TÜRK LOYDU

Chapter 35 – Tentative Rules for Ships less than 500 GT

JULY 2015

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 IACS PR No.29 is on or after 1st of July 2015. 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 Terms and 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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Section 5-Fore- and Aft- Body

Section 6 - Watertight Subdivision and Access

Section 7 –Stability

Section 8-Hull Outfitting

CHAPTER 35-B– MACHINERY

Section 1 – General Rules and Instructions

Section 2 – Internal Combustion Engines

Section 3 – Steering Gear

Section 5 - Electrical Equipment

CHAPTER 35-D– FIRE SAFETY

AMENDMENTS

Revised Sections	RCS No.	EIF Date*
D Section 04	05/2018	01.01.2019
Section 01	04/2017	01.01.2018
B Section 05	04/2017	01.01.2018
D Section 09	04/2017	01.01.2018
B Section 04	02/2016	01.07.2016

* 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.

GENERAL REQUIREMENTS & DEFINITIONS

A. General Requirements

1. Scope

1.1 The rules apply to cargo vessels of less than 500 Gross Tonnage that are not covered by the SOLAS Convention.

1.2 As in the SOLAS Convention, a cargo vessel may be taken to mean any vessel which is not a passenger vessel, gas carrier or chemical tanker. Smaller vessels due to a combination of their size and constant exposure to coastal hazards are particularly vulnerable and therefore careful consideration should be given to all aspects of their safety.

In addition to those above, high speed craft and yachts are also excluded from the scope of this rule.

Fishing vessels are also not part of these Rules.

1.3 The requirements of this rule set "Chapter 35 Tentative Rules for Ships less than 500 GT" are applicable to cargo ships (as defined in item 1.1 and 1.2) engaged in unrestricted, restricted and protected service as defined in item B.1.

Within this rule set, special requirements for ships engaged in restricted and unrestricted service are given when necessary.

1.4 When the administration of the state whose flag the ship is entitled to fly refers to specific rules covering the subjects in these Rules, TL may accept rules of the Flag State in lieu of the present Rules. In such cases a special notation clarifying this situation is entered on the Certificate of Class of the ship concerned.

Attention is to be drawn on the possible additional requirements of the flag administration.

2. Purpose

This rule set is prepared to guide designers, ship owners intending to design a vessel less than 500 GT as stated above. This rule set includes requirements for hull structures, hull stability, machinery installations, electrical installations and fire safety.

3. Application

3.1 The requirements as specified in this document, are within the spirit of the International Conventions and Protocols, and are applicable for cargo vessels of less than Convention size (less than 500 Gross Tonnage).

3.2 The provisions of these recommendations are intended to apply to new and - as far as reasonable and practicable, or as found necessary by the relevant Administration – to existing cargo vessels of less than 500 Gross Tonnage (GT). Vessels carrying dangerous goods- chemicals, and/or liquefied gasses in bulk, should comply with IMDG (Refer to MSC/Circ 858 Document of compliance with SOLAS regulation 11-2/54), IGC and IBC Codes, as applicable.

3.3 Due to tentative nature of these Rules, where any point not clearly clarified is encountered, relevant corresponding requirement stated in Part A Chapter 1 Hull, Part A Chapter 2 – Material, Part A Chapter 3 – Welding, Part B Chapter 4 – Machinery, Part B Chapter 5 – Electrical Installations, as amended shall be referred to.

3.4 For requirements concerning material properties welding techniques, and automation configurations, TL Rules Part A Chapter 2 Material, Part A Chapter 3 Welding, and Part B Chapter 4-1 Automation, as amended shall be applied respectively.

3.6 TL reserves right to impose stricter requirements compared with those stated in this rule set, dispense with requirements of these Rules and apply other requirements not stated in rule set.

4. Documents for Approval

To ensure conformity with the Rules the following drawings and documents are to be submitted in triplicate showing the arrangement and the scantlings of structural members:

4.1 Midship section

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

4.2 Longitudinal section

The plan of longitudinal sections must 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 arrangement of superstructures and deck houses, as well as supporting structures of cargo masts, cranes etc.

4.3 Decks

Plans of the decks showing the scantlings of the deck structures, length and breadth of cargo hatches, openings above the engine and boiler 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. Furthermore, details on possible loads caused by fork lift trucks and containers are to be stated.

4.4 Shell

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

4.6 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-vacuum relief valves (if any).

4.7 Bottom structure

4.7.1 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. For bulk and ore carriers, data are to be stated on the maximum load on the inner bottom.

4.7.2 Docking plan and docking calculation according to Section 7 and 8 are to be submitted for information.

4.8 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.

4.9 Stem and stern post and rudder

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

4.10 Hatchways

Drawings of hatchway construction and hatch covers. The drawings of the hatch coamings must contain all details including cut-outs for the fitting of equipment such as stoppers, securing devices etc. necessary for the operation of hatches.

4.12 Materials

The drawings mentioned in 4.1 to 4.10 and 4.15 must 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.

4.13 Weld joints

The drawings listed in items 4.1 to 4.10 and 4.15 must 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 Chapter 3 - Welding.

4.14 Lashing and stowage devices

Drawings containing details on stowage and lashing of cargo (e.g. containers, car decks).

4.15 Substructures

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

4.16 Closing condition

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

4.17 Intact stability

An inclining experiment must be performed upon completion of newbuildings and/or conversions in order to determine the lightship particulars.

Intact stability particulars containing all information required for calculation of stability in different loading conditions are to be provided. For initial assignment of class to newbuildings, preliminary particulars will be acceptable.

4.18 Damage stability

Damage stability particulars containing all information required for establishing unequivocal condition for intact stability are to be provided. A damage control plan with details on watertight subdivision, closable openings in watertight bulkheads as well as cross-flooding arrangements and discharge openings shall also be submitted.

4.19 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.

4.20 Special particulars for examination

4.20.1 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.

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

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

5. Vibrations and Noise

5.1. 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 minimization of possible cavitation. In the shaping of the bow of large ships, consideration is to be given to limit excitation from the seaway. As far as critical excitation loads cannot be eliminated, appropriate measures are to be taken on the basis of theoretical investigations at an early design stage. Fatigue considerations must be included. For machinery, equipment and other installations the vibration level is to be kept below that specified in Chapter 4, Machinery Section 1.D, as far as possible.

The evaluation of vibrations in living and working areas should follow ISO 6954 except where other national or international rules or standards are mandatory. It is recommended to use the lower transition curve of ISO 6954 as a criteria for design, whereas the upper curve may serve for the evaluation of vibration measurements.

5.2. Noise

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

6. Rounding-Off Tolerances

Where in determining plate thicknesses in accordance with the provisions of the following Sections, the figures differ from full or half mm, they may be rounded off to full or half millimeters up to 0.2 or 0.7, above 0.2 or 0.7 mm they are to be rounded up.

7. 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 **TL** 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.

8. Direct Strength Calculations

8.1 General

For procedures and basics on the strength analyses of the ship structures with Finite Element Method (FEM), Part A Chapter 1 Hull Section 4 shall be applied. The aim of the section referred above is to prevent errors in selecting methods, in the modelling, in executing analyses, in evaluating results and to provide feasible engineering judgment (approach).

For The strength calculations of ship structures with using FEM, below topics are described in more detail in the following sections:

- Determination of the objective, type and extent of the analysis,
- Building up the concurrent engineering approach or model,
- Modelling of the structure,
- Determination of loads and boundary conditions compatible with the type and the objective of the analysis,
- Execution of the analysis,
- Evaluation and assessment of results.

8.2 Permissible stresses

Where direct calculations of the resistance of primary supporting members are carried out, the maximum permissible stresses due to local bending, in N/mm^2, are given in the Tables G-1 and G-2 below.

Table G-1 Permissible stress for direct calculations

Permissible stress, in N/mm2	Open sea conditions		Tank testing conditions	Watertight bulkheads
	Longitudinal members	Transverse members		
Bending stress	125 / n·k	150 / n·k	200 / k	235 / k
Shear stress	85 / n·k	100 / n·k	115 / k	135 / k
Combined stress	150 / n·k	175 / n·k	215 / k	

Table G-2 Navigation coefficients

Navigation notation	Navigation coefficient n
Unrestricted navigation	1,00
Summer zone	0,95
Tropical zone - Coastal area	0,90
Sheltered area	0,85

The combined stress is to be calculated according to the Von Mises criterion:

$$\sigma_C = \sqrt{\sigma^2 + 3 \cdot \tau^2}$$

where:

σ = Bending stress, in N/mm^2
τ = Shear stress, in N/mm^2.
Where exceptional loading conditions are considered, the permissible stress values are to be specially reviewed by the Society.

8. 3 Computer Programs

8.3.1. General

8.3.1.1 In order to increase the flexibility in the structural design of ships **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.

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

8.3.2. Programs

8.3.2.1 The choice of computer programs is free. The programs may be checked by **TL** through comparative calculations with predefined test examples. A generally valid approval for a computer program is, however, not given by **TL** .

8.3.2.2 Direct calculations may be used in the following fields:

- Longitudinal strength,
- Beams and grillages,
- Detailed strength,
- Global strength.

8.3.2.3 For such calculation the computer model, the boundary condition and load cases are to be agreed upon with **TL**. The calculation documents are to be submitted including input and output. During the examination it may prove necessary that **TL** perform independent comparative calculations.

9. Workmanship

9.1. General

9.1.1 Requirements to be complied with by the manufacturer

9.1.1.1 The manufacturing plant must be provided with suitable equipment and facilities to enable proper handling of the materials, manufacturing processes, structural components, etc. **TL** reserves the right to inspect the plant accordingly or to restrict the scope of manufacture to the potential available at the plant.

9.1.1.2 The manufacturing plant must have at its disposal sufficiently qualified personnel. **TL** must be advised of the names and areas of responsibility of all supervisory and control personnel. **TL** reserves the right to require proof of qualification.

9.1.2 Quality control

9.1.2.1 As far as required and expedient, the manufacturer's personnel has to examine all structural components both during manufacture and on completion, to ensure that they are complete, that the dimensions are correct and that workmanship is satisfactory and meets the standard of good shipbuilding practice.

9.1.2.2 Upon inspection and corrections by the manufacturing plant, the structural components are to be shown to the **TL** Surveyor for inspection, in suitable sections, normally in unpainted condition and enabling proper access for inspection.

9.1.2.3 The Surveyor may reject components that have not been adequately checked by the plant and may demand their re-submission upon successful completion of such checks and corrections by the plant.

9.2. Structural Details

9.2.1 Details in manufacturing documents

9.2.1.1 All significant details concerning quality and functional ability of the component concerned shall be entered in the manufacturing documents workshop drawings, etc.). This includes not only scantlings but - where relevant - such items as permissible tolerances, surface conditions (finishing), and special methods of manufacture involved as well as inspection and acceptance requirements. For weld joint details, see Part A Chapter 1 Hull Section 20, A.1.

9.2.1.2 If, due to missing or insufficient details in the manufacturing documents, the quality or functional ability of the component cannot be guaranteed or is doubtful, **TL** may require appropriate improvements. This includes the provision of supplementary or additional parts (for example reinforcements) even if these were not required at the time of plan approval or if as a result of insufficient detailing such requirement was not obvious.

9.2.2 Cut-outs, plate edges

9.2.2.1 The free edges (cut surfaces) of cut-outs, hatch corners, etc. are to be properly prepared and are to be free from notches. As a general rule, cutting drag lines etc. must not be welded out, but are to be smoothly ground. All edges should be broken or in cases of highly stressed parts, should be rounded off.

9.2.2.2 Free edges on flame or machine cut plates or flanges are not to be sharp cornered and are to be finished off as laid down in 9.2.2.1 This also applies to cutting drag lines etc., in particular to the upper edge of shear strake and analogously to weld joints, changes in sectional areas or similar discontinuities.

9.2.3 Cold forming

9.2.3.1 For cold forming (bending, flanging, beading) of plates the minimum average bending radius should not fall short of 3 t (t = plate thickness) and must be at least 2 t. Regarding the welding of cold formed areas, see Part A Chapter 1 Hull Section 20, B.2.6.

9.2.3.2 In order to prevent cracking, flame cutting flash or sheering burrs must be removed before cold forming. After cold forming all structural components and, in particular, the ends of bends (plate edges) are to be examined for cracks. Except in cases where edge cracks are negligible, all cracked components are to be rejected. Repair welding is not permissible.

9.2.4 Assembly, alignment

9.2.4.1 The use of excessive force is to be avoided during the assembly of individual structural components or during the erection of sections. As far as possible major distortions of individual structural components should be corrected before further assembly.

9.2.4.2 Girders, beams, stiffeners, frames etc. that are interrupted by bulkheads, decks etc. must be accurately aligned. In the case of critical components, control drilling are to be made where necessary, which are then to be welded up again on completion.

9.2.4.3 After completion of welding, straightening and aligning must be carried out in such a manner that the material properties will not be influenced significantly: In case of doubt, **TL** may require a procedure test or a working test to be carried out.

10. Corrosion Protection

An adequate corrosion protection of the hull and other parts and equipment shall be provided according to the rules and guidelines provided in Part A Chapter 1 Hull Section 22. In addition, fouling control measures must be taken into account for the submerged part of the hull.

11. Testing Procedures of Watertight Compartments

For testing procedures of watertight compartments, see **TL** Rules, Chapter 1, Section 3, E, Part B.

B. Definitions

1. Service Area Definitions

Unrestricted service means a vessel engaged on International voyages, and not bounded by any limitations on operating environment.

Service restrictions are broken down into 2 broad categories:

- vessels operating coastal or specified operating areas,
- vessels operating within protected or extended protected waters.

1.1. Restricted Service:

1.1.1 Specified coastal service. Service along a coast the geographical limits of which should be defined and for a distance out to sea generally not exceeding 20 nautical miles, unless some other distance is specified for 'coastal service' by the Administration with which the vessel is registered, or by the Administration of the coast off which it is operating.

1.1.2 Specified operating or service areas. Service between two or more ports or other geographical features, or service within a defined geographical area such as: "Red Sea Service", "Piraeus to Thessaloniki and Islands within the Aegean Sea".

1.2. Protected Service:

1.2.1 Protected water service. Service in sheltered water adjacent to sand banks, reefs, breakwaters to other coastal features, in sheltered waters between islands and lagoons.

1.2.2 Extended protected water service. Service in protected waters and also short distances (generally less than 15 nautical miles) beyond protected waters in 'reasonable weather'.

2. Terms used in this Chapter

2.1. The terms, used in these Recommendations are as defined in SOLAS 1974 (as amended) and the classification rules of IACS Member Societies, as applicable at the date of shipbuilding or major conversion contract. The term Gross Tonnage (GT) is as defined in IMO Resolution A.493 (XII), calculated in accordance with the International Convention of Tonnage Measurements of Ships of 1969.

2.2. Where required, definitions of some certain terms are included in each section and general terms referred to in this Chapter are given under this item however if there is any definition not stated above, other TL Rules (e.g. Classification and Surveys, Chapter 1-Hull, Chapter-2 Material, Chapter 3-Welding, Chapter 4-Machinery, Chapter 4-1 Automation, Chapter-5 Electrical Installations) shall be referred to.

2.3. Unless otherwise mentioned, the dimensions are to be inserted in [m] into the formula stated in the following Sections.

2.4. Rule Length L : The length **L** is the distance, on the summer load waterline from the fore side of stem to the after side of the rudder post, or the centre of the rudder stock, if there is no rudder post. **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.

2.5. Load Line Length L_c : The length L_c is to be taken as 96% of the total length on a waterline at 85 % of the least moulded depth 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.

2.6. Subdivision length L_s : The subdivision L_S of the ship is the greatest projected moulded length of that part of the ship at or below deck or decks limiting the vertical extent of flooding with the ship at the deepest subdivision draught.

2.7. Forward perpendicular : The forward perpendicular coincides with the foreside of the stem on the waterline on which the respective length **L, L_c**, or **L^*** is measured.

2.8. Breadth B : The breadth **B** is the greatest moulded breadth of the ship.

2.9. 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 **H** is to be measured up to the superstructure deck for determining the ship's scantlings.

2.10. 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. For ships with timber load line the draught **T** is to be measured up to the freeboard mark for timber load waterline.

2.11. Frame Spacing a : The frame spacing **a** will be measured from moulding edge to moulding edge of frame.

2.12. Block Coefficient C_B : Moulded block coefficient at load draught **T**, based on rule length **L**.

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

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

2.13. Lightweight

The lightweight is the displacement, in t, without cargo, fuel, lubricating oil, ballast water, fresh water and feed water, consumable stores and passengers and crew and their effects, but including liquids in piping.

2.14. Deadweight

The deadweight is the difference, in t, between the displacement, at the summer draught in sea water of density ρ = 1,025 t/m^3, and the lightweight.

2.15. Margin line

The margin line is a line drawn at least 76 mm below the upper surface of the bulkhead deck at side.

2.16. 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.

2.17. Bulkhead deck

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

2.18. Freeboard deck

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

2.18.1 The freeboard deck is normally the uppermost complete deck exposed to weather and sea, which has permanent means of closing of all openings in the weather part thereof, and below which all openings in the sides of the ship are fitted with permanent means of watertight closing

2.18.2 At the option of the owner and subject to the approval of the Society, a lower deck may be designated as the freeboard deck provided it is a complete and permanent deck continuous in a fore and aft direction at least between the machinery space and peak bulkheads and continuous athwarthships

- When this lower deck is stepped the lowest line of the deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck

- When a lower deck is designated as the freeboard deck, that part which extendes above the freeboard deck is treated as a superstructure so far as concerns the application of the conditions of assignment of freeboard. It is from this deck that the freeboard is calculated

- When a lower deck is designated as the freeboard deck, such deck as a minimum shall consist of suitably framed stringers at the ship sides and transversely at each watertight bulkhead which extends to the upper deck, within cargo spaces. The width of these stringers shall not be less than can be conveniently fitted having regard to the structure and the operation of the ship. Any arrangement of stringers shall be such that structural requirement can also be met.

2.18.3 Discontinuous freeboard deck, stepped deck

2.18.3.1 Where a recess in the freeboard deck extends to the sides of the ship and is in excess of one meter in length, the lowest line of the exposed deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck (see Figure G-1).

2.18.3.2 Where a recess in the freeboard deck does not extend to the sides of the ship, the upper part of the deck is taken as the freeboard deck.

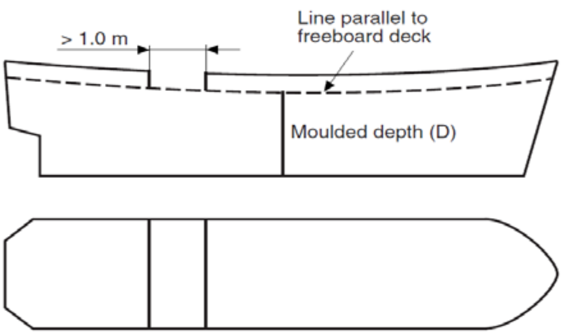


Figure G-1 Recessed Freeboard Deck

2.18.3.3 Recesses not extending from side to side in a deck below the exposed deck, designated as the free-board deck, may be disregarded, provided all openings in the weather deck are fitted with weathertight closing appliances.

2.18.3.4 Due regard shall be given to the drainage of exposed recesses and to free surface effects on stability.

2.18.3.5 Provisions of 1) through 4) are not intended to apply to dredgers, hopper barges or other similar types of ships with large open holds, where each case requires individual consideration.

2.19. Strength deck

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

2.19.1 The sectional area of the strength deck is the sum of sectional areas of members contributing to the longitudinal strength.

This sectional area includes:

- deck plating abreast hatchways

- stringer plates

- where the deck is framed longitudinally, deck longitudinals provided their continuity is ensured.

2.19.2 Deck sectional area

2.19.2.1 The total strength deck sectional area S, in cm^2, at midship section, is not to be less than:

$$S = 0.02B\left[N(2\alpha L + 50 - L) - 2\beta\left(t_o + 0.1\,\frac{S_o}{B}\right)L\right]$$

where:

$$N = \frac{L}{D}(T + 0.015L)$$

t_o = Actual thickness of the bottom plating, in mm

S_o = Total sectional area of bottom longitudinals, in cm^2.

α and β are coefficients defined in Table G-3 below.

Table G-3 Coefficients α and β

D/B	0,3	0,4	0,5	0,6	0,7	0,8
α	0,54	0,55	0,56	0,57	0,58	0,59
β	0,96	1,26	1,56	1,86	2,15	2,44

2.19.2.2 Scantlings of members contributing to the longitudinal strength are to be maintained within 0,4 L amidships.

2.20. Weather deck

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

2.21. Lower decks

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

2.22. Inner deck

The inner side is the longitudinal bulkhead which limits the inner hull for ships fitted with double hull.

2.23. 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.

2.24. Superstructure

A superstructure is a decked structure connected to the free-board deck, extending from side to side of the ship or with the side plating not being inboard of the shell plating more than 0,04 B.

2.25. Enclosed and open superstructure

A superstructure may be:

enclosed, where:

- it is enclosed by front, side and aft bulkheads complying with the hull requirements

- all front, side and aft openings are fitted with efficient weathertight means of closing

open, where it is not enclosed.

2.26. Bridge

A bridge is a superstructure which does not extend to either the forward or after perpendicular.

2.27. Poop

A poop is a superstructure which extends from the after perpendicular forward to a point which is aft of the forward perpendicular. The poop may originate from a point aft of the aft perpendicular.

2.28. Forecastle

A forecastle is a superstructure which extends from the forward perpendicular aft to a point which is forward of the after perpendicular. The forecastle may originate from a point forward of the forward perpendicular.

2.29. Full superstructure

A full superstructure is a superstructure which, as a minimum, extends from the forward to the after perpendicular.

2.30. Raised quarter deck

A raised quarterdeck is a partial superstructure of reduced height.

It extends forward from the after perpendicular and has an intact front bulkhead (sidescuttles of the non-opening type fitted with efficient deadlights and bolted man hole covers). Where the forward bulkhead is not intact due to doors and access openings, the superstructure is then to be considered as a poop.

2.31. Deckhouse

A deckhouse is a decked structure other than a superstructure, located on the freeboard deck or above.

2.32. Trunk

A trunk is a decked structure similar to a deckhouse, but not provided with a lower deck.

Table G-4 Standard Height of Superstructure

Load line length L_C, in m	Standard height h_S, in m	
	Raised quarter deck	All other superstructures
$L_C \le 30$	0,90	1,80
$30 < L_C < 75$	$0{,}9 + 0{,}00667\ (L_C - 30)$	1,80
$75 \le L_C < 125$	$1{,}2 + 0{,}012\ (L_C - 75)$	$1{,}8 + 0{,}01\ (L_C - 75)$
$L_C \ge 125$	1,80	2,30

2.33. Well

A well is any area on the deck exposed to the weather, where water may be entrapped. Wells are considered to be deck areas bounded on two or more sides by deck structures

2.34. Standard height of superstructure

The standard height of superstructure is defined in the Table G-4.

2.35. Type A ship

A Type A ship is one which:

- is designed to carry only liquid cargoes in bulk

- has a high integrity of the exposed deck with only small access openings to cargo compartments, closed by watertight gasketed covers of steel or equivalent material; and

- has low permeability of loaded cargo compartments.

A Type A ship is to be assigned a freeboard following the requirements reported in the International Load Line Convention 1966, as amended.

2.36. Type B ship

All ships which do not come within the provisions regard- ing Type A ships stated in [1.3.25] are to be considered as Type B ships.

A Type B ship is to be assigned a freeboard following the requirements reported in the International Load Line Convention 1966, as amended.

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

2.37.1 Position 1

Upon exposed freeboard and raised quarter decks, and upon exposed superstructure decks situated forward of a point located 0,25 $\mathbf{L_c}$ from the forward perpendicular.

2.37.2 Position 2

Upon exposed superstructure decks situated abaft 0,25 $\mathbf{L_c}$ from the forward perpendicular and located at least one standard height of superstructure above the freeboard deck.

Upon exposed superstructure decks situated forward of a point located 0,25 $\mathbf{L_c}$ from the forward perpendicular and located at least two standard heights of superstructure above the freeboard deck.

2.38. Scuppers

Scuppers are piping systems for evacuation from or draining of open spaces situated above the freeboard deck. This includes the following arrangements:

- draining of exposed decks
- draining of open superstructures
- gravity sanitary evacuation from open superstructures.

2.39. Pipe discharges

Pipe discharges are piping systems for pump overboard discharges from spaces situated below the freeboard deck and evacuation from or draining of enclosed spaces situated above the freeboard deck. This includes the following arrangements:

- overboard discharges of pumps situated under the freeboard deck
- draining of enclosed superstructures
- gravity sanitary evacuation from enclosed superstructures.

2.40. Inboard end

The inboard end of discharge piping is the open end of the pipe situated inside the ship opposite to the end where the discharge is led through the hull.

2.41. Definition of Symbols

g = Acceleration due to gravity [9.81 m/s^2]

GM = Metacentric height [m]

k = Material factor

P = Applicable design pressure load [kN/m^2]

F = Single forces [kN]

V = Ship's speed [knots]

x = Distance from aft end of length L [m]

y = Horizontal distance [m].

z = Vertical distance [m]

ρ_L = Density of liquids [t/m^3]

a_V = Vertical acceleration [m/s^2]

t = Plate thickness [mm]

t_K = Corrosion addition [mm]

t_{min} = Minimum plate thickness [mm]

Δ = Displacement of the ship [t].

T = Temperature [$^\circ$C]

ℓ = Unsupported span [m]

i_S = Radius of gyration of pillar [cm]

λ_S = Degree of slenderness of pillar

R_{eH} = Minimum nominal upper yield point [N/mm^2]

I = Moment of inertia [cm^4]

W = Section modulus [cm^3]

σ = Bending stress [N/mm^2]

τ = Shear stress [N/mm^2]

E = Young's modulus [N/mm^2]

S = First moment of the sectional area considered [m^3],

M = Bending moment [kNm]

Q = Shear force [kN]

CLASSIFICATION AND SURVEYS

1. The hull, machinery and all equipment of every vessel shall be constructed and installed so as to be capable of being regularly maintained to ensure that they are at all times, in all respects, satisfactory for the vessel's intended service.

2. Surveys of vessel during construction and, at regular intervals after completion, shall be carried out generally as prescribed within Chapter I of SOLAS 1974, as amended. However TL Rule for Classification and Surveys may be applied where any point not clearly clarified is encountered however as applicable to ships of less than 500 GT and as not contradicting to Chapter I of SOLAS 1974, as amended.

3. The condition of the vessel and its equipment shall be maintained to conform to the provisions of this Chapter 35 to ensure that the vessel will remain fit for the intended operation.

4. No change shall be made in the structural arrangements, machinery, equipment and other items covered by the survey, without the approval of the Administration or recognized organization.

5. Whenever an accident occurs to a vessel or a defect is discovered, the master or owner of the vessel shall report to the Administration or surveying authority without delay.

6. For indication of ships of less than 500 GT, “<500GT” shall be affixed to their ship type notation (e.g. **OIL TANKER <500GT**)

TÜRK LOYDU

Chapter 35 – A

Hull

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 IACS PR No.29 is on or after 1st of July 2015. 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 Terms and 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.

http:/www.turkloydu.org

SECTION 1

DESIGN LOADS

Page

A. General

1. This Section provides data regarding design loads for determining the scantlings of the hull structural elements by means of the design formula given in the following Sections or by means of direct calculations.

2. The dynamic portions of the design loads are design values which can only be applied within the design concept of this Chapter.

3. For design loads not given under this section, Part A Chapter 1 Hull Section 5, as amended shall be referred to however as not contradicting or replacing the provision stated hereunder.

B. Definitions

Load center:

For plates:

- Vertical stiffening system:

  0.5 x stiffener spacing above the lower support of plate field, or lower edge of plate when the thickness changes within the plate field.

- Horizontal stiffening system:

  Midpoint of plate field.

For stiffeners and girders:

- Center of span ℓ.

Definition of symbols:

ρ_c = Density of cargo as stowed in [t/m^3]

ρ = Density of liquids in [t/m^3]

ρ = 1.0 t/m^3, for fresh water

ρ_{SW} = 1.025 t/m^3, for sea water

z = Vertical distance of the structure's load centre above base line in [m]

x = Distance from aft end of length **L** in [m]

C_B = Moulded block coefficient. C_B is not to be taken less than 0.60.

p_0 = Basic external dynamic load

$$P_o = 2.1 \cdot (C_B + 0.7) \cdot c_o \cdot c_L \cdot f \quad [\mathrm{kN/m^2}]$$

for wave directions with or against the ship's heading

c_0 = Wave coefficient

$$C_0 = \left[\frac{L}{25} + 4.1\right] \cdot C_{RW}$$

c_L = Length coefficient

$$C_L = \sqrt{\frac{L}{90}}$$

c_{RW} = Service range coefficient

c_{RW} = 1.00 for unlimited service range

= 0.90 **Y** for service range

= 0.75 **K**50 for service range

= 0.66 **K**20 for service range

= 0.60 **L** for service range

f = Probability factor

f = 1.0 for plate panels of the outer hull (shell plating, weather decks)

f = 0.75 for secondary stiffening numbers of the outher hull (frames, deck beams), but not less than f_Q according to Part A Chapter 1 Hull Section 6, D.1.

f = 0.60 for girders and girder systems of the outer hull (web frames, stringers, grillage systems) but not less than f_Q /1.25.

c_D, c_F = Distribution factors according to Table 1.1.

a_v = acceleration factor

$$a_V = F \cdot m$$

$$F = 0.11 \cdot \frac{V_o}{\sqrt{L}}$$

$$m = m_o - 5(m_o - 1) \cdot \frac{x}{L} \quad \text{for } 0 \le \frac{x}{L} < 0.2$$

$$m = 1 \quad \text{for } 0.2 \le \frac{x}{L} < 0.7$$

$$m = 1 + \frac{(m_o + 1)}{0.3}\left[\frac{x}{L} - 0.7\right] \quad \text{for } 0.7 \le \frac{x}{L} \le 1$$

$$m_o = (1.5 + F)$$

V_o is not to be taken less than $(L)^{1/2}$ [kn]

C. Load on the Ship's Bottom

The external load p_B of the ship's bottom is to be determined according to the following formula:

$$P_B = 10 \cdot T + P_o \cdot C_F \ [kN/m^2]$$

D. Load on Ship's Sides

The external load P_S on the ship's sides is to be determined as stated below:

1. For elements the load center of which is located below load waterline:

$$P_S = 10 \cdot (T - z) + P_o \cdot C_F \cdot \left(1 + \frac{z}{T}\right) \ [kN/m^2]$$

for wave directions with or against the ship's heading.

y = Horizontal distance between load centre and centerline [m]

2. For elements the load centre of which is located above load waterline:

$$P_S = P_o \cdot C_F \cdot \frac{20}{10 + z - T} \ [kN/m^2]$$

for wave directions with or against the ship's heading.

E. Load on Weather Decks

1. The load on weather decks is to be determined according to the following formula:

$$P_D = P_o \cdot \frac{20 \cdot T}{(10 + z - T) \cdot H} \cdot C_D \ \ [kN/m^2]$$

Table 1.1 The Coefficients C_D and C_F

Range		c_D	C_F (1)
A	$0 \le \frac{x}{L} < 0.2$	$1.2 - \frac{x}{L}$	$1 + \frac{5}{C_B}\left(0.2 - \frac{x}{L}\right)$
M	$0.2 \le \frac{x}{L} < 0.7$	1	1
F	$0.7 \le \frac{x}{L} \le 1$	$1 + \left[1.67 \cdot \left(\frac{x}{L} - 0.7\right)\right]$	$1 + \frac{20}{C_B}\left(\frac{x}{L} - 0.7\right)^2$
(1) *Within the range **A** the ratio x/**L** need not be taken less than 0.1, within the range **F** the radio x/**L** need not be taken greater than 0.93.*			

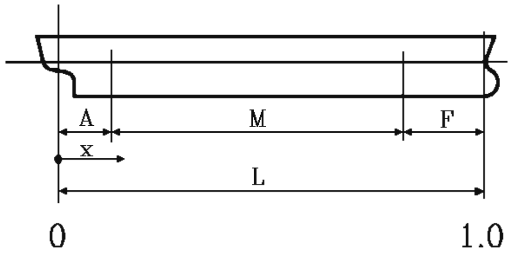


Figure 1.1 Longitudinal sections, A, M and F according to Table 1.1

2. For strength decks which are to be treated as weather decks as well as for forecastle decks the load is not to be less than the greater of the following two values:

$p_{Dmin} = 16 \cdot f \quad [kN/m^2]$

or

$p_{Dmin} = 0.7 \cdot p_0 \; [kN/m^2]$.

3. For ships engaged in sheltered water service (assigned with **K6, L1** and **L2** notations), the deck load on weather decks is to be taken as $P_D = 6$ kN/m^2 unless a greater load is required by the Owner.

4. Where deck cargo is intended to be carried on the weather deck resulting in a load greater than the value determined, the scantlings are governed by the greater load.

5. Where the stowage height of deck cargo is less than 1.0 m, the deck cargo load may require to be increased by the following value:

$p_z = 10\,(1 - h_s)\; [kN/m^2]$

h_s = Stowage height of the cargo in [m].

F. Load on Decks of Superstructures and Deckhouses

1. The load on exposed decks and parts of superstructure and deckhouse decks, which are not to be treated as strength deck, is to be determined as follows:

$P_{DA} = P_D \cdot n \; [kN/m^2]$

P_D = Load according to E.

$$n = 1 - \frac{z - H}{10}$$

$n_{min} = 0.5$

n = 1.0 for the forecastle deck

For deckhouses the value so determined may be multiplied by the factor

$$0.7 \cdot \frac{b'}{B'} + 0.3$$

b' = Breadth of deckhouse

B' = Largest breadth of ship at the position considered.

Except for the forecastle deck the minimum load is:

$P_{DAmin} = 4\; [kN/m^2]$.

2. For exposed wheel house tops the load is not to be taken less than

p = 2.5 $[kN/m^2]$.

G. Load on Cargo Decks

1. The load on cargo decks is to be determined according to the following formula:

$$P_L = P_C \cdot (1 + a_V)\;\; [kN/m^2]$$

p_c = Static cargo load in $[kN/m^2]$

if no cargo load is given:

pc = 7 · h for 'tween decks but not less than 15 kN/m^2.

h = Mean 'tween deck height in [m].

In way of hatch casings the increased height of cargo is to be taken into account

a_v = Acceleration factor as defined in item B.

For timber and coke deck cargo the load on deck is to be determined by the following formula:

$p_L = 5 \cdot h_s (1 + a_v)$ [kN/m^2]

h_s = Stowing height of cargo in [m].

The loads due to single forces P_E (e.g. in case of containers) are to be determined as follows:

$P = P_E (1 + a_v)$ [kN].

The cargo pressure of bulk cargoes is to be determined by the following formula:

$p_{bc} = p_c \cdot (1 + a_v)$, [kN/m^2]

p_c = Static bulk cargo load

Pc = 9.81· ρc · h · n [kN/m2]

h = Distance between upper edge of cargo and the load centre in [m]

$$n = \left[\tan^2\left(45° - \frac{\gamma}{2}\right)\sin^2\alpha + \cos^2\alpha\right]$$

α = Angle in degrees between the structural element considered and a horizontal plane

γ = Angle of repose of the cargo in degrees.

2. The inner bottom cargo load is to be determined as follows:

$$P_i = 9.81 \cdot \frac{G}{V} \cdot h \cdot (1 + a_v\ )\ \ [kN/m^2]$$

G = Mass of cargo in the hold in [t]

V = Volume of the hold in [m3] (hatchways excluded)

h = Height of the highest point of the cargo above the inner bottom in [m], assuming hold to be completely filled.

a_v = See B. Definitions

For calculating av the distance between the center of gravity of the hold and the aft end of the length L is to be taken.

For inner bottom load in case of ore stowed in conical shape, see Section 23, B.3.

H. Loads on Accommodation and Machinery Decks

The deck load in accommodation and service spaces is:

$p = 3.5 (1 + a_v)$ [kN/m^2].

The deck load of machinery decks is:

$p = 8 (1 + a_v)$ [kN/m^2].

Significant single forces are also to be considered, if necessary.

I. Load on Tank Compartments

For tank structures of tanks adjacent to the shell the pressure p below T_{min} need not be larger than:

$$P = P_1 - \left[10(T_{min} - z) - P_o \cdot C_F\left(1 + \frac{z}{T_{min}}\right)\right] \quad [kN/m^2]$$

1. For filled tanks;

1.1 The design pressure for service conditions is the greater of the following values:

p_1 = $9.81 \cdot h_1 \cdot \rho (1 + a_v) + 100 \cdot p_v$ [kN/m^2],

or

p_1 = $9.81 \cdot \rho[h_1 \cdot \cos\varphi + (0.3 \cdot b + y)\sin\varphi] + 100 \cdot p_v$ [kN/m^2]

h_1 = Distance of load center from tank top in [m]

a_v = Acceleration factor

φ = Design heeling angle [°] for tanks

$$= \tan^{-1}\left(f_{bk} \cdot \frac{H}{B}\right)$$

in general

f_{bk} = 0.5 for ships with bilge keel,

= 0.6 for ships without bilge keel,

φ ≥ 20° for hatch covers of holds carrying liquids, b = Upper breadth of tank in [m]

y = Distance of load center from the vertical longitudinal central plane of tank in [m]

p_v = Set pressure of pressure relief valve in [bar], if a pressure relief valve is fitted

= Working pressure during ballast water exchange [bar]

$$= \frac{\Delta Z - 2.5}{10} + \Delta P_v$$

ΔZ = Distance from top of overflow to tank top [m],

Δp_v = Pressure losses in the overflow line [bar],

Δp_{vmin} = 0.1 [bar],

p_{vmin} = 0.1 [bar], during ballast water exchange, for both, the sequential method as well as the flow-through method

= 0.2 bar (2.0 mWS) for cargo tanks of tankers (see also Chapter 4, Rules for Machinery, Section 15).

