems according to 2. to 5., are to be supplied from a common lighting switchboard. Each circuit shall be protected against short circuit and overload. Supplies to the switchboard are to be run from the main switchboard and the emergency switchboard of the Offshore Service Vessel and are to be fed from an Uninterrupted Power Supply (UPS) system.

6.2 The control of the lighting shall be possible from a central position overlooking the complete helicopter operations. It shall be executed by the officer responsible for flight operations on the Offshore Service Vessel, who shall be able to report any failures or outages immediately to the helicopter pilot.

H. Electrical Protection

1. Electrical appliances located within the open range of the helicopter landing area, like the lights defined in G., shall meet the requirements of IP 55 type protection or better.

2. Electrical equipment, including the aviation fuel handling system according to F., shall be explosion protected conforming to temperature class T3 and an explosion group II A suitable for installation in explosion Zone 1 as a minimum requirement. For the definition of Zone 1 see Section 11, F.3.

3. All equipment used in refuelling operations shall have earthing to the Offshore Service Vessel.

4. During the whole refuelling procedure, helicopters shall have earthing to the Offshore Service Vessel. This is to be done by a flexible cable with a minimum cross-section of 6 mm^2. The cable shall be connected to an electrically conductive and earthed part of the helicopter deck. The free end of the cable shall be fitted with a suitable device permitting easy and reliable connection to the helicopter.

I. Tests and Trials

1. Harbour Tests

The different systems necessary for helicopter operation are to be tested at the shipyard before sea trials:

1.1 Equipment

- Function of the wind director
- Test if safety net withstands the dropping of a 75 kg weight
- Functioning of raisable and retractable handrails
- Working of drainage measures
- Function of scales
- Other actual features

1.2 Fire Extinguishing

- Function test of all parts of the fire extinguishing system

1.3 Aviation Fuel System

- Filling of aviation fuel tanks
- Transfer of fuel between tanks
- Simulation of helicopter refuelling

1.4 Lighting

- Test of all lights with main and emergency power supply
- Test of visual warning system

2. Sea Trials

- Starting and landing of a helicopter of maximum planned size
- Test of earthing of helicopter

SECTION 22

OPERATION IN ICE

Page

A. General

1. Scope

1.1 The requirements of this Section apply to Offshore Service Vessels which are intended for operation in ice-covered waters or areas where a risk of icing exists at a minimum air temperature defined by the owner/operator.

1.2 The design targets for such an operation of Offshore Service Vessels are:

- Minimization of operation disturbances by low temperatures

- Minimization of accretion of ice

- Minimization of the effects of the accretion of ice, for example: no shutters should be fitted in the freeing ports

- Equipment for removing ice, for example: electrical and pneumatic devices, and/or special tools such as axes or wooden clubs for removing ice from bulwarks, rails and superstructures

1.3 This Section gives an integrated approach to all relevant aspects of such an operation to ensure that all machinery and systems are capable of functioning effectively and provide adequate levels of safety in normal operations, but also in accident and emergency situations.

2. Definitions

2.1 Ice Classes ICE-B, ICE-B1 to ICE-B4

Ice Class Notations **ICE-B, ICE-B1 to ICE-B4** are used throughout these Rules to convey differences between classes with respect to operational capability and strength. It is the responsibility of the owner to select an appropriate Ice Class and level of propulsion power. The following descriptions are intended to guide owners, designers and administrations in selecting an Ice Class for safe operation.

For further information see **TL** Part A, Chapter 1, Section 14, A.

Ice Class	Ice Description
ICE-B	Drift ice in mouths of rivers and coastal regions
ICE-B1 **ICE-B2** **ICE-B3** **ICE-B4**	Ice conditions as in the Northern Baltic according to paragraph 1.1 of the Finnish-Swedish Ice Class Rules, as amended.

2.2 Polar Ice Classes PC1 to PC7

Polar Class Notations are used throughout these Rules to convey differences between classes with respect to operational capability and strength. It is the responsibility of the owner to select an appropriate Polar Class and level of propulsion power. The following descriptions are intended to guide owners, designers and administrations in selecting an appropriate Polar Class for safe operation.

For further information see **TL** Part C, Chapter 33

Polar Class	Ice Description
PC 1	Year-round operation in all polar waters
PC 2	Year-round operation in moderate multi-year ice conditions
PC 3	Year-round operation in second-year ice which may include multi-year ice inclusions
PC 4	Year-round operation in thick first-year ice which may include old ice inclusions
PC 5	Year-round operation in medium firstyear ice which may include old ice inclusions
PC 6	Summer/autumn operation in medium first year ice which may include old ice inclusions
PC 7	Summer/autumn operation in thin firstyear ice which may include old ice inclusions

3. Documents to be Submitted for Approval

The following design documentation shall be submitted considering the general requirements defined in Section 1, F.:

- Arrangement of equipment for preventing of icing and de-icing for:
- Vessel arrangement and equipment
- Machinery equipment
- Fire safety
- Electrical installations
- Electrical single line diagrams for all heating circuits including required power consumption
- Arrangement and fixing of heating cables for the equipment concerned
- Piping and pumping scheme for heating fluids
- Arrangement of heating piping for the equipment concerned
- Piping schemes and details of installation of hydraulic power pack for hydraulic systems exposed to very low temperature
- Piping scheme and details of compressor for compressed air systems exposed to very low temperatures
- Details of protection of control consoles
- Definition of basic power supply and redundant power supply for essential equipment and equipment for life-saving
- Details of switchboard for central control of all measures defined above
- List of hand tools for ice removal and arrangements of their storage near the locations for their use
- Operating and Training Manual
- Test Program

4. Rules and Regulations to be Considered

The latest issue of the following Rules and regulations has to be considered:

4.1 TL Rules

- **TL** Part A, Chapter 1 or
- **TL** Part B, Chapter 4
- **TL** Part C, Chapter 33

4.2 Other regulations

- International Code for Ships Operating in Polar Waters
- Transport Canada TP 14335 E: Winter Navigation on the River and Gulf of St. Lawrence

5. Classification, Notations

5.1 Navigation and propulsion

If Offshore Service Vessels meet the requirements of the Rules defined in B. for hull strengthening and propulsion the Class Notations **ICE-B, ICE-B1, ICE-B2, ICE-B3, ICE-B4** or **PC1** to **PC7** may be assigned, as appropriate.

5.2 Additional requirements for operation at very low temperatures

Offshore Service Vessels built in accordance with the applicable requirements of C. to G. of this Section will be assigned the Notation **ICEOPS** in addition to **OFFSHORE SERVICE VESSEL** affixed to their Character of Classification.

6. Special Environmental Conditions

6.1 Causes for accumulation of ice on the decks, superstructures and equipment of the Offshore Service

Vessel can be:

- Wash of the sea
- Spray of the sea
- Condensation of humidity existing in the air on the cold vessel surfaces

The first two possibilities of icing are to be considered up to a height of 20 m above waterline. In higher areas only the third possibility is to be considered.

6.2 For ice accretion the following icing allowances should be made:

6.2.1 30 kg/m^2 on exposed weather decks and gangways

6.2.2 7,5 kg/m^2 for projected lateral area of each side of the ship above the water plane

6.2.3 the projected lateral area of discontinuous surfaces of rail, sundry booms, spars (except masts) and rigging of ships and the projected lateral area of other small objects should be computed by increasing the total projected area of continuous surfaces by 5 % and the static moments of this area by 10 %.

6.3 Guidance relating to ice accretion

In the application of the above standards the following icing areas should apply:

6.3.1 the area north of latitude 65° 30´ N, between longitude 28° W and the west coast of Iceland; north of the north coast of Iceland; north of the rhumb line running from latitude 66° N, longitude 15° W to latitude 73° 30´ N, longitude 15° E, north of latitude 73° 30´ N between longitude 15° E and 35° E, and east of longitude 35° E, as well as north of latitude 56° N in the Baltic Sea;

6.3.2 the area north of latitude 43° N bounded in the west by the North American coast and the east by the rhumb line running from latitude 43° N, longitude 48° W to latitude 63° N, longitude 28° W and thence along longitude 28° W;

6.3.3 all sea areas north of the North American Continent, west of the areas defined in 6.3.1 and 6.3.2;

6.3.4 the Bering and Okhotsk Seas and the Tartary Strait during the icing season; and

6.3.5 south of latitude 60° S.

For ships operating in areas where ice accretion may be expected:

6.3.6 within the areas defined in 6.3.1, 6.3.3, 6.3.4 and 6.3.5 known to have icing conditions significantly different from those described in 6.2, ice accretion requirements of 0,5 to 2 times the required allowance may be applied; and

6.3.7 within the area defined in 6.3.2, where ice accretion in excess of twice the allowance required by 6.2 may be expected, more severe requirements than those given in 6.2 may be applied.