Smaller set pressures than 0.2 bar may be accepted in special cases. The actual set pressure will be entered into the class certificate.

1.2 The maximum static design pressure is:

$p_2 = 9.81 \cdot h_2$ [kN/m^2]

h_2 = Distance of load center from top of overflow or from a point 2.5 m above tank top, whichever is the greater. Tank venting pipes of cargo tanks of tankers are not to be regarded as overflow pipes.

For tanks equipped with pressure relief valves and/or for tanks intended to carry liquids of a density greater than 1 t/m^3, the head h_2 is at least to be measured to a level at the following distance h_p above tank top:

$h_p = 2.5 \cdot \rho$ [m (head of water in [m])],

or

$h_p = 10 \cdot p_v$ [m],

where $p_v > 0.25 \cdot \rho$.

Regarding the design pressure of fuel oil tanks and ballast tanks which are connected to an overflow system, the dynamic pressure increase due to the overflowing is to be taken into account in addition to the static pressure height up to the highest point of the overflow system.

2. For Partially Filled Tanks;

2.1 For tanks which may be partially filled between 20% and 90 % of their height, the design pressure is not to be taken less than given by the following formula:

2.1.1 For structures located within b_t/4 from the bulkheads limiting the free liquid surface in the ship's longitudinaldirection:

$p_d = [4 - (\mathbf{L}/150)] \cdot \ell_t \cdot \rho \cdot n_x + 100 \cdot p_v$, [kN/m^2]

ℓ_t = Distance in [m] between transverse bulkheads or effective transverse wash bulkheads at the height where the structure is located.

2.1.2 For structures located within b_t/4 from the bulkheads limiting the free liquid surface in the ship's transverse direction:

$p_d = [5.5 - (B/20)] \cdot b_t \cdot \rho \cdot n_y + 100 \cdot p_v$ [kN/m^2]

b_t = Distance in [m] between tank sides or effective longitudinal wash bulkhead at the height where the structure is located.

$$n_x = 1 - \frac{4}{\iota_t} \cdot x_1$$

$$n_y = 1 - \frac{4}{b_t} \cdot y_1$$

x_1 = Distance of structural element from the tank's ends in the ship's longitudinal direction in [m]

y_1 = Distance of structural element from the tank's sides in the ship's transverse direction in [m].

2.2 For tanks with ratios ℓ_t/**L**>0.1 or b_t /**B**>0.6 a direct calculation of the pressure p_d may be required.

J. Slamming Load

The bottom impact pressure P_{SL} is to be obtained in kN/m^2 from the following formula:

$$P_{SL} = 62 \cdot C_1 \cdot C_{SL} \cdot L^{0.6}$$

$$C_1 = \frac{119 - 2300\frac{T_F}{L}}{78 + 1800\frac{T_F}{L}} \quad C_1 \geq 1$$

T_F = Smallest ballast design$C_{SL} = 0 \quad \text{for } x \leq x_1$

$$C_{SL} = \frac{x - x_1}{x_2 - x_1} \quad \text{for } x_1 \leq x \leq x_2$$

$$C_{SL} = 1 \quad \text{for } x \geq x_2$$

$$X_1 = \left(0.55 + \frac{L}{2000}\right) L$$

$$X_2 = \left(0.35 + 0.5C_B + \frac{L}{3000}\right) L \quad 0.6 \leq C_B \leq 0.85$$

K. Bow Impact Load

The bow impact pressure P_{IB} is to be obtained, in kN/m^2, from the following formula:

$$P_{IB} = n \cdot C_S \cdot C_L \cdot C_Z \cdot (0.22 + 0.15\tan\alpha) \cdot (0.4 \cdot V \cdot \sin\beta + 0.6\sqrt{L})$$

Navigation notation	Navigation coefficient, n
Unrestricted navigation	1.00
Summer zone	0.95
Tropical zone Coastal area	0.90
Sheltered area	0.85

where:

C_S = Coefficient depending on the type of structures on which the bow impact pressure is considered to be acting:

- C_S = 1.8 for plating and ordinary stiffeners
- C_S = 0.5 for primary supporting members

C_L = 0.0125 L

C_Z = Coefficient depending on the distance between the summer load waterline and the calculation point:

$$C_Z = C_o - 0.5\,(z - T) \quad \text{for } z \geq 2Co + T - 11$$

$$C_Z = 5.5 \quad \text{for } z < 2Co + T - 11$$

Co = Wave coefficient

α = Flare angle at the calculation point, defined as the angle between a vertical line and the tangent to the side plating, measured in a vertical plane normal to the horizontal tangent to the shell plating (see Figure below)

β = Entry angle at the calculation point, defined as the angle between a longitudinal line parallel to the centreline and the tangent to the shell plating in a horizontal plane (see Figure below)

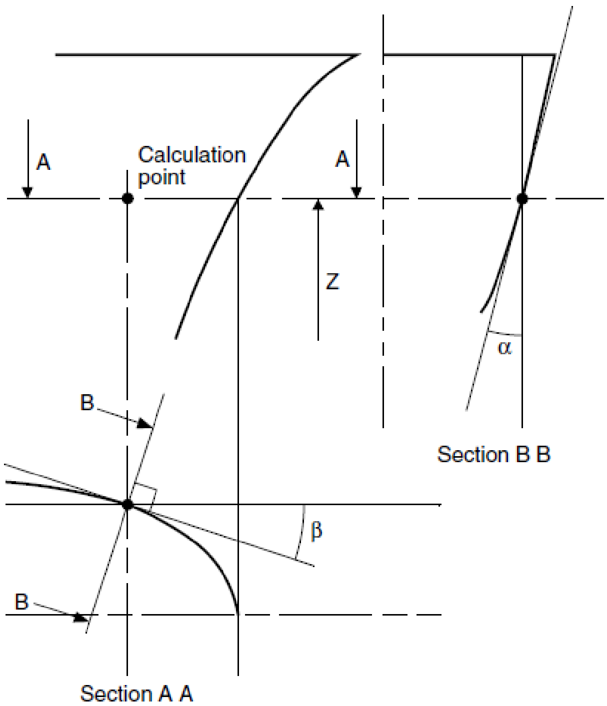


Figure 1.2 Definitions of angles α and β

L. Stern Impact Load

The design load for stern structures from the aft end to 0.1L forward of the aft end of L and above the smallest design ballast draught at the centre of the rudder stock up to $T+C_W/2$ is to be determined according to the following formula:

$P_{IS} = C_A L$ [kN/m^2]

C_A = 0.36 In general

= $0.88 \cdot \sin^2 \alpha$ For extremely flared sides where the flare angle α is larger than 40º

The flare angle α at the load centre is to be measured in the plane of frame between a vertical line and the tangent to the side shell plating.

P_{IS} shall not be smaller than wave pressure load, P_{WS}, given in **TL** Rules Chapter 1 Section 5 item D.2.2.

SECTION 2

PLATING

A. General

1. The plate thicknesses are to be tapered gradually, if different.

Gradual taper is also to be effected between the thicknesses required for strengthening of the bottom forward and the adjacent thicknesses.

2. Scantlings for ship's plating not prescribed under this section, Part A Chapter 1 Hull Section 7, as amended shall be referred to however as not contradicting or replacing the provision stated hereunder.

3. For specific scantling criteria with respect to Ship Type Notations, e.g. minimum thickness requirements for bulk carrier or tankers relevant sections of Part A, Chapter 1, Hull to be referred.

4. "Section 1 – Design Loads" of this rule set shall be referred to for loads used in this section.

B. Definitions

a = Width of smaller side of plate panel [m]

$$f_1 = 1 - \frac{s}{2r}$$

(Coefficient of curvature of the panel, to be taken not less than 0.75)

$$f_2 = \sqrt{1.1 - 0.5 \cdot \left(\frac{s}{l}\right)^2}$$

Coefficient of aspect ratio of the plate panel, to be taken not greater than 1.0

ℓ = Length of the longer side of the elementary plate panel [m],

s = Length of the shorter side of the elementary plate panel [m],

r = Radius of curvature [m],

k = Material factor according to Part A Chapter 1 Hull Section 3, A

P_B = Load on bottom in [kN/m^2]

P_s, P_{s1} = Load on sides in [kN/m^2]

e = Design pressure the bow area in [kN/m^2]

P_{SL} = Design slamming pressure in [kN/m^2]

nf = 1,0 for transverse framing

nf = 0,83 for longitudinal framing

σ_{LB} = Maximum bottom design hull girder bending stress in [N/mm^2]

σ_{LS} = Maximum design hull girder bending stress in the side shell at the station considered

τ_L = Maximum design shear stress due to longitudinal hull girder bending in [N/mm^2]

C. Minimum Thickness

1. At no point the thickness of the bottom and side shell plating shall be less than:

$$t_{min} = (1.5 - 0.01L) \cdot \sqrt{L \cdot k}$$

2. For ships engaged in sheltered water service (assigned with the notations **K6, L1** and **L2**), the minimum thickness t_{min} is defined as:

t_{min} = 3.5 [mm]

D. Bottom Thickness

1. General

The thickness of the bottom shell plating within 0,4 **L** amidships is not to be less than:

$$t_{B1} = 1.9 \cdot n_f \cdot a \cdot \sqrt{P_B \cdot k} + t_k \quad [mm]$$

Within 0,1 **L** forward of the aft end of the length **L** and within 0,05 **L** aft of **F.P.** the thickness is not to be less than t_{B2}.

$$t_{B1} = 1.21 \cdot a \cdot \sqrt{P_B \cdot k} + t_k \quad [mm]$$

n_f = 1,0 for transverse framing

n_f = 0,83 for longitudinal framing

The thickness of bilge plating is to be not less than that of the adjacent bottom or side plating, whichever is the greater.

2. Bottom Plating Thickness for Ships engaged in Sheltered Water Service (Assigned with the Notations K6, L1 and L2)

2.1 The thickness t_B of bottom plating is not to be less than determined by the following formula:

$$t_B = 1.3 \cdot \frac{a}{a_0} \cdot \sqrt{\frac{L \cdot T}{H}} \quad [mm]$$

t_B is not to be less than minimum thickness t_{min} determined in the item C.2 and need not to be greater than greater of tmin determined according to C.1 and minimum thickness in conjuction with A.3.

a_0 = standard frame spacing [m], defined as:

$$a_0 = \frac{L}{500} + 0.48$$

2.2 For ships having flat bottoms the thickness is to be increased by 0.5 mm.

2.3 The thickness within 0.05 L from the forward and aft end of the length L may be 1.0 mm less than the value determined by according to item C.2.

2.4 Strengthening of the bottom forward according to item H is not required.

3. Flat Plate Keel Thickness

The width of the flat plate keel is not to be less than:

b = 800 + 5 **L** [mm]

The thickness of the flat plate keel is not to be less than:

$t_{FK} = t_B + 2{,}0$ [mm] within 0,7 **L** amidships and in way of the engine seating

$t_{FK} = t_B$ [mm] otherwise

t_B = Thickness of the bottom plating in [mm] according to 1. - 2.

4. Inner Bottom Thickness

The thickness of the inner bottom plating is not to be less than:

$$t_{B1} = 1.1 \cdot a \cdot \sqrt{P \cdot k} + t_k \quad [mm]$$

P = Design pressure in [kN/m^2]

P_1 = 10 (**T** - h_{DB})

p_2 = 10 · h, where the inner bottom forms a tank boundary

p_3 = p_i (see Section 1 “Design Loads”)

G = Mass of cargo in the hold in [t]

V = Volume of the hold in [m^3] (hatchways excluded)

h = Height of the highest point of the cargo above the inner bottom in [m], assuming hold to be completely filled.

a_v = See Section 1 “Design Loads”

h = Distance from top of overflow pipe to inner bottom in [m]

h_{DB} = Double bottom height in [m].

E. Side Shell Thickness

1. General

The thickness of the side shell plating within 0,4 L amidships is not to be less than:

$$t_{S1} = 1.9 \cdot n_f \cdot a \cdot \sqrt{P_S \cdot k} + t_k \quad [mm]$$

Within 0,1 L forward of the aft end of the length L and within 0,05 L aft of F.P. the thickness is not to be less than t_{S2}.

$$t_{S2} = 1.21 \cdot a \cdot \sqrt{P \cdot k} + t_k \quad [mm]$$

2. Side Shell Plating and Sides of Superstructures for Ships Engaged In Sheltered Water Service (Assigned With the Notations K6, L1 and L2)

2.1 Thickness for side shell plating and sides of superstructures t_s shall be;

$$t_S = t_B \qquad t_S \geq t_{min}$$

Thickness may be reduced by 0.5 mm within 0.4**L** however no reduction of thickness shall be carried out within 0.05 **L** from the forward and aft end of the length **L**.

However the thickness t_s shall be not less than minimum thickness t_{min} given in the item C.2.

2.2 The thickness t_S of the side shell plating within 0.4**L** may be 0.5 mm less than the bottom plating according to item 2.1 above.

F. Strength Deck Thickness

1 The thickness of deck plating for 0,4 **L** amidships outside line of hatchways is not to be less than the greater of the two following values:

t_E according to 2

$$t_{min} = (4.5 + 0.05L) \cdot \sqrt{k} \quad [mm]$$

2 The thickness of strength deck plating for 0,1 **L** from the ends and between hatchways is not to be less than:

$$t_{E1} = 1.21 \cdot a \cdot \sqrt{P_D \cdot k} + t_k \quad [mm]$$

$$t_{E2} = 1.1 \cdot a \cdot \sqrt{P_L \cdot k} + t_k \quad [mm]$$

$$t_{Emin} = (5.5 + 0.02L) \cdot \sqrt{k} \quad [mm]$$

Between the midship thickness and the end thickness, the thicknesses are to be tapered gradually.

G. Thickness of Side Plating and Decks of Non-Effective Super-Structures

1. Side Plating

The thickness of the side plating above the strength deck is not to be less than the greater of the following values:

$$t = 1.21 \cdot a \cdot \sqrt{P \cdot k} + t_k \quad [mm]$$

or $$t = 0,8 \cdot t_{min} \quad [mm]$$

p = p_s or p_e as the case may be

t_{min}, see C. Minimum Thickness

1.2 The thickness of the side plating of upper tier superstructures may be reduced if the stress level permits such reduction.

2. Deck Plating

2.1 The thickness of deck plating is not to be less than the greater of the following values:

$$t = C \cdot a \cdot \sqrt{p \cdot k} + t_k \quad [mm]$$

$$t = (5.5 + 0.02L) \cdot \sqrt{k} \quad [mm]$$

p = p_{DA} or p_L, the greater value is to be taken.

C = 1,21 if $p = p_{DA}$

C = 1,10 if $p = p_L$

2.2 Where additional superstructures are arranged on non-effective superstructures located on the strength deck, the thickness required by 2.1 may be reduced by 10 per cent.

2.3 Where plated decks are protected by sheathing, the thickness of the deck plating according to 2.1 and 2.2 may be reduced by t_K, however, it is not to be less than 5 mm.

Where sheathing other than wood is used, attention is to be paid that the sheathing does not affect the steel. The sheathing is to be effectively fitted to the deck.

H. Bottom Plating Forward

Note: *Strengthening of the bottom forward is not required for Ships engaged in Sheltered Water Service (Assigned with the Notations K6, L1 and L2)*

1 The thickness of the bottom plating of the flat part of the ship's bottom in the fore body up to a height of $0.05T_{BFP}$ or 0.3 m above base line, whichever is smaller, is not to be less than:

$$t = 0.9 \cdot f_1 \cdot f_2 \cdot s \cdot \sqrt{P_{SL} \cdot k} + t_k \quad [mm]$$

T_{BFP} = Smallest design ballast draft at the forward perpendicular [m]

P_{SL} = Slamming load on bottom in the forebody [kN/m^2], as defined in “Section 1 - Design Loads”.

Note: *For every oil tanker subject to Regulation 18 of MARPOL 73/78 Annex I, scantlings of the strengthening of bottom forward is to be based on the draft obtained by using segregated ballast tanks only.*

2 Above $0.05T_{BFP}$ or 0.3 m above base line (whichever is smaller) the plate thickness may gradually be tapered to the rule thickness. For ships with a rise of floor the strengthened plating shall at least extend to the bilge curvature.

I. Bow and Stern Plating

1 The thickness of the side shell plating forward of 0.15L from the stem is not to be less than

$$t = 10 \cdot f_1 \cdot f_2 \cdot s \cdot \sqrt{\frac{P_{IB}}{\sigma_P}} + t_k \quad [mm]$$

where:

P_{IB} = Bow impact load [kN/m^2], as defined in “Section 1 - Design Loads”,

σ_P = Allowable stress [N/mm^2] of the material,

$$= \frac{160}{k}$$

2 The thickness of the side shell plating aft of 0.15L from the AP is not to be less than

$$t = 10 \cdot f_1 \cdot f_2 \cdot s \cdot \sqrt{\frac{P_{IS}}{\sigma_P}} + t_k \quad [mm]$$

where:

P_{IS} = Stern impact load [kN/m^2], as defined in “Section 1 - Design Loads”.

SECTION 3

SUPPORTING STRUCTURES

Page

A. General, Definitions

1. In this section requirements to bottom, side and deck supporting structures are given

2. “Section 1 Design Loads” shall be referred to for application of scantling formulae given under following subsections.

3. For scantling requirements not given under this section, Part A Chapter 1 Hull Section 8, as amended shall be referred to however as not contradicting or replacing the provision stated hereunder.

B. Bottom Strengthening

Bottom structural design principles are in general to be in accordance with TL Rules Chapter 1 Hull Section 8, B.

1. Centre Girder

1.1 For single bottom

The web thickness within 0,7 **L** amidships is not to be less than:

$t_W = 0{,}07\,\mathbf{L} + 5{,}5$ [mm].

The sectional area of the top plate within 0,7 **L** amidships is not to be less than:

$A_f = 0{,}7\,\mathbf{L} + 12$ [cm^2].

Towards the ends the thickness of the web plate as well as the sectional area of the top plate may be reduced by 10 per cent. Lightening holes are to be avoided.

1.2 For double bottom

The depth of the centre girder is not to be less than:

$h = 350 + 45 \cdot \mathbf{B}$ [mm]

$h_{min} = 600$ mm.

The thickness of the centre girder is not to be less than:

- Within 0,7 **L** amidships:

$$t_m = \frac{h}{h_a}\left(\frac{h}{100} + 1{,}0\right)\cdot\sqrt{k} \quad [\mathrm{mm}] \;\; (\text{for } h \le 1200\,[\mathrm{mm}])$$

$$t_m = \frac{h}{h_a}\left(\frac{h}{120} + 3{,}0\right)\cdot\sqrt{k} \quad [\mathrm{mm}] \;\; (\text{for } h > 1200\,[\mathrm{mm}])$$

- 0,15 **L** at the ends:

$t_e = 0{,}9 \cdot t_m$

h_a = Depth of centre girder as built in [mm],

h_a need not be taken less than h to calculate t.

t_m = Must not be less than t

$$t = (5{,}0 + 0{,}03L)\cdot\sqrt{k} \quad [\mathrm{mm}]$$

$$t_{min} = 6{,}0\cdot\sqrt{k} \quad [\mathrm{mm}]$$

2. Side Girder

2.1 For single bottom

The web thickness within 0,7 **L** amidships is not to be less than:

$t_W = 0{,}04\,\mathbf{L} + 5$ [mm]

The sectional area of the face plate within 0,7 **L** amidships is not to be less than:

$A_f = 0{,}2\,\mathbf{L} + 6$ [cm^2]

Towards the ends, the thickness of the web plate and the sectional area of the face plate may be reduced by 10 per cent.

2.2 For double bottom

The thickness of the side girders is not to be less than:

$$t = \frac{h^2}{120 \cdot h_a} \cdot \sqrt{k} \quad [mm]$$

h = Depth of the center girder in [mm] according to 1.2.

h_a = As built depth of side girders in [mm],

h_a need not be taken less than h to calculate t,

t = Must not be less than t;

$$t = (5{,}0 + 0{,}03L) \cdot \sqrt{k} \quad [mm]$$

$$t_{min} = 6{,}0 \cdot \sqrt{k} \quad [mm]$$

3. Floors

3.1 For single bottom

3.1.1 Floor plates in the cargo hold area

On ships without double bottom or outside any double bottom the scantlings of floor plates fitted between afterpeak bulkhead and collision bulkhead are to be determined according to the following formula:

$W = c \cdot \mathbf{T} \cdot \mathbf{e} \cdot \ell^2$ [cm³]

e = Spacing of plate floors in [m],

ℓ = Unsupported span in [m], generally measured on upper edge of floor from side shell to side shell.

ℓ_{min} = 0,7 **B**, if the floors are not supported at longitudinal bulkheads.

c = 7,5 for spaces which may be empty at full draught, e.g. machinery spaces, storerooms, etc.

c = 4,5 elsewhere.

The depth of the floor plates is not to be less than:

h = 55 · **B** - 45 [mm]

h_{min} = 180 mm.

In ships having rise of floor, at 0,1 ℓ from the ends of the length ℓ where possible, the depth of the floor plate webs shall not be less than half the required depth.

In ships having a considerable rise of floor, the depth of the floor plate webs at the beginning of the turn of bilge is not to be less than the depth of the frame.

The web thickness is not to be less than

$$t = \frac{h}{100} + 3 \quad [mm]$$

3.2 For double bottom

The thickness of plate floors is not to be less than:

$$t_{pf} = t_m - 2{,}0 \cdot \sqrt{k} \quad [mm]$$

t_m = Thickness of centre girder according to 1.2.

The thickness need not exceed 16 mm.
The shear area of primary supporting members is to be calculated as 10 · t · h where t is thickness of web plating and h is web height after deduction of cut-outs.

4. Bottom Longitudinals

Section modulus W_ℓ and shear are A_ℓ of longitudinals are not to be less than:

$$W_\ell = \frac{83{,}3}{\sigma_{pr}} \cdot m \cdot a \cdot \ell^2 \cdot p \ [cm^3]$$

$$A_\ell = (1 - 0{,}817 \cdot m_a) \cdot 0{,}05 \cdot a \cdot \ell \cdot p \cdot k \ [cm^2]$$

ℓ = Unsupported span in [m]

For m and m_a see TL Rules Chapter 1 Hull Section 8, item C.2.3.1

a = Span between secondary supporting members (stiffeners)

p = Bottom load

The permissible stress σ_{pr} is to be determined according to the following formulae:

$$\sigma_{pr} = \sigma_{perm} - |\sigma_L| \ [N/mm^2]$$

$$\sigma_{pr} \leq \frac{150}{k} \ [N/mm^2]$$

$$\sigma_{perm} = \left(0{,}8 + \frac{L}{450}\right) \cdot \frac{230}{k} \ [N/mm^2]$$

$$\sigma_{perm,max} = \frac{230}{k} \ [N/mm^2]$$

$$\sigma_L = 12{,}6 \cdot \frac{\sqrt{L}}{k} [N/mm^2] \quad \text{(as a first approximation)}$$

C. Deck Strengthening

Deck structural design principles are in general to be in accordance with TL Rules Chapter 1 Hull Section 8, D.

1. Definitions

k = Material factor

ℓ = Unsupported span in [m]

e = Width of deck supported in [m], measured from centre to centre of the adjacent unsupported fields

a = Span between secondary supporting members (stiffeners)

p = Deck load p_D, p_{DA} or p_L in [kN/m²],

c = 0,55

c = 0,75 for beams, girders and transverses which are simply supported on one or both ends.

2. Stringer plate

Stringer plate is to comply with TL Rules Chapter 1 Hull Section 7, D.3. Thickness of stringer plate is not to be less than that of the adjacent deck plating.

3. Longitudinals and Longitudinal Beams

Section modulus W_ℓ and shear are A_ℓ of longitudinals and longitudinal beams of the strength deck are not to be less than:

$$W_\ell = \frac{83{,}3}{\sigma_{pr}} \cdot m \cdot a \cdot \ell^2 \cdot p \ [cm^3]$$

$$A_\ell = (1 - 0{,}817 \cdot m_a) \cdot 0{,}05 \cdot a \cdot \ell \cdot p \cdot k \ [cm^2]$$

The permissible stress σ_{pr} is to be determined according to the following formulae:

$$\sigma_{pr} = \sigma_{perm} - |\sigma_L| \ [N/mm^2]$$

$$\sigma_{pr} \leq \frac{150}{k} \ [N/mm^2]$$

$$\sigma_{perm} = \left(0{,}8 + \frac{L}{450}\right) \cdot \frac{230}{k} \ [N/mm^2]$$

$$\sigma_{perm,max} = \frac{230}{k} \ [N/mm^2]$$

$$\sigma_L = 1{,}25 \cdot \left(12{,}6 \cdot \frac{\sqrt{L}}{k}\right) [N/mm^2] \ \text{(as a first approximation)}$$

The section modulus of girders and transverses is not to be less than:

$$W = c \cdot e \cdot \ell^2 \cdot p \cdot k \qquad [cm^3]$$

Shear area is not to be less than:

$$A_w = 0{,}05 \cdot p \cdot e \cdot \ell \cdot k \quad [cm^2]$$

The shear area of primary supporting members is to be calculated as 10 · t · h where t is thickness of web plating and h is web height after deduction of cut-outs.

4. Pillars

Principles and scantlings of pillars shall in general comply with Part A Chapter 1 Hull Section 8 D.3.

D. Side Strengthening

Side structural design principles are in general to be in accordance with TL Rules Chapter 1 Hull Section 8, C.

1. Definitions

1.1 Frame spacing

Forward of the collision bulkhead and aft of the afterpeak bulkhead, the frame spacing shall in general not exceed 600 mm.

1.2 Definitions

k = Material factor

ℓ = Unsupported span in [m]

ℓ_{min} = 2,0 m.

ℓ_{Ku}, ℓ_{Ko} = Length of lower/upper bracket connection of main frames within the length ℓ in [m] see Fig. 9.1.

$$m_a = 0{,}204 \cdot \frac{a}{\ell} \cdot \left[4 - \left(\frac{a}{\ell}\right)^2\right], \text{where } \frac{a}{\ell} \leq 1$$

e = Spacing of web frames in [m]

p = p_s or p_e as the case may be

p_s = Load on ship's sides in [kN/m^2]

p_e = Load on bow structures in [kN/m^2]

p_L = Tween deck load in [kN/m^2]

c_r = Factor of curved frames

c_r = 1,0 - 2 · (s/ℓ)

c_{rmin} = 0,75

s = Maximum height of curve.

2. Sheerstrake

Sheerstrake plating is to comply with TL Rules Chapter 1 Hull Section 7, C.4. Thickness of sheerstrake is not to be less than that of the adjacent side shell plating. Where needed higher steel corrections shall be taken into consideration.

3. Transverse Framing

3.1. Main Frames

The section modulus W_R and shear area A_R of the main frames including end attachments are not to be less than:

$W_R = n \cdot c \cdot \mathbf{a} \cdot \ell^2 \cdot p \cdot c_r \cdot k$ [cm^3]

upper end shear area:

$A_{R0} = (1 - 0{,}817 \cdot m_a) \cdot 0{,}04 \cdot \mathbf{a} \cdot \ell \cdot p \cdot k$ [cm^2]

lower end shear area:

$A_{RU} = (1 - 0{,}817 \cdot m_a) \cdot 0{,}07 \cdot \mathbf{a} \cdot \ell \cdot p \cdot k$ [cm^2]

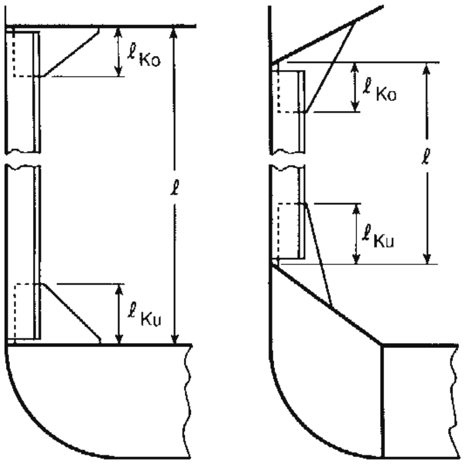
n = 0,9 - 0,0035 · **L**

$$c = 1{,}0 - \left(\frac{\ell_{KU}}{\ell} + 0{,}4 \cdot \frac{\ell_{KO}}{\ell}\right)$$

c_{min} = 0,6

The shear area of primary supporting members is to be calculated as 10 · t · h where t is thickness of web plating and h is web height after deduction of cut-outs.

Within the lower bracket connection the section modulus is not to be less than the value obtained for c = 1,0.



Unsupported span of transverse frame

3.2 Tween deck and superstructure frames

3.2.1 The section modulus Wt and shear area At of the tween deck and superstructure frames are not to be less than:

$$W_t = 0{,}55 \cdot a \cdot \ell^2 \cdot p \cdot C_r \cdot k \ [cm^3]$$

$$A_t = (1 - 0{,}817 \cdot m_a) \cdot 0{,}05 \cdot a \cdot \ell \cdot p \cdot k \ [cm^2]$$

p is not to be taken less than:

$$P_{min} = 0{,}4 \cdot P_L \cdot \left(\frac{b}{\ell}\right)^2 \quad [kN/m^2]$$

b = Unsupported span of the deck beam below the respective tween deck frame, in [m].

For tween deck frames connected at their lower ends to the deck transverses, p_{min} is to be multiplied by the factor:

$f_1 = 0{,}75 + 0{,}2 \cdot e/a \geq 1{,}0$

2.3 In the engine room of transversely framed ships, the section modulus of web frames is not to be less than four times that of adjacent frames.

The web height is not to be less than twice that of adjacent frames.

4. Side Transverses and Side Longitudinals

4.1 Section modulus W_ℓ and shear area A_ℓ of longitudinals and longitudinal beams of the strength deck are not to be less than:

$$A_\ell = (1 - 0{,}817 \cdot m_a) \cdot 0{,}05 \cdot a \cdot \ell \cdot p \cdot k \ [cm^2]$$

The permissible stress σ_{pr} is to be determined according to the following formulae:

$$\sigma_{pr} = \sigma_{perm} - |\sigma_L| \ [N/mm^2]$$

$$\sigma_{pr} \leq \frac{150}{k} \ [N/mm^2]$$

For side longitudinals W_ℓ and A_ℓ shall not be less than:

$$A_{\ell,min} = (1 - 0{,}817 \cdot m_a) \cdot 0{,}037 \cdot a \cdot \ell \cdot p_{s1} \cdot k \ [cm^2]$$

P_{s1} according to Section 1 Design Loads

4.2 Section modulus W and shear area Aw of side transverses supporting side longitudinals are not to be less than:

$$W = 0{,}55 \cdot e \cdot \ell^2 \cdot p \cdot k \ [cm^3]$$

$$A_W = 0{,}55 \cdot e \cdot \ell \cdot p \cdot k \ [cm^2]$$

SECTION 4

BULKHEADS

A. General

1. Application

1.1 For requirements related to bulkheads not given under this section, Part A Chapter 1 Hull Section 11 and Section 12, as amended shall be referred to however as not contradicting or replacing the provision stated hereunder.

1.2 Section 1 Design Loads shall be referred to for loads required for scantling purposes.

2. Definitions

t_K = Corrosion allowance

a = Spacing of stiffeners in [m],

ℓ = Unsupported span in [m],

$P = 9{,}81 \cdot h \quad [kN/m^2]$

h = Distance from the load center of the structure to a point 1 m. above the bulkhead deck, for the collision bulkhead to a point 1 m. above the collision bulkhead.

c_p, c_s= Coefficients according to Table below

Table 4.1 Coefficients c_p and c_s

c_p , c_s		**Collision Bulkhead**	**Other Watertight Bulkheads**
Plating	c_p:	$1{,}1 \cdot \sqrt{f}$	$0{,}9 \cdot \sqrt{f}$
Stiffeners, corrugated bulkheads elements	c_s: (in case of constraint of both ends)	$0{,}33 \cdot f$	$0{,}265 \cdot f$
	c_s: (in case of simple support of one end and constraint at the other end)	$0{,}45 \cdot f$	$0{,}36 \cdot f$
	c_s: (both ends simply supported)	$0{,}66 \cdot f$	$0{,}53 \cdot f$
(1) *The plating and stiffeners of watertight longitudinal structures shall be dimensioned according to column "Other bulkheads".*			

$$f = \frac{235}{R_{eH}}$$

R_{eH} = Minimum nominal upper yield point in [N/mm^2].

R_{eH} = Minimum nominal upper yield point in [N/mm^2].

B. Collusion and Watertight Bulkheads

1. Bulkhead Plating

The thickness of the bulkhead plating is not to be less than:

$$t = C_P \cdot a \cdot \sqrt{P} + t_k \quad [mm]$$

$$t_{min} = 6{,}0 \cdot \sqrt{f} \quad [mm]$$

2. Bulkhead Stiffeners

The section modulus of bulkhead stiffeners is not to be less than:

$W = c_s a \ell^2 P \qquad [cm^3]$

c_s = Coefficient according to Table 4.1

2.1 In horizontal part of bulkheads, the stiffeners are also to comply with the rules for deck beams according to Section 3.

2.2 The scantlings of the brackets are to be determined in dependence of the section modulus of the stiffeners according to Chapter 1 Hull Section 3, B.4.2 If the length of the stiffener is 3,5 m. and over, the brackets are to extend to the next beam or the next floor.

2.3 Unbracketed bulkhead stiffeners are to be connected to the decks by welding. The length of weld is to be at least 0,6 x depth of the section.

2.4 If the length of stiffeners between bulkhead deck and the deck below is 3 m. and less, no end attachment according to 3.4 is required. In this case the stiffeners are to be extended to about 25 mm from the deck and sniped at the ends. (See also Chapter 1 Hull Section 3, B.4.3.)

2.5 Bulkhead stiffeners cut in way of watertight doors are to be supported by carlings or stiffeners.

3. Corrugated Bulkheads

3.1 The plate thickness of corrugated bulkheads is not to be less than required according to 1. For the spacing a, the greater one of the values b or s in [m] according to 3.3 is to be taken.

3.2 The section modulus of a corrugated bulkhead element is to be determined according to 3.1. For the spacing a, the width of an element e, in [m] according to 3.3 is to be taken. For the end attachment see Part A Chapter 1 Hull Section 3,D.4.

3.3 The actual section modulus of a corrugated bulkhead element is to be assessed according to the following formula:

$$W = t \cdot d\left(b + \frac{s}{3}\right) \quad [cm^3]$$

e = Width of element in [cm],

b = Breadth of face plate in [cm],

s = Breadth of web plate in [cm],

d = Distance between face plates in [cm],

t = Plate thickness in [cm],

α ≥ 45°

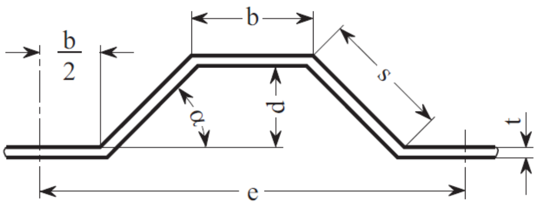


Figure 4.1 Element of a corrugated bulkhead

C. Tank Bulkheads

1. Bulkhead Plating

The thickness of all structures in tanks is not to be less than the following minimum value:

t_{min} = 5,5 + 0,02 **L** [mm]

The bulkhead plate thickness is not to be less than:

$$t_1 = 1{,}1 \cdot a \cdot \sqrt{P \cdot k} + t_k \quad [mm]$$

$$t_2 = 0{,}9 \cdot a \cdot \sqrt{P_2 \cdot k} + t_k \quad [mm]$$

Where;

P = Load p_1 or p_d in [kN/m²] according to Section 1 Design Loads; the greater load to be taken.

For tank structures of tanks adjacent to the shell the pressure p below T_{min} need not be larger than:

$$p = p_1 - \left[10 \cdot (T_{min} - z) - p_o \cdot C_F \cdot \left(1 + \frac{z}{T_{min}}\right)\right] \quad [kN/m^2]$$

T_{min} = Smallest design ballast draught [m],

p_2 = Load in [kN/m²] according to Section 1 - Design Loads

2. Tank Stiffeners and Girders

The section modulus of stiffeners and girders constrained at their ends, is not to be less than:

$$W_1 = 0{,}55 \cdot a \cdot \ell^2 \cdot p \cdot k \quad [cm^2]$$

$$W_2 = 0{,}44 \cdot a \cdot \ell^2 \cdot p_2 \cdot k \quad [cm^2]$$

Where one or both ends are simply supported, the section moduli are to be increased by 50 per cent.

The cross sectional area of the girder webs is not to be less than:

$$A_{W1} = 0{,}05 \cdot a \cdot \ell \cdot p \cdot k \quad [cm^2]$$

$$A_{W2} = 0{,}04 \cdot a \cdot \ell \cdot p_2 \cdot k \quad [cm^2]$$

A_{w2} is to be increased by 50 per cent at the position of constraint for a length of 0,1 ℓ.