General guidance relating to ice accreditation should be given to the Captain in the form of instructions in the stability booklet.

6.4 National standards for icing where environmental conditions are considered to warrant a higher standard than those recommended above, are to be applied.

B. Navigation and Propulsion

1. Hull

The strengthening of the vessel's hull for navigation in ice for Class Notation **ICE-B, ICE-B1** to **ICE-B4** is defined in **TL** Part A, Chapter 1, Section 14.

The structural requirements for hulls with the Polar Class Notations **PC1** to **PC7** are defined in the **TL** Part C, Chapter 33, Section 2.

2. Intact and Damage Stability

2.1 For the requirements for intact and damage stability see **TL** Part A, Chapter 1, Section 26.

2.2 For Offshore Service Vessels with Class Notation **PC1** to **PC7** additional requirements are defined in IMO Resolution A.1024 (26), Chapter 3.

3. Navigational Equipment

3.1 Navigational equipment is only partly subject to Classification. For detailed requirements for Offshore Service Vessels with Class Notations **PC1** to **PC7** refer to IMO Resolution A.1024(26), Chapter 12.

3.2 Magnetic compasses situated on the open deck or bridge wings, etc. are to be protected from ice by a cover.

4. Propulsion

4.1 The machinery of Offshore Service Vessels strengthened for navigation in ice designated with Class Notations **ICE-B, ICE-B1, ICE-B2, ICE-B3 or IC-B4** has to meet the requirements contained in the **TL** Part B, Chapter 4, Section 19 and the relevant structural requirements set out in **TL** Part A, Chapter 1, Section 14 together with the supplements thereto. The reinforcements necessary for the Class Notation **ICE-B** may also be applied to the machinery alone.

4.2 For Offshore Service Vessels with Class Notations **PC1** to **PC7** the requirements concerning:

- Materials
- Propellers
- Shafting
- Gears, flexible couplings, clutches
- Prime movers including propulsion engines and emergency power units
- Steering systems

which are defined in the **TL** Part C, Chapter 33, Section 3 are to be fulfilled.

C. Vessel Arrangement and Equipment

1. Navigation Bridge

1.1 A completely closed navigation bridge is to be arranged. Effective heating of the complete bridge and adjoining spaces is to be provided.

1.2 The windows of the navigation bridge shall be provided with suitable means of de-icing to allow for an unimpaired 360° vision.

Effective measures to clear melted ice, freezing rain, snow mist and sea spray from outside of the windows are to be installed. The mechanisms of these measures are to be protected from freezing or ice accumulation.

1.3 Humidity in the air inside the bridge from the heating system shall be avoided in order to prevent window fogging and icing from the inner side. It shall be possible to clear accumulated condensation at the inner side of the windows.

2. Accommodation

2.1 All personnel accommodation shall be designed and arranged to protect the crew and all other persons on board from unfavourable environmental conditions and minimize risk of injury during normal operations including ice transiting or ice breaking and emergency conditions.

2.2 All personnel accommodation, public spaces and equipment installed in them shall be designed so that each person making proper use of them will not suffer injury during normal open water operations, designed ice transiting modes of operation and emergency manoeuvring conditions.

2.3 Offshore Service Vessels with Class Notations **PC1** to **PC5** shall have sufficiently available and reliable facilities to maintain a life sustaining environment in the event of an emergency and/or of extended ice entrapment.

2.4 Offshore Service Vessels with Class Notations **PC1** to **PC3** and vessels intended to be used in the ramming mode shall be designed with adequate provisions to ensure the safety of personnel using shower facilities. Such facilities shall include non-slip decking, three rigid sides, hand holds and insulation from exposed hot water pipes.

2.5 Galley facilities shall be provided with grab rails projecting from the front on cooking equipment for use by the crew during ice operations. Equipment such as deep fat fryers shall be located in a position suitably separated from hot plates or other hot surfaces. Such appliances are also to be secured to the deck or other fixed structure and provided with an oil tight lid or closure to prevent splashing or spillage during ice operations.

2.6 Near the exits of the superstructure to the open deck rooms for storing and dressing with cold weather clothing are to be arranged. There shall also be the possibility to dry wet clothing after outside use.

3. Escape Measures

3.1 All means of escape from accommodation or interior working spaces shall not be rendered inoperable by ice accretion or by malfunction due to low external air temperatures.

3.2 All escape routes shall be dimensioned not to hinder passage of persons wearing suitable polar clothing.

3.3 Escape routes shall be designed to minimize the distance between their exit to an open deck and the survival equipment to which they lead.

4. Accessibility of Deck

4.1 All parts of the decks where equipment which cannot be remote controlled is installed and has therefore to be operated locally have to be reached by the crew under icing conditions. This has to be accomplished by one of the following means:

- Removable covers on the access path
- Heating of the access path
- Tunnel from the lower deck
- Installation of deck machinery one deck below the main upper deck
- Other suitable means

4.2 For Offshore Service Vessel provided with a large cargo deck in the rear part of the vessel, it has to be ensured that proper cargo handling is also possible under icing conditions.

5. Anchoring Arrangements

5.1 Anchoring systems shall be provided with an independent means of securing the anchor so that the anchor cable can be disconnected for use as an emergency towing bridle.

5.2 The hawse pipes are to be adequately heated to be ice free if the anchor has to be dropped. For the hawse pipe washing line complete drainage or continuous heating is to be provided.

5.3 Offshore Service Vessels with Class Notation **PC1** to **PC5** shall, as far as practicable, be designed to protect the anchor from being dislodged from its stowed position and from jamming or damaging the hull by direct impact with ice.

5.4 The freezing of fluids, like hydraulic oil and lubricants, has to be avoided. This shall be achieved by the use of fluids suitable for low temperature operation and heating arrangements where appropriate.

6. Towing Arrangements

6.1 Towing arrangements shall facilitate connection and release of a tow line and provide bollards, fairleads and other components suitable for the size of Offshore Service Vessel on which they are fitted.

6.2 All Offshore Service Vessels with Class Notation **PC1** to **PC7** and designed to perform dedicated towing operations shall:

- Have a quick release system, operable from the central control position; see also Section 14.
- Be provided with a line throwing apparatus in addition to that for life-saving; this apparatus shall be capable of delivering

messenger lines for the transfer of towing equipment. Such line throwing apparatus shall not be of powder/ rocket type, in order that it may safely used to make a transfer to a tanker vessel.

- Be capable of receiving emergency towing assistance.

7. Life-Saving

7.1 Life Saving Appliances

7.1.1 Lifeboats, rescue boats and life rafts shall be kept in protected places to avoid malfunction caused by ice accretion. Their launching appliances are to be protected or electrically heated to guarantee functioning in due time. An ice removal mallet shall be provided and stored in the vicinity of the lifeboats and life rafts for regular removal of remaining ice accretion.

7.1.2 To enable starting of the engines of life and rescue boats and to achieve a habitable temperature inside, connections for electrical heating are to be provided at their storage locations.

7.2 Life Saving Equipment

This equipment is not subject to Classification, but it is recommended to consider the following aspects:

7.2.1 Life saving equipment, when stored in an exposed position, shall be of a type that is rated to perform its design function at the minimum anticipated air temperature.

7.2.2 Lifeboats

The following requirements are to be considered:

- All lifeboats shall be either of the partially or totally enclosed type to provide adequate shelter from the anticipated operating environment

- The capacity of lifeboats shall be evaluated with regard to operability, accessibility, seating capacity and overall space, considering the needs of personnel wearing clothing suitable for the minimum anticipated air temperature

- An icing removal mallet stored in the vicinity of the lifeboat shall be used to remove regularly ice accretion from the life boats

- All lifeboat engines shall be equipped with means to ensure that they will start readily when required at the minimum anticipated operating temperature; to the cooling water system an adequate amount of anti-freezing compound has to be added

- The lifeboat engine fuel oil shall be suitable for operation in the minimum anticipated operating temperature

- Drinking water shall be stored in containers that allow for expansion due to freezing

7.2.3 Liferafts

The following requirements are to be considered:

- The vessel shall keep in a warm space in the vicinity of the life rafts manual inflation pumps that are proven to be effective in the anticipated air temperatures

- Air or other proven cold temperature gas shall be used for the inflation of life-saving equipment according to their environmental conditions of operation

7.2.4 Survival Kits

Personal and group survival kits shall be provided for the crew and all other persons aboard. For detailed requirements refer to IMO Resolution A.1024 (26), Chapter 11.

D. Machinery Equipment

1. General

1.1 Machinery and systems outside the superstructures shall be designed so that personnel exposure to very low temperatures and other environmental hazards during normal operations including routine maintenance is minimized.