3. Corrugated Bulkheads

3.1 The plate thicknesses of corrugated bulkheads as well as the required section moduli of corrugated bulkhead elements are to be determined according to 2.and 3., proceeding analogously to B.4.

The plate thickness is not to be less than t_{min} according to C.1, or

- If subjected to load p

$$t_{krit} = \frac{b}{905} \cdot \sqrt{\sigma_D} + t_k \quad [mm]$$

- If subjected to load p_2

$$t_{krit} = \frac{b}{960} \cdot \sqrt{\sigma_D} + t_k \quad [mm]$$

σ_D = Compressive stress [N/mm^2]

b = Breadth of face plate strip in [mm].

3.2 For the end attachment Part A Chapter 1 Hull Section 3, D.4. is to be observed.

D. Wash Bulkheads

Wash bulkheads are in general to comply with Chapter 1 Hull Section 12, G.

1. The thickness of wash bulkhead is not to be less than the following minimum value:

$$t_{min} = 5{,}5 + 0{,}02L \quad [mm]$$

Strengthening may be required for load bearing structural parts.

2. The section modulus of the stiffeners and girders is not to be less than

$$W = C_S \cdot a \cdot \ell^2 \cdot P \quad [cm^3]$$

However, in lieu of p

The load P_D according to Section 2 Design Loads (Design Pressure for Partially Filled Tanks) but disregarding P_v is to be taken.

E. Pillar Bulkheads

1. As a rule, the plating thickness of pillar bulkheads is not to be less than 7 mm.

2. Scantlings of bulkhead stiffeners with associated plating are to be determined in such a way as to ensure the same buckling strength of pillars.

The breadth of associated plating, in mm, is to be not taken greater than 30 t, where t is the thickness of the associated plating.

F. Central longitudinal bulkhead

1. General

Except for dry peaks, a centreline longitudinal wash bulkhead may be required in liquid compartments for which there is a risk of resonance in the transverse direction.

F. Central longitudinal bulkhead

1. General

Except for dry peaks, a centreline longitudinal wash bulkhead may be required in liquid compartments for which there is a risk of resonance in the transverse direction.

2. Extension

In the case of a bulbous bow, such bulkhead is generally to extend for the whole length and depth of the fore peak.

Where hull structures are flared, such as those situated above the bulb and in the fore part of the peak, the bulkhead may be locally omitted.

Similarly, the extension of the bulkhead may be limited for bows without a bulb, depending on the shape of the hull. However, the bulkhead is to be fitted in the higher part of the peak.

3. Plating thickness

The net plating thickness of the lower part of the longitudinal bulkhead over a height at least equal to rule height of floors is to be not less than that required for the rule thickness of centre girder.

Elsewhere, the net thickness of the longitudinal bulkhead plating is to be not less than the value obtained, in mm, from the following formula:

$$t = 6{,}5 + 0{,}013L \quad [mm]$$

4. Ordinary stiffeners

The net section modulus of ordinary stiffeners is to be not less than the value obtained, in cm^3, from the following formula:

$$W = 3{,}5 \cdot s \cdot \ell^2 \cdot k \cdot (z_{TOP} - z_M) \ [cm^3]$$

where:

z_{TOP} : Z co-ordinate, in m, of the highest point of the tank

z_M : Z co-ordinate, in m, of the stiffener mid-span.

5. Primary supporting members

Vertical and longitudinal primary supporting members, to be made preferably with symmetrical type sections, are to have a section modulus not less than 50% of that required for the corresponding side transverse or side girder.

The vertical and longitudinal webs are to be provided with adequate fairing end brackets and to be securely connected to the struts, if any.

6. Openings

Bulkhead openings are to be limited in the zone corresponding to the centre girder to approximately 2% of the total area of the bulkhead, and, in the zone above, to not less than 10% of the total area of the bulkhead. Openings are to be located such as to affect as little as possible the plating sections adjacent to primary supporting members.

SECTION 5

FORE- AND AFT- BODY

Page

A. Connection of the fore part with the structures located aft of the collision bulkhead

1. Where the area between 0,15 **L** from the forward perpendicular and the collision bulkhead is transversely framed, side girders are to be fitted in line with those of the fore peak.

2. The web of such side girders is to be made of intercostals plates and the face plate is to be made of a flat bar continuous across the vertical primary supporting members and connected to them.

3. The thickness t of plates, in mm, and the area A of the flat bar, in cm^2, are to be not less than the values obtained from the following formula:

$$t = \left(0{,}032 \cdot L \cdot \sqrt{k} + 6\right) \cdot n \quad [mm]$$

Without being taken less than 6,5 mm.

$$A = (0{,}11 \cdot L \cdot k + 5{,}5) \cdot n \quad [cm^2]$$

Without being taken less than 8 cm^2.

n = 1 for unrestricted navigation

= 0.95 for summer zone

= 0.90 for tropical zone, coastal area

= 0.85 for sheltered area

4. The above mentioned side girders may be omitted provided that thickness of the side plating in the corresponding zone of the ship is increased by 20% however this is subject to discretion of TL.

B. Strengthening in Fore- and Aft Body

1. General

1.1 In the fore body, i.e. from the forward end to 0,15 **L** behind F.P. flanged brackets have to be used in principle.

1.2 As far as practicable and possible, tiers of beams or web frames and stringers are to be fitted in the fore- and afterpeak.

2. Tiers of beams

2.1 Forward of the collision bulkhead, tiers of beams (beams at every other frame) generally spaced no more than 2,6 m. apart, measured vertically, are to be arranged below the lowest deck within the forepeak. Stringer plates are to be fitted on the tiers of beams which are to be connected by continuous welding to the shell plating and by a bracket to each frame. The scantlings of the stringer plates are to be determined from the following formula:

Width:

$$b = 75 \cdot \sqrt{L} \quad [mm]$$

Thickness:

$$t = 6{,}0 + \frac{L}{40} \quad [mm]$$

2.2 The cross sectional area of each beam is to be determined according to Part A Chapter 1 Hull Section 10, C.2 for a load

$$P = A \cdot p \quad [kN]$$

A = Load area of a beam in [m^2]

2.3 In the afterpeak, tiers of beams with stringer plates generally spaced 2,6 m. apart, measured vertically, are to be arranged as required under 2.1, as far as practicable with regard to the ship's shape.

2.4 Intermittent welding at the stringers in the afterpeak is to be avoided. Any scalloping at the shell plating is to be restricted to holes required for welding and for limbers.

2.5 Where peaks are used as tanks, stringer plates are to be flanged or face bars are to be fitted at their inner edges. Stringers are to be effectively fitted to the collision bulkhead so that the forces can be properly transmitted.

2.6 Where perforated decks are fitted instead of tiers of beams, their scantlings are to be determined as for wash bulkheads. The requirements regarding cross sectional area stipulated in 2.2 are, however, to be complied with.

3. Web frames and stringers

3.1 Where web frames and supporting stringers are fitted instead of tiers of beams, their scantlings are to be determined as follows:

3.1.1 Section modulus:

$$W = 0{,}55 \cdot e \cdot \ell^2 \cdot p \cdot n_c \cdot k \quad [cm^3]$$

3.1.2 Web shear area at the supports:

$$A_W = 0{,}05 \cdot e \cdot \ell_1 \cdot p \cdot k \quad [cm^2]$$

ℓ = Unsupported span in [m], without consideration of cross ties, if any

ℓ_1 = Similar to ℓ, however, considering cross ties, if any

n_c = Coefficient according to the following Table 5.1.

3.2 Vertical transverses are to be interconnected by cross ties the cross sectional area of which is to be determined according to 2.2.

Table 5.1 Reduction coefficient n_c

Number of cross ties	n_c
0	1,0
1	0,5
2	0,3
≥3	0,2

3.3 Where web frames and stringers in the fore body are dimensioned by strength calculations the stresses must not exceed the permissible stresses.

Note:
Where a large and long bulbous bow is arranged a dynamic pressure p_{sdyn} is to be applied unilaterally. The unilateral pressure can be calculated approximately as follows:

$$P_{sdyn} = P_o \cdot C_F \cdot \left(1 + \frac{z}{T}\right) \quad [kN/m^2]$$

p_o, c_F, z and f according to Section 4, with. f = 0,75.
For the effective area of P_{sdyn}, the projected area of the z-x-plane from forward to the collision bulkhead may be assumed.

4. Web frames and stringers in tween decks and superstructure decks

Where the speed of the ship exceeds v_0 =1,6 $\sqrt{\mathbf{L}}$ [kn] or in ships with a considerable bow flare respectively, stringers and transverses according to 3 are to be fitted within 0,1 **L** from forward perpendicular in tween deck spaces and superstructures.

The spacing of the stringers and transverses in not to be taken less than 2,8 m. A considerable bow flare exists, if the flare angel exceeds 40°, measured in the ship's transverse direction and related to the vertical plane.

5. Tripping brackets

5.1 Between the point of greatest breadth of the ship at maximum draught and the collision bulkhead tripping brackets spaced not more than 2,6 m., measured vertically, according to Figure 5.1 are to be fitted. The thickness of the brackets is to be determined according to 2.1. Where proof of safety against tripping is provided tripping brackets may partly or completely be dispensed with.

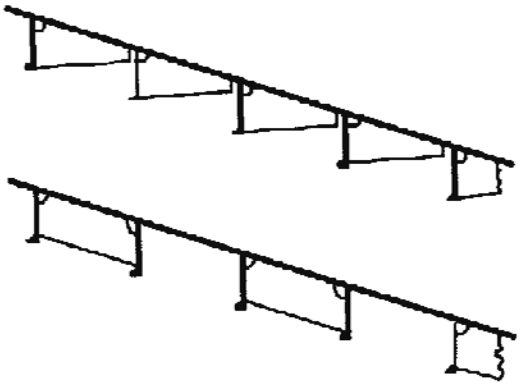


Figure 5.1 Tripping brackets

5.2 In the same range, in tween deck spaces and superstructures of 3 m. and more in height, tripping brackets according to 5.1 are to be fitted.

5.3 Where peaks or other spaces forward of the collision bulkhead are intended to be used as tanks, tripping brackets according to 5.1 are to be fitted between tiers of beams or stringers.

SECTION 6

WATERTIGHT SUBDIVISION AND ACCESS

A. Watertight Subdivision

1. General

1.1 The following transverse, watertight bulkheads shall be fitted in all ships:

- A collision bulkhead,
- An after peak bulkhead,
- A bulkhead at each end of the engine room.

In ships with machinery aft, the stern tube bulkhead may substitute the aft engine room bulkhead.

In the case of ships with an electrical propulsion plant, both the generator room and the engine room are to be enclosed by watertight bulkheads.

1.2 Number and location of transverse bulkheads fitted in addition to those specified in 1.1 are to be so selected as to ensure sufficient transverse strength of the hull.

1.3 For ships which require proof of survival capability in damaged conditions, the watertight subdivision will be determined by damage stability calculations.

2. Arrangement of Watertight Bulkheads

2.1 Transverse watertight bulkheads are to extend watertight up to the bulkhead deck.

2.2 Where it is not practicable to arrange a watertight bulkhead in one plane, a stepped bulkhead may be fitted. In this case, the part of the deck which forms the step is to be watertight and equivalent in strength to the bulkhead.

3. Collision Bulkhead

3.1 A collision bulkhead is to be fitted which is to be watertight up to the bulkhead deck. This bulkhead is to be located at a distance from the forward perpendicular of not less than $0.05 \cdot L_C$ and, except as may be permitted by the Society, not more than $(0.05 \cdot L_C + 3)$ m or 5,5 m, whichever is the greater.

3.2 Where any part of the ship below the waterline extends forward of the forward perpendicular, e.g., a bulbous bow, the required distances specified in 3.1 are to be measured from a reference point located at a distance x forward of the F.P. which shall be the minimum of:

- 0.5 a
- $0.015L_C$
- 3 m

The length L_C and the distance a are to be specified in the approval documents.

3.3 The bulkhead may have steps or recesses provided they are within the limits prescribed in 3.1 and 3.2.

3.4 At Owner request, the Society may, on a case by case basis, accept a distance from the collision bulkhead to the forward perpendicular FP greater than the maximum specified in 3.1 and 3.2, provided that subdivision and stability calculations show that, when the ship is in upright condition on full load summer waterline, flooding of the space forward of the collision bulkhead will not result in any part of the freeboard deck becoming submerged, or in any unacceptable loss of stability.

3.5 No doors, manholes, access openings, or ventilation ducts are permitted in the collision bulkhead below the bulkhead deck.

The number of openings in the extension of the collision bulkhead above the bulkhead deck shall be restricted to the minimum compatible with the design and normal operation of the ship. All such openings shall be capable of being closed weathertight.

3.6 Except as provided in 3.5 the collision bulkhead may be pierced below the bulkhead deck by not more than one pipe for dealing with fluid in the forepeak tank, provided that the pipe is fitted with a screw down valve capable of being operated from above the bulkhead deck, the valve chest being secured inside the forepeak to the collision bulkhead. TL may, however, authorize the fitting of this valve on the after side of the collision bulkhead provided that the valve is readily accessible under all service conditions and the space in which it is located is not a cargo space. All valves shall be of steel, bronze or other approved ductile material. Valves of ordinary cast iron or similar material are not acceptable.

3.7 If the forepeak is divided to hold two different kinds of liquids TL may allow the collision bulkhead to be pierced below the bulkhead deck by two pipes, each of which is fitted as required by 3.6, provided TL is satisfied that there is no practical alternative to the fitting of such a second pipe and that, having regard to the additional subdivision provided in the forepeak, the safety of the ship is maintained.

4. Stern Tube and Remaining Watertight Bulkheads

4.1 Bulkheads shall be fitted separating the machinery space from cargo and accommodation spaces forward and aft and made watertight up to the bulkhead deck.

4.2 In all cases stern tubes shall be enclosed in watertight spaces of moderate volume. Measures to minimize the danger of water penetrating into the ship in case of damage to stern tube arrangements may be taken at the discretion of **TL**.

A stern tube enclosed in a watertight space of moderate volume, such as an aft peak tank, where the inboard end of the stern tube extends through the aft peak/engine room watertight bulkhead into the engine room is considered to be an acceptable solution provided the inboard end of the stern tube is effectively sealed at the aft peak/engine room bulkhead by means of an approved watertight/oiltight gland system.

5. Openings in Watertight Bulkheads and Decks

5.1 Watertight doors are to be sufficiently strong and of an approved design and type and arrangement of doors are to be submitted for approval.

5.1 No doors, manholes, access openings, or ventilation ducts are permitted in the collision bulkhead below the bulkhead deck.

5.2 In the other watertight bulkheads, watertight doors may be fitted.

5.4 The number of openings in watertight subdivisions is to be kept to a minimum compatible with the design and proper working of the ship. Where penetration of watertight bulkheads and internal decks are necessary for access, piping, ventilation, electrical cables, etc., arrangements are to be made to maintain the watertight integrity.

5.5 Openings for watertight doors in the bulkheads are to be effectively framed such as to facilitate proper fitting of the doors and to guarantee perfect water tightness.

5.6 Before being fitted, the watertight bulkhead doors, together with their frames, are to be tested by a head of water corresponding to the bulkhead deck height. After having been fitted, the doors are to be hose- or soap- tested for tightness and to be subjected to an operational test. Deviating and additional requirements hereto are subject to approval and agreement of **TL**.

5.7 Definitions of openings on watertight bulkheads are as given below:

- Openings “used while at sea” are openings which are allowed to remain open during navigation.

- Openings “normally closed at sea” are openings which are not allowed to be remained open but can be used during navigation. These openings are considered to be immediately closed after use.

- Openings “permanently kept closed at sea” are openings which remain closed and are not used during navigation.

5.8 The requirements relevant to the degree of tightness, as well as the operating systems, for doors or other closing appliances are specified below:

5.8.1 For sliding doors;

Watertight doors which are open at sea shall be provided with remote operation indication on the bridge. Doors that are normally closed shall be provided with indicator on the bridge and notice is to be affixed on the both sides of the door stating “to be kept closed at sea”. The doors remain closed at sea shall also have a notice on the both sides of the door stating “to be kept closed at sea” and shall only be for local operation only. These doors are to be closed before the voyage commences and if the door is accessible during the voyage, a device which prevents unauthorised opening is to be fitted.

Note: Sliding doors are to be carefully fitted and are to be properly guided in all positions. The closing mechanism is to be safely operable from each side of the bulkhead and from above the freeboard deck. If closing of the door cannot be observed with certainty, an indicator is to be fitted which shows, if the door is closed or open; the indicator is to be installed at the position from which the closing mechanism is operated.

5.8.2 For hinged doors;

Watertight doors that are normally closed or remain closed shall have a notice on the both sides of the door stating “to be kept closed at sea”. For doors that are normally to be kept closed shall be provided with indicator on the bridge and the doors remain closed shall only be for local operation only and are to be closed before the voyage commences and if the door is accessible during the voyage, a device which prevents unauthorised opening is to be fitted.

Note: Hinged doors are to be provided with rubber sealings and toggles or other approved closing appliances which guarantee a sufficient sealing pressure. The toggles and closing appliances are to be operable from both sides of the bulkhead. Hinges are to have oblong holes. Bolts and bearings are to be of corrosion resistant material.

5.9 Openings used while at sea

Doors provided to ensure the watertight integrity of internal openings which are used while at sea are to be sliding watertight doors capable of being remotely closed from the bridge and are also to be operable locally from each side of the bulkhead. Indicators are to be provided at the control position showing whether the doors are open or closed, and an audible alarm is to be provided at the door closure. The power, control and indicators are to be operable in the event of main power failure. Particular attention is to be paid to minimise the effect of control system failure. Each power-operated sliding watertight door is to be provided with an individual hand-operated mechanism.

5.10 Openings normally closed at sea

Doors provided to ensure the watertight integrity of internal openings which are normally closed at sea are to be provided with means of indication locally and on the bridge showing whether these doors are open or closed. A notice is to be affixed to each such door or hatch cover to the effect that it is not to be left open.

5.11 Openings permanently kept closed at sea

Doors provided to ensure the watertight integrity of internal openings which are kept permanently closed at sea are to be provided with a notice which is to be affixed to each such closing appliance to the effect that it is to be kept closed. Manholes fitted with closely bolted covers need not be so marked.

5.12 On ships for which proof of floatability in damaged condition is to be provided, hinged doors are permitted above the most unfavourable damage waterline for the respective compartment only. Deviating and additional requirements hereto for cargo ships are subject to approval and agreement of **TL**.

5.13 Where bulkhead fittings are penetrating watertight bulkheads, care is to be taken to maintain watertightness.

Heat sensitive materials are not to be used in systems which penetrate watertight subdivision bulkheads, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads.

B. Shaft Tunnels

1. General

1.1 Shaft and stuffing box are to be accessible. Where one or more compartments are situated between stern tube bulkhead and engine room, a watertight shaft tunnel is to be arranged. The size of the shaft tunnel is to be adequate for service and maintenance purposes.

1.2 The access opening between engine room and shaft tunnel is to be closed by a watertight sliding door. For extremely short shaft tunnels watertight doors between tunnel and engine room may be dispensed with subject to special approval.

1.3 Tunnel ventilators and the emergency exit are to be constructed watertight up to the freeboard deck.

C. Compartment arrangement

1. Cofferdams

1.1 A cofferdam means an empty space arranged so that compartments on each side have no common boundary; a cofferdam may be located vertically or horizontally. As a rule, a cofferdam is to be properly ventilated and of sufficient size to allow for inspection.

1.2 Cofferdams are to be provided between:

- compartments intended for liquid hydrocarbons (fuel oil, lubricating oil) and compartments intended for fresh water (drinking water, water for propelling machinery and boilers)

- compartments intended for liquid hydrocarbons (fuel oil, lubricating oil) and tanks intended for the carriage of liquid foam for fire extinguishing.

2.1.3 Spaces intended for the carriage of highly flammable liquids (flash point less than 60°C) are to be separated from accommodation and service spaces by means of a cofferdam.

Where accommodation and service spaces are arranged immediately above such spaces, the cofferdam may be omitted only where the deck is not provided with access openings and is coated with a layer of material recognized as suitable by the Society.

2. Double bottoms

2. 1 Double bottom for ships other than tankers

If fitted, double bottoms are to be in accordance with Part A Chapter 1 Hull, as applicable.

2.2 Double bottom for tankers

Special requirements for tankers are specified in Part A Chapter 1 Hull Section 28.

3. Compartments forward of the collision bulkhead

3.1 The fore peak and other compartments located forward of the collision bulkhead cannot be used for the carriage of fuel oil or other flammable products.
This requirement does not apply to ships of less than 400 tons gross tonnage, except for those where the fore peak is the forward cofferdam of tanks arranged for the carriage of flammable liquid products having a flash point not exceeding 60°C.

D. Means of Access

Note: Provisions of Part A Chapter 1 Hull Section 16 may be referred to where any point not clearly defined under this subsection however as not to cause any contradiction with the requirements given below.

1. General

1.1 Each space within the cargo area are to be provided with a permanent means of access to enable, throughout the life of a ship, overall and close-up inspection and thickness measurements of the ship's structure.

1.2 Where a permanent means of access may be susceptible to damage during normal cargo loading and unloading operations or where it is impracticable to fit permanent means of access **TL** may allow, in lieu thereof, the provision of movable or portable means of access, provided that the means of attaching, rigging, suspending or supporting the portable means of access forms a permanent part of the ship's structure. All portable equipment is to be capable of being readily erected or deployed by ship's personnel.

1.3 The construction and materials of all means of access and their attachment to the ship's structure is to be to the satisfaction of **TL**.

1.4 The number and size of small hatchways for trimming and access openings to tanks or other enclosed spaces, are to be kept to the minimum consistent with access and maintenance of the space.

2. Safe Access to Cargo Holds, Cargo Tanks, Ballast Tanks and Other Spaces

2.1 Safe access to cargo holds, cofferdams, ballast tanks, cargo tanks and other spaces in the cargo area is to be direct from the open deck and such as to ensure their complete inspection. Safe access double bottom spaces may be from a pump-room, deep cofferdam, pipe tunnel, cargo hold, double hull space or similar compartment not intended for the carriage of oil or hazardous cargoes.

2.2 Tanks, and subdivisions of tanks, having a length of 35 m. or more, is to be fitted with at least two access hatchways and ladders, as far apart as practicable. Tanks less than 35 m. in length is to be served by at least one access hatchway and ladder. When a tank is subdivided by one or more wash bulkheads, at least two hatchways are to be fitted, and these hatchways are to be so located that the associated ladders effectively serve all subdivisions of the tank.

2.3 Each cargo hold is to be provided with at least two means of access as far apart as practicable. In general, these accesses should be arranged diagonally, for example one access near the forward bulkhead on the port side, the other one near the aft bulkhead on the starboard side.

3. Technical Provisions

Note: For definitions of any term refered to in this subsection, see Part A Chapter 1 Hull Section 16 G.3.

3.1 Structural members subject to the close-up inspections and thickness measurements of the ship's structure, except those in double bottom spaces, shall be provided with a permanent means of access to the extent as specified in Part A Chapter 1 Hull section 16 Table 16.6 and Table 16.7, as applicable.

3.2 Permanent means of access should as far as possible be integral to the structure of the ships, thus ensuring that they are robust and at the same time contributing to the overall strength of the structure of the ship.

3.3 The dimensions of any access through horizontal openings, hatches or manholes are to be sufficient to allow a person wearing a self-contained breathing apparatus to ascend or descend the ladder without obstruction and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the tank which is not to be less than 600 mm. x 600 mm.

3.4 When access to a cargo hold is arranged through the cargo hatch, the top of the ladder to be placed as close as possible to the hatch coaming. Access hatch coamings having a height greater than 900 mm. is also to have steps on the outside in conjunction with the ladder.

3.5 For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the space, the minimum opening is to be not less than 600 mm×800 mm and so arranged as to facilitate the access of persons wearing breathing apparatus or carrying a stretcher with a patient.

3.6 To provide ease of movement on the tank bottom throughout the length and breadth of the tank, a passageway is to be fitted on the upper part of the bottom structure of each tank, or alternatively, manholes having at least the dimensions of 600 mm x 800 mm are to be arranged in the floors at a height of not more than 600 mm from the bottom shell plating.

3.7 **TL** may approve, in special circumstances, smaller dimensions for the openings referred to in 3.8 and 3.9 if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of **TL**.

3.8 Passageways in the tanks are to have a minimum width of 600 mm considering the requirement for the possibilityof carrying an unconscious person. Elevated passageways forming sections of a permanent means of access, where fitted, is to have a minimum clear width of 600 mm, except for going around vertical webs where the minimum clear width may be reduced to 450 mm, and have guard rails over the open side of their entire length. Where guard rails are provided on one side only,foot rails are to be fitted on the opposite side. Shelvesand platforms forming a part of the access to the tanksare to be of non-skid construction where practicable and be fitted with guard rails. Guard rails are to be fittedto bulkhead and side stringers when such structures arebeing used for recognised access. When the height of the bottom structure does not exceed 1,50 m, the passageways required in this item may be replaced by alternative arrangements having regard to the bottom structure and requirement for ease of access of a person wearing a self-contained breathing apparatus or carrying a stretcher with a patient.

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

3.10 Guard rails are to be 900 mm in height and consist of a rail and intermediate bar. These guard rails are to be of substantial construction.

3.11 Permanent inclined ladders are to be inclined at an angle of less than 70°. Resting platforms of adequate dimensions are to be provided, normally at a maximum of 9 m. vertical height. Ladders and handrails are to be constructed of steel or equivalent material of adequate strength and stiffness and securely attached to the structure by stays. The method of support and length of stay is to be such that vibration is reduced to a practical minimum. In cargo holds, ladders are to be designed and arranged so that cargo handling difficulties are not increased and the risk of damage from cargo handling gear is minimized.

3.12 Provision is to be made for maintaining the structural strength of the ladders and railings taking into account the corrosive effect of the cargo.

3.13 For vertical ladders or spiral ladders, the width and construction should be in accordance with international or national standards accepted by **TL**.

3.14 The width of inclined ladders between stringers is to not be less than 400 mm. The treads are to be equally spaced at a distance apart, measured vertically, of between 200 mm. and 300 mm. When steel is used, the treads are to be formed of two square bars of not less than 22 mm. by 22 mm. in section, fitted to form a horizontal step with the edges pointing upward. The treads are to be carried through the side stringers and attached thereto by double continuous welding. All inclined ladders are to be provided with handrails of substantial construction on both sides, fitted at a convenient distance above the treads.

3.15 Access to the tunnel is to be provided by a watertight door fitted on the aft bulkhead of the engine room in compliance with item A.5 , and an escape trunk which can also act as watertight ventilator is to be fitted up to the subdivision deck, for tunnels greater than 7 m in length.

3.16 Tunnels are to be large enough to ensure easy access to shafting.

3.17 The steering gear compartment is to be readily accessible and, as far as practicable, separated from machinery spaces.

3.18 Suitable arrangements to ensure working access to steering gear machinery and controls are to be provided.

These arrangements are to include handrails and gratings or other non-slip surfaces to ensure suitable working conditions in the event of hydraulic fluid leakage.

3.19 No free-standing portable ladder is to be more than 5 m long.

SECTION 7

STABILITY

Page

A. Intact Stability

1. General

Each ship is to be provided with a stability booklet, approved by TL, which contains sufficient information to enable the Master to operate the ship in compliance with the applicable requirements contained in this Section and to obtain accurate guidance as to the stability of the ship under varying conditions of service and to operate the ship in compliance with the applicable requirements. If a stability instrument is used as a supplement to the stability booklet for the purpose of determining compliance with the relevant stability criteria such instrument shall be subject to the approval by TL.

Where any alterations are made to a ship so as to materially affect the stability information supplied to the Master, amended stability information is to be provided. If necessary the ship is to be re-inclined.

Stability data and associated plans are to be drawn up in the working language of the ship and any other language the Society may require. reference is also made to the International Safety Management (ISM) Code, adopted by IMO by resolution A.741(18). All translations of the stability booklet are to be approved.

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

2. Application

The following requirements shall be applied to vessels greater than 24 metres in length:

- The 2008 Intact Stability Code (IMO Resolution MSC.267 (85)) as a basis

- Part A Chapter 1 Hull Section 26.B as applicable to ships less than 500 GT

- The Requirements, if any, of the Administration

- For additional criteria that could be required for tankers, Part A Chapter 1 Hull Section 28 D.1

Due regard should also be paid to particulars of either the vessel concerned or its cargo, for assessing, whether additional or amended criteria need to be applied.

B. Subdivision and Damaged Stability

1. Every oil tanker of 150 GT and above is to comply with the subdivision and damage stability criteria as specified in Annex I of MARPOL 73/78 Regulations for the Prevention of Pollution by Oil - Chapter 4 - Requirements for the Cargo Area of Oil Tankers - Part A - Construction - Regulation 28 - Subdivision and damage stability after the assumed damage as specified in aforementioned MARPOL reference for any operating draught reflecting actual partial or full load conditions consistent with trim and strength of the ship as well as relative densities of the cargo.

2. Taking into account, as initial conditions before flooding, the standard loading conditions as referred to in Part A Chapter 1 Hull Section 26, B.2, the ship is to comply with the damage stability requirements given in this subsection.

3. Relaxation in damaged stability requirements could be accepted for ships engaged in sheltered water service and assigned with relevant class notation.

SECTION 8

HULL OUTFITTING

Foreword: For hull outfitting requirements not given under this section, Part A Chapter 1 Hull Section 15 and 16, as amended shall be referred to however as not contradicting or replacing the provision stated hereunder.

A. Side Scuttles, Windows and Skylights

1. General

1.1 Side scuttles and windows, together with their glasses, deadlights and storm covers**,** if fitted, are to be of an approved design and substantial construction in accordance with, or equivalent to, recognized national or international standards. Non-metallic frames are not acceptable.

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.

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 in accordance with recognized national or international standards, and round or oval, openings with an area exceeding 0.16 m^2.

1.4 Side scuttles to the following spaces are to be fitted with hinged inside deadlights:

- Spaces below freeboard deck,
- Spaces within the first tier of enclosed super-structures as defined in ICLL, Rule 3 (10) (b).
- First tier deckhouses on the freeboard deck protecting openings leading below or considered buoyant in stability calculations.

Deadlights are to be capable of being closed and se-cured watertight if fitted below the freeboard deck and weathertight if fitted above.

1.5 Side scuttles are not to 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 0.025 of the breadth (B), or 500 mm, whichever is the greatest distance, above the Summer Load Line.

1.6 Side scuttles are to be of the non-opening type in ships subject to damage stability regulations, if calculations indicate that they would become immersed by any intermediate stage of flooding or the final equilibrium waterplane in any required damage case

1.7 Windows are not to be fitted below freeboard deck, in the first tier end bulkheads or sides of enclosed superstructures (as defined in ICLL, Rule 3 (10) (b)) and in first tier deckhouses considered buoyant in the stability calculations or protecting openings leading below.

For ships with restricted navigation, windows could be accepted in first tier end bulkheads or sides of enclosed superstructures and in first tier deckhouses.

1.8 All sidescuttles, the sills of which are below the freeboard deck, are to be of such construction as to prevent effectively any person opening them without the consent of the Master of the ship.

1.9 The number of openings in the shell plating are to be reduced to the minimum compatible with the design and proper working of the ship.

1.10 The arrangement and efficiency of the means for closing any opening in the shell plating are to be consistent with its intended purpose and the position in which it is fitted is to be generally to the satisfaction of the Society.

1.11 No sidescuttles may be fitted in any spaces which are appropriated exclusively for the carriage of cargo. Sidescuttles may, however, be fitted in spaces appropriated alternatively for the carriage of cargo or passengers, but they are to be of such construction as to prevent effectively any person opening them or their deadlights without the consent of the Master.

1.12 Side scuttles and windows at the side shell in the second tier, protecting direct access below or considered buoyant in the stability calculations, are to be provided with efficient hinged inside deadlights capable of being effectively closed and secured weathertight.

1.13 Side scuttles and windows set inboard from the side shell in the second tier protecting direct access below to spaces listed in 1.4 are to be provided with either efficient hinged inside deadlights or, where they are accessible, permanently attached external storm covers of approved design and of substantial construction and capable of being effectively closed and secured weathertight.

1.14 Cabin bulkheads and doors in the second tier separating side scuttles and windows from a direct access leading below may be accepted in place of deadlights or storm covers fitted to the side scuttles and windows.

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

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

1.17 Gangway, cargo and fuelling ports fitted below the freeboard deck of cargo ships are to be watertight and in no case they are to be so fitted as to have their lowest point below the summer load line.

2. Construction and Tests of Windows and Side scuttles

Construction and Tests of Windows and Side scuttles shall be in compliance with Part A Chapter 1 Hull Section 16 A.2, as applicable

B. Scuppers, Inlets and Discharges

1. Inlets and Discharges

1.1 All inlets and discharges in the shell plating are to be fitted with efficient and accessible arrangements for preventing the accidental admission of water into the ship.

Normally each separate discharge is to have one automatic non-return valve with a positive means of closing it from a position above the freeboard deck. Or one automatic non-return valve and one sluice valve controlled from above the freeboard deck instead of one automatic non-return valve with a positive means of closing from a position above the freeboard deck, is acceptable.

Sea inlets are, as a rule, considered as pipe discharges and therefore are to be in accordance with item B.1. The automatic non-return valve with positive means of closing is however replaced by a closing valve.

1.2 Where the inboard end of the discharge pipe is located at least 0.01 L_C above the summer load line, the discharge may have two automatic non-return valves without positive means of closing. Where two automatic non-return valves are required;

- the inboard valve is always to be accessible for examination under service conditions (i.e., the inboard valve is to be above the level of the tropical load line).

- If this is not practicable, the inboard valve need not be located above the tropical load line, provided that a locally controlled sluice valve is fitted between the two automatic non-return valves.

1.3 Where that vertical distance exceeds 0.02 L_C, a single automatic non-return valve without positive means of closing may be accepted. The means for operating the positive-action valve is to be readily accessible and provided with an indicator showing whether the valve is open or closed.

1.4 Where sanitary discharges and scuppers lead overboard through the shell in way of machinery spaces, a locally operated positive-closing valve at the shell, together with a non-return valve inboard, is acceptable. The controls of the valves are to be in an easily accessible position.

1.5 The position of the inboard end of discharges is to be related to the summer timber load line when the timber freeboard is assigned.

1.6 The requirements for non-return valves are applicable only to those discharges which remain open during the normal operation of a ship. For discharges which are to be kept closed at sea, a single screw-dow valve operated from the deck is acceptable.

1.7 Table 16.1 provides the acceptable arrangements of scupper, inlets and discharges.

1.8 In manned machinery spaces, main and auxiliary sea inlets and discharges in connection with the operation of machinery may be controlled locally. The controls are to be readily accessible and be provided with indicators showing whether the valves are open or closed.

1.9 Discharge pipes originating at any level and penetrating the shell either more than 450 mm. below the freeboard deck or less than 650 mm. above the summer load line are to be provided with a non-return valve at the shell. This valve, unless required by item 1.1, may be omitted if the piping is of substantial thickness.

1.10 All shell fittings and the valves required by this rule are to be of steel, bronze or other approved ductile material. Valves of ordinary cast iron or similar material are not acceptable. All pipes to which this rule refers are to be of steel or other equivalent material to the satisfaction of **TL**.

1.11 Inboard opening of ash-chute, rubbish-chute, etc.

The inboard opening of each ash-chute, rubbish-chute, etc. is to be fitted with an efficient cover.

If the inboard opening is situated below freeboard deck for cargo ships, the cover is to be watertight, and in addition an automatic non-return valve is to be fitted in the chute in an easily accessible position above the deepest subdivision summer load line. When the chute is not in use, both the cover and the valve are to be kept closed and secured.

1.12 Arrangement of garbage chutes

1.12.1 Inboard end above the waterline

The inboard end is to be located above the waterline formed by an 8,5°heel, to port or starboard, at a draught corresponding to the assigned summer freeboard, but not less than 1000 mm above the summer load waterline.
Where the inboard end of the garbage chute exceeds 0,01 L_C above the summer load waterline, valve control from the freeboard deck is not required, provided the inboard gate valve is always accessible under service conditions.

1.12.2 Inboard end below the waterline

Where the inboard end of a garbage chute is below the freeboard deck, then:

- the inboard end hinged cover/valve is to be watertight

- the valve is to be a screw-down non-return valve fitted in an easily accessible position above the deepest subdivision load line

- the screw-down non-return valve is to be controlled from a position above the bulkhead deck and provided with open/shut indicators. The valve control is to be clearly marked: “Keep closed when not in use”.

1.13 Gate valves

For garbage chutes, two gate valves controlled from the working deck of the chute may be accepted instead of a non-return valve with a positive means of closing it from a position above the freeboard deck. In addition, the lower gate valve is to be controlled from a position above the freeboard deck. An interlock system between the two valves is to be arranged.