1.2 Machinery shall be protected from the harmful effects of ingestion or accumulation of ice or snow. Where continuous operation is necessary, means shall be provided to purge the system of accumulated ice or snow.

1.3 Basic tools for removing ice shall be made available for all elements of machinery equipment. Such tools may be electrical and pneumatic devices and/or special tools such as axes or wooden clubs, etc.

2. Materials

2.1 Materials used in machinery and systems shall be suitable for operation in the environment which prevails at their location. In particular, machinery or systems which are essential for preventing pollution or for safe operation of the vessel when:

- Located outside and above the waterline in any vessel operation condition, or
- In unheated locations inside

shall not be susceptible to brittle fracture within the range of operating conditions.

2.2 Essential machinery and equipment required for the safe operation of the vessel or systems required for preventing pollution, located within spaces which, upon failure of the primary heating system, could be subject to outside ambient temperatures shall be:

- Provided with an independent source of heat, and
- Fabricated from materials that will not be susceptible to brittle fracture under anticipated loads and temperatures.

2.3 For Offshore Service Vessels with Class Notations **PC1** to **PC7**, which may be laid up in polar waters, materials for all systems with the potential to pollute shall be suitable for avoiding pollution and ensuring safe operation on re-activation of the systems.

3. Provisions for Inlets of Seawater

3.1 General

The inlet of seawater has to be ensured under all operating conditions for the following tasks:

- Cooling of all machinery installations
- Feeding of at least one of the fire pumps
- Ballast operations, if required

3.2 Vessels with Class Notations ICE-B1 to B4

For Offshore Service Vessels with Class Notations **ICE-B1** to **B4** the following requirements have to be complied with, see also **TL** Part B, Chapter 4, Section 16, I.2.:

3.2.1 For one of the two required sea chests the sea inlet is to be located as near as possible to centerline and as far aft as possible. The seawater discharge line of the entire engine plant is to be connected to the top of the sea chest.

3.2.2 The sea chest is to be arranged as follows:

- In calculating the volume of the sea chest the following value is to be applied as a guide:
- 1 m^3 for every 750 kW of the vessel's engine output including the output of auxiliary engines.
- The sea chest is to be of sufficient height to allow ice to accumulate above the inlet pipe.
- The free area of the strum holes is to be not less than four times the sectional area of the seawater inlet pipe.

3.2.3 As an alternative two smaller sea chests of a design as specified in 3.2.2 may be arranged.

3.2.4 All discharge valves are to be so arranged that the discharge of water at any draught will not be obstructed by ice.

3.2.5 Where necessary, a steam connection or a heating coil is to be arranged for de-icing and thawing the sea chests.

3.2.6 Additionally, cooling water supply to the engine plant may be arranged from ballast tanks with circulating cooling. This system does not replace the requirements stated in 3.2.2.

3.2.7 Ballast water tanks which are arranged above the ballast load line are to be equipped with means to prevent the water from freezing, see **TL** Part A, Chapter 1, Section 14, B.4.

3.2.8 Drinking water tanks located at the ship's side above the ballast waterline are to be provided with means for tank heating to prevent freezing.

3.3 Vessels with Class Notations PC1 to PC7

For Offshore Service Vessels with Class Notations **PC1** to **PC7** the following requirements have to be observed, compare also **TL** Part C, Chapter 33, Section 3, I.2.:

3.3.1 Seawater Inlet System

Seawater inlet systems for machinery that are essential for the propulsion and safety of the vessel shall be designed for the environmental conditions applicable to the ice class.

The suggested arrangement of the system is shown in Figure 22.1.

3.3.2 Sea Boxes

3.3.2.1 At least two sea chests are to be arranged as ice boxes (sea chests for water intake in severe ice conditions) for Classes **PC1** to **PC5**. The calculated volume for each of the ice boxes shall be at least 1m³ for every 750 kW of the totally installed power.

For **PC6** and **PC7** there shall be at least one ice box located preferably near centre line.

3.3.2.2 Ice boxes shall be fitted on different sides of the vessel (**PC1** to **PC5**) and as far aft and deeply submerged as possible (low sea suction). For operation in ice-free waters a high sea suction may be used.

3.3.2.3 Openings in vessel sides for ice boxes are to be fitted with gratings, or holes or slots in shell plates. The net area through these openings is to be not less than 5 times the area of the inlet pipe. The diameter of holes and width of slots in shell plating is to be approximately 20 mm to prevent ingestion of large ice particles. Gratings of the ice boxes are to be provided with means of clearing. Clearing pipes are to be provided with screw-down type non return valves.

3.3.2.4 Ice boxes are to be designed for an effective separation of ice and venting of air.

3.3.2.5 The ice box may be arranged with a vertical weir plate. Any ice entering the ice box can float on the top and it is unlikely that it will be drawn down to the low arranged ice box outlet on the other side of the weir, see Figure 22.2.

For removing the ice, access is to be provided to the ice box from above. Access hatches with detachable manholes on the top are to be led above the deepest load line.

3.3.2.6 Sea inlet valves are to be secured directly to the ice boxes. The valve shall be a full bore type.

3.3.3 Sea Bay

3.3.3.1 It is recommended to install an intermediate sea bay of considerable size to gather the ice-free seawater after the sea boxes and before the direct suction of the seawater to the machinery installations, see Figure 22.1.

3.3.3.2 In the connection between the ice boxes and the sea bay, strainers shall be provided to hold back the remaining ice pieces in the seawater. At least two strainers for each ice box connection shall be provided to be able to clean one strainer without interrupting the water flow via the other.

3.3.3.3 The design flow velocity of sea water through the suction pipe to any pump shall not be more than 2 m/s.

3.3.4 Venting

3.3.4.1 Ice boxes and sea bays are to have vent pipes. For small systems the cross sectional area shall be at least equal to that of the suction piping. In case of larger systems, the ratio may be reduced, but the minimum recommended diameter is 150 mm. The valve at the top of box or bay shall be of a full flow type.

3.3.4.2 For operating areas with heavy spray ice accumulation precautions have to be taken to avoid blockage of air pipes by spray ice which could create structural damage. Air pipes shall therefore be positioned in protected areas of superstructures or provided with heating at the top.

3.3.5 Prevention of freezing

3.3.5.1 Means are to be provided to prevent freezing of sea bays, ice boxes, ship side valves and fittings above the load water line.

3.3.5.2 At the inner side of the seawater intake grating in the shell plating according to 3.3.2.3, a system of low pressure steam or compressed air nozzles shall be situated to clear the holes or slots from ice pieces.

3.3.5.3 Controlled means are to be provided to recirculate hot cooling seawater before the discharge to the sea to the ice boxes and the sea bay. Total sectional area of the circulating pipes is not to be less than the area of the cooling water discharge pipe.

In this way it should be possible to keep the incoming water to the strainers after the sea boxes above 20 °C.

3.4 Use of ballast water

3.4.1 For relatively short time the water of ballast tanks may be applied for cooling tasks. In this operation mode water is drawn from a ballast tank by ballast pump and pushed through the regular engine cooling system.

Because of the cooling effect of the vessel’s shell, the use of double bottom tanks would be preferable.

3.4.2 Another task for ballast tank water could be the temporary back flushing of the strainers, one by one.

4. Tanks

4.1 Efficient means are to be provided to prevent freezing in fore and aft peak tanks, wing tanks, ballast tanks located above the water line and any other tanks where found necessary.

4.2 Fresh water, ballast, fuel and lube oil tanks shall be carefully located and fitted with heating facilities. The tank heating is to be so designed that the fuel and lubricating oil remains capable of being pumped under all ambient conditions.

For ballast tanks an air bubble system may be used to prevent freezing in a higher temperature range.

4.3 Heating facilities may be needed also for further tanks (e.g. tanks for sludge, leakage, bilge water, sewage, etc.), pending on location and media.

4.4 For Offshore Service Vessels with Class Notations **PC1** to **PC7** no pollutants should be carried in Tanks directly against the shell in hull areas at significant risk of ice impact.