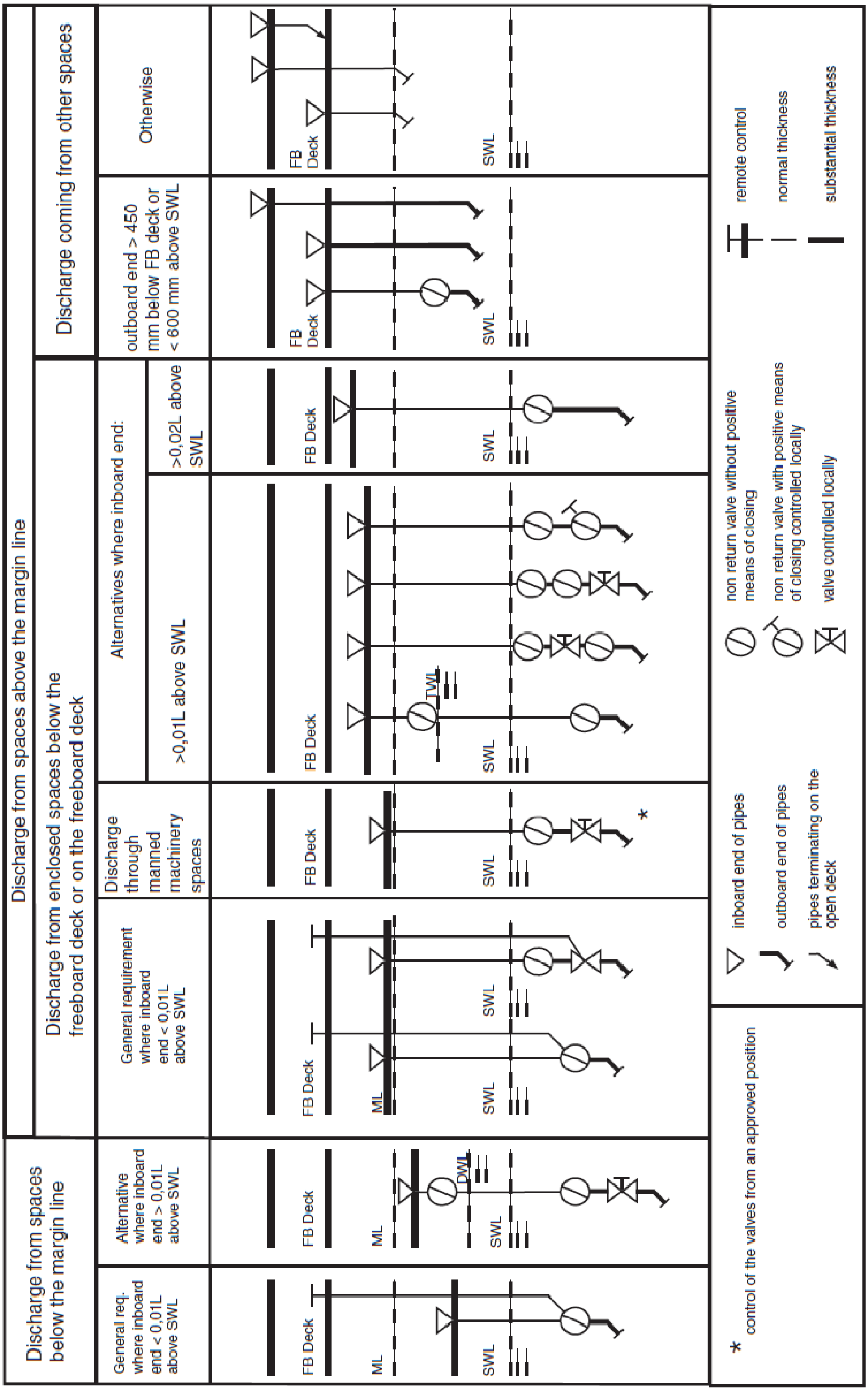


Table 8.1: Acceptable arrangements of scupper, inlets and discharges

The distance between the two gate valves is to be adequate to allow the smooth operation of the interlock system.

1.14 Hinged cover and discharge flap

The upper gate valve, as required in item 1.13, may be replaced by a hinged weathertight cover at the inboard end of the chute together with a discharge flap which replaces the lower gate valve.
The cover and discharge flap are to be arranged with an interlock so that the flap cannot be operated until the hopper cover is closed.

1.15 Marking of valve and hinged cover

The gate valve controls and/or hinged cover are to be clearly marked: "Keep closed when not in use".

1.16 Scantlings of garbage chutes

1.16.1 Material

The chute is to be constructed of steel. Other equivalent materials are considered by the Society on a case-by-case basis.

1.16.2 Wall thickness

The wall thickness of the chute up to and including the cover is to be of extra reinforced wall thickness.

2. Scuppers and Discharge Pipes

2.1 Scuppers are to be led overboard. Exception is made for sanitary gravity evacuation systems which can be led to suitable sanitary tanks. A sufficient number of scuppers is to be fitted on all decks to provide effective drainage.

Pipe discharges can be led overboard or led to the bilge. In case of sanitary gravity evacuation systems, they are to be led either overboard or to suitable sanitary tanks.

2.2 Scuppers led through the shell from enclosed superstructures used for the carriage of cargo are to be permitted only where the edge of the freeboard deck is not immersed when the ship heels 5º either way. In other cases the drainage is to be led inboard in accordance with the requirements of SOLAS in force.

2.3 Scuppers leading from superstructures or deckhouses not fitted with doors complying with the requirements of ICLL Reg. 12 are to be led overboard.

2.4 Scuppers led through the deck and shell are to comply with the requirements to material given for discharges.

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

2.6 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 line are to be provided with a non-return valve at the shell. This valve, unless required by items 2.1 and 2.2, may be omitted if the piping is of substantial thickness.

2.7 For scuppers and discharge pipes, where substantial thickness is not required:

2.7.1 For pipes having an external diameter equal to or less than 155 mm, the thickness is not to be less than 4.5 mm.

2.7.2 For pipes having an external diameter equal to or more than 230 mm, the thickness is not to be less than 6.0 mm. Intermediate sizes are to be determined by linear interpolation.

2.8 For scuppers and discharge pipes, where substantial thickness is required:

2.8.1 For pipes having an external diameter equal to or less than 80 mm, the thickness is not to be less than 7.0 mm.

2.8.2 For pipes having an external diameter of 180 mm, the thickness is not to be less than 10.0 mm.

2.8.3 For pipes having an external diameter equal to or more than 220 mm, the thickness is not to be less than 12.5 mm.

For items 2.7 and 2.8, intermediate sizes are to be determined by linear interpolation.

3. Other arrangements

3.1 Closed circuits

For closed circuits such as cooling systems or exhaust systems with closed piping between the sea inlet and the overboard discharge, the automatic non-return valve with positive means of closing as required in B.1.1 could be replaced by a closing valve to the discretion of the Society.

3.2 Pumps

Pumps forming part of pipe discharge systems could be considered as an automatic non return valve if duly justified.

3.3 Remote control

The means of closing in other spaces could be locally operated if it is duly justified that the valve is easily accessible, can be rapidly closed and that a water level detector is fitted in the space.

3.4 Engine exhaust gas outlets under freeboard deck

In addition to the provisions related to engine protection, the hull connection in way of engine exhaust gas outlets under freeboard deck is to comply with one of the following features, in order to respect hull integrity:

- the connection with the hull is fitted with a means of closure or a non-return valve

- the exhaust pipe arrangement is looped above the waterline to a minimum height of 0,02 L_C and the pipe construction is of a strength equivalent to that of the hull structure.

C. Freeing Ports

1. Where bulwarks on weather portions of freeboard or superstructure decks form wells, ample provision is to be made for rapidly freeing the decks of water and for draining them.

2. Arrangement and area of freeing ports shall in general comply with Part A Chapter 1 Hull Section 16,C. Reductions may be agreed on case by case basis with satisfaction of TL.

D. Air Pipes

1. Air Pipes Extending Above the Freeboard or Superstructure Decks

1.1 Where air pipes to ballast and other tanks extend above the freeboard or superstructure decks, the exposed parts of the pipes is to be of substantial construction; the height from the deck to the point where water may have access below is to be at least 760 mm. on the freeboard deck and 450 mm. on the superstructure deck.

This height is to be measured from the upper face of the deck, including sheathing or any other covering, up to the point where water may penetrate inboard.

1.2 Where these heights may interfere with the working of the ship, a lower height may be approved, provided that **TL** is satisfied that the closing arrangements and other circumstances justify a lower height. Satisfactory means which are permanently attached are to be provided for closing the openings of the air pipes.

1.3 The height of air pipes may be required to be increased for the purpose of compliance with buoyancy calculations.

The air pipe of tanks other than oil tanks may discharge through the side of the superstructures.

1.4 The height of air pipes discharging through the side of the superstructure is to be at least 2,3 m above the summer load waterline.

1.5 For ships with restricted navigation or L_C less than 24 m, the height of air pipes extending above the freeboard deck or superstructure deck from the deck to the point where water may have access below is to be at least:

- 380 mm on the freeboard deck, and
- 225 mm on the superstructure deck.

2. Air Pipe Closing Arrangements

2.1 Satisfactory appliances which are permanently attached are to be provided for closing the openings of air pipesin order to prevent the free entry of water into the spaces concerned.

2.2 Where required by Regulation 20 of ICLL, air pipe closing devices are to be weathertight. Closing devices are to be automatic if, while the vessel is at its draught corresponding to summer load line, the openings of the air pipes to which these closures are fitted submerge at angles up to 40º or up to a lesser angle which may be agreed on the basis of stability requirements.

Pressure vacuum valves (PV valves) may, however, be accepted on tankers.

Wooden plugs and trailing canvas are not to be accepted in position 1 and position 2.

2.3 For ships assigned timber freeboards the air pipes should be provided with automatic closing appliances.

2.4 Automatic closing appliances are to be of a type approved by the Society. Requirements for type tests aregiven in Chapter 35-B Machinery.

2.5 Where the tank venting system is not of an automatic type approved by the Society, provision is to be made for relieving vacuum when the tanks are being pumped out, and for this purpose a hole of about 10 mm in diameter in the bend of the air pipe, or at a suitable position in the closing device, is acceptable.

3. Exposed part of air pipes

Where air pipes extend above the freeboard deck or superstructuredeck, the exposed parts of the pipes are to be of reinforced thickness

3.1 Minimum Wall Thickness of Air Pipes

The thickness of air pipes in position 1 and 2 leading to spaces below the freeboard deck or to spaces within closed superstructures is not to be less than given in the following:

3.1.1 For pipes having external diameter equal to or less than 80 mm, thickness should not be less than 6 mm.

3.1.2 For pipes having external diameter equal to or more than 165 mm, thickness should not be less than 8.5 mm.

Intermediate sizes should be determined by linear interpolation.

E. Ventilators

1. Ventilator Coamings

1.1 Ventilators in position 1 or 2 to spaces below freeboard deck or decks of enclosed superstructures are to have coamings of steel or other equivalent material, substantially constructed and efficiently connected to the deck.

Ventilators passing through superstructures other than enclosed superstructures are to have substantially constructed coamings of steel or other equivalent material at the freeboard deck.

1.2 Coaming Height

1.2.1 Ventilators in position 1 shall are to have coamings of a height of at least 900 mm above the deck; in position 2 are to be of a height at least 760 mm. above the deck.

1.2.2 For ships with restricted navigation or L_C less than 24 m, Ventilators in position 1 shall are to have coamings of a height of at least 760 mm above the deck; in position 2 are to be of a height at least 380 mm. above the deck.

1.2.3 Where the coaming of any ventilator exceeds 900 mm in height it is to be specially supported (suitably stiffened or supported by stays).

1.2.4 In exposed locations or for the purpose of compliance with buoyancy calculations, the height of coamings may be required to be increased to the satisfaction of the Society.

2. Ventilator Closing Arrangements

2.1 Ventilator in position 1 the coamings of which extend to more than 4.5 m above the deck, and in position 2 the coamings of which extend to more than 2.3 m above the deck, need not be fitted with closing arrangements unless specifically required by **TL**.

2.2 Except as provided in 2.1, ventilator openings are to be provided with weathertight closing appliances

2.3 Where required, weathertight closing appliances for all ventilators in position 1 and 2 are to be of steel or other equivalent materials.

Wood plugs and canvas covers are not acceptable in these positions.

2.4 In order to satisfactorily ensure, in all weather conditions:

- the continuous ventilation of machinery spaces, and, when necessary,

- the immediate ventilation of the emergency generator room,

the ventilators serving such spaces are to comply with 2.1, i.e. their openings are to be so located that they do not require closing appliances.

2.5 Where, due to the ship's size and arrangement, the requirements in 2.4 are not practicable, lesser heights may be accepted for machinery space and emergency generator room ventilator coamings fitted with weathertight closing appliances in accordance with 2.1, 2.2, 2.3 in combination with other suitable arrangements, such as separators fitted with drains, to ensure an uninterrupted, adequate supply of ventilation to these spaces.

2.6 Closing arrangements of ventilators led overboard to the ship side or through enclosed superstructures are considered by the Society on a case-by-case basis. If such ventilators are led overboard more than 4,5 m above the freeboard deck, closing appliances may be omitted provided that satisfactory baffles and drainage arrangements are fitted.

3. Minimum Wall Thickness of Ventilator Coamings

The thickness of ventilator coamings in position 1 and 2 leading to spaces below the freeboard deck or to spaces within closed superstructures is not to be less than given in the following:

3.1 For coamings having external diameter equal to or less than 80 mm, thickness should not be less than 6 mm.

3.2 For coamings having external diameter equal to or more than 165 mm, thickness should not be less than 8.5 mm.

Intermediate sizes should be determined by linear interpolation.

4. Machinery Space and Emergency Generator Room Ventilator Coaming Heights

4.1 In general, ventilators necessary to continuously supply the machinery space and, on demand, immediately supply the emergency generator room should have coamings which comply with Regulation 19 (3) of ICLL 66, without having to fit weathertight closing appliances.

4.2 However, where due to vessel size and arrangement this is not practicable, lesser heights for machinery space and emergency generator room ventilator coamings may be accepted with provisions of weathertight closing appliances in accordance with regulation 19 (4) of ICLL 66 in combination with other suitable arrangements to ensure an uninterrupted, adequately supply of ventilation to these spaces.

F. Hatchways

1. Coamings

The coamings of hatchways shall be constructed according to Part A Chapter 1 Hull Section 15, as applicable in accordance with their position and their height shall be at least as follows:

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

For ships with restricted navigation or LC less than 24 m, these values could be reduced to:

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

For ships with a length LC less than 24 m, the coaming height of hatches closed at sea may be reduced or omitted entirely, on condition that the Society is satisfied that the safety of the ship is not thereby impaired in any sea conditions.

2. Hatch covers

Hatch covers are to comply with Part A Chapter 1 Hull Section 15, as applicable.

3. Manholes and flush scuttles

Manholes and flush scuttles in positions 1 or 2, or within superstructures other than enclosed superstructures, are to be closed by substantial covers capable of being made watertight. Unless secured by closely spaced bolts, the covers are to be permanently attached.

G. Deck Openings

1. Machinery Space Openings

1.1 Openings in machinery space casings in positions 1 or 2 are to be fitted with doors of steel or other equivalent materials, 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. The doors are to be capable of being operated from both sides and generally to open outwards to give additional protection against wave impact.

1.2 Other openings in such casings are to be fitted with equivalent covers, permanently attached in their proper position.

1.3 Machinery casings on Type A ships are to be protected by an enclosed poop or bridge of at least standard height, or by a deckhouse of equal height and equivalent strength. Machinery casings may, however, be exposed if there are no openings giving direct access from the freeboard deck to the machinery spaces.However, a weathertight door is permitted in the machinery casing, provided that it leads to a space or passageway which is as strongly constructed as the casing and is separated from the stairway to the engine room by a second weathertight door of steel or other equivalent material.

1.4 The height of the sill of the door is to be not less than 600 mm above decks in pos. 1 and 450 mm and 380 mm above decks in pos. 2 and 230 mm in all other cases.

For ships with restricted navigation, these values could be reduced to:

- 450 mm above the deck if in position 1
- 230 mm in all other cases.

1.5 Where casings are not protected by other structures, double doors (i.e. inner and outer doors) are required for ships assigned freeboard less than that based on Table B of regulation 28 of the International Load Line Convention 1966, as amended. An inner sill of 230 mm in conjunction with the outer sill of 600 mm is to be provided.

1.6 Fiddly openings are to be fitted with strong covers of steel or other equivalent material permanently attached in their proper positions and capable of being secured weathertight.

1.7 Coamings of any fiddly, funnel or machinery space ventilator in an exposed position on the freeboard deck or superstructure deck are to be as high above the deck as is reasonable and practicable.

In general, ventilators necessary to continuously supply the machinery space and, on demand, the emergency generator room are to have coamings whose height is in compliance with E.2.1, but need not be fitted with weathertight closing appliances.

Where, due to the ship's size and arrangement, this is not practicable, lesser heights for machinery space and emergency generator room ventilator coamings, fitted with weathertight closing appliances in accordance with E.2.1, may be permitted by the Society in combination with other suitable arrangements to ensure an uninterrupted, adequate supply of ventilation to these spaces.

2. Companionway

2.1 Openings in freeboard deck other than hatchways, machinery space openings, manholes and flush scuttles are to be protected by an enclosed superstructure or by a deckhouse or companionway of equivalent strength and weathertightness.

2.2 Openings in an exposed superstructure deck or in the top of a deckhouse on the freeboard deck which give access to a space below the freeboard deck or a space within an enclosed superstructure are to be protected by an efficient deckhouse or companionway.

2.3 Openings in the top of a deckhouse on a raised quarterdeck or superstructure of less than standard height, having a height equal to or greater than the standard quarterdeck height are to be provided with an acceptable means of closing but need not be protected by an efficient deckhouse or companionway provided the height of the deckhouse is at least the standard height of a superstructure.

2.4 Companionways on exposed decks protecting openings leading into enclosed spaces are to be of steel and strongly attached to the deck and are to have adequate scantlings.

2.5 Doorways in deckhouses or companionways leading to or giving access to spaces below the freeboard deck or to enclosed superstructures are to be fitted with weathertight doors. The doors are to be made of steel or other equivalent materials, to be capable of being operated from both sides and generally to open outwards to give additional protection against wave impact.

Alternatively, if stairways within a deckhouse are enclosed within properly constructed companionways fitted with weathertight doors, the external door need not be watertight.

Where the closing appliances of access openings in superstructures and deckhouses are not weathertight, interior deck openings are to be considered exposed, i.e. situated in
the open deck.

2.6 Companionways or access hatches on exposed parts of freeboard decks, on decks of closed superstructures and in special cases on the deck of deckhouses are to be of solid construction. The height of the doorway sills is to be 600 mm above decks in position 1 and 450 mm and 380 mm above decks in position 2.

For ships with restricted navigation, these values could be reduced to:

- 380 mm in position 1
- 230 mm in all the other cases.

2.7 Where access is not provided from above, the height of the sills to doorways in a poop bridge or deckhouse on the freeboard deck is to be 600 mm.

2.8 Where access is provided to spaces inside a bridge or poopn from the deck as an alternative to access from the freeboard deck, the height of the sills into the bridge or poop is to be 380 mm. This also applies to deckhouses on the freeboard deck

TÜRK LOYDU

Chapter 35 – B

Machinery

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 IACS PR No.29 is on or after 1st of July 2015. 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 Terms and 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.

http:/www.turkloydu.org

SECTION 1

GENERAL RULES AND INSTRUCTIONS

Page

A. General

1. Scope

The Rules and instructions for machinery installations apply to design, construction, installation, tests and trials the propulsion systems of the ships classed by TL, including all the auxiliary machinery and equipment necessary for the operation and safety of the ship. They also apply to machinery which TL is to confirm as being equivalent to classed machinery.

2. Application

Where any point not clearly clarified is encountered, Part B Chapter 4 Machinery Section 1 may be applied as applicable to ships less than 500 GT and as not causing any contradictions with requirements stated in this section.

3. Documentation to be submitted

Unless otherwise stated in this Chapter, plans or documents requested to be submitted stated in relevant items of TL Rule Chapter 2 Machinery shall be considered.

4. Definitions

In addition to those stated in TL Rule Chapter 4 Machinery, following definitions are given:

4.1 Engine space

On ships of less than 24 m in length, the engine space is the space or compartment of the ship containing main or auxiliary engine(s).

4.2 Machinery spaces

On ships of 24 m in length and over, 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 stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

4.3 Machinery spaces of category A

On ships of 24 m in length and over, machinery spaces of category A are those spaces and trunks to such spaces which contain either

- 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, or any oil-fired equipment other than boilers, such as inert gas generators, incinerators, etc.

4.4 Fuel oil unit

Fuel oil unit is the equipment used for the preparation of fuel oil 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 pressure of more than 0,18 N/mm^2.

B. Design principles

1. General

1.1 All parts (e.g. machinery, pressure vessels, associated piping systems and fittings) must be capable of withstanding the stresses and loads peculiar to shipboard service, e.g. those due to motions of the ship, vibrations, intensified corrosive attack, temperature changes and wave impact, and are to be of a design and construction adequate for the service for which they are intended and are to be so installed and protected as to reduce to a mini- mum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards.

In the absence of Rules governing the dimensions of parts, the recognized Rules of engineering practice are to be applied.

Where connections exist between systems or plant items which are designed for different forces, pressures and temperatures (stresses), safety devices are to be fitted which prevent the overstressing 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.

1.2 The design is to have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.

1.3 Provision is to be made to facilitate cleaning, inspection and maintenance of main propulsion and auxiliary machinery, including boilers and pressure vessels. Easy access to the various parts of the propulsion machinery is to be provided by means of metallic ladders and gratings fitted with strong and safe handrails.

Spaces containing main and auxiliary machinery are to be provided with adequate lighting and ventilation.

1.4 Gratings in engine rooms, if any, are to be divided into easily removable panels.

1.5 Bedplates of machinery are to be securely fixed to the supporting structures by means of foundation bolts which are to be distributed as evenly as practicable and of a sufficient number and size so as to ensure proper fitting.

Where the bedplates bear directly on the inner bottom plating, the bolts are to be fitted with suitable gaskets so as to ensure a tight fit and are to be arranged with their heads within the double bottom.

Continuous contact between bedplates and foundations along the bolting line is to be achieved by means of chocks of suitable thickness, carefully arranged to ensure a complete contact.

The same requirements apply to thrust block and shaft line bearing foundations.

Particular care is to be taken to obtain levelling and general alignment between the propulsion engines and their shafting.

1.6 Chocking resins are to be type approved.

1.7 Where stays are provided for fixing the upper part of engines to the ship's structure in order, for example, to reduce the amplitude of engine vibrations, such stays are to be so designed as to prevent damage to these engines further to deformation of the shell plating in way of the said stays. The stays are to be connected to the hull in such a way as to avoid abnormal local loads on the structure of the ship.

1.8 Suitable protective devices on access restrictions are to be provided in way of moving parts (flywheels, belts, couplings, etc.) in order to avoid accidental contact of personnel with moving parts.

1.9 Gauges are to be clearly visible, with indication of type of fluid.

1.10 Hot surfaces and fire protection

Surfaces, having temperature exceeding 60°C, with which the crew is likely to come into contact during operation, are to be suitably protected or insulated.

Surfaces of machinery with temperatures above 220°C, e.g. steam, thermal oil and exhaust gas lines, silencers, exhaust gas boilers and turbochargers, are to be effectively insulated with non-combustible material or equivalently protected to prevent the ignition of combustible materials coming into contact with them. Where the insulation used for this purpose is oil absorbent or may permit the penetration of oil, the insulation is to be encased in steel sheathing or equivalent material. Fire protection, detection and extinction are to comply with the provisions of Chapter 35-D Fire Safety.

1.11 Pressure vessels

Pressure vessels are to be reviewed, constructed, installed and tested in accordance with the applicable requirements of relevant TL Rule. The acceptance of national and international standards as an alternative may be considered by the society on a case-by-case basis.

2. Materials, welding and testing

2.1 Material

All components subject to the Rules for Machinery must comply with the Rules for Materials and welding contained in Chapter 2 and 3. Other details concerning material and welding stated in this chapter shall also be applied, if any.

2.2 Welding

The fabrication of welded components, the approval of companies and the testing of welders are subject to Chapter 3, Welding Rules.

2.2.1 Welded Machinery Components

For welding of machinery components, relevant sections of Chapter 3 Welding (e.g Section 5 for Welding Consumables and Auxiliary Materials etc.) shall apply. Section 16 of Chapter 3 shall be applied for Welding of Machinery Components, as applicable.

References to welding procedures adopted are to be clearly indicated on the plans submitted for approval.
Joints transmitting loads are to be either:

- Full penetration butt-joints welded on both sides, except when an equivalent procedure is approved

- Full penetration T- or cruciform joints.

For joints between plates having a difference in thickness greater than 3 mm, a taper having a length of not less than 4 times the difference in thickness is required. Depending on the type of stress to which the joint is subjected, a taper equal to 3 times the difference in thickness may be accepted.

T-joints on scalloped edges are not permitted.

Lap-joints and T-joints subjected to tensile stresses are to have a throat size of fillet welds equal to 0,7 times the thickness of the thinner plate on both sides.

In the case of welded structures including cast pieces, the latter are to be cast with appropriate extensions to permit connection, through butt-welded joints, to the surrounding structures, and to allow any radiographic and ultrasonic examinations to be easily carried out.

Where required, preheating and stress relieving treatments are to be performed according to the welding procedure specification.

3. Vibrations

Shipyards and manufacturers are to give special consideration to the design, construction and installation of propulsion machinery systems and auxiliary machinery so that any mode of their vibrations shall not cause undue stresses in this machinery in the normal operating ranges.

4. Operation in inclined position

Chapter 4 Machinery Section 1 Tables 1.1-1.4 shall apply.

The Society may permit deviations from angles given in Chapter 4 Machinery Section 1 Tables 1.1-1.4, taking into consideration the type, size and service conditions of the ship.

Machinery with a horizontal rotation axis is generally to be fitted on board with such axis arranged alongships. If this is not possible, the Manufacturer is to be informed at the time the machinery is ordered.

5. Ambient conditions

Chapter 4 Machinery Section 1 C shall apply.

6. 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.

7. Availability of Machinery

7.1 Ship'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 that auxiliary sources of energy such as starting air, battery supplied starting current etc. are not available for restoring the ship'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. It is assumed that means are available to start the emergency generator at all times.

7.2 In case of “dead-ship” condition it must 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 Chapter 5, Electrical Installations, Section 3, C.).

8. Control and Regulating

8.1 Machinery must be so equipped that it can be controlled in accordance with operating requirements in such a way that the service conditions prescribed by the manufacturer can be met.

For the control equipment of main engine and system essential for operation see Part B Chapter 5, Electrical Installations Section 9, B.3.

8.2 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 must 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 regulated is not increased, and
- No unintentional start-up sequences are initiated.

8.3 Manual operation

Every functionally important, automatically or remote controlled system must also be capable of manual and local operation respectively.

9. Propulsion Plant

9.1 Unless otherwise stated in each Section of this Chapter, where scantlings of components are based on power, the values to be used are determined as follows:

- for main propulsion machinery, the power/rotational speed for which classification is requested
- for auxiliary machinery, the power/rotational speed which is available in service.

9.2 Where power exceeds 5 kW, means for going astern is to be provided to secure proper control of the ship in all normal circumstances.

Propulsion plant shall provide the sufficient astern power to maintain manoeuvring of the ship in all normal service conditions.

Propulsion plant shall be capable of maintaining in free route astern at least 70% of rated ahead speed for a period of at least 30 minutes.

By the rated ahead speed is meant a speed corresponding to the maximum continuous power of the main machinery.

The astern power shall be sufficient to take way off a ship making a full ahead speed on an agreeable length, which must be confirmed during trials.

In propulsion plants with reversing gears or CPP propellers as well as in azimuthing thrusters, precautions are to be taken against any possible overload of main machinery en excess of permissible values.

10. Manoeuvering equipment

Every engine control platform is to be equipped in such a way that:

- The propulsion plant can be adjusted to any setting,
- The direction of propulsion can be reserved, and,
- The propulsion unit or the propeller shaft can be stopped.

11. Remote controls

The remote control of the propulsion plant from the bridge is subject to the provisions of Chapter 4-1 Automation.

12. 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-shaft systems each shaft is to be provided with a locking device by means of which dragging of the shaft can be prevented.

13. Turning Appliances

Machinery is to be equipped with suitable and adequcitely dimensioned turning appliances.

The turning appliances are to be of the self-locking type. Electric motors are to be fitted with suitable retaining brakes.

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 installation warning devices may be provided alternatively.

14. Operating and Maintenance Instructions

Manufacturers of machinery, boilers and auxiliary equipment must supply a sufficient number of operating and maintenance notices and manuals together with the equipment.

In addition, an easily legible board is to be mounted on boiler operating platforms giving the most important operating instructions for boilers and oil-firing equipment.

15. Marking, 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.

16. Fuels

16.1 The flash point (Based, up to 60°C, on determination of the flash point in a closed crucible (cup test)) of liquid fuels for the operation of boilers and diesel engines may not be lower than 60°C.

For emergency generating sets, however, use may be made of fuels with a flash point less than 60°C but not less than 43°C.

16.2 In exceptional cases, for ships 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 must invariably be 10°C below the flash point.

16.3 For ships less than 12 m in length, fuel oils having a flash point less than 43°C could be used for engines with arrangements specially approved by the Society. Fuel oils having a flash point less than 43°C may be employed on board provided that it is stored outside machinery spaces and the arrangements adopted are specially approved by the Society.

C. Measurements, Testing and Certification

1 Measurements

1.1 Proof based on measurements is normally required only for reciprocating machines with an output of more than 100 kW. Where circumstances warrant this, TL may also require proofs based on measurements for smaller outputs.

1.2 Measurements are to be performed in every case under realistic service conditions at the point of installation. During verification, the output supplied by the reciprocating machine shall be not less than 80% of the rated value. The measurement shall cover the entire available speed range in order to facilitate the detection of any resonance phenomena.

1.3 TL may accept proofs based on measurements which have not been performed at the point of installation (e.g. test bed runs) or at the point of installation but under different mounting conditions provided that the transferability of the results can be proved.

The results are normally regarded as transferable in the case of flexibly mounted reciprocating machines of customary design.

If the reciprocating machine is not flexibly mounted, the transferability of the results may still be acknowledged if the essential conditions for this (similar bed construction, similar installation and pipe routing etc.) are satisfied.

1.4 The assessment of the vibration stresses affecting or generated by reciprocating machines normally related to the location in which the vibration stresses are greatest. Figure 1.8 indicates the points of measurement which are normally required for an in-line piston engine. The measurement has to be performed in all three directions. In justified cases exceptions can be made to the inclusion of all the measuring points.

1.5 The measurements may be performed with mechanical manually-operated instruments provided that the instrument setting is appropriate to the measured values bearing in mind the measuring accuracy.

Directionally selective, linear sensors with a frequency range of at least 2 to 300 Hz should normally be used. Non-linear sensors can also be used provided that the measurements take account of the response characteristic.

With extremely slow-running reciprocating machines, measurements in the 0.5 to 2 Hz range may also be required.

1.6 The records of the measurements for the points at which the maximum stresses occur are to be submitted to TL together with a tabular evaluation.

The stresses are to be determined proceeding from the greatest vibration or stress amplitudes measured in the respective section of the torsiogram or oscillogram.

When estimating the total stresses due to the vibration of several orders, the registered parameters.

1.7 The free resonance vibration frequencies obtained as a result of measurement shall not differ from the design values by more than 5%. Otherwise, the calculation needs to be corrected accordingly.

1.8 For new building ships or repaired ships, the vibration level of the machinery and the equipment shall not exceed the upper limit of Category A, determined as to ensure sufficient margin for changing of vibration strength and reliability of ship machinery and equipment.

Under conditions of long-term service of the ship, the vibration level of the machinery and equipment shall not exceed the upper limit of Category B, determined as to ensure vibration strength and reliability of ship machinery and equipment.

1.9 The measurement results shall be compared with the permissible vibration levels. Vibration levels of machinery and equipment shall not exceed the standards both when the ships is lying and at specified ahead speeds under different conditions.
Where vibration exceeds the standards, the suitable solutions and analyses which are approved by TL surveyor shall be taken to reduce it to permissible levels.

1.10 At non-specified rates of speed vibration exceeding established standards may be permitted after confirming of approval from TL, when these rates are not continuous.

Withdrawal from the present standards is in each case subject to special consideration by TL.

2. Test, Inspections, Sea Trials

2.1 General

2.1.1 Machinery and its component parts are subject to constructional and material tests, pressure and leakage tests, and trials. All the tests prescribed in the following Sections are to be conducted under the supervision of TL.

2.1.2 For Type Tests of Mass Produced Internal Combustion Engines, Part B Chapter 4 Machinery Section 2, E shall be referred to.

2.1.3 In the case of parts produced in series, other methods of testing may be agreed with TL instead of the tests prescribed, provided that the former are recognized as equivalent by TL.

2.1.4 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 the Rules.

2.1.5 Components subject to mandatory testing are to be replaced with tested parts.

2.1.6 After installation on board of the main and auxiliary machinery, the operational functioning of the machinery including the associated ancillary equipment is 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 the TL's Representative.

In addition, the entire machinery installation is to be tested during sea trials, as far as possible under the intended service conditions.

2.2 Shipboard tests

Shipboard tests are intended to demonstrate that the main and auxiliary machinery and associated systems are functioning properly, in respect of the criteria imposed by the Rules. The tests are to be witnessed by a Surveyor.

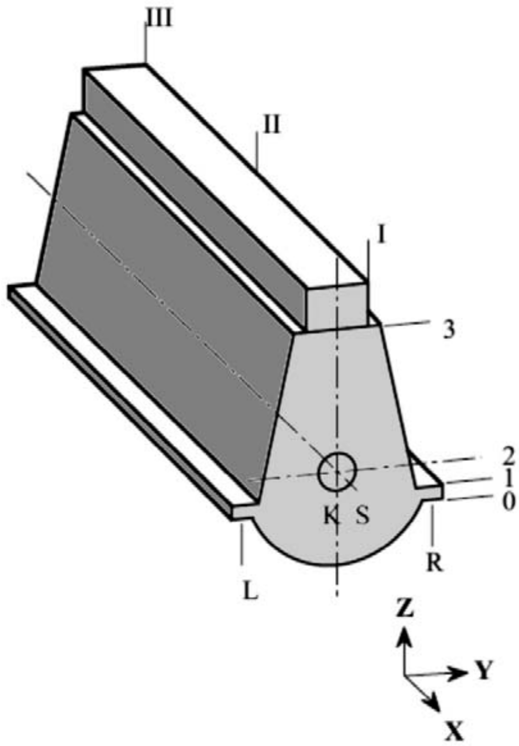
2.2.1 Documentation to be submitted

A comprehensive list of the shipboard tests intended to be carried out by the shipyard is to be submitted to the Society.

For each test, the following information is to be provided for scope of the test and parameters to be recorded.

2.2.2 Alternative procedure

If the proposed list of tests is not in complete accordance with the requirements of this section, justifications and alternative tests are to be submitted prior to the sea trials.



Side for measurement	**L**	left side looking towards coupling flange
	R	right side looking towards coupling flange
Measuring height	**0**	bed
	1	base
	2	crankshaft height
	3	frame top
Measuring point over engine length	**I**	coupling side (KS)
	II	engine centre
	III	opposite side to coupling (KGS)

Figure 1.1 Schematic representation of in-line piston engine

2.2.3 Trials at the moorings

Trials at the moorings are to demonstrate the following:

- Satisfactory operation of the machinery

- Quick and easy response to operational commands
- Protection of the various installations, as regards:
- The protection of mechanical parts
- The safeguards for personnel
- Accessibility for cleaning, inspection and maintenance.

Where the above features are not deemed satisfactory and require repairs or alterations, the Society reserves the right to require the repetition of the trials at the moorings, either wholly or in part, after such repairs or alterations have been carried out.

2.2.4 Sea trials

Sea trials are to be conducted after the trials at the moorings and are to include the following:

- Demonstration of the proper operation of the main and auxiliary machinery, including monitoring, alarm and safety systems, under realistic service conditions
- Check of the propulsion capability when one of the essential auxiliaries becomes inoperative
- Detection of dangerous vibrations by taking the necessary readings when required.

2.3 Shipboard tests for machinery

2.3.1 Except in cases of practical impossibility, or in other cases to be considered individually, the sea trials are to be carried out:

- With the ship in the completed condition with permanently installed engine(s) -where applicable- and all usual equipment in place
- Under weather and sea conditions corresponding as far as possible to the conditions for which the ship is intended to operate
- When fitted, with an engine of the largest power for which it has been approved
- In light weight and fully loaded condition.

2.3.2 The power developed by the propulsion machinery in the course of the sea trials is to be as close as possible to the power for which classification has been requested. In general, this power is not to exceed the maximum continuous power at which the weakest component of the propulsion system can be operated. In cases of die- sel engines and gas turbines, it is not to exceed the maximum continuous power for which the engine type concerned has been approved.

2.3.3 Where the rotational speed of the shafting is different from the design value, thereby increasing the stresses in excess of the maximum allowable limits, the power developed in the trials is to be suitably modified so as to confine the stresses within the design limits.

2.3.4 The rotational speed of the shafting is to be recorded in the course of the sea trials, preferably by means of a continuous counter.

2.3.5 In general, the power is to be determined by means of torsiometric readings, to be effected with procedures and instruments deemed suitable by the Society.

As an alternative, for reciprocating internal combustion engines, the power may be determined by measuring the fuel consumption and on the basis of the other operating characteristics, in comparison with the results of bench tests of the prototype engine.

Other methods of determining the power may be considered by the Society on a case by case basis.

2.4 Navigation and manoeuvring tests

Where required by the Rules, the speed of the ship is to be determined using procedures deemed suitable by the Society.

The ship speed is to be determined as the average of the speeds taken in not less than two pairs of runs in opposite directions.

2.4.1 Astern trials

2.4.1.1 The ability of the machinery to reverse the direction of thrust of the propeller in sufficient time, and so to bring the ship to rest within reasonable distance from maximum ahead service speed, is to be demonstrated and recorded.

2.4.1.2 The stopping times, ship headings and distances recorded on trials, together with the results of trials to determine the ability of ships having multiple propellers to navigate and manoeuvre with one or more propellers inoperative are to be available on board for the use of the Master or designated personnel.

2.4.1.3 Where the ship is provided with supplementary means for manoeuvring or stopping, the effectiveness of such means is to be demonstrated and recorded as referred to in items 2.4.1.1 and 2.4.1.2

Alternative procedure for sea trials could be accepted on a case to case basis.

2.5 Tests of diesel engines

2.5.1 The scope of the trials of diesel engines may be expanded in consideration of the special operating conditions, such as towing, trawling, etc.

Where the machinery installation is designed for residual or other special fuels, the ability of engines to burn such fuels is to be demonstrated.

2.5.2 Main propulsion engines driving fixed propellers

Sea trials of main propulsion engines driving fixed propellers are to include the following tests:

- Operation at rated engine speed n_0 for at least 4 hours
- Operation at engine speed corresponding to normal continuous cruise power for at least 2 hours
- Operation at engine speed $n = 1{,}032 \cdot n_0$ for 30 minutes

Note: The present test is to be performed only where permitted by the following engine adjustment:

After running on the test bed, the fuel delivery system is to be so adjusted that the engine cannot deliver more than 100% of the rated power at the corresponding speed {overload power cannot be obtained in service}.

- Operation at minimum load speed
- Starting and reversing manoeuvres
- Operation in reverse direction of propeller rotation at a minimum engine speed of $n = 0{,}7 \cdot n_0$ for 10 minutes. These values could be reduced to $0{,}5 \cdot n0$ for 5 minutes for waterjets and surface propellers

Note: The present test may be performed during the dock or sea trials.

- Tests of the monitoring, alarm and safety systems
- For engines fitted with independently driven blowers, emergency operation of the engine with the blowers inoperative.

2.5.3 Main propulsion engines driving controllable pitch propellers or reversing gears

- The scope of the sea trials for main propulsion engines driving controllable pitch propellers or reversing gears is to comply with the relevant provisions of item 2.5.2.
- Engines driving controllable pitch propellers are to be tested at various propeller pitches.

2.5.4 Engines driving generators for propulsion

Sea trials of engines driving generators for propulsion are to include the following tests:

- Operation at 100% power (rated power) for at least 4 hours
- Operation at normal continuous cruise power for at least 2 hours
- Operation at 110% power for 30 minutes
- Operation in reverse direction of propeller rotation at a minimum engine speed 70% of the nominal propeller speed for 10 minutes

Note: The present test may be performed during the dock or sea trials.

- Starting manoeuvres
- Tests of the monitoring, alarm and safety systems.

Note: The above six tests are to be performed at rated speed with a constant governor setting. The powers refer to the rated electrical powers of the driven generators.

2.5.5 Engines driving auxiliaries

- Engines driving generators or important auxiliaries are to be subjected to an operational test for at least 4 hours. During the test, the set concerned is required to operate at its rated power for at least 2 hours.

- It is to be demonstrated that the engine is capable of supplying 100% of its rated power and, in the case of shipboard generating sets, account is to be taken of the times needed to actuate the generator's overload protection system.

2.6 Tests of electric propulsion system

2.6.1 Dock trials

2.6.1.1 The dock trials are to include the test of the electrical production system, the power management and the load limitation.

2.6.1.2 A test of the propulsion plant at a reduced power, in accordance with dock trial facilities, is to be carried out. During this test, the following are to be checked:

- Electric motor rotation speed variation

- Functional test, as far as practicable (power limitation is to be tested with a reduced value)

- Protection devices

- Monitoring and alarm transmission including inter- locking system.

2.6.1.3 Prior to the sea trials, an insulation test of the electric propulsion plant is to be carried out.

2.6.2 Sea trials

Testing of the performance of the electric propulsion system is to be effected in accordance with an approved test program.

This test program is to include at least:

- Speed rate of rise

- Endurance test:

- Operation at normal continuous cruise power for at least 4 hours

- 1 hour at 100% rated output power with winding temperature rise below 2°K per hour, according to IEC publication 60034-1

- Operation in reverse direction of propeller rotation at the maximum torque or thrust allowed by the propulsion system for 10 minutes

- Check of the crash astern operation in accordance with the sequence provided to reverse the speed from full ahead to full astern, in case of emergency

  During this test, all necessary data concerning any effects of the reversing of power on the generators are to be recorded, including the power and speed variation.

- Test of functionality of electric propulsion, when manoeuvring and during the ship turning test

- Test of power management performance: reduction of power due to loss of one or several generators to check, in each case, the power limitation and propulsion avail- ability.

2.7 Tests of gears

2.7.1 Tests during sea trials

During the sea trials, the performance of reverse and/or reduction gearing is to be verified, both when running ahead and astern.

In addition, when the power per shaft line exceeds 220 kW, the following checks are to be carried out:

- Check of the bearing and oil temperature

- Detection of possible gear hammering,

- Test of the monitoring, alarm and safety systems.

2.7.2 Check of the tooth contact

When the power per shaft line exceeds 220 kW, the following checks are to be carried out:

- Prior to the sea trials, the tooth surfaces of the pinions and wheels are to be coated with a thin layer of suitable coloured compound.

Upon completion of the trials, the tooth contact is to be inspected. The contact marking is to appear uniformly distributed without hard bearing at the ends of the teeth and without preferential contact lines.

The tooth contact is to comply with Table 1.1.

- The verification of tooth contact at sea trials by methods other than that described above will be given special consideration by the Society.

- The tooth contact is to be checked when the casing is cast steel.

In the case of reverse and/or reduction gearing with several gear trains mounted on roller bearings, manufactured with a high standard of accuracy and having an input torque not exceeding 20000 Nm, the check of the tooth contact may be reduced at the Society's discretion.

Such a reduction may also be granted for gearing which has undergone long workshop testing at full load and for which the tooth contact has been checked positively.

In any case, the teeth of the gears are to be examined by the Surveyor after the sea trials. Subject to the results, additional inspections or re-examinations after a specified period of service may be required.

Table 1: Tooth contact for gears

Heat treatment and machining	Percentage of tooth contact	
	across the whole face width	of the tooth working depth
Quenched and tempered, cut	70	40
-Quenched and tempered, shaved ground -Surface-hardened	90	40

2.8 Tests of main propulsion shafting and propellers

2.8.1 Shafting alignment

Where alignment calculations are required to be submitted, the alignment conditions are to be checked on board by the Shipyard, as follows:

2.8.1.1 Shafting installation and intermediate bearing position, before and during assembling of the shafts:

- Optical check of the relative position of bushes after fitting

- Check of the flanged coupling parameters (gap and sag)

- Check of the centring of the shaft sealing glands.

2.8.1.2 Engine (or gearbox) installation, with floating ship:

- Check of the engine (or gearbox) flanged coupling parameters (gap and sag)

- Check of the crankshaft deflections before and after the connection of the engine with the shaft line, by measuring the variation in the distance between adjacent webs in the course of one complete revolution of the engine.

Note: The ship is to be in the loading conditions defined in the alignment calculations.

2.8.1.3 Load on the bearings:

- Check of the intermediate bearing load by means of jack-up load measurements

- Check of the bearing contact area by means of coating with an appropriate compound.

2.8.2 Shafting vibrations

Torsional vibration measurements are to be carried out where required by this Chapter. The type of the measuring equipment and the location of the measurement points are to be specified.

2.8.3 Bearings

The temperature of the bearings is to be checked under the machinery power conditions specified in 2.3.2.

2.8.4 Stern tube sealing gland

The stern tube oil system is to be checked for possible oil leakage through the stern tube sealing gland.

2.8.5 Propellers

- For controllable pitch propellers, the functioning of the system controlling the pitch from full ahead to full astern position is to be demonstrated. It is also to be checked that this system does not induce any overload of the engine.

- The proper functioning of the devices for emergency operations is to be tested during the sea trials.

2.9 Tests of piping systems

2.9.1 Hydrostatic tests of piping after assembly on board

- When the hydrostatic tests of piping are carried out on board, they may be carried out in conjunction with the leak tests required in 2.9.2.

- Low pressure pipes, such as bilge or ballast pipes are to be tested, after fitting on board, under a pressure at least equal to the maximum pressure to which they can be subjected in service.

- Fuel pipes are to be subjected, after fitting on board, to a hydraulic test under a pressure not less than 1,5 times the design pressure, with a minimum of 4 bars.

2.9.2 Leak tests

Except otherwise permitted by the Society, all piping systems are to be leak tested under operational conditions after completion on board at a pressure not less than:

- 1,25 times the design pressure p, if welded joints have been made on board, or

- The setting pressure of safety valves or other overpressure protective devices in the alternative case.

2.9.3 Functional tests

During the sea trials, piping systems serving propulsion and auxiliary machinery, including the associated monitoring and control devices, are to be subjected to functional tests at the nominal power of the machinery. Operating parameters (pressure, temperature, consumption) are to comply with the values recommended by the equipment manufacturer.

The Society reserves the right to require performance tests, such as flow rate measurements, should doubts arise from the functional tests.

2.10 Tests of steering gear

2.10.1 General

- The steering gear is to be tested during the sea trials under the conditions stated in Sec 3 in order to demonstrate, to the Surveyor's satisfaction, that the applicable requirements of Sec 3 are fulfilled.

- For controllable pitch propellers, the propeller pitch is to be set at the maximum design pitch approved for the maximum continuous ahead rotational speed.

- If the ship cannot be tested at the deepest draught, alter- native trial conditions will be given special consideration by the Society. In such case, the ship speed corresponding to the maximum continuous number of revolutions of the propulsion machinery may apply.

2.10.2 Tests to be performed

Tests of the steering gear are to include at least:

- Functional test of the main and auxiliary steering gear with demonstration of the performances.

- Test of the steering gear power units, including transfer between steering gear power units

- Test of the isolation of one power actuating system, checking the time for regaining steering capability

- Test of the hydraulic fluid refilling system

- Test of the alternative power supply

- Test of the steering gear controls, including transfer of controls and local control

- Test of the means of communication between the navigation bridge, the engine room and the steering gear compartment

- Test of the alarms and indicators

- where the steering gear design is required to take into account the risk of hydraulic locking, a test is to be per- formed to demonstrate the efficiency of the devices intended to detect this.

Note: Tests defined in items from fourth and last items may be carried out either during the mooring trials or during the sea trials.

Note: For ships less than 24 m in length, the Society may accept departures from the above list, in particular to take into account the actual design features of their steering gear.

Note: Azimuth thrusters are to be subjected to the above tests, as far as applicable.

3. Inspection of machinery after sea trials

3.1 General

3.1.1 For all types of propulsion machinery, those parts which have not operated satisfactorily in the course of the sea trials, or which have caused doubts to be expressed as to their proper operation, are to be disassembled or opened for inspection.

Machinery or parts which are opened up or disassembled for other reasons are to be similarly inspected.

3.1.2 Should the inspection reveal defects or damage of some importance, the Society may require other similar machinery or parts to be opened up for inspection.

3.1.3 An exhaustive inspection report is to be submitted to the Society for information.

3.2 Diesel engines

3.2.1 For all diesel engines, where it is technically possible, the following items are to be verified:

- Deflection of the crankshafts
- Cleanliness of the lubricating oil filters.

3.2.2 In the case of propulsion engines for which power tests have not been carried out in the workshop, some parts, agreed upon by the interested parties, are to be disassembled for inspection after the sea trials.

4. Certification, inspection and testing of piping systems

Certification and workshop inspection and testing programme to be performed on the various components of piping systems and the materials used for their manufacture.

On board testing is to be performed in compliance with this section.

Certification, inspection and testing of piping systems is to comply with the provisions of the Part B Chapter 4 Machinery Section 16 as not contradicting with the provisions given in this section.

D. Engine and Boiler Room Equipment

1. Operating and Monitoring Equipment

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.

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 equipment and appliances:

- Protection against humidity and the accumulation of dirt,
- Avoidance of excessive temperature variations,
- Adequate ventilation and

In consoles and cabinets containing electrical or hydraulic equipment or lines carrying steam or water the electrical equipment is to be protected from damage due to leakage. Redundant ventilation systems are to be provided for air-conditioned machinery and control rooms.

1.2 Pressure gauges

The scales of pressure gauges must extend 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 must be installed in such a way that they can be isolated.

Lines leading to pressure gauges must be installed in such a way that the readings cannot be affected by liquid heads and hydraulic hammer.

2. Accessibility of Machinery and Boilers

2.1 Machinery and boiler installations and apparatus must be accessible for operation and maintenance.

2.2 In the layout of machinery spaces (design of foundation structures, lying of pipelines and cable conduits etc.) and the design of machinery and equipment (mountings for filters, coolers etc.), 2.1 is to be complied with.

3. Engine Control Rooms

Engine control rooms are to be provided with at least two exist, one of which can also be used as an escape route.

4. Lighting

All operating spaces must be adequately lit to ensure that control and monitoring instruments can be easily read. In this connection see the Rules for the Electrical Installations Chapter 5.

5. Bilge Wells / Bilges

5.1 Bilge wells and bilges must be readily accessible, easy to clean and either visible or adequately lit.

5.2 Bilges beneath electrical machines must be so designed as to prevent bilge water from penetrating into the machinery at all angles of inclination and movements of the ship in service.

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” and other machinery rooms (class notation AUT) are to be equipped with at least 2 indicators for bilge level monitoring.
- Other unmanned machinery rooms, such as bow thruster and steering gear compartments arranged below the load waterline are irrespective of class notation AUT to be equipped at least one indicator for bilge level monitoring.

6. Ventilation

Engine or machinery spaces are to be sufficiently ventilated so as to ensure that when machinery or boilers therein are operating at full power in all weather conditions, including heavy weather, a sufficient supply of air is maintained to the spaces for the operation of the machinery.

This sufficient amount of air is to be supplied through suitably protected openings arranged in such a way that they can be used in all weather conditions.

Special attention is to be paid both to air delivery and extraction and to air distribution in the various spaces. The quantity and distribution of air are to be such as to satisfy machinery requirements for developing maximum continuous power.

The ventilation is to be so arranged as to prevent any accumulation of flammable gases or vapours.

The machinery ventilation is to be designed under consideration of ambient conditions as mentioned in item B.5.

7. Noise Abatement

In compliance with the relevant national regulations, care is to be taken to ensure that operation of the ship is not unacceptably impaired by engine noise.

E. Safety Equipment and Protective Measures

1. Where risk from overspeeding of machinery exists, means are to be provided to ensure that the safe speed is not exceeded.

Machinery is to be installed and safeguarded in such a way that the risk of accidents is largely ruled out. Besides national regulations particular attention is to be paid to following:

2. 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 are not protected by insulation, e.g. the pressure lines of air compressors.

3. When using hand cranks for starting internal combustion engines, step 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.

4. Blowdown and drainage facilities are to be designed in such a way that the discharged medium is safely drained off.

5. In operating spaces, anti-skid floor-plates and floor-coverings must be used.

6. Service gangways, operating platforms, stairways and other areas open to access during operation must be safeguarded by guard rails. The outside edges platforms and floor areas are to be fitted with coamings unless some other means is adopted to prevent persons and objects from sliding off.

7. Glass water level gauges for steam boilers are to be equipped with protection devices.

Devices for blowing through water level gauges must be capable of safe operation and observation.

8. Safety valves and shutoffs must be capable of safe operation. Fixed steps, stairs or platforms are to be fitted where necessary.

9. Safety valves are to be installed to prevent the occurrence of excessive operating pressures.

10. 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 must 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.

F. Communication and Signaling Equipment

1. Voice Communication

Means of voice communication are to be provided between the ship's manoeuvering station, the engine room and the steering gear compartment, and these means shall allow fully satisfactory intercommunication independent of the shipboard power supply under all operating conditions (see also Part B Chapter 5 Electrical Installations, Section 9, C.5).

2. Engineer Alarm

From the engine room or the engine control room it must be possible to activate an alarm in the engineers' living quarters (see also Part B Chapter 5 Electrical Installations, Section 9, C.5).

3. Engine Telegraph

Machinery operated from the engine room must be equipped with a telegraph.

In the case of multiple-shaft installations, a telegraph must be provided for each unit.

Local control stations are to be equipped with an emergency telegraph.

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 Part B Chapter 4 Machinery Section 16.

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 must be clearly indicated at the main engine control platform.

Signaling devices must be clearly perceptible from all parts of the engine room when the machinery is in full operation.

SECTION 2

INTERNAL COMBUSTION ENGINES

Page

A General

1. Application

The requirements in this Section apply to internal combustion engines used as main propulsion units and auxiliary units (including emergency units).

2. Definitions

Definitions stated in Chapter 4 Section 2 A.2 apply as applicable.

3. Approval

Basic principles of engine approval and documents for approval for ships listed below are to be in accordance with Part B Chapter 4 Machinery Section 2 B.

- Main propulsion engines, when the power " exceeds 220 kW per engine
- Engines driving electric generators, including emergency generators, when they develop a power of 110 kW and over
- Engines driving other auxiliaries essential for safety and navigation, when they develop a power of 110 kW and over.

For other internal combustion engines, an alternative approval scheme could be accepted after satisfactory review of the following to be submitted documents:

- Type test report
- Drawing of crankshaft
- Engine documentation
- Justifications of marine application of the engine.

4. Material

For materials used for the components of diesel engines, Part B Chapter 4 Machinery Section 2 C is to be taken as a reference.

B. Installation

1. Protective guards, jacketing or engine boxes are to be provided whenever persons or gear might come in contact with the engine or its components as installed in normally occupied spaces, where their temperature exceeds 90°C.

2. Fuel, lubricating oil, cooling systems are to be in accordance with the relevant provisions of Section 4 of this Chapter 35-B.

3. A drip tray is not essential provided that the transverse and longitudinal bearers form any oil-tight box section compartment of the above mentioned extent.

4. All external high pressure fuel delivery lines between the high pressure fuel pumps and the fuel injectors are to be protected with a shielded piping system capable of containing fuel from high pressure line failure.

5. A shielded pipe incorporates an outer pipe into which the high pressure fuel pipe is placed forming a permanent assembly.

6. For engines with a maximum rated power of 375 kW fitted on board of ships with a restricted navigation, alternative means of protection could be accepted, e.g. protective screens.

C. Starting Systems

1. Where internal combustion engines are started by means of compressed air, the relevant requirements of Section 5 regarding the number and position of compressors as well as the arrangement of compressed air systems are to be complied with.

2. Where internal combustion engines are fitted with electric starting, relevant requirements given in Chapter 35-C Electrical Installations are to be complied with.

3. Where suitable emergency manual starting means are provided, attenuation to these requirements may be considered by the Society.

D. Control - Safety - Monitoring And Instrumentation

1. Control systems

1.1 Components of the propulsion control system are to be suitably resistant to corrosion, either by virtue of material or coating thereof and galvanically compatible with each other.

1.2 On a twin-engine ship, the throttle controls should be located so that both engines can be throttled with one hand.

1.3 Where control cables are used, they are to be installed with as few bends as possible. Bends are to have a radius as large as possible and the radius is not to be smaller than the manufacturer's recommended mini- mum. The routes of the cables are to be direct and uncrowded by accessory equipment.

The primary control actuation is to be through a lever and not a knob directly attached to the end of the cable.

2. Safety arrangements

2.1 Except where duly justified, a means for operating the throttle without engaging the gears is to be provided for all ships exceeding 5 kW in shaft power. To ensure this, it should not be possible to start the motor unless the shift control is in neutral position.

2.2 Non-propulsion engines intended for automatic operation are to be fitted with an automatic shutdown device actuated by low oil pressure.

2.3 Engine crankcases are to be sufficiently vented to prevent excessive pressurization.

Diesel engines of a cylinder diameter of 200 mm and above or a crankcase gross volume of 0,6 m^3 are to be provided with crankcase explosion relief valves.

Diesel engines of a cylinder diameter of 300 mm and above or a power of 2250 kW and above are to be provided with oil mist detection.

Note: As a rule, when fitted, crankcase explosion relief valves and oil mist detection are to be in accordance with the provisions of Part B Chapter 4 Machinery Section F.4

2.4 Each outboard engine is to be provided with a tilt mechanism which shall operate when the driveleg comes into contact with an obstruction. Adequate means are to be provided to adjust the force required to activate the tilt mechanism.

3. Speed Control and Engine Protection Against Over speed (Governors)

For speed control and engine protection against over speed (governors), Chapter 4 Section 2 F.1 shall apply.

4. Indications, Alarms and Shut Down

For this purpose diesel engines may be sorted in to two categories according to their output power:

4.1 For engine of 1000 kW and above:

The requirements laid down in Part B Chapter 4 Machinery Section 2 Table 2.9

4.2 For engine with a power less than 1000 kW:

- Lubrication oil pressure indication

- Fresh water temperature indication.

The indicators are to be fitted at a normally attended position (on the engine or at local control station).

The alarms are to be visual and audible at a normally attended position (on the engine or at local control station).

5. Reduction in monitoring equipment and automatic control

In the following cases, the acceptance of a reduction in the monitoring equipment and automatic control required in item 4 may be considered:

- Main propulsion engines for ships with two or more propulsion plants

- Engines with power less than 220 kW

- Ships with restricted navigation.

E. Reduction Gear - Transmissions

1. General and Application

Reduction gear and transmissions are to be of marine type and suitably matched to the engine with which they are to be used.

Where the power per shaft line exceeds 220 kW, reduction gear and transmissions are to be in compliance with the relevant requirements of Part B Chapter 4 – Machinery Section 7.

2. Design and construction

Reduction gear incorporating an independent oiling system is to include a suitable oil sump, an oil level indicating device, and a vent located to provide adequate breathing, but positioned to prevent oil leakage from the transmission under normal operating conditions.

Reduction gear and transmissions are to be provided with a method of cooling so that recommended maximum sump temperatures will not be exceeded under normal operating conditions.

Hydraulically actuated transmissions are to have a provision to monitor oil pressure and/or oil temperature.

F. Shafting

1. General

1.1 For propulsion shaft line, following requirements are to be applied irrespective of power of each shaft. Shafting components shall conform to requirements those given in relevant provisions of Chapter 4 Section 2 Internal Combustion Engines and Air Compressors, Section 7 – Gears, Couplings, Section 9 – Steering Gears and Thrusters.

1.2 Material and welding properties of shafting elements shall comply with Chapter 2 Material and Chapter 3 Welding as applicable.

2. Shaft diameter

The diameter of the shaft going through the stern tube (propeller shaft) and intermediate shafts is not to be less than the diameter d, in mm, given by the following formula:

$$d = p\,.\,a \cdot K \cdot \sqrt[3]{\frac{P_B}{n}}$$

When the propeller shaft is made out of carbon manganese steel and is protected by a continuous liner or by oil lubrication with approved oil sealing gland, the diameter of the shaft going through the stern tube is not to be less than the diameter d, in mm, given by the following formula:

$$d = p\,.\,a \cdot 126 \cdot \sqrt[3]{\left[\frac{560}{(R_m + 160)}\right]} \cdot \sqrt[3]{\frac{P_B}{n}}$$

Furthermore, the shaft diameter is not to be less than 25 mm for carbon steel or carbon manganese steel, and 20 mm for the other materials listed in Tab 1

The use of materials other than those included in Tab 1 is to be subject to special examination.

Where;

P_B = Brake power, in kW

n = Shaft revolutions per minute

K = Coefficient having the values given in Table 2.1.

a = 1 for propeller shaft

= 0.8 for intermediate shafts

R_m = Value of the minimum tensile strength of the shaft material, in N/mm^2. The value of R_m to be introduced in the formula is not to be taken higher than 600 N/mm^2.

p = 1 for solid shafts (for hollow shafts following values are set relative to their Ratio of the internal diameter to the outer shaft Diameter (Q)).

Q	0,4	0,5	0,6	0,7
p	1,01	1,02	1,05	1,10

Note: Characteristics of the cardan shaft and justification of the cardan shaft life duration are to be submitted for information.

Table 2.1 Values of coefficient K

Material	R_{eH} (min) (N/mm^2)	R_m (min) (N/mm^2)	K
Carbon and carbon manganese steel	200	400	126
Austenitic stainless steel (type 316)	175	470	91
Manganese bronze	245	510	92
Martensitic stainless steel (type 431)	675	850	88
Ni-Al bronze	390	740	85
Nickel-copper alloy (Monel 400)	350	550	85
Nickel-copper alloy (Monel K 500)	690	960	71
Duplex stainless steel (type S31803)	450	650	63

3. Coupling flanges

The thickness of coupling flanges on intermediate and thrust shafts and on the inboard end of the propeller shaft must be equal to at least 20% of the Rule diameter of the shaft at the relevant location or the thickness of the coupling bolt diameter calculated for the material having the same tensile strength as the corresponding shaft, whichever is greater.

Special consideration will be given by TL for flanges having non-parallel faces, but in no case is the thickness of the flange to be less than the coupling bolt diameter.

The fillets of coupling flanges at their junction with the shafts are to have a radius at least equal to 8% of the diameter of the corresponding shaft. Where propellers are attached to a forged flange on the propeller shaft, the flange should have a thickness of at least 25% of the calculated minimum diameter of the solid shaft at that relevant location and condition. These flanges may not be thinner than the Rule diameter of the fitted bolts if these are based on the same tensile strength as that of the shaft material.

The fillets are to be carefully machined and, as a rule, recesses are to be avoided as far as possible in way of bolt heads and nuts.

4. Coupling bolts

For intermediate, propeller and thrust shafts, following formula apply to define diameter of coupling bolts at the joining faces of the couplings:

$$d_b = \sqrt{\frac{121 \cdot 10^6 \cdot P}{z \cdot r \cdot R_b \cdot n}}$$

z = Number of bolts in the coupling

r = Radius of the pitch circle of the bolts, in mm

R_b = Ultimate tensile strength of the bolt metal, in N/mm^2

P = Brake power, in kW

n = Shaft revolutions per minute

For the fitted bolts of coupling flanges for crankshaft parts as well as of coupling flanges between crankshafts and thrust and flywheel-shafts, the formula below applies:

$$d_b = \sqrt{\frac{196 \cdot 10^6 \cdot P}{z \cdot r \cdot R_b \cdot n}}$$

Flange coupling with non-fitted coupling bolts may be accepted on the basis of the calculation of bolts tightening, bolts stress due to tightening and assembly construction.

To this end, the torque based on friction between the mating surfaces of flanges is not to be less than 2,8 times the transmitted torque, assuming a friction coefficient for steel on steel of 0,18. In addition, the bolt stress due to tightening in way of the minimum cross-section is not to exceed 0,8 times the minimum yield strength (ReH), or 0,2 proof stress (Rp 0,2), of the bolt material.

Transmitted torque has the following meanings:

- For main propulsion systems powered by diesel engines fitted with slip type or high elasticity couplings, by turbines or by electric motors: the mean transmitted torque corresponding to the maximum continuous power P and the relevant speed of rotation n,

- For main propulsion systems powered by diesel engines fitted with couplings other than those mentioned in (a): the mean torque above increased by 20% or by the torque due to torsional vibrations, whichever is the greater.

The value 2,8 above may be reduced to 2,5 in the following cases:

- Ships having two or more main propulsion shafts

- When the transmitted torque is obtained, for the whole functioning rotational speed range, as the sum of the nominal torque and the alternate torque due to the torsional vibrations, calculated as required in Chapter 4 Section 6.

Where the pieces of the shafting are not joined by means of forged coupling flanges, the arrangement is to be given special consideration by the Society; in this case, provision is to be made for the coupling to resist the rated astern pull.

Where the shafts have peculiar machining such as grooves, longitudinal slots or transverse holes, the design is to be such as to reduce stress concentrations. A local increase of the shaft diameter may be required by the Society.

5. Shaft liners

5.1 Propeller shafts which are not made of corrosion-resistant material and which run in seawater are to be protected against contact with seawater by seawater-resistant metal liners or other liners approved by TL and by proven seals at the propeller. (Also refer to Figure 5.3 of Part B Chapter 4 Machinery Section 5 Item C.4.1.3) Alternatively, the liner may be omitted provided the shaft runs in an oil lubricated stern tube with an approved sealing gland at the after end. Length of shafting between stern tube and propeller bracket may be protected by suitable coatings.

5.2 Shaft liners may be of bronze, corrosion resistant stainless steel or other approved alloys and are to be free from porosity and other defects. Continuous liners are to be in one piece or, if made of two or more lengths, the joining of the separate pieces is to be done by an approved method of welding through not less than two thirds the thickness of the liner or by an approved rubber seal arrangement.

5.3 Metal liners in accordance with 5.2, which run in seawater, are to be made in a single piece. With the expressed consent of TL the liner may consist of two or more parts, provided that the abutting edges of the parts are additionally sealed and protected after fitting by a method approved by TL to guarantee watertightness. Such a possibility is special coatings. Such joints will be subject to special tests to prove their effectiveness.

5.4 The thickness of bronze shaft liners in way of the bushes and stern gland is to be not less than the thickness e, in mm, given by the following formula:

$$0.03 \cdot \mathrm{d} + 7.5$$

Where;

d = Actual diameter of the propeller shaft, in mm.

5.5 The thickness of the continuous liner between the bushes is to be, as a rule, not less than 0,75 e.

The liners are considered as continuous when they are:

- Either cast in one piece, or

- made of two or more lengths assembled by joints of an approved type.

5.6 Where parts of liners are assembled by welding, arrangements are to be made to protect the surface of the shaft during welding and to allow the free contraction of the joint after welding.

5.7 The joints between liner parts are not to be located in way of the bushes or stern gland.

5.8 Each continuous liner or length of liner is to be tested by hydraulic pressure to 2 bar after rough machining.

5.9 Liners are to be carefully shrunk on the shafts either whilst hot, or by hydraulic press, or by any other approved process. Pins or other similar devices are not to be used to secure the liners on the shafts.

5.10 Where ways are provided between liner and propeller shaft outside the bearings, these ways are to be filled with a material insoluble in water and non-corrosive.

5.11 Means are to be provided, particularly at the junction of liner and propeller boss, to prevent any entry of sea water under the liner and on the propeller boss.

6. Stern tube bearings

6.1 Oil lubricated white metal bearings

The length of white-metal-lined, oil-lubricated propeller end bearings fitted with an approved oil-seal gland is to be not less than two times the required tail shaft diameter.

The length of the bearing may be reduced, provided the nominal bearing pressure is not more than 0.80 N/mm2, as determined by static bearing reaction calculation taking into account shaft and propeller weight which is deemed to be exerted solely on the aft bearing, divided by the projected area of the bearing surface.

The minimum length, however, is not to be less than 1.5 times the actual diameter.

6.2 Oil lubricated synthetic material bearings

The length of synthetic rubber, reinforced resin or plastic oil-lubricated propeller end bearings fitted with an approved oil-seal gland is to be not less than two times the required tail shaft diameter. The length of bearing may be reduced, provided the nominal bearing pressure is not more than 0.60 N/mm2, as determined by static bearing reaction calculation taking into account shaft and propeller weight which is deemed to be exerted solely on the aft bearing, divided by the projected area of the bearing surface. The minimum length, however, is not to be less than 1.5 times the actual diameter. Where the material has demonstrated satisfactory testing and operating experience, consideration may be given to increased bearing pressure.

6.3 Water lubricated bearings of synthetic materials

Where the bearing is constructed of synthetic materials which are approved for use as water lubricated stern bush bearings, such as rubber or plastics, the length of the bearing is to be not less than 4,0 times the rule diameter of the shaft in way of the bearing

For a bearing design substantiated by experiments to the satisfaction of the Society, consideration may be given to a bearing length not less than 2,0 times the rule diameter of the shaft in way of the bearing.

6.3 Oil lubricated cast iron or bronze bearings

The length of oil-lubricated cast iron or bronze bearings which are fitted with an approved oil-seal gland is to be not less than four times the required tail shaft diameter.

6.4 Other arrangements

The other arrangements beside those defined in items 6.1-6.3 are to be given special consideration. The length of the after bearing of the propeller shaft is to be not less than 4,0 times the rule diameter of the shaft in way of the bearing.

6.5 Where the bearings are lubricated by water, arrangements are to be made for an adequate supply of water.

A forced water lubrication is to be provided, if necessary, namely for bearings lined with lignum vitae, rubber or plastic materials.

6.6 For oil lubricated bearings and where the lubrication is made by gravity, the lubricating oil tank is to be located above the load centre water line. In this case, a low level indication or preferably an alarm is to be given at the operator's position.

7. Sealing glands

7.1 The sealing glands are to be readily accessible, for inspection or replacement.

7.2 The sealing glands are to be periodically inspected.

7.3 It is to be mentioned, in the Owner's manual, all necessary measures to be taken in case of accidental breaking of a main element, as well as the periodicity of inspections and replacement of elements subject to deterioration or wearing.

7.4 The wear strength of non-metallic parts is to be established, either by satisfactory operations, or by relevant tests.

An easy to fit emergency device may be accepted.

8. Propeller shaft keys and keyways

8.1 Keyed connexions are in general not to be used in installations with a barred speed range.

8.2 Keyways on the propeller shaft cone are to comply with the following requirements (see Figure 2.1).

Keyways are to have well rounded corners, with the forward end faired and preferably spooned, so as to minimize notch effects and stress concentrations.

The fillet radius at the bottom of the keyway is to be not less than 1,25% of the actual propeller shaft diameter at the large end of the cone.

The distance from the large end of the propeller shaft cone to the forward end of the key is to be not less than 20% of the actual propeller shaft diameter in way of the large end of the cone

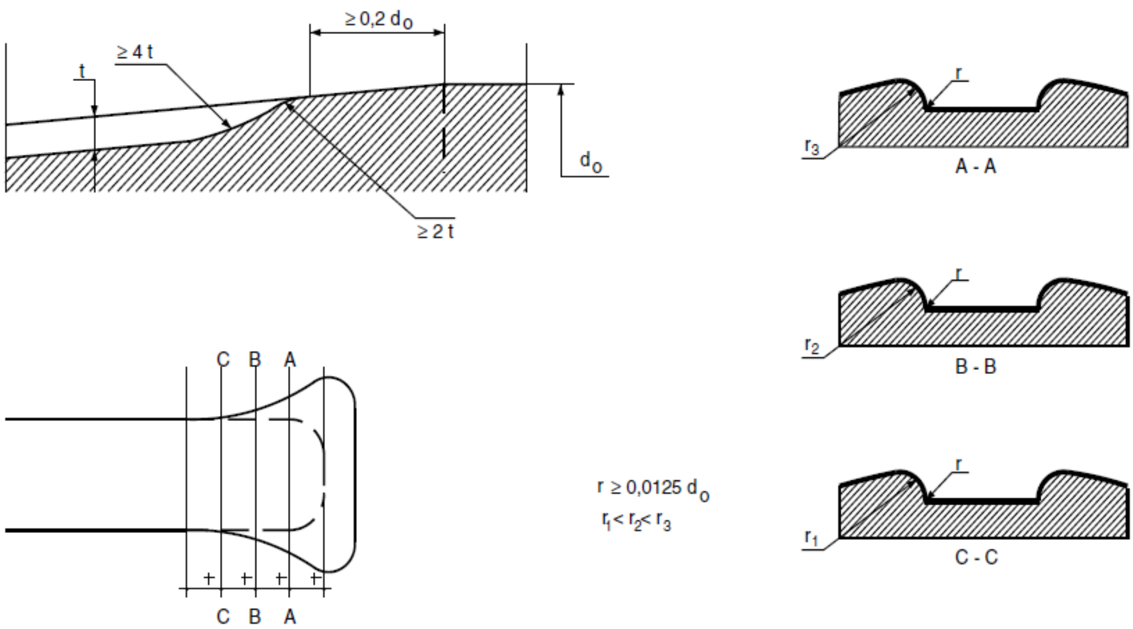


Figure 2.1 - Details of forward end of propeller shaft keyway

Key securing screws are not to be located within the first one-third of the cone length from its large end; the edges of the holes are to be carefully faired.

Note: Different scantlings may be accepted, provided that at least the same reduction in stress concentration is ensured.

8.3 Keys

The sectional area of the key subject to shear stress is to be not less than the value A, in mm2, given by the following formula:

$$A = \frac{2 \cdot d^3}{5 \cdot d_{PM}}$$

where:

d = Rule diameter, in mm, of the intermediate shaft calculated in compliance with the requirements of this section, assuming:

R_m = 400 N/mm^2

d_{PM} = Actual diameter of propeller shaft at mid-length of the key, in mm.

The edges of the key are to be rounded.

9. Propeller

9.1 Propeller scantlings are to comply with the requirements of TL Rule Chapter 4 - Machinery - Section 8 "Propellers".

9.2 The Society may agree, for propellers, scantlings justified by either adequate calculations, or satisfactory experience in service.

10. Shaft vibrations

A torsional vibration calculation is to be submitted for review for the shafting of the following installation in compliance with the relevant requirements of TL Rule Chapter 4 - Machinery - Section 6 "Torsional Vibrations":

- Propulsion systems with prime movers developing 220 kW or more

- Other systems with internal combustion engines developing 110 kW or more and driving auxiliary machinery intended for essential services.