4.5 A temperature control is to be provided to protect the tank content against overheating.

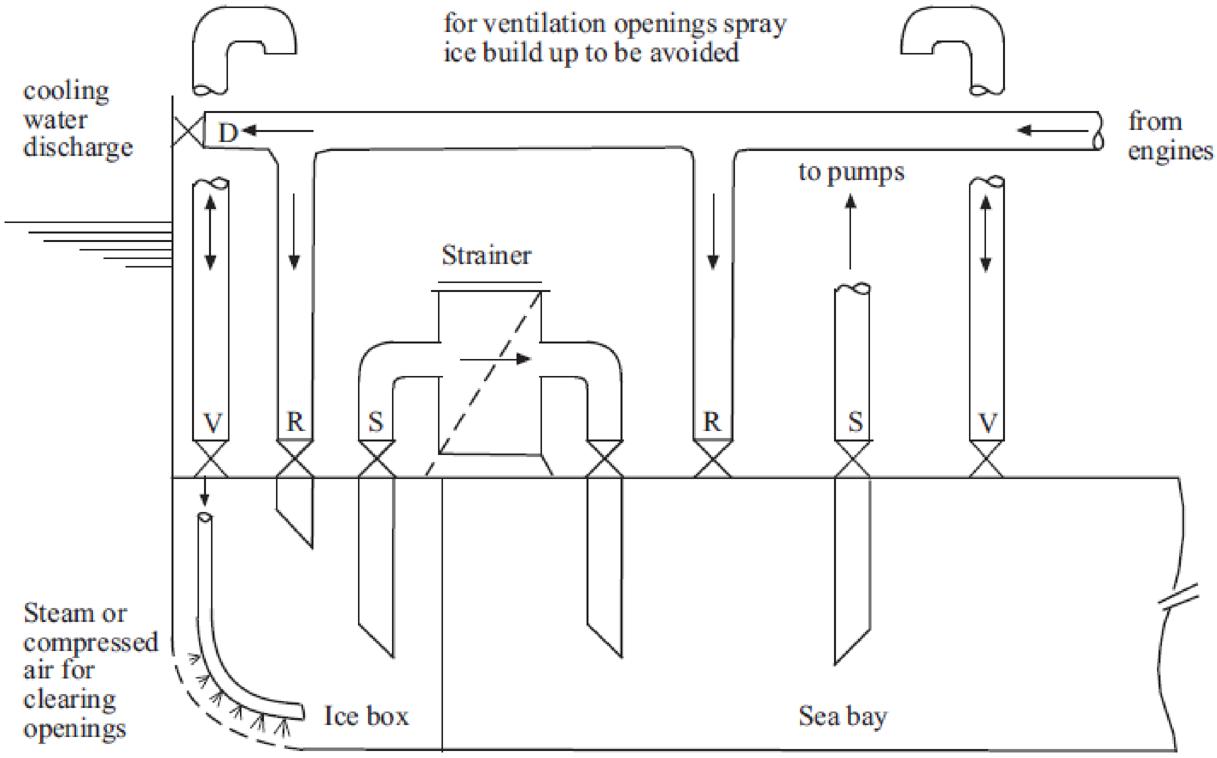
5. Piping Systems

5.1 General

Vent pipes, intake and discharge pipes and associated systems shall be designed to prevent blockage due to freezing or ice and snow accumulation. The top of vent pipes is to be located as far as possible in protected areas of the superstructure.

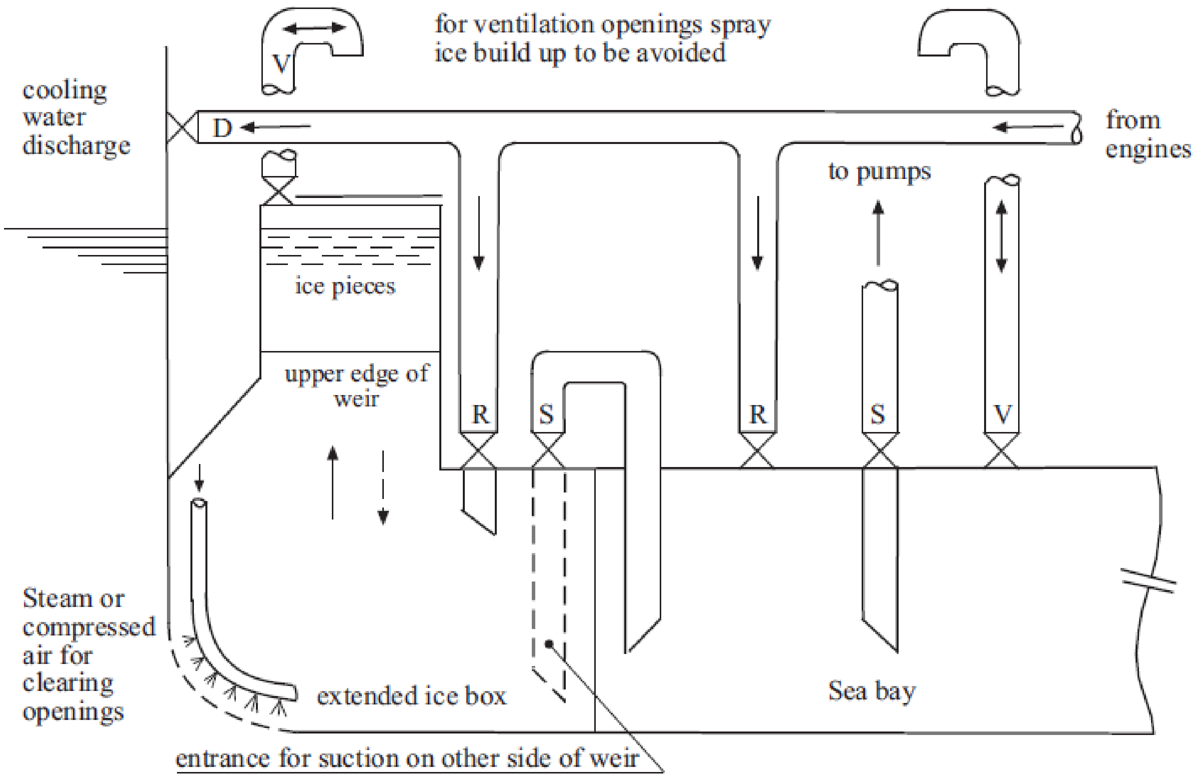
5.2 Pipes endangered by freezing

The following measures are to be provided alternatively or in addition for exposed pipes with fluids endangered by freezing.



V = Ventilation R = Re-circulation S = Suction D = Discharge

Figure 22.1 - Suggested arrangement of seawater inlet system (IMO suggested arrangement)



V = Ventilation R = Re-circulation S = Suction D = Discharge

Figure 22.2 - Arrangement of extended sea box with weir

5.2.1 Drainage

Shut-off of the exposed part of the piping system immediately after use is to be established by valves situated in spaces with temperature above 0° C. The drainage of the exposed part shall then be possible by a drain valve at the lowest part of the pipe. To keep the line completely dry after use, a connection for blowing the pipe through with air may be required in special cases.

Sounding air pipes of ballast tanks shall be emptied of water.

5.2.2 Heating

Electric trace heating of the exposed part of the piping system is to be provided.

5.2.3 Insulation

The trace heating according to 5.2.2 requires an adequate insulation of the exposed part of the piping system. The design of the insulation has to consider the minimum anticipated air temperature. The outer side of the insulation is to be protected against damage as far as necessary.

An adequate insulation of the exposed part of the piping system is also to be provided if already heated liquid is circulating in the piping system e.g. for bringing heating energy to other parts of the equipment which are endangered by icing.

5.3 Pipes for other fluids

Additional heating of lubrication oil may also be needed for equipment located in machinery spaces.

5.4 Hydraulic systems

Hydraulic oil of a type suitable for the minimum anticipated operating temperature should be used and ifthis is not sufficient also possibilities for heating are to be installed.

Hydraulic power packs are to be installed in enclosed heated spaces.

Exposed control stands for remote control of hydraulically driven equipment shall be equipped with removable covers and heating of at least the control valves.

5.5 Compressed air system

5.5.1 The compressed air shall be dried to avoid condensation and ice building in exposed parts of the piping system.

5.5.2 Compressors are to be installed in enclosed heated spaces. The air intake has to be protected against ice and snow.

5.6 Decontamination system for handling of hazardous and noxious substances

The decontamination shower and eyewash of Offshore Service Vessels for chemical recovery and handling of hazardous and noxious liquid substances are to be arranged at a protected location on deck. Exposed pipes of the system have to be insulated or heated to avoid freezing of the cleaning fluid. It is recommended that the cleaning fluid is warmed up within its storage tank.

5.7 Pumps

Pumps have to be installed in spaces where a climate suitable for their functioning can be established.

5.8 Deck tunnel

For Offshore Service Vessels which are equipped with extensive piping, valves and accessories on the upper deck, as e.g. vessels for oil and chemical recovery or for transport of hazardous or noxious liquids in bulk, it is recommended to concentrate this equipment in a tunnel on deck, which is isolated and inside temperatures can be brought to above zero.

6. Ventilation

6.1 Closing apparatus for ventilation inlets and outlets shall be designed and located to protect them from ice and snow accumulation that could interfere with the effective closure of such systems.

6.2 The air intakes for machinery and accommodation ventilation are to be located on both sides of the vessel. The air intakes are to be sufficient for safe operation of the vessel in heavy weather respectively in ice storm conditions.

6.3 Accommodation and ventilation air intakes shall be provided with means of heating.

6.4 The temperature of combustion air is to be suitable for the operation of the machinery. Direct ducting to the engines with own heating facilities shall be considered.

7. Deck Machinery

7.1 The winches on deck used e.g. for towing and anchor handling are to be situated in an - at least partly-protected area, situated mostly forward of the working deck, or are to be protected from icing by suitable covers not hindering routine operations in combination with heating of critical elements.

7.2 Special devices for anchor handling, like stern roller, retractable guiding pins or shark jaws at the rear end of the working deck are to be heated at their critical positions.

7.3 For all types of deck machinery the freezing of operating fluids, like hydraulic and lubricating oil has to be avoided by thermal insulation and adequate heating of the systems.

7.4 Control consoles for machinery on open deck have to be located in a heated space of adequate size or have to be protected by movable covers in combination with heating of critical elements.

7.5 A sheltered place for the pilot ladder is to be provided to avoid ice cover before use.

7.6 Bins and covered stowing racks are to be provided for all lashing material on deck, as far as practicable.

7.7 For lashings on deck no manila ropes shall be used as it becomes stiff and impossible to handle. Polypropylene or other synthetic ropes are better suited for use at low temperatures. The storage drums for mooring ropes shall be provided with strong canvas covers.

7.8 The whistle drive on the foremast is to be securely protected (if practicable by canvas covers).

8. Deck Cranes

8.1 All elements for moving deck cranes are to be equipped with coverings not restricting crane movements. Fixed protection covers have to be provided especially for winches, drums, cylinders, etc.

8.2 On critical motion elements ice removers are to be provided, ice formation on wire sheaves is to be avoided by mechanical measures.

8.3 Electrical heating is to be installed for gear boxes, electric cabinets and junction boxes or other critical elements with the aim to avoid moisture because of temperature changes in the enclosed air volume. For oil reservoirs de-humidifiers are to be provided.

Hydraulic pipelines are to be isolated and heated. Continuous circulation of the warmed-up oil should be considered.

8.4 Only oils suitable for the minimum anticipated operating temperature are to be used.

8.5 If deck cranes are not remote controlled but are provided with a driver’s cabin, a habitable working climate in the cabin has to be established during operation times by heating and also the windows have to allow a clear view to the working area, compare measures defined in F.3.3.

A save access to the cabin is to be secured by e.g. open grating solutions.

9. Waste Disposal

9.1 Contaminated liquids

Contaminated liquids, like dirty ballast water, tank washings, oil and purifier sludge, black water shall be safely stored on board until they can be discharged ashore.

If bilge water is discharged through a bilge water separator, a lower rate of contamination than 15 ppm may be required in ice operating regions. Therefore measures to allow repeated flow through the separator before finally discharging are to be provided. See also Section 23, B.2.

9.2 Garbage

According to national regulations discharge of domestic garbage is forbidden in most ice operating regions. Garbage has to be stored completely on board or can be separated into non-burnable or burnable elements. The latter part may be burned in an approved incinerator on board.

10. Machinery Rooms

All machinery rooms, like main engine room, steering gear compartment, pump rooms, bow thruster room, emergency generator room, emergency fire pump room, CO_2 storage rooms and other fire fighting rooms, etc. are to be insulated against cold.

An adequate heating system is to be provided to keep the temperature in the room above 0 °C even if the machinery is out of operation.

E. Fire Safety

1. Fire Extinguishing

1.1 Fire extinguishing systems shall be designed and located so that they are not made inaccessible by ice and snow accumulation or low temperature such that:

- Equipment, appliances, systems and extinguishing agents shall be protected from freezing at minimum temperature for the intended voyage

- Precautions shall be taken to prevent nozzles, piping and valves of any fire extinguishing system from becoming clogged by impurities, corrosion or ice build-up

- Exhaust gas outlets and pressure vacuum arrangements shall be protected from ice built-up that could interfere with effective operation

.2 Water or foam extinguishers shall not be located in any position that is exposed to freezing temperatures. These locations shall be provided with extinguishers capable of operation under such conditions.

2. Fire Pumps and Associated Equipment

2.1 A suction from the de-iced seawater cooling system is to be provided for at least one of the fire pumps, see D.3. Where a fixed fire extinguishing system situated in a space separate from the compartment containing the main fire pumps utilizes its own independent sea suction, this sea suction shall be capable of being cleared of accumulations of slush ice.

2.2 For fire mains the following additional measures may be applied:

- Filling with a fluid of low freezing point (e.g. mixture of glycol and water)

- Allowing the fire main to flow continuously over board (only operable for relatively short time because of build-up of ice at overflow points)

2.3 Fire pumps including emergency fire pumps shall be installed in heated compartments and in any event shall be adequately protected from freezing for the minimum temperature for the intended voyage.

2.4 Isolating valves shall be accessible and if located in exposed positions shall not be subject to icing from freezing spray. The fire main shall be so arranged that external sections can be isolated and draining devices shall be provided.

2.5 Hydrants shall be positioned or designed to remain operable under all anticipated temperatures. Ice accumulation and freezing shall be taken into account.

2.6 All hydrants shall be equipped with an efficient two-handed valve handle.

3. Protection Against Ice Build-up

Components of the fire fighting system which may be exposed to icing that could interfere with the proper functioning of that component shall be adequately protected.

4. Fire Fighters' Outfits

At least two spaces have to be arranged to store the fire fighters' outfits in warm condition as widely separated as practical.

F. Electrical Installations

1. General

1.1 The selection, layout and arrangement of all electrical installations shall be such as to ensure faultless continuous operation in ice-covered waters. The provision may not be effected of emergency heat and power by interference in the electrical system.

1.2 Precautions shall be taken to minimize risk of supplies to essential and emergency services being interrupted by the inadvertent or accidental opening of switches or circuit breakers due to vibrations or accelerations during ice breaking operations.

2. Communication

2.1 The public address system and the general emergency alarm system have to be audible over the loudest ambient noise level occurring during ice transiting, ice breaking or ramming.

2.2 Emergency power for communications equipment provided by battery is to be provided with a means whereby the batteries are protected from extreme low temperatures.

3. Electric Heating

3.1 Objects

Electrical heating may become necessary for e.g.:

- Railings
- Gangways, stairways
- Windows of the navigating bridge or other control stands
- Necessary accessible working deck areas
- Helicopter deck
- Electric motors of drives in the open
- Switch boxes in the open
- Ventilation openings for essential ventilation
- Crane cabins
- Lighting
- Searchlights
- Life and rescue boat storage locations and passageways leading to them

3.2 Cables

An effective heat transfer from the heating cables to the equipment is to be ensured.

The heating system has to be divided into different electrical circuits. Each circuit shall be protected against short circuit and overload. An earth fault protection with 30 mA RCD is strongly recommended.

A periodic insulation test should be carried out according to the manufacturer's instruction, preferably with an automatic device. Occurrence of failures is to be alarmed.

Cables running on the open are to be protected by steel pipes or covers to enable manual ice removal. These covers are to be equipped for drainage.

3.3 Windows

Windows at the bridge and other control positions are to be fitted with suitable means for de-icing sufficient to provide unimpaired forward and astern vision.

The windows shall also be fitted with an efficient means of clearing melted ice, freezing rain, snow mist and spray from outside and accumulated condensation from inside. A mechanical means to clear moisture from the outside face of a window shall have operating mechanisms protected from freezing or the accumulation of ice that would impair effective operation.

3.4 Electric power

The electric power for all types of heating the different parts of the equipment has to be included in the overall power balance of the vessel. The different applications of continuous heating of essential and safety relevant equipment or only temporary heating e.g. for de-icing before performing a service duty, have to be considered in this balance.

The electric power actually needed for heating shall be indicated in a separate part of the central switchboard. The heating shall be divided into several circuits. Active circuits shall be indicated by signal lamps. The circuits supplying essential equipment and life saving appliances are to be connected additionally to the emergency switchboard of the Offshore Service Vessel.

4. Emergency Power Batteries

Emergency power batteries including the reserve source of energy for the radio installation, including those stored in deck boxes, shall be secured in a position where excessive movement is prevented during ice-transiting operations and explosive gas ventilation is not restricted by the accumulation of ice and snow.

5. Searchlights

Offshore Service Vessels shall be equipped with the necessary number of suitable search lights which shall be controllable from the bridge and/or other control positions. The searchlights shall be installed to provide, as far as practicable, all-round illumination suitable for performing the intended services and also for docking, astern manoeuvres or emergency towing.

The searchlights shall be fitted with an adequate means of de-icing to ensure proper directional movement.

6. Lighting

6.1 All working places on the deck of the vessel have to be provided with adequate lighting for a safe execution of the service duties. This shall be able to withstand also the danger of icing, e.g. by heating as far as necessary in addition to the energy developed by the lamps themselves. Special attention is to be paid to the cargo or anchor transport and handling deck.