11 Shaft alignment

11.1 In general, the shaft alignment calculations and the shipyard's shaft alignment procedures indicating the proposed alignment method and alignment verification after installation (such as gap and sag, jack-up, laser or strain gauges, etc.), for cold, hot static and dynamic conditions, are to be submitted to the Society's review when the shaft diameter is 350 mm or greater in way of the aftermost stern tube bearing.

The Society may also require the above calculations in the case of special arrangements.

Refer to the relevant requirements of Chapter 4 - Machinery - Section 5 D.2 Fundamentals of Shaft Alignment.

11.2 The alignment of the propulsion machinery and shafting and the spacing and location of the bearings are to be such as to ensure that the loads are compatible with the material used and the limits prescribed by the Manufacturer.

Shaft alignment should be carried out with the ship floating and should be checked occasionally or if unusual vibration is evident.

The alignment is to be checked on board by the Shipyard by a suitable measurement method.

12. Thrusters and waterjets

12.1 Thrusters and waterjets developing power equal to, or more than, 110 kW intended for propulsion and steering are to be in compliance with the relevant requirements of Chapter 4 - Machinery - Section 9.

12.2 Thrusters and waterjets developing power less than 110 kW intended for propulsion and steering are to built in accordance with sound marine practice.

SECTION 3

STEERING GEAR

Page

A. General

1. Application

1.1 All vessels are to be provided with power-operated means of steering. Such means, as a minimum, are to be supported by duplication of power units, and by redundancy in piping, electrical power supply, and control circuitry. Steering is to be capable of being readily regained in the event of the failure of a power unit, a piping component, a power supply circuit or a control circuit.

1.2 This section "Steering Gear" is applicable to ships for which steering is affected by means of a rudder and an electric, hydraulic or electro-hydraulic steering gear. The requirements contained in this subsection apply to the steering gear including all the equipment used to operate the rudder, the steering station and all transmission elements from the steering station to the steering gear.

Unless otherwise specified, the requirements of this Section apply to the design arrangements, control systems, construction and testing of installations intended for rudder operation, and to the steering mechanism of thrusters used as means of propulsion.

For the rudder and manoeuvring arrangement, see Chapter 1 - Hull, Section 18 and for sea trials see Section 1 Item 3. For the purposes of these requirements, steering gears comprise all the equipment used to operate the rudder from the rudder actuator to the steering station including the transmission elements.

2. Documents to be submitted

Before starting construction, all plans and specifications listed in Part B Chapter 4 Machinery Section 9 A.1.2 are to be submitted to the Society for approval.

3. Symbols and Definitions

Main and auxiliary steering gears may be:

- Electric, when both the power source and the rudder torque transmission are electric
- Electrohydraulic, when the power source is electric and the rudder torque transmission is hydraulic
- Engine hydraulic, when the power source is an internal combustion engine and the rudder torque transmission is hydraulic
- Manual hydraulic, when the power source is human force and the rudder torque transmission is hydraulic

Part B Chapter 4 Machinery Section 9 A.3 shall be applied, as applicable for definitions to be applied within scope of this section.

V_{AV} = Maximum ahead service speed, in knots, with the ship on summer load waterline; if VAV is less than 10 knots, the maximum service speed is to be taken not less than the value VMIN obtained from the following formula:

$$V_{MIN} = \frac{V_{AV} + 20}{3}$$

M_{TR} = Rule rudder torque

$$M_{TR} = 13.5 \cdot {d_s}^3 \cdot 10^{-6}$$

ds = Rule rudder stock diameter with null bending moment in way of the tiller, in mm (k1 is to be taken 1)

$$d_S = 4.2 \cdot (M_{TR} \cdot k_1)^{(1/3)}$$

d_{se} = Actual diameter of the rudder stock in way of the tiller, in mm (in the case of a tapered coupling, this diameter is measured at the base of the assembly)

σ = Normal stress due to bending moments and tensile/compression forces, in N/mm^2

τ = Shear stress due to torsional moments and shear forces, in N/mm^2

σ_a = Permissible stress (von Mises), in N/mm^2

σ_c = Combined stress, determined by the following formula:

$$\sigma_C = \sqrt{\sigma^2 + 3\tau^2}$$

R_m = Minimum ultimate tensile strength, in N/mm^2, of the steel used

R_{eH} = Minimum yield stress, in N/mm2, of the specified steel, and not exceeding the lower of 0,7 R_m and 450 N/mm^2

K = Material factor, to be obtained from the following formula:

$$k = \left(\frac{235}{R_{eH}}\right)^n$$

where:

n = Coefficient to be taken equal to:

= 0,75 for R_{eH} > 235 N/mm^2

= 1,00 for $R_{eH} \leq$ 235 N/mm^2.

B. Design Requirements For Conventional Steering Systems

1. General

1.1 Mechanical systems

1.1.1 All the steering gear components and the rudder stock are to be of sound and reliable construction to the satisfaction of the Society.

1.1.2 Any non-duplicated essential component is, where appropriate, to utilise anti-friction bearings, such as ball bearings, roller bearings or sleeve bearings, which are to be permanently lubricated or provided with lubrication fittings.

1.1.3 The construction is to be such as to minimise local concentration of stress.

All steering gear components transmitting mechanical forces to the rudder stock, which are not protected against overload by structural rudder stops or mechanical buffers, are to have a strength at least equivalent to that of the rudder stock in way of tiller.

1.1.4 Mechanical components of the steering gear are to be of adequate strength to transmit the rudder torque to the rudder stock and to resist to the loads induced by the steering gear power given in subsequent items of this section.

1.2 Hydraulical systems

1.2.1 The design pressure for calculations to determine the scantlings of piping and other steering gear components subjected to internal hydraulic pressure is to be at least 1,25 times the maximum working pressure to be expected under the operational conditions specified in this section, taking into account any pressure which may exist in the low pressure side of the system.

1.2.2 The power piping for hydraulic steering gear is to be arranged so that transfer between units can be readily effected.

1.2.3 Arrangements for bleeding air from the hydraulic system are to be provided, where necessary.

1.2.4 The hydraulic piping system, including joints, valves, flanges and other fittings, is to comply with the requirements of Section 4 for class I piping systems.

2. Materials and welding

2.1 Approved materials

2.1.1 Ram cylinders; pressure housings of rotary vane type actuators; hydraulic power piping valves, flanges and fittings; and all steering gear components transmitting mechanical forces to the rudder stock (such as tillers, quadrants, or similar components) should be of steel or other approved ductile material, duly tested in accordance with the requirements of TL. In general, such material should not have an elongation of less than 12% nor a tensile strength in excess of 650 N/mm^2.

Pressure vessels should be generally made of steel, cast steel or nodular cast iron (with a predominantly ferritic matrix).

With the consent of the TL, cast iron may be used for certain components. Gray cast iron may be accepted for redundant parts with low stress level, excluding cylinders, upon special consideration. Gray cast iron or other material having an elongation (L_0 /d = 4) less than 12% in 50 mm is not to be used for these parts

2.1.2 Casings which integrated house journal and guide bearings on ships with a nozzle rudder and ice class are not to be made of grey cast iron.

2.1.3 The pipes of hydraulic steering gears 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 danger or damage, copper pipes for control lines are to be provided with a protective shielding and are to be safeguarded against hardening due to the vibration by the use of suitable fastenings.

2.1.4 High-pressure hose assemblies may be used for short pipe connections subject to compliance with Part B Chapter 4 Machinery Section 16, U, if this is necessary due to vibrations or flexibly mounted units.

2.1.5 Materials used for the pressurized components including the seals must be suitable for the hydraulic oil in use.

Oil seals between the non-moving parts, forming part of the exterior pressure boundary, shall be of the metal upon metal type or of an equivalent type.

Oil seals between the moving parts, forming part of the external boundary, shall be fitted in duplicate so that the failure of one seal does not render the actuator inoperative. Alternative seal arrangements providing equivalent protection against leakage may be acceptable provided protection against leakage can be assured.

2.2.2 Testing of materials

2.2.2.1 The materials of essential load-transmitting components of the steering gear as well as of the pressurized casings of hydraulic steering gears are to be tested under supervision of TL in accordance with the requirements of Chapter 2 - Material.
For pressurized oil pipes, the requirements according to Part B Chapter 4 Machinery Section 16, Table 16.6 are to be observed.

2.2.2 In the case of small hand-operated main steering gears and small manually operated auxiliary steering gear TL may dispense with testing the materials of individual components such as axiometer gear shafts, etc.

3 Welding features

3.1 For welded structures such as pressurized casings etc, the TL Rules Chapter 3 - Welding are to be applied.

3.2 The welding details and welding procedures should be approved by TL.

All welded joints within the pressure boundary of a rudder actuator or connecting parts transmitting mechanical loads should be full penetration type or of equivalent strength.

4. Steering Components and Design Principles

4.1 Number of steering gears

Each ship must be equipped with at least one main and one auxiliary steering gear. Both steering gears are to be independent of each other and, wherever possible, act separately upon the rudderstock. TL may agree to components being used jointly by the main and auxiliary steering gear.

4.2 Main steering gear and rudder stock

4.2.1 The main steering gear and rudder stock shall be:

4.2.1.1 Of adequate strength and capable of steering the ship at maximum ahead at the ship’s service speed for which the rudder has been designed in accordance with Part A - Chapter 1 - Hull, Section 18 which shall be demonstrated;

4.2.1.2 Capable of putting the rudder over from 35° on one side to 35° on the other side or where declared steering angle limits is different, capable of changing direction of the ship's directional control system from one side to the other at declared steering angle limits, with the ship at its deepest seagoing draught and running ahead at maximum ahead service speed and, under the same conditions, from 35° on either side to 30° on the other side in not more than 28 s. or where declared steering angle limits according to 1.3.12 is different, at declared steering angle limits at an average rotational speed of not less than 2.3°/s.;

4.2.1.3 Operated by power where necessary to meet the requirements of above paragraph and

4.2.1.4 So designed that they will not be damaged at maximum astern speed; however, this design requirement need not be proved by trials at maximum astern speed and maximum rudder angle.

The main steering gear shall be power-operated.

4.2.1.5 Manual operation is acceptable for rudderstock diameters up to 120 mm. calculated for torsional loads in accordance with the Part A Chapter 1 - Hull, Section 18, C.1. Not more than 25 turns of the handwheel shall be necessary to put the rudder form one hard over position to the other. Taking account of the efficiency of the system, the force required to operate the handwheel should generally not exceed 200 N.

4.3 Auxiliary steering gear

4.3.1 The auxiliary steering gear shall be:

4.3.1.1 Of adequate strength and capable of steering the ship at navigable speed and of being brought speedily into action in an emergency;

4.3.1.2 Capable of putting the rudder over from 15° on one side to 15° on the other side in not more than 60 s. or where declared steering angle limits is different, capable of changing direction of the ship's directional control system from one side to the other at declared steering angle limits at an average rotational speed, of not less than 0.5°/s, with the ship at its deepest seagoing draught and running ahead at 1/2 of the maximum ahead service speed or 7 knots, whichever is the greater; and

4.3.2 Operated by power where necessary to meet the requirements of paragraph above

Hydraulically operated auxiliary steering gears must be fitted with their own piping system independent of that of the main steering gear. The pipe or hose connections of steering gears must be capable of being shut-off directly at the pressurized casings.

4.3.3 Operational rapidly

If the operation of the auxiliary steering gear requires immobilisation of the tiller, an efficient braking system is to be installed. In case of hydraulic steering gear, braking may be obtained by shutting off the isolating valves, fitted directly on the actuator.

4.3.4 Hand operation

As a rule, operation of hand operated steering gears should not require an effort exceeding 160 N under normal conditions.

Manual operation of auxiliary steering gear systems is permitted up to a theoretical stock diameter of 230 mm referring to steel with a minimum nominal upper yield stress R_{eH}=235 N/mm^2.

4.4 Power unit

4.4.1 Main and auxiliary steering gear power units shall be arranged to restart automatically when power is restored after a power failure and capable of being brought into operation from a position on the navigation bridge.

In the event of a power failure to any one of the steering gear power units, an audible and visual alarm shall be given on the navigation bridge.

4.4.2 Where power operated main steering gears are equipped with two or more identical power units, auxiliary steering gear need not be installed provided that the following conditions are fulfilled.

4.4.3 On cargo ships, the power units must be so designed that requirements 4.2.1.2 and steering torque are fulfilled while operating with all power units.

4.4.4 In the event of failure of a single component of the main steering gear including the piping, excluding the rudder tiller or similar components as well as the cylinders, rotary vanes and casing, means must be provided for quickly regaining control of one steering system.

4.4.5 In the event of a loss of hydraulic oil, it must be possible to isolate the damaged system in such a way that the second control system remains fully operable.

4.5 Rudder angle limitation and power gear stops

Power-operated steering gears are to be provided with positive arrangements, such as limit switches, for stopping the gear before the rudder stops are reached. These arrangements are to be synchronized with the rudder stock or the position of the gear itself and may be an integral part of rudder actuator. Arrangements to satisfy this requirement through the steering gear control system are not permitted.

The rudder angle in normal service is to be limited by devices fitted to the steering gear (e.g. limit switches) to a rudder angle of 35° on both sides. Deviations from this requirement are permitted only with the consent of TL.

4.6 End position limitation

For the limitation by means of stoppers of the end positions of tillers and quadrants, see Chapter 1 - Hull, Section 18, G.

In the case of hydraulic steering gears without an end position limitation of the tiller and similar components, a mechanical end position limiting device must be fitted within the rudder actuator.

4.7 Locking equipment

Steering gear systems are to be equipped with a locking system effective in all rudder positions (see also Chapter 1 - Hull, Section 18, G)

Where hydraulic plants are fitted with shut-offs directly at the cylinders or rotary vane casings, special locking equipment may be dispensed with.

In the case of steering gears with cylinder units which have mutually independent operation, these shut-off devices do not have to be fitted directly on the cylinders.

4.8 Overload protection and relief valves

4.8.1 Power-operated steering gear systems are to be equipped with overload protection (slip coupling, relief valve) to ensure that the driving torque is limited to the maximum permissible value.

The design and setting of safety valves must be such that their response threshold does not allow the maximum permissible working pressure to be exceeded by more than 10% of the setting pressure of the valve.

The overload protection device must be secured to prevent re-adjustment by unauthorized persons. Means must be provided for checking the setting while in service.

The pressurized casings of hydraulic steering gears which also fulfil the function of the locking equipment mentioned in 3.7 are to be fitted with relief valves unless they are so designed that the pressure generated when the elastic-limit torque is applied to the rudderstock cannot cause rupture, deformation or any other damages of the pressurized casings.

4.8.2 Relief valves have to be provided for protecting any part of the hydraulic system which can be isolated and in which pressure can be generated from the power source or from external forces should comply with the following:

- The relief valves are to be set to a pressure value higher than 1.25 times of the maximum working pressure but lower than the design pressure of the steering gear (definition of maximum working pressure and design pressure in accordance to 4.1).

- The minimum discharge capacity of the relief valves is not to be less than 1.1 times the total capacity of the pumps, which can deliver through them.

With this setting any higher peak pressure in the systems than 1.1 times the setting pressure of the valves is to be prohibited. In this regard, due consideration should be given to extreme foreseen ambient conditions in respect of oil viscosity.

TL may require, for the relief valves, discharge capacity tests and/or shock tests.

4.8.3 Isolating valves

Shut-off valves, non-return valves or other appropriate devices are to be provided to comply with the availability requirements.

4.8.4 Hydraulic oil reservoirs

Hydraulic power-operated steering gear is to be provided with the following:

- A low level alarm for each hydraulic fluid reservoir to give the earliest practicable indication of hydraulic fluid leakage. Audible and visual alarms are to be given on the navigation bridge and in the machinery space where they can be readily observed.

- Where the main steering gear is required to be power operated, a storage mean, as a readily accessible drum, having sufficient capacity to recharge at least one power actuating system if necessary.

4.8.5 Hydraulic pumps

Hydraulic pumps are to be type tested.

4.9 Hydraulic power supply

Hydraulic power installations supplying steering gear may also supply other equipment at the same time provided that:

- The operation of the steering gear is not inoperative. affected by the operation of this equipment

- The piping system of this system can be isolated from the steering gear system by means of closing valves.

4.10 Accumulators

Refer to Section 5.

4.11 Rudder actuators

Rudder actuators are to be designed in accordance with the requirements of Part B Chapter 4 Machinery Section 14, except that the maximum permissible primary general membrane stress is not exceed the lower of the following ratios:

$$\frac{U}{A} \text{ or } \frac{Y}{B}$$

Where;

Y = Specified minimum yield strength or %2 proof stress of the material, at ambient temperature, [N/mm^2]

U = Specified minimum tensile strength of the material at ambient temperature. [N/mm^2]

A = 3.5, Factor for Steel,

= 4.0, Factor for Cast Steel,

= 5.0, Factor for Nodular Cast Iron

B = 1.7, Factor for Steel,

= 2.0, Factor for Cast Steel,

= 3.0, Factor for Nodular Cast Iron

Oil seals between non-moving parts, forming part of the external pressure boundary, are to be of metal upon metal or equivalent type.

Oil seals between moving parts, forming part of the external pressure boundary, are to be duplicated, so that the failure of one seal does not render the actuator

Alternative arrangements providing equivalent protection against leakage may be accepted.

The strength and connection of the cylinder heads (or, in the case of actuators of the rotary type, the fixed vanes) acting as rudder stops are to comply with the provisions of this section.

4.12 Controls

4.12.1 Control of the main steering gear must be exercised from bridge. Control of the auxiliary steering gear must be exercised from the bridge, steering gear compartment or another suitable position. Controls must be mutually independent and so designed that the rudder cannot move unintentionally.

4.12.2 Means must also be provided for exercising control from the steering gear compartment. The transmission system must be independent of that serving the main steering station.

4.12.3 Suitable equipment is to be installed to provide means of communication between the bridge, all steering stations and the steering gear compartment.

4.12.4 The main steering gear and the auxiliary steering gear are to be arranged so that failure of one of the following components will not render the other inoperative:

- For electric steering gear: electric motor
- For hydraulic steering gear: Hydraulic pump or its prime mover
- For mechanical steering gear: mechanical components such as cables or chains but excluding the tiller.

Failures of single control components (e.g. control system for variable displacement pump or flow control valve) which may lead to loss of steering shall be monitored by an audible and visible alarm system on the navigating bridge, if loss of steering cannot be prevented by other measures.

Arrangements for bleeding air from the hydraulic system are to be provided where necessary.

An autopilot may be installed as a complement to main and auxiliary steering gears when it is possible to disconnect rapidly this autopilot. The main and auxiliary steering gears shall not be affected by the autopilot when disconnected.

If the autopilot is considered as an auxiliary steering gear, then the autopilot shall be reviewed as such.

4.13 Rudder angle indication

4.13.1 The rudder position must be clearly indicated on the bridge and at all steering stations. The rudder angle indication is to be independent of the steering gear control system and be supplied through the emergency switchboard, or by an alternative and independent source of electrical power.

Where the steering gear is operated electrically or hydraulically, the rudder angle must be indicated by a device (rudder position indicator) which is actuated either by the rudderstock itself or by parts which are mechanically connected to it. In case of time-dependent control of the main and auxiliary steering gear, the midship position of the rudder must be indicated on the bridge by some additional means (signal lamp or similar). In general, this indicator is still to be fitted even if the second control system is a manually operated hydraulic system. See also Part B Chapter 5 - Electrical Installations, Section 9, C.

4.13.2 The actual rudder position during the service must be indicated at the steering gear itself.

It is recommended that an additional rudder angle indicator should be fitted at the main engine control station.

4.14 Piping and hoses

4.14.1 Pipes of the hydraulic steering gear systems are to be installed in such a way as to ensure maximum protection while remaining readily accessible.

The power piping for hydraulic steering gears is to be arranged so that transfer between units can be readily affected.

Pipes are to be installed at a sufficient distance from the ship's shell. As far as possible, pipes should not pass through cargo spaces.

Connections to other hydraulic systems are not permitted.

4.14.2 Piping, joints, valves, flanges and other fittings are to comply with TL's requirements for Class 1 components.

4.14.3 Hose assemblies of type approved by TL may be installed between two points where flexibility is required but should not be subjected to torsional deflection (twisting) under normal operating conditions. In general, the hose should be limited to the length necessary to provide for flexibility and for proper operation of machinery.

Hoses should be high pressure hydraulic types according to recognized standards and suitable for the fluids, pressures, and temperatures and ambient conditions in question.

Burst pressure of hoses should not be less than 4 times of the design pressure.

4.15 Oil level indicators, filters

4.15.1 Each tanks of the hydraulic system are to be fitted with oil level indicators.

4.15.2 The lowest permissible oil level is to be monitored. Audible and visual alarms are to be provided for the navigation bridge and in the machinery space or machinery control room. The alarm on the navigation bridge shall be an individual alarm.

4.15.3 Filters or equivalent arrangements for cleaning the operating fluid are to be fitted in the piping system, to maintain the cleanliness of the hydraulic fluid taking into consideration the type and design of the hydraulic system. Filters of appropriate mesh fineness are to be provided in the piping system, in particular to ensure the protection of the pumps.

torque and maximum working torque of the steering

4.16 Storage tank

In hydraulically operated main steering gear systems, an additional permanently installed storage tank is to be fitted which has a capacity sufficient to refill at least one of the control systems including the service tank.

The storage tank is to be permanently connected by pipes to the control systems so that the latter can be refilled from a position inside the steering gear compartment.

4.17 Arrangement

Steering gears are to be so installed that they are easily accessible and to be maintainable.

5. Electrical systems

Electrical systems should comply with the requirements of TL (see Chapter 5 - Electrical Installations, Section 7, A). However following requirements shall be complied with as minimum.

5.1 Application

The provisions of 5.2 to 5.6 apply to all electric or electrohydraulic steering gear.

The provisions of 5.7 and 5.8 apply to steering gear where main and auxiliary steering gears are electric or electrohydraulic.

5.2 Power circuit supply

The circuits supplying electric or electrohydraulic steering gear are to have adequate rating for supplying all motors which can be simultaneously connected to them and may be required to operate simultaneously.

The main electric or electrohydraulic steering gear is to be supplied directly by the main switchboard.

5.3 Motors and associated control gear

5.3.1 To determine the required characteristics of the electric motors for power units, the breakaway gear under all operating conditions are to be considered. The ratio of pull- out torque to rated torque is to be at least 1,6.

5.3.2 Motors for steering gear power units may be rated for intermittent power demand.

The rating is to be determined on the basis of the steering gear characteristics of the ship in question; the rating is always to be at least:

- S3 − 40% for motors of electric steering gear power units
- S6 − 25% for motors of electrohydraulic steering gear power units and for convertors.

5.3.3 Each electric motor of a main or auxiliary steering gear power unit is to be provided with its own separate motor starter gear, located within the steering gear compartment.

5.4 Supply of motor control circuits and steering gear control systems

5.4.1 Each control for starting and stopping of motors for power units is to be served by its own control circuits supplied from its respective power circuits.

5.4.2 Any electrical main and auxiliary steering gear control system operable from the navigating bridge is to be served by its own separate circuit supplied from a steering gear power circuit from a point within the steering gear compartment, or directly from switchboard busbars supplying that steering gear power circuit at a point on the switchboard adjacent to the supply to the steering gear power circuit. The power supply systems are to be protected selectively.

5.5 Circuit protection

5.5.1 Short-circuit protection is to be provided for each control circuit and each power circuit of electric or electro- hydraulic main and auxiliary steering gears

.

5.5.2 No protection other than short-circuit protection is to be provided for steering gear control system supply circuits.

5.5.3 Protection against excess current (e.g. by thermal relays), including starting current, if provided for power circuits, is to be for not less than twice the full load cur- rent of the motor or circuit so protected, and is to be arranged to permit the passage of the appropriate starting currents.

5.5.4 Steering gear motor circuits obtaining their power supply via an electronic converter, e.g. for speed control, and which are limited to full load current are exempt from the requirement to provide protection against excess current, including starting current, of not less than twice the full load current of the motor. The required overload alarm is to be set to a value not greater than the normal load of the electronic converter.

Note: "Normal load" is the load in normal mode of operation that approximates as close as possible to the most severe conditions of normal use in accordance with the manufacturer's operating instructions.

5.5.5 Where fuses are fitted, their current ratings are to be twice the rated current of the motors. However, in the case of intermittent service motors, the fuse rating is not to exceed 160% of the rated motor current.

5.5.6 The instantaneous short-circuit trip of circuit breakers is to be set to a value not greater than 15 times the rated current of the drive motor.

5.5.7 The protection of control circuits is to correspond to at least twice the maximum rated current of the circuit, though not, if possible, below 6 A.

5.6 Starting and stopping of motors for steering gear power units

5.6.1 Motors for power units are to be capable of being started and stopped from a position on the navigation bridge and from a point within the steering gear compartment.

5.6.2 Means are to be provided at the position of motor starters for isolating any remote control starting and stopping devices (e.g. by removal of the fuse-links or switching off the automatic circuit breakers).

5.6.3 Main and auxiliary steering gear power units are to be arranged to restart automatically when power is restored after a power failure.

5.7 Power circuit supply in case of electric or electrohydraulic main and auxiliary steering gears

5.7.1 Electric or electrohydraulic steering gear is to be served by at least two exclusive circuits fed directly from the main switchboard; however one of the circuits may be supplied through the emergency switchboard.

5.7.2 Auxiliary electric or electrohydraulic steering gear, associated with main electric or electrohydraulic steering gear, may be connected to one of the circuits supplying the main steering gear.

5.8 Separation in case of electric or electrohydraulic main and auxiliary steering gears

5.8.1 Where electric or electrohydraulic main and auxiliary steering gears are provided, the supply and associated control cables are to follow different routes which are to be as far as practicable separated both vertically and horizontally.

5.8.2 In the case of double follow-up control, the amplifier is to be designed and fed so as to be electrically and mechanically separated. In the case of non-follow-up control and follow-up control, it is to be ensured that the follow-up amplifier is protected selectively.

5.8.3 Control circuits for additional control systems, e.g. steering lever or autopilot, are to be designed for all- pole disconnection.

5.8.4 The feedback units and limit switches, if any, for the steering gear control systems are to be separated electrically and mechanically connected to the rudder stock or actuator separately.

6. Control, monitoring and alarm systems

6.1 Monitoring and alarm systems, including the rudder angle indicators, should be designed, built and tested to the satisfaction of TL.

6.2 Where the hydraulic locking, caused by a single failure, may lead to loss steering, an audible and visual alarm, which identifies the failed system, shall be provided on the navigating bridge.

6.3 Audible and visual alarm should be activated whenever:

- Position of the variable displacement pump control system does not correspond with given order; or

- Incorrect position of 3-way full flow valve or similar in constant delivery pump system is detected.

6.4 Displays and alarms are to be provided in the locations indicated in Table 3.1.

7. Steering gear room arrangement

The steering gear compartment is to be:

7.1 Readily accessible and, as far as practicable, separated from machinery spaces, and

7.2 Provided with suitable arrangements to ensure working access to steering gear machinery and controls. These arrangements are to include handrails and gratings or other non-slip surfaces to ensure suitable working conditions in the event of hydraulic fluid leakage.

8. Rudder actuator installation

8.1 Rudder actuators are to be installed on foundations of strong construction so designed as to allow the transmission to the ship structure of the forces resulting from the torque applied by the rudder and/or by the actuator, considering the strength criteria defined in item 12 and 9.1. The structure of the ship in way of the foundations is to be suitably strengthened.

8.2 Seating of the steering gear has to be applied according to Part B Chapter 4 Machinery Section 2, K. In case of seating on cast resin the forces according to the elastic limit torque of the rudder shaft as well as the rudder bearing forces have to be transmitted to the ship's structure by welded stoppers.

Table 3.1: Location of displays and alarms

Item	Display	Alarms (audible and visible)	Location		
			Navigation Bridge (1)	**Steering gear compartment**	**Steering gear compartment or engine room**
Indication that electric motor of each power unit is running	X		X		X
Power failure of each power unit		X	G		X
Overload of electric motor of each power unit		X	G		X
Phase failure of electric motor of each power unit **(2)**		X	G		X
Low level of each hydraulic fluid reservoir		X	G		X
Hydraulic lock		X	G		X
Power failure of each control system		X	X		
Rudder angle indicator	X		X	X	

(1) *G: Group alarm*
(2) *Where three-phase supply is used.*

8.3 Where the rudder actuators are bolted to the hull, the grade of the bolts used is not to be less than 8.8. Unless the bolts are adjusted and fitted with a controlled tightening, strong shocks are to be fitted in order to prevent any lateral displacement of the rudder actuator.

8.4 The fixation of actuators on ship's structure built in composite materials is to be designed to prevent their loss.

9. Overload protections

9.1 Mechanical rudder stops

9.1.1 The steering gear is to be provided with strong rudder stops capable of mechanically stopping the rotation of the rudder at an angle slightly greater than its maximum working angle. Alternatively, these stops may be fitted on the ship to act on another point of the mechanical transmission system between the rudder actuator and the rudder blade. These stops may be built the rudder may be oriented to more than 35° at very in with the actuator design.

9.1.2 The scantlings of the rudder stops and of the components transmitting to the ship's structure the forces applied on these stops are to be determined in accordance with item 12.

As a general rule, the rudder stops are to be fitted between the rudder actuator and the rudder stock, unless the rudder stock as well as all the components transmitting mechanical forces between the rudder actuator and the rudder blade are suitably strengthened.

9.2 Rudder angle limiters

9.2.1 Power-operated steering gear is to be provided with positive arrangements, such as limit switches, for stopping the gear before the rudder stops are reached. These arrangements are to be synchronised with the gear itself and not with the steering gear control.

9.2.2 For power-operated steering gears and where reduced speed, it is recommended to fit a limit system

35° for full speed. A notice is to be displayed at all steering wheel stations indicating that rudder angles of more than 35° are to be used only at very reduced speed.

9.3 Relief valves

Relief valves are to be fitted in accordance with item 4.8.

9.3 Buffers

Buffers are to be provided on all ships fitted with mechanical steering gear. They may be omitted on hydraulic gear equipped with relief valves or with calibrated bypasses.

10. Means of communication

Means of communication between the navigation bridge and the steering gear compartment is to be provided in accordance with Chapter 35-C Electrical Installations.

11. Operating instructions

Where applicable, the following standard signboard should be fitted at a suitable place on steering control post on the bridge or incorporated into operating instruction board:

CAUTION

IN SOME CIRCUMSTANCES WHEN 2 POWER UNITS ARE RUNNING SIMULTANEOUSLY, THE RUDDER MAY NOT RESPOND TO HELM. IF THIS HAPPENS, STOP EACH PUMP IN TURN UNTIL CONTROL IS REGAINED.

The above signboard is related to steering gears provided with 2 identical power units intended for simultaneous operation, and normally provided with either their own control systems or two separate (partly or mutually) control systems which are/may be operated simultaneously.

12. Scantling of components

The scantlings of steering gear components are to be determined considering the design torque M_T, the resulting combined stresses σ_c and the permissible stresses σ_a, as follows:

12.1 For all components:

$$M_T = M_{TR}$$

$$\sigma_a = \frac{118}{k}$$

12.2 For all components which are subject to loads induced by the steering gear power unit, M_T is calculated considering the steering gear pushed against the mechanical rudder stops by the power unit. The following permissible stress is to be taken into account:

$$\sigma_a = \frac{148}{k}$$

For example, for electrohydraulic steering gear, the design torque will be based on an actuator force taking into account the design pressure and a lever resulting from a position where the steering gear is positioned against the mechanical rudder stops.

12.3 For all components in manual steering gear used as auxiliary steering gear the following rudder torque M_T can be taken into account:

$$M_T = \left(\frac{V_E}{V_{AV}}\right)^2 \cdot M_{TR}$$

where:

V_E = 7,0 if $V_{AV} \leq 14$

V_E = $0{,}5 \cdot V_{AV}$ if $V_{AV} > 14$

The following permissible stress is to be used:

$$\sigma_a = \frac{118}{k}$$

12.4 Tillers and quadrants

12.4.1 The scantling of tillers and quadrants are to be determined as follows:

- The depth H_0 of the boss is not to be less than $0{,}75 \cdot ds$

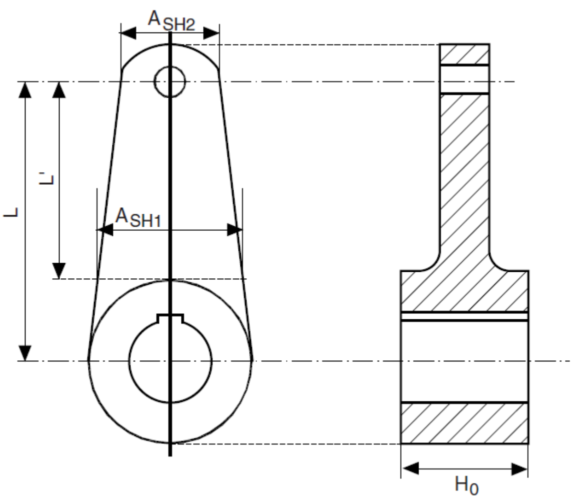
- The scantlings are to be designed by direct calculation in accordance with item 12.

As an example, for a typical tiller as presented in Figure 3.1, the following stresses should be taking into account:

- Bending and shear stresses in way of section A_{SH}
- Shear stresses in way of section A_{SH2}

- Torsional shear stresses in way of tiller boss.

Figure 3.1 - Tiller Arm



12.4.2 Keys are to satisfy the following provisions:

- Tiller fitted with keys are to be in metallic material.

- The width of the key is not to be less than: $0{,}25 \cdot d_s$

- The thickness of the key is not to be less than: $0{,}10 \cdot d_s$

- The ends of the keyways in the rudder stock and in the tiller (or rotor) are to be rounded and the keyway root fillets are to be provided with small radii of not less than 5% of the key thickness.

- For such system fitted on composite rudder stocks, examination is to be made by the Society on a case-by-case basis, with direct calculation on all component of the system.

  As a rule, tillers of this type do not required a key. They are generally fitted in way of plane area on the rudder stock and coupling is made by the shape of the tiller and the rudder stock.

12.4.3 Bolted tillers and quadrants are to satisfy the following provisions:

For arrangements such as shown in Fig 2, the bolt diameter is not to be less than the value db, in mm, calculated from the following formula:

$$d_b = 153 \cdot \sqrt{\frac{M_{TR}}{n \cdot (b + 0{,}5 \cdot d_{se})} \cdot \frac{235}{R_{eb}}}$$

Where:

n = Number of bolts located on the same side in respect of the stock axis (n is not to be less than 2)

b = Distance between bolts and stock axis, in mm (see Figure 3.2)

R_{eb} : Yield stress, in N/mm^2, of the bolt material.

- For other arrangements, direct calculations are to be made to check the following stresses in the bolts:

- Tensile stresses, in N/mm^2, to be less than the allowable tensile stress of the bolts material

- Shear stresses, in N/mm^2, to be less than the allowable shear stress of the bolt material.

- The thickness of each tightening flange of the two parts of the tiller is not to be less than:

where:

D_e = External boss diameter, in mm (average value)

R_{eH} = As defined in A.3.

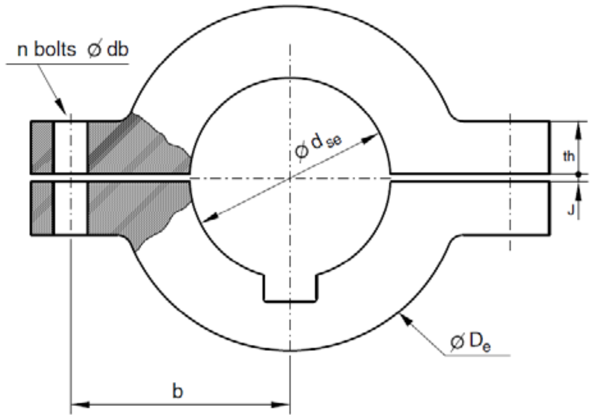


Figure 3.2 - Bolted tillers

- In order to ensure the efficient tightening of the coupling around the stock, the two parts of the tiller are to bored together with a shim having a thickness not less than the value j, in mm, calculated from the following formula:

$j = 0{,}0015 \cdot d_{se}$

where:

d_{se} = Actual diameter, in mm, of the upper part of the rudder stock in way of the tiller.

Special examination for the fitting of such tiller system on hollow section rudder stock is to be carried out

- For such system fitted on composite rudder stocks, examination is to be made by the Society on a case-by-case basis, with direct calculation on all components of the system.

As a rule, tillers of this type do not require a key.

They are generally fitted in way of plane area on the rudder stock and coupling is made by the shape of the tiller and the rudder stock.

12.4.4 Shrink-fit connections of tiller (or rotor) to stock are to comply with the provisions of the Rules for Steel Ships, Part A Chapter 1 Hull Section 18.