6.2 For lighting of the accommodation the use of full-spectrum lighting should be considered to reduce the influence of the dark winter season in polar regions on the crew.

7. Controls

Control systems based on computers and other electronic hardware installations necessary for the proper functioning of essential equipment shall be designed for redundancy and resistance to vibration, dampness and low humidity.

G. Tests and Trials

1. Operating Manual

The basis for performing tests and trials should be established by an Operating and Training Manual which is mandatory for Offshore Service Vessels with Class Notations **PC1** to **PC7**.

The manual shall contain the following information:

- Normal operation including operating limitations of the vessel and essential systems in anticipated ice conditions and temperatures

- Risk management taking into account the results of any risk or failure analysis report developed during the vessel's history and its design limits and redundancy features

- Training covering all aspects of vessel operation under very low temperatures. Further details are defined in IMO Resolution A.1024 (26), Chapter 13.

2. Testing

The reliable functioning of all systems and measures described above for operation in ice-covered waters at a minimum anticipated air temperature has to be verified during the initial tests on board. The test program has to be agreed with **TL.**

SECTION 23

ENVIRONMENTAL PROTECTION

A. General

1. Scope

1.1 The following Rules define the requirements which Offshore Service Vessels shall meet as a minimum and, as optional, additional measures to protect the environment during the missions to be performed in their operating area of the sea. If the requirements are met, an Environmental Passport may be issued, on request, for the vessel by **TL**.

1.2 Basic Rules

For further details see the latest issue of the **TL** Part D, Chapter 76.

2. Definitions

Black Water

"Black water" is identical to sewage and includes waste water from human waste and medical facility sink drainage.

Global Warming Potential GWP

GWP means global warming potential, and is the ratio of the warming caused by a certain substance to the warming caused by the corresponding mass of carbon dioxide (the GWP of CO_2 is defined to be 1,0). GWP values are calculated over time horizons of 25 or 100 or 500 years.

Grey Water

"Grey water" is only waste water including galley, laundry, bath and sink water.

Hazardous Wastes

Hazardous wastes are wastes consisting of substances which are defined as marine pollutants in the international Maritime Dangerous Goods Code (IMDG Code).

IBC Code

IBC Code means the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk.

IGC Code

IGC Code means the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk.

IMDG Code

IMDG Code means International Maritime Dangerous Goods Code.

NO_x Technical Code

NO_x Technical Code means the Technical Code on Emissions of Nitrogen Oxides from Marine Diesel Engines, adapted by Res. 2 of 1997 MARPOL Conference, as amended.

3. Documents for Approval

3.1 Documents to be Submitted for Approval

3.1.1 Equivalent Information

Equivalent information shall be submitted to **TL** if the following documents are not issued by **TL**:

- All mandatory certificates according to **MARPOL 73/78** and Annexes I - VI, as amended
- Documentation verifying compliance with **MARPOL 73/78** Annexes, as applicable
- International Oil Pollution Certificate IOPP, Annex I
- Safety Management Certificate in accordance with the ISM Code
- International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk
- International Certificate of Fitness (NLS CoF)

- International Sewage Pollution Prevention Certificate (ISPP)

- Certificate concerning the Prevention of Pollution by Garbage

- International Air Pollution Prevention Certificate (IAPP)

- Engine International Air Pollution Prevention Certificate (EIAPP)

- Measurement and assessment reports and documentation issued by authorities and by recognized or accredited bodies

- Vapour Emission Control System certification in accordance with IMO MSC/Circ.585

- International Antifouling System Certificate

- List of environmentally relevant equipment, and corresponding certificates not covered by MARPOL 73/78

3.1.2 Additional Plans and Information

The following additional plans, descriptions and/or flow charts shall be submitted, as applicable, for:

- Fuel oil system

- Ballast tank arrangement and ballast system

- Fire fighting system

- Cooling system

- Refrigeration system

- Incinerator system

- Sewage system

- Garbage management system

- Biocide free coating

- Arrangement and description of function of system to reduce amount of particulate matter in exhaust gases

- Advanced sewage treatment

- Different measures to prevent oil penetrating from various equipment to seawater

- Environmental aspects of the propulsion system as far as not already documented in the general vessel documentation (e.g. stern tube seals, advanced ballast water management, etc.)

- Design measures to prevent pollution in case of accidents

3.2 Documents to be Kept on Board

The Environmental Passport is to be kept on board.
For general requirements see Section 1, F.3.

3.3 Operating and Maintenance Instructions

- Vapour emission control system

- Preventive measures, such as selective catalytic reduction (SCR)

- System for removal of particulate matter from exhaust gas

- Fuel oil management plan (SO_x/NO_x emission control)

- Bunkering procedures, bunker delivery notes, bunker samples, (S)ECA Fuel Change-over Manual, if applicable

- Refrigeration system management plan, refrigerant record book

- Bilge water management plan, oily water record book

- Ballast water management plan, ballast water exchange record book

- Ballast water treatment plan

- Garbage management plan, garbage record book

- Sewage treatment plan

- Details of the different measures to prevent oil penetrating from various equipment to seawater (record book for stern tube seals, etc.)

4. Reference to Further Rules

4.1 TL Rules

The latest issues of the following **TL** Rules have to be considered:

- **TL**, Part D, Chapter 76

- **TL**, Part C, Chapter 26.

4.2 National Regulations

As far as national regulations existing alongside **TL**'s Rules define more strict requirements, compliance with these regulations of national administrations is not conditional for Class assignment by these Rules.

National regulations could be required for operation of the Offshore Service Vessel in special local areas.

4.3 International Conventions and Codes

- **MARPOL 73/78:**

  - Amended Annex I "Regulation for the Prevention of Pollution by Oil"

  - Amended Annex II "Regulation for the Control of Pollution by Noxious Liquid Substances in Bulk"

  - Annex III "Regulation for the Prevention of Pollution by Harmful Substances Carried by Sea in Packed Form"

  - Amended Annex IV "Regulations for the Prevention of Pollution by Sewage from Ships"

  - Annex V "Regulations for the Prevention of Pollution by Garbage from Ships"

  - Annex VI "Regulations for the Prevention of Air Pollution from Ships"

- IMO Resolution MEPC 244(66): "2014 Standard Specification for Shipboard Incinerators"

– IMO Resolution MEPC 227(64), as amended: "2012 Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants"

- IMO Resolution MEPC.259(68): "2015 Guidelines of Exhaust Gas Cleaning Systems"

- IMO Resolution MEPC 269(68): "2015 Guidelines for the Preparation of Inventory of Hazardous Materials"

- IMO Resolution MSC/Circ.585: "Standards for Vapour Emission Control Systems"

- IMO Resolution MSC.98(73): "International Code for Fire Safety Systems (FSS Code), as amended"

- SOLAS 74/88, Chapter VII "Carriage of dangerous goods"

- International Maritime Dangerous Goods Code (IMDG Code)

- SR/CONF 45: "Hong Kong Convention"

- International Convention on the Control of Harmful Anti-Fouling Systems on Ships (AFS Convention)

5. Classification, Notations

5.1 Environmental Passport EP

On request and on fulfilling the technical requirements according to B. - D. an Environmental Passport may be issued by **TL** for the Offshore Service Vessel and the Class Notation **EP** assigned.

This comprises the "Environmental Passport" Certificate, together with Certificates issued by the flag state and Certificates and statements of compliance and test certificates issued by **TL** or by other recognized IACS Classification Societies.

5.2 Ballast Water Management (BWM)

For the Environmental Passport and the Class Notation **EP** the vessel specific Ballast Water Management Plan according to B.5. has to be approved by **TL.**

B. Emissions to the Sea

According to the **TL** Part D, Chapter 76, Section 2, B. the following emissions have to be restricted:

1. Oil

1.1 Discharge of oil or oily mixtures from Offshore Service Vessels into the sea is prohibited unless all conditions of Regulation 15, Control of Discharge of Oil, of Annex I of **MARPOL 73/78** are satisfied.

1.2 Oil record books shall be provided in a form according to Appendix III to Annex I of **MARPOL 73/78**

1.3 The requirements of "Regulation 12 A - Fuel oil tank protection" shall apply for all Offshore Service Vessels with an aggregate oil fuel capacity of 600 m^3 and above.

1.4 On Offshore Service Vessels recovering oil or chemicals or handling hazardous or noxious substances, all cargo transfer manifolds are to be fitted with spill trays of sufficient volume and a possibility of drainage.

If another working area with equipment for liquid handling is established on deck, also this area has to be enclosed and drainage is to be provided. The stability of the vessel shall not be endangered by performing normal deck drainage when no liquid handling operations are under way.

2. Bilge Water

2.1 The discharge of oily bilge water removed from the machinery space bilges of Offshore Service Vessels is prohibited, unless the oil content does not exceed 15 ppm according to Annex I, Regulation 15 of **MARPOL 73/78**.

2.2 Offshore Service Vessels shall be equipped as follows with:

- 5 ppm bilge water separator or less
- 5 ppm oil content alarm
- Automatic stopping device

2.3 The piping and pumping arrangements of the 5 ppm bilge water separator shall be independent of all other piping systems.

2.4 Holding tank capacity of sufficient size shall be provided for the delivery of bilge water to shore.

2.5 For further details see **TL** Part B, Chapter 4, Section 16, O.

3. Noxious and/or Dangerous Cargoes

For the transportation of noxious and/or dangerous cargoes, the applicable requirements of Annex II and Annex III of **MARPOL 73/78**, the IGC Code, the IBC Code and the IMDG Code shall be met.

4. Sewage

4.1 Discharge of sewage (black water) into the sea is prohibited unless any of the conditions of Regulation 3 or Regulation 11 of Annex IV of **MARPOL 73/78** is applicable. Dimensions of shore discharges are to be in accordance with Regulation 10.

4.2 All means of grey water treatment and the capacity of holding tanks on board shall be documented.

4.3 The sewage treatment plant has to be examined and satisfactorily tested.

5. Ballast Water

5.1 Translocation of non-native organisms in ballast water and sediments of Offshore Service Vessels shall be limited to a minimum. During ballasting, the uptake of organisms and sediments shall also be minimized by suitable precautionary measures.

5.2 Uptake and discharge of ballast water shall be carefully planned. Sediments in ballast water tanks shall be removed during routine cleaning.

5.3 A ballast water management system (comprising tanks for ballast water and the associated piping, pumping and treatment systems, if applicable) shall be established to implement the exchange, treatment or other method accepted as being equivalent.

5.4 A vessel specific Ballast Water Management Plan shall be drawn up. The approval of this plan is a condition to achieve Class Notation **EP**.

6. Antifouling Systems

The anti-fouling systems used on Offshore Service Vessels shall not contain any organotin compounds which act as biocides and Cybutryne, see also E.2.

The application, re-application, installation or use of harmful anti-fouling systems containing organotin compounds which act as biocides and Cybutryne is prohibited.

7. Garbage

7.1 A Garbage Management Plan shall be established and kept on board of Offshore Service Vessels. This plan shall provide written procedures for the collecting, storing, processing and disposing of garbage, including the use of the equipment on board. A person in charge of carrying out the plan has to be designated.

7.2 A Garbage Record Book, comprising all relevant information of the discharge operations or completed incineration, shall be kept on board.

7.3 Equipment shall be provided on board for sorting, minimizing and storing the garbage prior to discharge or incineration. The respective procedures for sorting, minimizing and storing shall be incorporated into the Garbage Management Plan.

7.4 Every Offshore Service Vessel shall display placards which notify the crew and passengers of the garbage disposal requirements.

8. Hazardous Wastes

Hazardous wastes are to be collected separately and stored in clearly marked containments. They have to be disposed in due time ashore.

C. Emissions into the Air

According to the **TL** Part D, Chapter 76, Section 2, C. the following emissions have to be restricted:

1. NO_x emissions from marine diesel engines

1.1 The requirements apply to diesel engines with a power output of more than 130 kW, but do not apply to emergency diesel engines and engines in lifeboats.

1.2 Operation of diesel engines is prohibited unless emissions of nitrogen oxides are within certain limits. For higher emissions an exhaust gas cleaning system to reach the limits is required (Equivalent Solution).

1.3 The technical file of any marine diesel engine containing at least the information specified in 2.4 of the NO_x Technical Code shall be approved and kept on board. Emphasis shall be laid on the description of a practicable system of onboard NO_x verification procedures which form the basis for periodical surveys.

2. SO_x Emissions from Diesel Engines

2.1 The sulphur content of fuel oil used on board

Offshore Service Vessels is to be reduced in two steps steps - first by 1 July 2010 and, second, by 1 January 2015.

2.2 Exhaust gas cleaning systems may be used to reduce the emissions of SO_x (Equivalent Solution).

2.3 A Fuel Oil Management Plan shall be established as well as bunker delivery notes and fuel oil samples shall be kept on board.

3. Vapour Emissions from Volatile Products in Bulk

Offshore Service Vessels transporting volatile products, such as gasoline, other petroleum products and organic chemicals in bulk are to be provided with a vapour emission collection and control system approved by **TL** or organizations recognized by **TL**.

4. Exhaust Gas Emissions from Shipboard Incineration

Incinerators for garbage, oily residues and oily wastes need a type approval of **TL** or organizations recognized by **TL**.

5. Emissions from Refrigeration Systems

5.1 The requirements are applicable to refrigeration plants used for cargo refrigeration, gas reliquefaction, air conditioning, provision cooling and catering systems on Offshore Service Vessels, they are not applicable to stand-alone refrigeration or air conditioning systems in galleys, pantries, crew accommodation, etc.

5.2 The following aspects are to be considered:

- Refrigeration systems shall be filled with environment friendly refrigerants. GWP of less than 3800 required.

- Periodic leak-detection procedures shall be established to minimize refrigerant leakage. Loss of 10 % has to trigger an alarm to be incorporated to general machinery alarm.

- Maintenance, servicing and repair work shall be carried out without releasing any substantial quantity of refrigerant.

6. Emissions of Fire-Fighting Substances

6.1 Fire-fighting systems shall be provided with environment friendly fire-fighting substances.

6.2 The following aspects are to be considered:

- Use of natural substances is recommended

- Use of halo-carbons is not permitted

- Alternative substances are permitted, provided that they have a GWP of less than 4000

D. Vessel Recycling

TL recommends the following:

1. An Inventory of Hazardous Materials for all Offshore Service Vessels above 500 GT is to be prepared and certified (Statement of Compliance).

2. Hazardous materials listed in Table A of Appendix 1 of the Hong Kong Convention (SR/CONF 45) and in the related Guidelines for the Preparation of Inventory of Hazardous Materials (Res.MEPC 269(68)) shall not be present on board new vessels or in new equipment or materials installed on board existing vessels.

Hazardous materials listed in Table A and Table B of the Appendix 1 of the Hong Kong Convention (SR/ CONF 45) are to be identified, quantified and documented according to the Guidelines Res. MEPC 269(68).

E. Advanced Environmental Pollution Prevention Measures

1. General

On request, **TL** will also examine and document, for the Environmental Passport, other additional environmental protection properties of the Offshore Service Vessel surpassing the requirements of B. to D.

Test Certificates, statements of compliance and Certificates of **TL** will be included in the Environmental Passport to document the elevated environmental standard of the Offshore Service Vessel.

2. Biocide Free Coatings

2.1 Actual Minimum Requirements

For every Offshore Service Vessel of 400 gross tonnage and above engaged in international voyages it has to be confirmed by an International Antifouling System Certificate issued by **TL** or an organization recognized by **TL**.

2.2 Protection of the Environment

In order to reduce the emission of CO_2 to a lower level, the most effective antifouling system approved for use under the AFS Convention shall be applied and maintained in due consideration of the vessel's operating profile. Therefore technical advice from the systems' manufacturer shall be obtained to ensure that an appropriate system is applied.

In some countries, only biocidal antifouling coatings registered under biocidal product laws can be applied. This shall be complied with, if applicable.

2.3 Advanced Strategy

If anti-fouling systems are available, which are suitable under consideration of the vessel parameters (e.g. planned docking intervals, speed, vessel type, operation area, etc.) and according to the characteristics defined by the producer, the biocide and cybutryne-free alternative shall be applied.

If the shell has to be treated with a new procedure, the effectiveness of which is already not proven, the following documentation is to be submitted to **TL** for pre-checking:

- Description of effectiveness
- Technical data sheets
- Safety data sheets
- Remarks for application

Based on a review of the documentation, the time of survey of the shell to check the effectiveness will be determined. If the effectiveness cannot be proven then, the antifouling coating is to be removed and replaced by an antifouling coating with proven effectiveness.

3. Particle Reduction of Exhaust Gases

3.1 The exhaust gas cleaning system shall be independent for each combustion engine or combustion plant. General requirements on the use of combustible materials and on structural fire protection are to be complied with. Thermal expansion of the system and its mechanical connections to both the vessel's structure and the exhaust pipes has to be considered.

3.2 Where an exhaust gas cleaning system is installed with a single main propulsion engine a bypass, controlled by flap valves or other suitable cut-off devices, is required in order to allow unrestricted engine operation in case of system failure.

3.3 The maximum gas pressure in the exhaust pipes and the additional pressure loss in the cleaning system shall not exceed the maximum allowable values defined by the engine manufacturer.