12.5 Piston rods

The scantling of the piston rod is to be determined taking into account the bending moments, if any, in addition to compressive or traction forces and is to satisfy the following provisions:

- $\sigma_c \leq \sigma_a$

where:

σ_c = Combined stress according to item A.3

σ_a = Permissible stress according to item 12

- In respect of the buckling strength:

$$\frac{4}{\pi \cdot {D_2}^2} \cdot \left(\omega F_C + \frac{8M}{D_2}\right) \leq 0{,}9 \cdot \sigma_a$$

Where:

D_2 = Piston rod diameter, in mm

F_c = Compression force in the rod, in N, when it extends to its maximum stroke

M = Possible bending moment in the piston rod, in N.mm, in way of the fore end of the cylinder rod bearing

$$\omega = \beta + (\beta^2 - \alpha)^{0{,}5}$$

$$\alpha = 0{,}0072(l_s \cdot D_2)^2 \cdot R'_e$$

$$\beta = 0{,}48 + 0{,}5\alpha + 0{,}1\alpha^{0{,}5}$$

C. Requirements for Several Rudders

1. General

1.1 In addition to the provisions of subsection C, as applicable, ships equipped with two or more aft rudders are to comply with the provisions of this subsection C.

1.2 Where the ship is fitted with two or more rudders, each having its own actuation system, the latter need not be duplicated.

1.3 Where the rudders are served by a common actuating system, the diameter of the rudder stock is to be replaced by the equivalent diameter d obtained from the following formula:

$$d = \sqrt[3]{\sum_{j}^{n} d_j^{\,3}}$$

with:

d_j = Rule diameter of the upper part of the rudder stock of each rudder in way of the tiller.

1.4 Where the ship has several rudders, a system for synchronising the movement of both rudders is to be fitted, either:

- By a mechanical coupling, or
- By other systems giving automatic synchronising adjustment.

1.5 Where the synchronisation of the rudder motion is not achieved by a mechanical coupling, the following provisions are to be met:

- The angular position of each rudder is to be indicated on the navigation bridge
- The rudder angle indicators are to be independent from each other and, in particular, from the synchronizing system
- In case of failure of the synchronising system, means are to be provided for disconnecting this system so that steering capability can be maintained or rapidly regained.

D. Requirements for Thrusters as Steering Means

1. General

1.1 The main and auxiliary steering gears referred to in subsection 2 may consist of thrusters of the following types:

- Azimuth thrusters
- Water-jets
- Cycloidal propellers,

Relevant provisions of Part A Chapter 1 Hull shall be complied with for abovementioned items.

1.2 Thrusters used as steering means are to be fitted with a main actuation system and an auxiliary actuation system.

1.3 Where the steering means of the ship consists of two or more thrusters, their control system is to include a device ensuring an automatic synchronisation of the thruster rotation, unless each thruster is so designed as to withstand any additional forces resulting from the thrust exerted by the other thrusters.

1.4 Where the ship is fitted with one azimuth thruster used as the sole steering means, this thruster is to comply with B.4.12.1 as applicable, except that:

1.4.1 The main actuation system is required to be capable of a rotational speed of at least 0,4 rpm and to be operated by power where the expected steering torque exceeds
1,5 kNm

1.4.2 the auxiliary actuation system is required to be capable of a rotational speed of at least 0,1 rpm and to be operated by power where the expected steering torque exceeds 3 kNm.

1.5 Where the auxiliary steering gear consists of one or more azimuth thrusters, at least one such thruster is to be capable of:

- Steering the ship at maximum ahead service speed
- Being brought speedily into action in case of emergency
- A rotational speed of at least 0,4 rpm.

The auxiliary actuation system referred to in 1.2 need not be fitted.

1.6 Where the steering means of the ship consists of two independent azimuth thrusters or more, the auxiliary actuation system referred to in 1.2 need not be fitted provided that:

- The thrusters are so designed that the ship can be steered with any one out of operation

- The actuation system of each thruster complies with 1.4.2

1.7 The use of water-jets as steering means are to be given special consideration by the Society.

E. Certification, Inspection and Testing

1. Type tests

Each type of power unit pump is to be subjected in the workshop to a type test of not less than 100 hours' duration.

The test arrangements are to be such that the pump may run both in idling conditions, and at maximum delivery capacity at maximum working pressure.

During the test, idling periods are to be alternated with periods at maximum delivery capacity at maximum working pressure. The passage from one condition to another is to occur at least as quickly as on board.

During the test, no abnormal heating, excessive vibration or other irregularities are permitted.

After the test, the pump is to be disassembled and inspected.

Note: Type tests may be waived for a power unit which has been proven to be reliable in marine service.

2. Testing of materials

2.1 Components subject to pressure or transmitting mechanical forces

2.1.1 Materials of components subject to pressure or transmitting mechanical forces, specifically:

- Cylindrical shells of hydraulic cylinders, rams and piston rods

- Tillers, quadrants

- Rotors and rotor housings for rotary vane steering gear

- Hydraulic pump casings, and

- Hydraulic accumulators, if any,

are to be duly tested, including examination for internal defects, in accordance with the requirements of Part A Chapter 2 Material and Chapter 3 Welding.

2.1.2 A works' certificate may be accepted for low stressed parts, provided that all characteristics for which verification is required are guaranteed by such certificate.

2.2 Inspection and tests during manufacturing

2.2.1 Components subject to pressure or transmitting mechanical forces

The mechanical components referred to in item 2.1 are to be subjected to appropriate non-destructive tests. For hydraulic cylinder shells, pump casings and accumulators, refer to the TL Rules concerning Pressure Vessels.

Defects may be repaired by welding only on forged parts or steel castings of weldable quality. Such repairs are to be conducted under the supervision of the Surveyor in accordance with the applicable requirements of Part A Chapter 2 Material and Chapter 3 Welding.

2.2.2 Hydraulic piping, valves and accessories

Hydraulic piping, valves and accessories are to be inspected and tested during manufacturing in accordance with Section 4, for a class I piping system.

3. Inspection and tests after completion

3.1 Hydrostatic tests

Hydraulic cylinder shells and accumulators are to be subjected to hydrostatic tests according to the relevant provisions of TL Rules concerning Pressure Vessels.

Hydraulic piping, valves and accessories and hydraulic pumps are to be subjected to hydrostatic tests according to the relevant provisions of Section 4.

3.2 Shipboard tests

After installation on board the ship, the steering gear is to be subjected to the tests detailed in Section 1.

3.3 Sea trials

For the requirements of sea trials, refer to Section 1.

SECTION 4

HULL PIPING SYSTEM (PIPE LINES, VALVES, FITTINGS AND PUMPS)

Page

A. Piping Systems (General)

1. General

1. 1 Scope

These requirements apply to the design, testing, and certification of pipe lines and pumping systems, whether they are pressurized or not, including pumps, pipes, tubes, hoses, valves, fittings such as elbows, flanges, glands, filters and collectors etc. which are necessary for the operation of the main propulsion plant together with its auxiliaries and equipment.

The requirements in this section are to be applied the metallic or non-metallic pipe lines and pumping system.

1.2 General Measures for protection of piping

1.2.1 The arrangement of supports and collars is to be such that pipes and flanges are not subjected to abnormal bending stresses, taking into account their own mass, the metal they are made of, and the nature and characteristics of the fluid they convey, as well as the contractions and expansions to which they are subjected. Heavy components in the piping system, such as valves, are to be independently supported.

1.2.2 Pipes are to be efficiently protected against mechanical shocks, particularly in their most exposed parts.

1.2.3 Pipes are to be efficiently protected against corrosion, particularly in their most exposed parts, either by selection of their constituent materials, or by an appropriate coating or treatment.

1.2.4 The layout and arrangement of sea water pipes are to be such as to prevent sharp bends and abrupt changes in section as well as zones where water may stagnate. The inner surface of pipes is to be as smooth as possible, especially in way of joints. Where pipes are protected against corrosion by means of galvanising or other inner coating, arrangements are to be made so that this coating is continuous, as far as possible, in particular in way of joints.

1.2.5 If galvanised steel pipes are used for sea water systems, the water velocity is not to exceed 3 m/s. If copper pipes are used for sea water systems, the water velocity is not to exceed 2 m/s.

1.2.6 Arrangements are to be made to avoid galvanic corrosion.

1.2.7 Pipes are to be adequately insulated against cold wherever deemed necessary to prevent frost.

1.2.8 This applies specifically to pipes passing through refrigerated spaces and which are not intended to ensure the refrigeration of such spaces.

1.2.9 All pipes and other components where the surface temperature may exceed 80°C are to be efficiently insulated. Where necessary, precautions are to be taken to protect the insulation from being impregnated with flammable oils. Particular attention is to be paid to lagging in way of flanges.

1.2.10 Pipes made of heat sensitive materials are to be protected against contact with hot surfaces. Flexible pipes are to be secured to rigid pipes or fittings by corrosion resistant clips or pressed ferrules. For flexible piping of 25 mm diameter and above not less than two clips are to be fitted at each end. Where rubber or other heat sensitive material is used for hose, the run of hose is to be as direct as practicable, and the hose is to be adequately supported. If necessary, the hoses are to be protected against mechanical damage and contact with hot surfaces.

1.2 Documentation to be submitted

Chapter 4 Machinery Section 16 Item A.2 shall be applied as applicable.

1.3 Definitions

1.3.1 Piping and piping systems

1.3.1.1 Piping includes pipes and their connections, flexible hoses and expansion joints, valves and their actuating systems, other accessories (filters, level gauges, etc.) and pump casings.

1.3.1.2 Piping systems include piping and all the interfacing equipment such as tanks, pressure vessels, heat exchangers, pumps and centrifugal purifiers, but do not include boilers, turbines, internal combustion engines and reduction gears.

Note: The equipment other than piping is to be designed in accordance with the relevant Sections of Chapter 4.

1.3.2 Design pressure

1.3.2.1 The design pressure of a piping system is the pressure considered by the manufacturer to determine the scantling of the system components. It is not to be taken less than the maximum working pressure expected in this system or the highest setting pressure of any safety valve or relief device, whichever is the greater.

1.3.2.2 The design pressure of steam piping located upstream of pressure reducing valves (high pressure side) is not to be less than the setting pressure of the boiler or super heater safety valves.

1.3.2.3 The design pressure of a piping system located on the low pressure side of a pressure reducing valve where no safety valve is provided is not to be less than the maxi- mum pressure on the high pressure side of the pressure reducing valve.

1.3.2.4 The design pressure of a piping system located on the delivery side of a pump or a compressor is not to be less than the setting pressure of the safety valve for displacement pumps or the maximum pressure resulting from the operating (head-capacity) curve for centrifugal pumps, whichever is the greater.

1.3.3 Design temperature

The design temperature of a piping system is the maximum temperature of the medium inside the system.

1.3.4 Flammable oils

Flammable oils include fuel oils, lubricating oils, thermal oils and hydraulic oils.

1.4 Symbols

p = Design pressure, in MPa

T = Design temperature, in °C

t = Rule required minimum thickness, in mm

D = Pipe external diameter, in mm.

1.5 Class of piping systems

1.5.1 Piping systems are subdivided into three classes, denoted as class I, class II and class III, for the purpose of acceptance of materials, selection of joints, heat treatment, welding, pressure testing and the certification of fittings.

1.5.2 Definition of the classes of piping systems Classes I, II and III are defined in Table 4.1.

1.6 Materials

1.6.1 General

Materials to be used in piping systems are to be suitable for the medium and the service for which the piping is intended.

1.6.2 Use of metallic materials

1.6.2.1 Pipes, elbows, fittings, valve casings, flanges and semi finished products intended to be used in pipe class I and II are to be manufactured by TL approved manufacturers.

1.6.2.2 For the use in pipe class III piping systems an approval according to other recognized standards may be accepted.

1.6.2.3 Mechanical characteristics required for metallic materials are specified in Chapter 2 Material.

1.6.3 Use of plastics

Plastics may be used for piping systems belonging to class III in accordance with relevant subsection of this section. The use of plastics for other systems or in other conditions will be given special consideration. Plastics intended for piping systems dealt with in this Section are to be of a type approved by the Society.

Table 4.1 - Class of piping systems

Media conveyed by the piping system	Class I	Class II (1) (2)	Class III (3)
Flammable media: - heated above flashpoint, or - having flashpoint < 60°C	without special safeguards **(4)**	with special safeguards **(4)**	not applicable
Fuel oil **(5)** Lubricating oil Flammable hydraulic oil **(6)**	p > 1,6 or T > 15	other **(7)**	p ≤ 0,7 and T ≤ 60
Other media **(6) (8)**	p > 4 or T > 300	other **(7)**	p ≤ 1,6 and T ≤ 200

(1) *Valves under static pressure on oil fuel tanks or lubricating oil tanks belong to class II.*
(2) *Valves and fittings fitted on the ship side and collision bulkhead belong to class II.*
(3) *The open ended pipes, irrespective of T, generally belong to class III (as drains, overflows, vents, exhaust gas lines, boiler escape pipes, etc.).*
(4) *Safeguards for reducing leakage possibility and limiting its consequences: e.g. pipes led in positions where leakage of internal fluids will not cause a potential hazard or damage to surrounding areas which may include the use of pipe ducts, shielding, screening etc.*
(5) *Design pressure for fuel oil systems is to be determined in accordance with Tab 4.*
(6) *Steering gear hydraulic piping system belongs to class I irrespective of p and T.*
Note: Flammable media generally include the flammable liquids as oil fuel, lubricating oil and flammable hydraulic oil

Table 4.2 - Definition of the design pressure for fuel oil systems

Working pressure P, in MPa	Working temperature T, in °C	
	T ≤ 60	T > 60
P ≤ 0,7	0,3 MPa or Pmax, whichever is the greater	0,3 MPa or Pmax, whichever is the greater
P > 0,7	Pmax	1,4 MPa or Pmax, whichever is the greater

Pmax : Maximum working pressure

1.6.4 Use of flexible piping

Flexible piping may be used for ships of less than 12 m in length and for piping systems belonging to class III. The use of flexible piping for other systems or in other conditions will be given special consideration. Exceptional use of flexible piping for ships of 12 m in length and over will be given special consideration.

Requirements for use of flexible piping shall be as defined in this section.

1.6.5 For pipes, valves and fittings of steel, Chapter 4 Machinery Section 16 B.2.2 shall apply.

1.6.6 For pipes, valves and fittings of copper and copper alloys Chapter 4 Machinery Section 16 B.2.3 shall apply.

1.6.7 For pipes, valves and fittings of nodular cast iron, Chapter 4 Machinery Section 16 B.2.4 shall apply.

1.6.8 For pipes, valves and fittings of lamellar graphite cast iron (grey cast iron); Chapter 4 Machinery Section 16 B.2.5 shall apply.

2 Wall Thickness and Elasticity

2.1 Thickness of pressure piping

The pipe thickness stated in Tables 4.3, 4.4, 4.5, 4.6 is the assigned minimum thicknesses, unless due to stress analysis, greater thicknesses are necessary.

The following formula is to be used for calculating the wall thicknesses of cylindrical pipes and bends subject to internal pressure and as not being less than Tables 4.3, 4.4, 4.5, 4.6:

$$s = \frac{100 \cdot (s_0 + c + b)}{(100 - a)}$$

$$s_0 = \frac{D \cdot p}{2 \cdot \sigma_{perm} \cdot v + p}$$

where:

p = Design pressure, in MPa

D = Pipe external diameter, in mm.

σ_{perm} = Permissible stress

v = Weld efficiency factor to be:

- Equal to 1 for seamless pipes and pipes fabricated according to a welding procedure approved by the Society

- Specially considered by the Society for other welded pipes, depending on the service and the manufacture procedure

b = Thickness reduction, in mm, due to bending

c = Corrosion allowance

a = Negative manufacturing tolerance percentage that is equal to 10 for copper and copper alloy pipes, cold drawn seamless steel pipes and steel pipes fabricated according to a welding procedure approved by the Society and equal to 12,5 for hot laminated seamless steel pipes subject to special consideration by the Society in other cases.

The thickness thus determined does not take into account the particular loads to which pipes may be subjected. Attention is to be drawn in particular to the case of high temperature and low temperature pipes.

2.2 Permissible stress: K

2.2.1 The permissible stress K to be considered in the item 2.1 is given in Table 4.7 for carbon and carbon-manganese steel pipes, in Table 4.8 for alloy steel pipes and in Table 4.9 for copper and copper alloy pipes

2.2.2 Where, for carbon steel and alloy steel pipes, the value of the permissible stress K is not given in Table 4.7 or Table 4.8, it is to be taken equal to the lowest of the following values:

$$\frac{R_{m,20}}{2.7}$$

$$\frac{R_e}{A}$$

$$\frac{S_R}{A}$$

$$S$$

Where:

$R_{m,20}$ = Minimum tensile strength of the material at ambient temperature (20°C), in N/mm^2

R_e = Minimum yield strength or 0,2% proof stress at the design temperature, in N/mm^2

S_R = Average stress to produce rupture in 100000 h at design temperature, in N/mm^2

S = Average stress to produce 1% creep in 100000 h at design temperature, in N/mm^2

A = Safety factor to be taken equal to 1,6 when R_e and S_R values result from tests attended by the Society, 1,8 otherwise

2.2.3 The permissible stress values adopted for materials other than carbon steel, alloy steel, copper and copper alloy is to be specially considered by the Society.

Table 4.3 - Minimum wall thickness for steel pipes

External diameter, in mm	Minimum nominal wall thickness, in mm			Minimum reinforced wall thickness, in mm (4)	Minimum extra-reinforced wall thickness, in mm (5)
	Pipes in general (1)	Vent, overflow and sounding pipes for integral tanks (1) (2)	Sea water pipes, bilge and ballast systems (1) (3)		
10,2 - 12,0	1,6	–	–	–	–
13,5 - 19,3	1,8	–	–	–	–
20,0	2,0	–	–	–	–
21,3 - 25,0	2,0	–	3,2	–	–
26,9 - 33,7	2,0	–	3,2	–	–
38,0 - 44,5	2,0	4,5	3,6	6,3	7,6
48,3	2,3	4,5	3,6	6,3	7,6
51,0 - 63,5	2,3	4,5	4,0	6,3	7,6
70,0	2,6	4,5	4,0	6,3	7,6
76,1 - 82,5	2,6	4,5	4,5	6,3	7,6
88,9 - 108,0	2,9	4,5	4,5	7,1	7,8
114,3 - 127,0	3,2	4,5	4,5	8,0	8,8
133,0 - 139,7	3,6	4,5	4,5	8,0	9,5
152,4 - 168,3	4,0	4,5	4,5	8,8	11,0
177,8	4,5	5,0	5,0	8,8	12,7
197,7	4,5	5,4	5,4	8,8	12,7
219,1	4,5	5,9	5,9	8,8	12,7
244,5 - 273,0	5,0	6,3	6,3	8,8	12,7
298,5 - 368,0	5,6	6,3	6,3	8,8	12,7
406,4 - 457,2	6,3	6,3	6,3	8,8	12,7

(1) *Attention is drawn to the special requirements regarding:*

- bilge and ballast systems

- scupper and discharge pipes

- sounding, air and overflow pipes

- ventilation systems

- CO_2 fire-extinguishing systems (see Chapter 35-D Fire Safety).

(2) *For sounding pipes, the minimum wall thickness is intended to apply only to the part outside the tank.*

(3) *The minimum wall thickness for bilge lines and ballast lines through deep tanks is to be subject to special consideration by the Society.*

(4) *Reinforced wall thickness applies to pipes passing through tanks containing a fluid distinct from that conveyed by the pipe as well as for exposed parts of air pipes.*

(5) *Extra-reinforced wall thickness applies to pipes connected to the shell.*

General notes:

- A different thickness may be considered by the Society on a case by case basis, provided that it complies with recognised standards.

- For pipes efficiently protected against corrosion, the thickness may be reduced by an amount up to 1 mm.

- The thickness of threaded pipes is to be measured at the bottom of the thread.

- The minimum thickness listed in this table is the nominal wall thickness and no allowance is required for negative tolerance and reduction in thickness due to bending.

- Exhaust gas pipe minimum wall thickness is to be subject to special consideration by the Society.

Table 4.4 - Minimum wall thickness for copper and copper alloy pipes

External diameter, in mm	Minimum wall thickness, in mm	
	Copper	Copper alloy
8 - 10	1,0	0,8
12 - 20	1,2	1,0
25 - 44,5	1,5	1,2
50 - 76,1	2,0	1,5
88,9 - 108	2,5	2,0
133 - 159	3,0	2,5
193,7 - 267	3,5	3,0
273-457,2	4,0	3,5
470	4,0	3,5
508	4,5	4,0

Notes:
- The indicated values are valid for pipes in general, sea water pipes and vent, overflow and sounding pipes. When reinforced or extra-reinforced wall thicknesses are required, the values of, respectively, the first and second rows below are to be considered.
- A different thickness may be considered by the Society on a case-by-case basis, provided that it complies with recognised standards.

Table 4.5 - Minimum wall thickness for austenitic stainless steel pipes

External diameter, in mm	Minimum wall thickness, in mm
10,2 - 17,2	1,0
21,3 - 48,3	1,6
60,3 - 88,9	2,0
114,3 - 168,3	2,3
219,1	2,6
273,0	2,9
323,9 - 406,4	3,6
over 406,4	4,0

Notes:
- The indicated values are valid for pipes in general, sea water pipes and vent, overflow and sounding pipes. When reinforced or extra-reinforced wall thicknesses are required, the values of, respectively, the first and second rows below are to be considered.
- Diameters and thicknesses according to national or international standards may be accepted.

Table 4.6 - Minimum wall thickness for aluminium and aluminium alloy pipes

External diameter, in mm	Minimum wall thickness, in mm
0 - 10	1,5
12 - 38	2,0
43 - 57	2,5
76 - 89	3,0
108 - 133	4,0
159 - 194	4,5
219 - 273	5,0
above 273	5,5

Notes:
- The indicated values are valid for pipes in general, sea water pipes and vent, overflow and sounding pipes. When reinforced or extra-reinforced wall thicknesses are required, the values of, respectively, the first and second raws below are to be considered.
- A different thickness may be considered by the Society on a case-by-case basis, provided that it complies with recognised standards.

Table 4.7 - Permissible stress for carbon and carbon-manganese steel pipes

Specified minimum tensile strength, in N/mm^2	Design temperature, in °C			
	≤50	100	150	200
320	107	105	99	92
360	120	117	110	103
410	136	131	124	117
460	151	146	139	132
490	160	156	148	141

Table 4.8 - Permissible stress for alloy steel pipes

Type of steel	Specified minimum tensile strength, in N/mm^2	Design temperature, in °C		
		≤50	100	200
1Cr1/2Mo	440	159	150	137
2 1/4Cr1Mo annealed	410	76	67	57
2 1/4Cr1Mo normalised and tempered below 750°C	490	167	163	153
2 1/4Cr1Mo normalized and tempered above 750°C	490	167	163	153
1/2Cr 1/2Mo 1/4V	460	166	162	147

Table 4.9 - Permissible stress for copper and copper alloy pipes

Material (annealed)	Specified minimum tensile strength, in N/mm^2	Design temperature, in °C						
		≤50	75	100	125	150	175	200
Copper	215	41	41	40	40	34	27,5	18,5
Aluminium brass	325	78	78	78	78	78	51	24,5
Copper-nickel 95/5 and 90/10	275	68	68	67	65,5	64	62	59
Copper-nickel 70/30	365	81	79	77	75	73	71	69

2.3 Thickness reduction

Where applicable, reduction in thickness ”b” may be allowed due to bending of pipe. For straight pipes b=0.

$$b = \frac{(D \cdot s_o)}{2,5 . r}$$

Where:

r = Bending radius measured on the centre line of the pipe, in mm (if r is unknown, r=0.1 S_O)

D = Pipe external diameter, in mm.

S_O = coefficient defined in item 2.1.

2.4 Corrosion Allowance

The corrosion allowance, c, depends on the application of the pipe, in accordance with Part B Chapter 4 Machinery Section 16 Tables 16.12 and 16.13. With the agreement of TL, the corrosion allowance of steel pipes effectively protected against corrosion may be reduced by not more than 50 %. With agreement of TL, no corrosion allowance need be applied to pipes made of corrosion-resistant materials (e.g. austenitic steels and copper alloys) (see Part B Chapter 4 Machinery Section 16 Tables 16.8 and 16.9).

For pipes passing through tanks an additional corrosion allowance is to be considered according to the Chapter 4 Machinery Section 16 Table 16.12 and depending on the external medium, in order to account for the external corrosion.

2.5 T-Pipe Joints

As well as complying with the provisions of items 2.1 to 2.4 the thickness s_T of pipes on which a branch is welded to form a Tee is not to be less than that given by the following formula:

$$s_T = s_o + \left(\frac{s_o \cdot D_1}{D}\right)$$

Where:

D_1 = external diameter of the branch pipe

D = Pipe external diameter, in mm.

S_O = coefficient defined in item 2.1.

This requirement may be dispensed with for Tees provided with reinforcement or extruded.

3. Pipe connections

3.1 General

3.1.1 Pipe connections shall in general comply with Chapter 4 Machinery Section 16 D.2 however as not contradicting with the provision stated hereunder.

For relaxations or restrictions concerning type or service of the vessel, TL shall be agreed with.

3.1.2 The junctions between metallic pipe lengths or between metallic pipe lengths and fittings are to be made by:

- Direct welding (butt-weld, socket-weld)
- Bolted flanges (welded-on or screwed-on)
- Threaded sleeve joints, or
- Mechanical joints

Note: The expression "mechanical joints" means devices intended for direct connection of pipe lengths other than by welding, flanges or threaded joints.

3.1.3 The joints are to comply with a recognised standard or to be of a design proven to be suitable for the intended purpose and acceptable to the Society.

3.1.4 The number of joints in flammable oil piping systems is to be kept to the minimum necessary for mounting and dismantling purposes.

3.1.5 The gaskets and packings used for the joints are to suit the design pressure, the design temperature and the nature of the fluids conveyed.

3.1.6 The junction between plastic pipes is to comply with item 4.

3.2 Welded Connections

3.2.1 For welding of metallic piping, Part A Chapter 3 - Welding - Section 15 Welding of Pipelines shall be applied.

3.2.2 Welded connections are to be used in accordance with Table 4.10.

Welding and non destructive testing of welds are to be carried out in accordance with Part A Chapter 3 Welding.

3.2.2 Butt-welded joints are to be of full penetration type, with or without special provision for a high quality of root side.

Note: The expression "special provision for a high quality of root side" means that butt welds were accomplished as double welded or by use of a backing ring or inert gas back-up on first pass, or other similar methods accepted by the Society.

3.2.3 Slip-on sleeve and socket welded joints are to have sleeves, sockets and weldments of adequate dimensions in compliance with a standard recognised by the Society.

3.3 Flange connections

3.3.1 In general, the metallic flange connections used for piping systems are to be in compliance with a standard recognised by the Society.

3.3.2 The material used for flanges and gaskets is to be suitable for the nature and temperature of the fluid, as well as pipes on which the flanges are to be fitted.

3.3.3 The dimensions and configuration of flanges and bolts are to be chosen in accordance with recognised standard intended for design pressure and design temperature of the piping system. Otherwise, the flange connections are subject to special consideration.

3.3.4 Flanges are to be attached to the pipes by welding or screwing. Examples of acceptable metallic flange connections are shown in Part B Chapter 4 Machinery Section 16 Table 16.18. However, other types of flange connections may be also considered by the Society in each particular case, provided that they are in accordance with national or international standards applicable to the piping system and recognise the boundary fluids, design pressure and temperature conditions, external or cyclic loading and location.

Table 4.10 - Use of welded and threaded metallic joints in piping systems

Joints	**Permitted classes of piping**	**Restrictions of use**
Butt-welded, with special provision for a high quality of root side **(1)**	III, II, I	no restrictions
Butt-welded, without special provision for a high quality of root side **(1)**	III, II	no restrictions
Slip-on sleeve and socket welded **(2)**	III	no restrictions
Threaded sleeve joints with tapered thread **(3)**	I	not allowed for: - Pipes with outside diameter of more than 33,7 mm - Pipes inside tanks - Piping systems conveying flammable media or services where fatigue, severe erosion or crevice corrosion is expected to occur.
	III, II	not allowed for: - Pipes with outside diameter of more than 60,3 mm - Pipes inside tanks - Piping systems conveying flammable media or services where fatigue, severe erosion or crevice corrosion is expected to occur.
Threaded sleeve joints with parallel thread **(3)**	III	not allowed for: - Pipes with outside diameter of more than 60,3 mm - Pipes inside tanks - Piping systems conveying flammable media or services where fatigue, severe erosion or crevice corrosion is expected to occur.

(1) *For expression "special provision for a high quality of root side" see item 3.2.2*

(2) *Particular cases may be allowed by the Society for piping systems of Class I and II having outside diameter ≤ 88,9 mm except for piping systems conveying toxic media or services where fatigue, severe erosion or crevice corrosion is expected to occur.*

(3) *In particular cases, sizes in excess of those mentioned above may be accepted by the Society if they are found in compliance with a recognized national and/or international standard.*

Note: Other applications are to be specially considered by the Society.

3.3.5 Permitted applications are indicated in Part B Chapter 4 Machinery Section 16 Table 16.17.

3.4 Slip-on threaded joints

3.4.1 Slip-on threaded joints having pipe threads where pressure-tight joints are made on the threads with parallel or tapered threads are to comply with requirements of a recognised national or international standard and are to be acceptable to the Society.

3.4.2 Slip-on threaded joints may be used for piping systems in accordance with Table 4.10.

3.4.3 Threaded joints may be accepted also in CO2 piping systems, provided that they are used only inside protected spaces and in CO_2 cylinder rooms.

3.5 Mechanical joints

Due to the great variations in design and configuration of mechanical joints, specific recommendation regarding calculation method for theoretical strength calculations is not specified. The Type Approval is to be based on the results of testing of the actual joints.

Below specified requirements are applicable to pipe unions, compression couplings, slip-on joints as shown in Part B Chapter 4 Machinery Section 16 Table 16.19. Similar joints complying with these requirements may be acceptable.

3.5.1 Mechanical joints including pipe unions, compression couplings, slip-on joints and similar joints are to be of approved type for the service conditions and the intended application.

3.5.2 Where the application of mechanical joints results in reduction in pipe wall thickness due to the use of bite type rings or other structural elements, this is to be taken into account in determining the minimum wall thickness of the pipe to withstand the design pressure.

3.5.3 Construction of mechanical joints is to prevent the possibility of tightness failure affected by pressure pulsation, piping vibration, temperature variation and other similar adverse effects occurring during operation on board.

3.5.4 Material of mechanical joints is to be compatible with the piping material and internal and external media.

3.5.5 As far as applicable, the mechanical joints are to be tested to a burst pressure of 4 times the design pressure. For design pressures above 200 bar the required burst pressure is to be specially considered by the Society.

3.5.6 In general, mechanical joints are to be of fire resistant type as required by Part B Chapter 4 Machinery Section 16 Table 16.20.

3.5.7 Mechanical joints, which in the event of damage could cause fire or flooding, are not to be used in piping sections directly connected to the shell openings or tanks containing flammable fluids.

3.5.8 The mechanical joints are to be designed to withstand internal and external pressure as applicable and, where used in suction lines, are to be capable of operating under vacuum.

3.5.9 The number of mechanical joints in flammable liquid systems is to be kept to a minimum. In general, flanged joints conforming to recognised standards are to be used.

3.5.10 Piping in which a mechanical joint is fitted is to be adequately adjusted, aligned and supported. Supports or hangers are not to be used to force alignment of piping at the point of connection.

3.5.11 Slip-on joints are not to be used in pipelines in cargo holds, tanks, and other spaces which are not easily accessible, unless approved by the Society. Application of these joints inside tanks may be permitted only for the same media that is in the tanks. Unrestrained slip-on joints are to be used only in cases where compensation of lateral pipe deformation is necessary. Usage of these joints as the main means of pipe connection is not permitted.

3.5.12 Application of mechanical joints and their acceptable use for each service is indicated in Part B Chapter 4 Machinery Section 16 Table 16.20; dependence upon the class of piping, pipe dimensions, working pressure and temperature is indicated in Part B Chapter 4 Machinery Section 16 Table 16.21.

3.5.13 In some particular cases, sizes in excess of those mentioned above may be accepted by the Society if they are in compliance with a recognised national and/or international standard.

3.5.14 Application of various mechanical joints may be accepted as indicated by Part B Chapter 4 Machinery Section 16 Table 16.20. However, in all cases, acceptance of the joint type is to be subject to approval for the intended application, and subject to conditions of the approval and applicable Rules.

3.5.15 Mechanical joints are to be tested in accordance with a program approved by the Society, which is to include at least the following:

- Leakage test
- Vacuum test (where necessary)
- Vibration (fatigue) test
- Fire endurance test (where necessary)
- Burst pressure test
- Pressure pulsation test (where necessary)
- Assembly test (where necessary)
- Pull out test (where necessary).

4. Bending of pipes

4.1 This subsection applies to pipes made of Alloy or non-alloy steels and copper and copper alloys.

4.2 Bending process

The bending process is to be such as not to have a detrimental influence on the characteristics of the materials or on the strength of the pipes.

4.2.1 Bending radius

Unless otherwise justified, the bending radius measured on the centerline of the pipe is not to be less than twice the external diameter for copper and copper alloy pipes and 3 times the external diameter for cold bent steel pipes.

4.2.2 Acceptance criteria

4.2.2.1 The pipes are to be bent in such a way that, in each transverse section, the difference between the maximum and minimum diameters after bending does not exceed 10% of the mean diameter; higher values, but not exceeding 15%, may be allowed in the case of pipes which are not subjected in service to appreciable bending stresses due to thermal expansion or contraction.

4.2.2.2 The bending is to be such that the depth of the corrugations is as small as possible and does not exceed 5% of their length.

4.2.3 Hot bending

4.2.3.1 In the case of hot bending, all arrangements are to be made to permit careful checking of the metal temperature and to prevent rapid cooling, especially for alloy steels.

4.2.3.2 Hot bending is to be generally carried out in the temperature range 850°C-1000°C for all steel grades; however, a decreased temperature down to 750°C may be accepted during the forming process.

4.3 Heat treatment after bending

4.3.1 Copper and copper alloy

Copper and copper alloy pipes are to be suitably annealed after cold bending if their external diameter exceeds 50 mm.

4.3.2 Steel

4.3.2.1 After hot bending carried out within the temperature range specified in item 4.2.3, for C, C-Mn and C-Mo steels, no subsequent heat treatment is required however for Cr-Mo and C-Mo-V steels, a subsequent stress relieving heat treatment in accordance with Chapter 3 Welding Section 15 Table 15.6 is required.

4.3.2.2 After hot bending performed outside the temperature range specified in item 4.2.3.2, a subsequent new heat treatment in accordance with Chapter 3 Welding Section 15 Table 15.7 is required for all grades.

4.3.2.3 After cold bending at a radius lower than 4 times the external diameter of the pipe, a heat treatment in accordance with Chapter 3 Welding Section 15 Table 15.7 is required.

5. Plastic Pipes

5.1 General

5.1.1 The requirements in this section deal with the plastic pipes apply to all piping and piping systems independent of service or location. However, the plastic pipes may be used after special approval by TL. For testing and applications FTP CODE requirements will be provided.

5.1.2 Material properties and manufacturing methods of plastic pipes are to be approved by TL to be used for marine applications. Plastics pipes are produced of following material compositions, separately or combined:

- Elastomers (entirely elastic structured),
- Thermoplastics (solid under ambient atmospheric conditions, but can be reshaped by heat treatment),
- Thermosets (permanently solid, cannot be melted or re-shaped after cured due to the resin based additives),

Thermoset plastics are applicable for coating, moulding or Glassfiber reinforced.

Glassfiber Reinforced Plastic (GRP) pipes approved the requirements in this section are accepted by TL to be used in marine applications.

5.1.3 Plastic piping systems including valves, fittings, connecting pieces etc. are to be designed and manufactured according to the recognized standards and be subjected by the manufacturer to a continuous TL approved quality control.

Piping systems and pipe lines made of plastic material including pipes, valves, fittings, connecting pieces, whether reinforced or not, must have TL type approval certificate to be used in marine applications.

The following documents apply to type approval certificate by TL:

- Durability and tightness test results against to the design pressure and design temperature, and performance characteristics and response for surrounding and/or contained chemical medium previously carried out by the manufacturer,
- National and international standards and codes about plastic pipes applied to the design and manufacturing stages,
- Plans, drawings, documents including design calculations and functional descriptions,
- Documentation verifying manufacturer's quality management system,
- Detailed sectional assembly drawings of piping components.

5.1.4 Plastic pipes and fittings are to be permanently marked with identification, including:

- Pressure ratings
- The design standards that the pipe or fitting is manufactured in accordance with
- The material of which the pipe or fitting is made.

5.1.5 Approved plastic piping system shall also meet the following additional performance guidelines of TL:

5.1.5.1 The piping should have sufficient strength to take account of the most severe coincident conditions of pressure, temperature, the weight of the piping itself and any static and dynamic loads imposed by the design or environment.

5.1.5.2 For the purpose of assuring adequate robustness for all piping including open ended piping (e.g. overflows, vents and open-ended drains), all pipes should have a minimum wall thickness to ensure adequate strength for use on board ships, also to withstand loads due to transportation, handling, personnel traffic, etc. This may require the pipe to have additional thickness than otherwise required by service considerations

5.1.5.3 The performance requirements for any component of a piping system such as fittings, joints, and method of joining are the same as those requirements for the piping system they are installed in.

5.1.6 Pipe penetrations through watertight bulkheads and decks as well as through fire divisions are to be approved by TL. Plastic pipes are only approved to be used for piping system. Dependent on the application and installation location specific means respectively additional flame tests may be required.

3.1.7 Plastic pipes thickness is to be calculated using a maximum allowable stress not higher than 1/7 of the ultimate tensile strength of the material at the service temperature.