3.4 The main operating parameters of the exhaust gas cleaning system have to be monitored and should serve as indicators for possible abnormalities. As a minimum, the following operating parameters shall be monitored:

- Gas temperature upstream of the cleaning system
- Gas temperature downstream of the cleaning system
- Pressure drop across the exhaust gas cleaning system

- Engine exhaust gas back pressure

- Position of flap valves

3.5 After successful appraisal of the required documents and successful conclusion of the shipboard test in presence of a Surveyor, **TL** issues an Approval Certificate.

3.6 For further details see **TL** Part B, Chapter 4, Section 2, M.

4. Sewage Treatment Plant

4.1 If national and/or regional regulations require more stringent values for the main sewage (black or grey water) parameters than specified in MEPC227(64), as amended, then these have to be complied with.

If grey water is added to black water, the whole mixture is to be considered as sewage.

4.2 In general, the treatment process should contain the following steps:

- Filtration and separation of solids

- Biological process for oxidation of the organic matter

- Clarification and disinfection

- Treatment of produced sludge

The aim shall be to reach as far as possible an automatic operation with a minimum of manual adjustments of the treatment procedure to the actual influent.

4.3 The results have to be verified by performance tests according to Resolution MEPC 227(64), as amended, within a type approval by **TL** or an organization recognized by **TL**.

To enable such tests the treatment plant is to be designed for easy collection of influent and effluent samples. Sampling is to be done in a manner and at a frequency which are representative for effluent quality. The sampling frequency has also to consider the through-put time of the sewage in the plant. The testing has to be performed for a wide variance of volumetric influent input, but at least for minimum, maximum and average capacity.

If test facilities ashore are proposed by the manufacturer, they will be surveyed by **TL** and their use for the actual plant has to be approved by **TL**.

4.4 Where the sewage treatment plant has been tested ashore, the initial survey shall include installation and commissioning of the plant on board. It has to proven, that the plant works satisfactorily at the trim and heel, vibrations, etc. expected at the normal operation of the Offshore Service Vessel, see Section 9, A.

5. Oil Leakage from Equipment into Sea Water

5.1 General

The oil consumption of the following equipment, which might leak oil to sea water, is to be monitored. The monitoring may be done manually in regular time intervals or automatically.

If malfunctions or leakages are noticed, corrective action shall be initiated immediately.

All special corrective actions taken are to be documented.

5.2 Stern Tube Seals

The loss of lubricating oil from the stern tubes has to be monitored by a low level alarm at the lube oil tank according to **TL** Part B, Chapter 4, Section 5, E and **TL** Part B, Chapter 4.1, Section 8, E.

To avoid oil leakage from stern tube into the seawater the following methods may be accepted by **TL**:

5.2.1 Seawater Lubricated Tube Bearings

The seawater has to be pumped from the sea through non-metallic shaft bearings and returned to sea. To ensure that abrasives are removed from the incoming water an extraction system is to be included. The propeller shaft has to be protected against corrosion by bushes at the bearing locations and in between by suitable measures, e.g. FRP liners, etc.

5.2.2 Oil Lubricated Stern Seals with Special Separation Measures

Oil of the bearing lubrication has to be separated from the penetrating seawater by an environmentally neutral continuous flow of a third medium, e.g. air. In a second step this medium has to be cleaned from oil residues and the oil residues have to be gathered in a separate drain tank.

5.2.3 Oil lubricated stern tube seals with reduced Oil Pressure

The oil pressure at the stern tube bearing shall be slightly lower than the outside pressure of the seawater for all draughts of the Offshore Service Vessel. Seawater penetrating, consequently, into the lube oil chamber is to be led to a settling tank to separate water and oil. From the lower part of the tank water may be transferred to a special tank or the bilge of the machinery space.

5.2.4 Degradable Lubricating Oil

The use of biologically degradable lubricating oil can assist to reduce environmental loads. It is seen as a voluntary additional measure, but is a not mandatory requirement for the issue of the Environmental Passport.

5.2.5 Other Systems

Other systems working on principles different from the examples described above can be examined by **TL** on request.

5.2.6 Type Approval

For the issue of the Environmental Passport and the Class Notation **EP**, the systems to prevent oil leakage from stern tube seals need type approval by **TL** or an organisation recognized by **TL**.

5.3 Rudder Bearings

In addition to the measures described in the **TL** Part A, Chapter 1, Section 18, E. an efficient sealing system is to be provided to ensure that oil or grease does not leak from rudder bearings into the seawater. Proposals are to be submitted to **TL** for approval.

5.4 Further Sources of Oil Spills

Suitable measures against oil spills are to be undertaken for:

- Controllable pitch propellers
- Thruster bearings
- Rudder propellers
- Podded drives
- Stabilizer drive units
- etc.

Relevant documentation for the applied measures are to be submitted to **TL** and will be examined case by case by **TL** on request.

5.5 Hydraulically Operated Deck Equipment

Hydraulically operated deck equipment like:

- Winches
- Hoists
- Hydraulic topping cylinders of cranes, A-frames, etc.
- Equipment for hatch covers
- Closing appliances in the vessel's shell

has to be arranged as far as possible with spill trays of sufficient size underneath.

6. Choice of Propulsion System

For the judgement of the environmental protection ability of the Offshore Service Vessel also the type of power generation in connection with the propulsion system will be considered.

6.1 Hybrid Drive

Hybrid drive is to be understood as a combination of mechanical drive of at least a part of the propulsion system with electric drives for thrusters and all types of auxiliary equipment. For such a system electrical power has to be produced by several generator sets as well as by a shaft generator included in the mechanical drive system. Such a multi-drive power system has to achieve high flexibility in different modes:

- Operating with maximum mechanical and electrical power for propulsion and winches in case of anchor handling

- Operating only with electrical power in slow manoeuvring and dynamic positioning mode

- Mainly mechanical power in transit mode between two different working areas

With such flexibility the hybrid drive shall be in the position to optimise fuel efficiency and to reduce emissions into the air.

6.2 Fuel Cells

Fuel cells are a source of electrical power in which the chemical energy of a fuel is converted directly into electrical energy by electrochemical oxidation (also known as "cold combustion").

With the corresponding conditioning through the reforming process, FC systems can be supplied both with conventional marine fuels (flashpoint above 60 °C) and with fuels which have a flashpoint below 60 °C. The latter fuel types include, for example, methanol, liquefied gases such as LPG, the cryogenic liquefied gases LNG and liquefied hydrogen (LH2), as well as pressurized gases such as CNG, compressed hydrogen (GH2).

The emissions of the systems are water, heat, CO_2 (depending on the CO_2 content of the fuel) and emissions caused by a reformer unit which mainly is NO_x. In any case the emissions from fuel cell systems are much lower than from any other energy converter. Fuel cells are sensitive to sulphur content in the fuel gas. Therefore no or very low sulphur content of the fuel is required. Due to the absence of sulphur in the fuel SOx emissions can be fully avoided.

See **TL** Part C, Chapter 26. For guidance relating to the fuel supply and bunkering system, IMO Resolution MSC 391(95) International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code) requirements should be applied in addition to the fuel cell Guidelines mentioned above.

7. Redundant Propulsion

To avoid pollution of oil and chemicals in connection with a manoeuvring accident, permanent functioning of all propulsion and steering systems of the Offshore Service Vessel is important.

The level of redundancy for the propulsion and steering systems of the Offshore Service Vessel is to be stipulated. See **TL** Part C, Chapter 23. These Rules are based on the single-failure concept and a distinction is made between the three levels of redundancy **RP1x%**, **RP2x%** and **RP3x%**.

F. Noise

1. Indoor Noise

Noise limits for working and living spaces of the crew should be contractually agreed upon between shipyard and owner and have also to be in accordance with Flag State requirements.

2. Underwater Noise

Appropriate underwater-radiated noise limits may be agreed, to ensure that the vessel can successfully maintain specified operational tasks, e.g. using hydro acoustic equipment, seismic research measurements, vessel engaged in research or other underwater noise critical operations, etc.

G. Responsible Environmental Officer

The captain or an officer of the Offshore Service Vessel has to be nominated as the vessel's 'Responsible Environment Officer', with the following responsibilities:

- Being informed about the national and international rules and regulations, including those of **TL**, concerning environmental protection

- Establishing of environmental protection procedures in every day operation of the vessel

- Survey the implementation of environmental protection procedures

- The accuracy and reliability of necessary data in the environmental records

- Training of the crew in implementing the prescribed environmental protection procedures

H. Tests and Trials

1. All systems for environmental protection have - as far as possible - to be tested already at the manufacturer's works.

2. Systems with mandatory type approval have to comply with the **TL** Addintional Rules for Regulations for Performance of the Type Tests.

3. The complete function of the systems on board of the vessel at sea, including possible interactions between different systems during combined operation, is to be tested during the sea trials.