5.2 Application

For design pressures, axial strength, permissible temperature, fire endurance provisions, test method for fire endurance testing of plastic piping, ageing, fatigue, erosion resistance, impact resistance, electrical conductivity, fluid absorption, material compatibility, flame spread, smoke generation, toxicity, fire protection coatings, installation, penetrations of fire divisions, penetrations of watertight bulkheads and decks and methods of repair etc., provisions of Part B Chapter 4 Machinery Section 16 Item B.2.6, as amended shall apply as applicable.

5.3 Definitions

5.3.1 Plastic

Plastic includes both thermoplastic and thermosetting plastic materials with or without reinforcement, such as PVC and FRP (reinforced plastics pipes).

5.3.2 Piping systems

Piping systems include the pipes, fittings, joints, and any internal or external liners, coverings and coatings required to comply with the performance criteria.

5.3.3 Joints

Joints include all pipe assembling devices or methods, such as adhesive bonding, laminating, welding, etc.

5.3.4 Fittings

Fittings include bends, elbows, fabricated branch pieces, etc. made of plastic materials.

5.3.5 Nominal pressure

Nominal pressure is the maximum permissible working pressure.

5.3.6 Fire endurance

Fire endurance is the capability of the piping system to perform its intended function, i.e. maintain its strength and integrity, for some predicted period of time while exposed to fire.

5.4 Pipe and fitting connections

5.4.1 General

5.4.1.1 The strength of connections is not to be less than that of the piping system in which they are installed.

5.4.1.2 Pipes and fittings may be assembled using adhesive- bonded, welded, flanged or other joints.

5.4.1.3 When used for joint assembly, adhesives are to be suitable for providing a permanent seal between the pipes and fittings throughout the temperature and pressure range of the intended application.

5.4.1.4 Tightening of joints, where required, is to be performed in accordance with the manufacturer's instructions.

5.4.1.5 Procedures adopted for pipe and fitting connections are to be submitted to the Society for approval, prior to commencing the work.

5.4.2 Bonding of pipes and fittings

5.4.2.1 The procedure for making bonds is to be submitted to the Society for qualification. It is to include the following:

- Materials used
- Tools and fixtures
- Joint preparation requirements
- Cure temperature
- Dimensional requirements and tolerances
- Acceptance criteria for the test of the completed assembly.

5.4.2.2 When a change in the bonding procedure may affect the physical and mechanical properties of the joints, the procedure is to be re-qualified.

6. Non metallic flexible piping systems

6.1 General

6.1.1 Flexible piping is not metallic flexible pipes which are used for not limited lengths in piping systems as a replacement of metallic or plastic rigid piping. No confusion is to be made with flexible hoses and expansion joints.

6.1.2 Flexible piping may be used in accordance with the provisions of A.1.6.4.

6.1.3 The position of the flexible piping is to be clearly shown on the piping drawings submitted to the Society.

6.1.4 Isolating valves are to be provided permitting the isolation of flexible pipes intended to convey fuel, oil or compressed air.

6.1.5 Flexible piping is not to be used between the ship's side valves and the ship side plating.

6.1.6 Flexible piping is not to be used for the part of bilge piping circuits going through compartments intended to contain oil fuel.

6.1.7 The drawings of the flexible piping are to be submitted to the Society. These drawings are to indicate in particular:

- The manufacturer and the type
- The composition
- The physical and mechanical characteristics according to the temperature
- The characteristics of inflammability and the fire resistance
- Eventually the resistance to the various products they are likely to come into contact with the diameter and thickness the type of junctions with the other pipes and fittings.

6.2 Tests

6.2.1 Type-tests

Each type of flexible pipe is to undergo:

- A bursting test
- An external hydrocarbon resistance test
- A fire resistance test
- A collapse test
- Eventually vibration and ageing tests.

The tests are to be carried out on hoses having a significant length and fitted with connections

The fire resistance test is to be carried out in the following conditions; other test methods may apply after special examination.

The hose is to be submitted to fire for 30 minutes at a temperature of 800°C, while water at the maximum service pressure is circulated inside the hose; the temperature of the water at the outlets is not to be less than 80°C. No leak is to be recorded during and after the test.

Flexible pipes granted with a type approval certificate issued by the Society for the intended conditions of use are exempted from type-tests.

6.2.2 Hydraulic tests

Each flexible pipe, together with its connections, is to undergo a hydraulic test under a pressure at least equal to
1,5 times the maximum service pressure.

6.3 Design

6.3.1 Flexible pipes are to be made of materials resisting to marine environment and to the fluid they are to convey.

6.3.2 Flexible pipes are to be designed so as to withstand:

- Externally to hydrocarbons
- To internal pressure
- To vibrations.

6.3.3 Flexible pipes intended to convey oil or fuels are to be fire-resistant. Where a protective lining is provided for this purpose, it is to be impervious to hydrocarbons and hydrocarbon vapours.

6.3.4 If flexible pipes are intended to be fitted at pump suctions, in particular bilge pumps, they are to be so designed as to avoid any risk of collapsing due to the internal depression of the pipes.

6.3.5 Clips made of corrosion-resistant material may be used for the junction of flexible piping, with at least two clips at each end, except for oil and fuel circuits where crimped connections are to be used.

6.3.6 The bursting pressure of non-metallic hoses is not to be less than four times their maximum service pressure.

6.4 Installation

6.4.1 Flexible piping is to be so arranged as to be easily accessible.

6.4.2 They have to be supported by means of collars or similar devices, so that the hoses and the junctions are not submitted to excessive stresses in all the normal service conditions.

6.4.3 The parts of flexible piping which are likely to undergo shocks or frictions are to be adequately protected by means of shield or appropriate sleeve.

7. Principles for the Construction of Pipe Lines, Valves, Fittings and Pumps

7.1 General

7.1.1 Piping systems must be adequately identified according to their purpose. Valves are to be permanently and clearly marked.

7.1.2 Pipe penetrations leading through bulkheads, decks and tank walls must be water and oil tight. Bolts through bulkheads are not permitted. Holes for fastening screws are not be drilled in the tank walls.

7.1.3 Sealing systems for pipe penetrations through watertight bulkheads and decks as well as through fire divisions which are not welded into the bulkhead or deck are to be approved by TL (see Part A Chapter 1 - Hull, Section 11). See also Regulations for the Performance of Type Tests, Part 3 – Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations.

7.1.3 Piping systems close to electrical switchboards are to be so installed or protected that possible leakage cannot damage the electrical installation.

7.1.4 Piping systems are to be so arranged that they can be completely emptied, drained and vented. Piping systems in which the accumulation of liquids during operation could cause damage must be equipped with special drain arrangements.

7.1.5 Pipes lines laid through ballast tanks, which are coated in accordance with Chapter 1 - Hull, Section 22 are to be either effectively protected against corrosion or they are to be of low susceptibility to corrosion. The protection method against corrosion of the tanks as well as that of the pipes must be compatible to each other.

7.1.6 The wall thickness of pipes between ship's side and first shut-off device is to be in accordance with Part B Chapter 4 Machinery Section 16 Table 16.23 column B. Pipes are to be connected by welding or by flanges.

7.1.7 Unless otherwise specified, piping and pumping systems covered by the Rules are to be permanently fixed on board ship.

7.1.8 Piping systems are to be so designed and pipes so fixed as to allow for relative movement between pipes and the ship's structure, having due regard to the:

- Temperature of the fluid conveyed
- Coefficient of thermal expansion of the pipes material
- Deformation of the ship's hull.

7.1.9 All pipes subject to thermal expansion and those which, due to their length, may be affected by deformation of the hull, are to be fitted with expansion pieces or loops.

7.1.10 As a general rule, bilge and ballast lines are to be entirely independent and distinct from lines conveying lubricating oil and fuel oil, with the exception of:

- Pipes located between collecting boxes and pump suctions
- Pipes located between pumps and overboard discharges
- Pipes supplying compartments likely to be used alternatively for ballast, fuel oil, provided such pipes are fitted with blind flanges or other appropriate change-over devices, in order to avoid any mishandling.

7.1.11 Location of tanks and piping system components conveying flammable fluids is specially defined in subsequent parts of this section.

7.1.12 Location of open-ended pipes on board ships shall be defined as to comply with requirements for prevention of progressive flooding.

7.1.13 The passage of pipes through tanks, when permitted, normally requires special arrangements such as reinforced thickness or tunnels, in particular for bilge and ballast pipes, scuppers and sanitary discharges, air, sounding and overflow pipes and fuel oil pipes.

Junctions of pipes inside tanks are to be made by welding or flange connections.

7.1.14 Overboard discharges are to be so located as to prevent any discharge of water into the lifeboats while they are being lowered.

7.1.15 As far as possible, pipes are not to pass near switchboards or other electrical apparatus. If this requirement is impossible to satisfy, gutterways or masks are to be provided wherever deemed necessary to prevent projections of liquid or steam on live parts.

7.1.16 For flammable fluids, the drain tank is not to form part of an overflow system and is to be fitted with an overflow alarm device.

In ships required to be fitted with a double bottom, appropriate precautions are to be taken when the drain tank is constructed in the double bottom, in order to avoid flooding of the machinery space where drip trays are located, in the event of accidentally running aground.

7.1.17 All valves and cocks forming part of flammable oil systems are to be capable of being operated from readily accessible positions and, in machinery spaces, from above the working platform.

7.1.18 Level switches fitted to flammable oil tanks are to be contained in a steel or other fire-resisting enclosure.

7.1.19 For fuel oil systems in all spaces, lubricating oil systems, in machinery spaces and all flammable oil systems, in locations where means of ignition are present as far as practicable, the piping arrangement in the flammable oil systems is to comply generally with the following:

- The conveying of flammable oils through accommodation and service spaces is to be avoided. Where it is not possible, the arrangement may be subject to special consideration by the Society, provided that the pipes are of a material approved having regard to the fire risk

- The pipes are not to be located immediately above or close to the hot surfaces (exhaust manifolds, silencers, etc.), electrical installations or other sources of ignition. Otherwise, suitably protection (screening and effective drainage to the safe position) is to be provided to prevent of spraying or leak- age onto the sources of ignition

- Parts of the piping systems conveying heated flammable oils under pressure exceeding 0,18 MPa are to be placed above the platform or in any other position where defects and leakage can readily be observed. The machinery spaces in way of such parts are to be adequately illuminated.

No flammable oil tanks are to be situated where spillage or leakage there from can constitute a hazard by falling on:

- Hot surfaces, including those of heaters, exhaust manifolds and silencers

- Electrical equipment

- Air intakes

- Other sources of ignition.

Parts of flammable oil systems under pressure exceeding

0,18 MPa such as pumps, filters and heaters are to com- ply with the provisions of paragraph above.

Mechanical joints, expansion joints and flexible parts of flammable oil lines are to be screened or otherwise suit- ably protected to avoid as far as practicable oil spray or oil leakages onto hot surfaces, into machinery air intakes, or on other sources of ignition.

Any relief valve of fuel oil and lubricating oil systems is to discharge to a safe position, such as an appropriate tank.

7.1.20 For fuel oil systems in all spaces, lubricating oil systems, in machinery spaces and all flammable oil systems, in locations where means of ignition are present as far as practicable, following provisions for flammable oil leakage containment shall be adhered to:

Tanks used for the storage of flammable oils together with their fittings are to be so arranged as to prevent spillages due to leakage or overfilling.

Drip trays with adequate drainage to contain possible leakage from flammable fluid systems are to be fitted:

- Under independent tanks

- Under burners

- Under purifiers and any other oil processing equipment

- Under pumps, heat exchangers and filters

- Under valves and all accessories subject to oil leakage

- Surrounding internal combustion engines.

The coaming height of drip trays is to be appropriate for the service and not less than 80 mm.

Where drain pipes are provided for collecting leakages, they are to be led to an appropriate drain tank.

7.2 Application

Part B Chapter 4 Machinery Section 16, D may be applied where any point not clearly clarified is encountered as applicable and as not causing any contradictions with the requirements stated in this item 7.

7.3 Protection of Piping Systems against Overpressure

7.3.1 Provisions are to be made to prevent overpressure in any flammable oil tank or in any part of the flammable oil systems, including the filling pipes.

7.3.2 Provisions are to be made so that the discharge pressure of pumps and compressors cannot exceed the pressure for which the pipes located on the discharge of these pumps and compressors are designed.

7.3.3 When provided on the pump discharge for this purpose, safety valves are to lead back to the pump suction or to any other suitable place.

7.3.4 The discharge capacity of the safety valves installed on pumps and compressors is to be such that the pressure at the discharge side cannot exceed by more than 10% the design pressure of the discharge pipe in the event of operation with closed discharge.

7.3.5 Pipes likely to be subjected to a pressure exceeding their normal working pressure are to be provided with safety valves or equivalent overpressure protecting devices.

7.3.6 The following piping systems are to be fitted with safety valves to avoid unallowable overpressures:

- Piping systems and valves in which liquids can be enclosed and heated;

- Piping systems which may be exposed in service to pressures in excess of the design pressure.

7.3.7 Safety valves must be capable of discharging the medium at a maximum pressure increase of 10% of the allowable working pressure. Safety valves are to be fitted on the low pressure side of reducing valves.

7.3.8 In particular, pipes located on the low pressure side of pressure reducing valves are to be provided with safety valves unless they are designed for the maximum pressure on the high pressure side of the pressure reducing valve.

7.4 Flexible hoses and expansion joints

7.4.1 General

7.4.1.1 The Society may permit the use of flexible hoses and expansion joints, both in metallic and non-metallic materials, provided they are approved for the intended service.

7.4.1.2 Flexible hoses and expansion joints are to be of a type approved by the Society, designed installed, and tested in accordance with this item 5.4

7.4.1.3 Flexible hoses and expansion joints intended for piping systems with a design temperature below the ambient temperature will be given special consideration by the Society.

7.4.1.4 The use of flexible hoses and expansion joints is to be limited as far as practicable.

7.4.1.5 The position of flexible hoses and expansion joints is to be clearly shown on the piping drawings submitted to the Society.

7.4.1.6 The use of non-metallic expansion joints on pipes connected to sea inlets and overboard discharges will be given special consideration by the Society. As a rule, the fitting of such joints between the ship side and the valves is not permitted. Furthermore, unless the above-mentioned valves are fitted with remote controls operable from places located above the freeboard deck, efficient means are to be provided, wherever necessary, to limit the flooding of the ship in the event of rupture of the expansion joints.

7.4.1.7 Expansion joints may be fitted in sea water lines, provided they are arranged with guards which effectively enclose, but do not interfere with, the action of the expansion joints and reduce to the minimum practicable any flow of water into the machinery spaces in the event of failure of the flexible elements.

7.4.1.8 Use of expansion joints in water lines for other services, including ballast lines in machinery spaces, in duct keels and inside double bottom water ballast tanks, and bilge lines inside double bottom tanks and deep tanks, will be given special consideration by the Society.

7.4.2 Design

7.4.2.1 Flexible pipes and expansion joints are to be made of materials resistant to the marine environment and to the fluid they are to convey.

7.4.2.2 Flexible pipes and expansion joints are to be designed so as to withstand:

- External contact with hydrocarbons
- Internal pressure
- Vibrations
- Pressure impulses.

7.4.2.3 Flexible pipes intended to convey fuel oil or lubricating oil and end attachments are to be of fire-resisting materials of adequate strength and are to be constructed to the satisfaction of the Society.

Where a protective lining is provided for this purpose, it is to be impervious to hydrocarbons and to hydrocarbon vapours.

7.4.2.4 Flexible pipes intended to convey following media are to be fitted with a metallic braid.

- Gaseous fluid at a pressure higher than 1 MPa
- Fuel oil or lubricating oil,

7.4.2.5 As a general rule, flexible hoses are to be fitted with crimped connections or equivalent. For pipes subject to a pressure not exceeding 0,5 MPa, as well as for scavenge air and supercharge air lines of internal combustion engines, clips made of galvanised steel or corrosion-resistant material with thickness not less than 0,4 mm may be used. For flexible piping of 25 mm diameter and above not less than two clips are to be fitted at each end.

7.4.2.6 Flexible pipes and expansion joints are to be so designed that their bursting pressure at the service temperature is not less than 4 times their maximum service pressure, with a minimum of 2 MPa. Exemptions from this requirement may be granted for expansion joints of large diameter used on sea water lines.

7.4.2.7 The junctions of flexible hoses and expansion joints to their couplings are to withstand a pressure at least equal to the bursting pressure defined in item 7.4.2.6.

7.4.2.8 Where necessary, non-metallic pipes and hoses are to show a suitable resistance against collapse due to external pressure or bending.

7.4.3 Installation

7.4.3.1 Flexible hoses and expansion joints are to be so arranged as to be accessible at all times.

7.4.3.2 Flexible hoses and expansion joints are to be as short as possible.

7.4.3.3 The radius of curvature of flexible hoses is not to be less than the minimum recommended by the manufacturer.

7.4.3.4 The adjoining pipes are to be suitably aligned, supported, guided and anchored.

7.4.3.5 Isolating valves are to be provided permitting the isolation of flexible hoses intended to convey flammable oil or compressed air.

7.4.3.6 Expansion joints are to be protected against over extension or over compression.

7.4.3.7 Where they are likely to suffer external damage, flexible hoses and expansion joints of the bellows type are to be provided with adequate protection.

7.5 Shut-off Devices (Valves)

7.5.1 General

7.5.1.1 Shut-off devices must comply with a recognized standard. However they may be approved by special consideration of Society where they do not comply with a recognised standard.

7.5.1.2 Valves with screwed-on covers are to be secured to prevent unintentional loosening of the cover.

7.5.1.3 All valves and accessories are to be so designed as to prevent the loosening of covers and glands when they are operated.

7.5.1.4 Hand-operated shut-off devices are to be closed by turning in the clockwise direction (right hand motion).

7.5.1.5 Valves must be clearly marked to show whether they are in the open or closed position.

7.5.1.6 Cocks, valves and other accessories are generally to be arranged so that they are easily visible and accessible for manoeuvring, control and maintenance. They are to be installed in such a way as to operate properly.

7.5.1.7 Change-over devices in piping systems in which a possible intermediate position of the device could be dangerous in service must not be used.

7.5.1.8 Connections of valves and accessories with pipes are to respect the same rules as for connections between pipes.

7.5.1.9 Handles of valves or cocks are to be permanently fitted.

7.5.1.10 Shut-off valves are to be provided where necessary to isolate pumps, heat exchangers, pressure vessels, etc., from the rest of the piping system when necessary, and in particular to allow the isolation of duplicate components without interrupting the fluid circulation and for survey or repair purposes.

7.5.1.11 Valves are to be permanently marked. The marking must comprise at least the following details:

- Material of valve body,
- Nominal diameter,
- Nominal pressure.

7.5.1.12 Valves and fittings in piping systems are to be compatible with the pipes to which they are attached in respect of their strength and are to be suitable for effective operation at the maximum working pressure they will experience in service.

7.5.1.13 The design pressure of valves intended for use onboard a vessel is to be at least the maximum pressure to which they will be subjected but at least 350 kPa.

Valves used in open-ended systems, except those attached to side shell, may be designed for pressure below 350 kPa. Such valves may include those in vent and drain lines, and those mounted on atmospheric tanks which are not part of the pump suction or discharge piping (e.g., level gauges, drain cocks, and valves in inert gas and vapour emission control system).

7.5.1.14 All valves of Classes I and II piping systems having nominal diameters exceeding 50 mm are to have bolted, pressure seal or breech lock bonnets. All valves for Classes I and II piping systems and valves intended for use in steam or oil services are to be constructed so that the stem is positively restrained from being screwed out of the body.

All valves of Classes I and II piping systems having nominal diameters exceeding 50 mm are to have flanged or welded ends. Welded ends are to be butt welding type, except that socket welding ends may be used for valves having nominal diameters of 80 mm or less with the approval of TL.

7.5.1.15 All cast iron valves are to have bolted bonnets or are to be of the union bonnet type. For cast iron valves of the union bonnet type, the bonnet ring is to be of steel, bronze or malleable iron.

7.5.1.16 Stems, discs or disc faces, seats and other wearing parts of valves are to be of corrosion resistant materials suitable for intended service.

7.5.1.17 Resilient materials, where used, are subject to service limitations as specified by the manufacturers.

Use of resilient materials in valves intended for fire mains is to be specifically approved based on submittal of certified fire endurance tests conforming to a recognized standard.

7.5.1.18 Valves and accessories which are fitted in a class I piping system, or in a class II piping system, or on the ship side, on the collision bulkhead, on fuel oil tanks or on lubricating oil tanks under static pressure are to be subject to the applicable testing and inspection required by the Rules.

7.5.1.19 Accessories such as cocks and valves on the fluid lines referred to in this Section are to be provided with nameplates indicating the apparatus and lines they serve except where, due to their location on board, there is no doubt as to their purpose. Nameplates are to be fitted at the upper part of air and sounding pipes

7.5.2 Materials

7.5.2.1 The materials of the valve bodies and connecting pieces are to comply with Part B Chapter 4 Machinery Section 16 B.2, as amended.

7.5.2.2 The combination of different materials has to take into consideration the possibility of galvanic action.

7.5.3 Gratings

7.5.3.1 Gratings are to have a free flow area not less than twice the total section of the pipes connected to the inlet.

7.5.3.2 When gratings are secured by means of screws with a countersunk head, the tapped holes provided for such screws are not to pass through the plating or doubling plates outside distance pieces or chests.

7.5.3.3 Screws used for fixing gratings are not to be located in the corners of openings in the hull or of doubling plates.

7.5.3.4 In the case of large sea inlets, the screws used for fixing the gratings are to be locked and protected from corrosion.

7.5.3.5 When gratings are cleared by use of compressed air or steam devices, the chests, distance pieces and valves of sea inlets and outlets thus arranged are to be so constructed as to withstand the maximum pressure to which they may be subjected when such devices are operating.

7.5.4 Ship's Side (Shell Plating) Valves

7.5.4.1 For the mounting of valves on the ship's side, see Chapter 35-A Hull, Section 8 Hull Integrity and Part A Chapter 1 - Hull, Section 7, C.10 may also be referred to as not causing any contradictions with Chapter 35-A. Those valves together with their hull connections are not to substantially lower the hull resistance.

7.5.4.2 Sea inlets and overboard discharges are to be fitted with valves as to ensure hull integrity as clarified by Chapter 35-A Hull Section 8 Hull Integrity. Sea inlets are to be so designed and arranged as to limit turbulence and to avoid the admission of air due to motion of the ship. Sea inlets are to be fitted with gratings (refer to 7.5.3) and provisions are to be made for clearing sea inlet gratings.

7.5.4.3 Sea inlet and overboard discharge valves are to be secured directly on the shell plating, or on sea chests built on the shell plating, with scantlings in compliance with relevant items of Part A Chapter 1 Hull, or on extra-reinforced and short distance pieces attached to the shell.

7.5.4.4 Sea chests are to be suitably protected against corrosion.

7.5.4.5 The bodies of the valves and distance pieces are to have a spigot passing through the plating without projecting beyond the external surface of such plating or of the doubling plates and stiffening rings, if any.

7.5.4.6 Ship's side valves on the shell plating shall be easily accessible. Seawater inlet and outlet valves are to be capable of being operated from above the floor plates.

7.5.4.7 Cocks on the ship's side must be so arranged that the handle can only be removed when the cock is closed.

7.5.4.8 Valves with only one flange may be used on the ship's side (shell plating) and on the sea chests only after special approval.

7.5.4.9 Wafer type valves are not to be used for any connections to the vessel's shell unless specially approved. Lug type butterfly valves used as shell valves are to have a separate set of bolts on each end of the valve so that the inboard end may be disconnected with the valve closed to maintain its watertight integrity.

7.5.4.10 In sea water systems, hoses are to be secured by at least 2 clips. Hose clamps are to be made of austenitic stainless steel or equivalent.

7.5.4.11 Valves are to be secured by means of bolts screwed through the plating with a countersunk head, or studs screwed in heavy pads themselves secured to the hull or chest plating, without penetration of the plating by the stud holes.

Other screwing means be admitted by the Society, namely in the case of small size valves.

7.5.5. Remote Controlled Valves

7.5.5.1 Scope

These requirements apply to hydraulically, pneumatically or electrically operated valves in piping systems and sanitary discharge pipes.

7.5.5.2 Application

Part B Chapter 4 Machinery Section 16 D.6 may be applied for detailed requirements regarding remote controlled valves however as not contradicting with the requirements below and as applicable for ships less than 500 GT.

7.5.5.3 Construction and Arrangement of valves

7.5.5.3.1 Remote controlled bilge valves and essential valves for the safety of the ship are to be equipped with an emergency operating arrangement. That is all valves which are provided with remote control are also to be designed for local manual operation.

7.5.5.3.2 The remote control system and means of local operation are to be independent. In this respect, arrangement of the local operation by means of a fixed hand pump is to be specially considered by the Society.

7.5.5.3.3 In the case of valves which are to be provided with remote control in accordance with the Rules, opening and/or closing of the valves by local manual means is not to render the remote control system inoperable.

7.5.5.3.4 Power failure of the remote control system is not to cause an undesired change of the valve position.

7.5.5.3.5 For the emergency operation of remote controlled valves in cargo piping systems, see Part B Chapter 4 Machinery Section 20, B.2.3.3.

7.5.5.3.6 The accessibility of the valves for maintenance and repairing is to be taken into consideration.

7.5.5.3.7 Valves in bilge lines and sanitary pipes must always be accessible.

7.6 Control and Monitoring

7.6.1 Local indicators are to be provided for at least pressure (in pressure vessels, at pump or compressor discharge, at the inlet of the equipment served, on the low pressure side of pressure reducing valves), temperatures (in tanks and ships, at heat exchanger inlet and outlet), levels (in tanks and ships containing liquids).

7.6.2 Safeguards are to be provided where an automatic action is necessary to restore acceptable values for a faulty parameter.

7.6.3 Automatic controls are to be provided where it is necessary to maintain parameters related to piping systems at a pre-set value.

7.6.4 A level indication is to be provided for tanks intended to contain liquids as well as for all compartments which are not readily accessible at all times. For this purpose sounding pipes and level gauges of an approved type that are efficiently protected against shocks may be accepted.

Level gauges for use in flammable oil systems are also subject to the following conditions:

- cylindrical gauges may be used provided they are fitted with self-closing valves at their lower end as well as at their upper end if the latter is below the maximum liquid level

- in the case of tanks not subject to filling by power pumps, with the exception of fuel oil service tanks, the valves need not to be of the self-closing type. Such valves are, however, to be readily accessible and instruction plates are to be fitted adjacent to them to specify that they are to be kept closed

A remote level gauging system of an approved type.

7.6.5 Thermometers and other temperature-detecting elements in fluid systems under pressure are to be provided with pockets built and secured so that the thermometers and detecting elements can be removed while keeping the piping under pressure.

7.6.6 Pressure gauges and other similar instruments are to be fitted with an isolating valve or cock at the connection with the main pipe.

7.7 Piping Penetration through Bulkheads, Decks and Tank Tops

7.7.1 Watertight integrity

7.7.1.1 Where it is necessary for pipes to penetrate watertight bulkheads, decks or tank tops, the penetrations are to be made by methods which will maintain the watertight integrity.

For this purpose, bolted connections are to have bolts threaded into the plating from one side; through bolts are not to be used.

Welded connections are either to be welded on both sides or to have full penetration welds from one side.

7.7.1.2 In general, the pipe is to be as short as possible. The pipe is to extend through the shell plating and is to be welded on both sides or with full strength welds from one side. Consideration is to be given to supporting the pipe to the surrounding structure

7.7.1.3 Where pipes penetrate bulkheads, decks or tank-tops which are required to be fire tight or smoke tight, the penetrations are to be made by approved methods which will maintain the same degree of fire tight or smoke tight integrity.

7.7.1.4 For bilge, ballast, scupper and sanitary systems, lead or other heat sensitive materials are not to be used in piping systems which penetrate watertight subdivision bulkheads or decks, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkhead or decks. Provisions for penetration of watertight bulkheads or decks by plastic pipes are given in relevant provisions of this section.

7.7.1.5 Pipes passing through the collision bulkhead below the freeboard deck are to be fitted with suitable valves operable from above the freeboard deck. These valves are to be of steel, bronze or other approved ductile material. Valves of ordinary cast iron or similar material are not acceptable.

The remote operation device of the valve referred to in the paragraph above is to include an indicator to show whether the valve is open or shut.

B. Bilge System

1 General

1.1 A bilge system is intended to dispose of water which may accumulate in spaces within the vessel other than permanently appropriated for the carriage of fresh water, water ballast, fuel oil or liquid cargo and for which other efficient means of pumping are to be provided due to condensation, leakage, washing, fire fighting, etc. It is to be capable of controlling flooding in the propulsion machinery space as a result of limited damage to piping systems. Oily bilge water system in engine room is out of the scope of this section.

1.2 Bilge lines and bilge suctions are to be so arranged that the bilges can be completely pumped even under disadvantageous trim conditions. Bilge pumping systems are to be capable of draining the spaces when the vessel is on even keel and either upright or listed 5 degrees on either side.

1.3 Efficient means is to be provided for draining water from insulated holds.

1.4 Bilge pumping system is not intended for coping with water ingress resulting from structural or main sea water piping damage.

1.5 If deemed acceptable by the Society, bilge pumping arrangement may be dispensed with in specific compartments, provided the safety of the ship is not impaired.

1.6 As a general rule, bilge lines are to be distinct from the other lines of the ship. However, this requirement need not be applied to pipes located between collecting boxes and pump suctions or between pumps and overboard discharges.

1.7 Bilge pumping of multihull ships shall be specially considered by the Society.

1.8 To enhance system availability, bilge pump integrity is to be assured through testing and certification; at least two bilge pumps are to be provided for draining the propulsion engine room. At least one of these suctions is to be connected directly to a bilge pump at least one bilge suction is to be provided in watertight compartments other than the propulsion engine room and bilge suction control valves are to be accessible for maintenance at all times.

1.9 The suctions are to be located at the lowest points of the compartment. Additional suctions may be required if the flow of water towards the suctions is disturbed by irregularities of the bottom.

2. Components

2.1 Pumps

2.1.1 At least two power bilge pumps are to be provided; one of these pumps may be driven by a main propulsive engine.

2.1.2 The Society may permit, after special consideration, that one of the pumps be replaced by an ejector.

2.1.3 For ships of 12 m in length and over, the bilge pumps are to be connected to the bilge main unless the alternative arrangement given in this section is complied with.

2.1.3 For ships of less than 24 m in length, the Society may permit, after special consideration, that one of bilge pumps be a fixed hand pump.

2.1.4 Small compartments may be drained by means of portable or fixed hand pumps.

2.1.5 Where an ejector is used in lieu of a driven pump, its suction capacity is not to be less than the required capacity of the pump it replaces.

2.1.6 For bilge main diameter obtained from the formula given in item 2.2 and speed of water not less than 1.2 m/s, minimum capacity Q of the required bilge pump may be determined from the following equation:

$$Q = 3.45 \cdot 10^{-3} \cdot {d_H}^2$$

Q = minimum capacity of each pump, in m^3/h

d_H = internal diameter of bilge main [mm]

2.1.7 Alternatively, for compartments required to be drained may be fitted with individual bilge pumps for which following requirements apply;

2.1.7.1 The total capacity of the bilge pumps is not to be less than the following formula:

$$Q = 8.28 \cdot 10^{-3} \cdot {d_H}^2$$

d_H = internal diameter of bilge main [mm]

2.1.7.2 The capacity of each pump Q_n, in m^3/h, is not to be less than Q / (N − 1) with a minimum of 6 m^3/h

Where:

Q = Total capacity of bilge pumps

N = Number of individual pumps.

2.1.7.3 At least one additional means of pumping is to be provided for use in each individual space which can be a portable pump.

2.1.7.4 The machinery space is to be provided with at least two individual pumps or equivalent means of pumping capacity with two suctions.

2.1.8 Other pumps may be used for bilge duties, such as fire, general service or ballast pumps, provided that they meet the capacity requirements, suitable piping arrangements are made and pumps are available for bilge duty when necessary.

The use of bilge pumps for fire duty is to comply with the provisions of Chapter 35-D Fire Safety and relevant provisions of Part B Chapter 4 Machinery may be applied as applicable to ships less than 500 GT.

2.2 Bilge main

The internal diameter of the main bilge line suction is to be determined by the following equation. The actual internal diameter of the bilge main may be rounded off to the nearest pipe size of recognised standard.

$$d_H = 25 + 1.68 \cdot \sqrt{L_C \cdot (B + H)} \text{ (Not being less than 35 mm)}$$

Where:

L_c = Load line length of the ship, in m,

B = Breadth of the ship, in m,

H = Moulded depth of the ship, in m,

2.3 Suctions in holds and machinery spaces

The internal diameter, in mm, of bilge pipes situated between collecting boxes and suctions in holds and machinery spaces, is to be of the commercial size nearest to the diameter given by the following formula, in mm:

$$d_Z = 25 + 2.16 \cdot \sqrt{L_1 \cdot (B + H)}$$

Where:

L_1 = Length of the compartment, in m. In addition, d_Z is not to be less than 35 mm.

3. Design Requirements

3.1 If not contained in pipe tunnels, the part of bilge pipes passing through tanks is to be provided with non-return valves at their ends in the holds.

3.2 Accessories are to be provided to prevent intercommunication of compartments or lines which are to remain segregated from each other. For this purpose, non-return valves or similar devices are to be fitted, namely on the pipe connections to bilge distribution boxes or to the alternative cocks, if any.

3.3 Strainers and mud boxes are to be fitted on bilge lines wherever they are necessary.

3.4 Where the peaks, if any, are not used as tanks and bilge suctions are not fitted, drainage of both peaks may be effected by hand pump suction provided that the suction lift is well within the capacity of the pump and in no case exceeds
7,3 m.

3.5 Provision is to be made for the drainage of the chain lockers and watertight compartments above the fore peak tank, if any, by hand or power pump suctions.

Steering gear compartments or other small dry enclosed spaces situated in the aft peak may be drained by scuppers discharging in the machinery space if fitted with self-closing cocks situated in visible and readily accessible positions. However, in the case of rudder stock glands located below the summer load line, the draining of the steering gear compartment are to be connected to the main bilge system.

3.6 All distribution boxes and manually operated valves in connection with the bilge pumping arrangement are to be in positions which are accessible under ordinary circumstances.

3.7 For bilge alarms refer to Chapter 35-C Electrical Installations

C. Scuppers And Discharges

1. A sufficient number of scuppers and suitable in size, are to be provided to permit the drainage of water likely to accumulate in the spaces which are not located in the ship's bottom.

2. Discharges led through the shell either from spaces below the freeboard deck or from within superstructures and deckhouses on the freeboard deck fitted with doors complying with the requirements of ICLL Reg. 12 are to be fitted with efficient and accessible means for preventing water from passing inboard.

3. The number of scuppers and discharge openings in the shell plating is to be reduced to a minimum either by making each discharge serve as many as possible of the sanitary and other pipes, or in any other satisfactory matter.

4. In vehicle spaces fitted with a fixed pressure water-spraying fire-extinguishing system, the drainage arrangement is to be such as to prevent the build-up of free surfaces. If this is not possible, the adverse effect upon stability of the added weight and free surface of water are to be taken into account to the extent deemed necessary by the Society in its approval of the stability information. Refer to Chapter 35-Section 7 Stability.

5. Draining of enclosed vehicle spaces are not to be led to machinery spaces or other places where sources of ignition may be present.

6. Refer to Chapter 35-A Section 8 Hull Outfitting for hull integrity.

D Air, Sounding and Overflow Pipes

1. General

1.1 The laying of air, overflow and sounding pipes is permitted only in places where the laying of the corresponding piping system is also permitted.

1.2 Air pipes and overflow pipes are to be so arranged as to be self-draining when the ship is on an even keel.

1.3 Nameplates are to be fixed at the upper part of air pipes and sounding pipes.

2. Air and Overflow Pipes

2.1 Arrangement

2.1.1 All tanks, void spaces etc. are to be fitted at their highest position with air pipes or overflow pipes which must normally terminate above the open deck.

2.1.2 Air pipes are to be fitted to all tanks, double bottoms, cofferdams, tunnels and other watertight compartments which are not fitted with alternative ventilation arrangements, in order to allow the passage of air or liquid so as to prevent excessive pressure or vacuum in the tanks or compartments, in particular in those which are fitted with piping installations. Their open ends are to be so arranged as to prevent the free entry of sea water in the compartments.

2.1.3 Overflow pipes are to be fitted to tanks which can be filled by pumping and are designed for a hydrostatic pressure lower than that corresponding to the height of the air pipe, or where the cross-sectional area of air pipes is less than that prescribed in item 2.9.1.

2.1.4 Air and overflow pipes are to be laid vertically.

2.1.5 Air and overflow pipes passing through cargo holds are to be protected against damage.

2.1.6 Air pipes are to be led above the freeboard deck for fuel oil tanks, lubrication oil and hydraulic oil tanks in contact with seawater (e.g. integrated side tanks) and all tanks intended to be pumped up double bottom and other watertight compartments.

2.1.7 Air pipes from unheated leakage oil tanks and lubricating oil tanks may terminate at clearly visible positions in the engine room. Where these tanks form part of the ship's hull, the air pipes are to terminate above the free board deck. It must be ensured that no leaking oil can spread onto heated surfaces where it may ignite.

2.1.8 Air pipes from lubricating oil tanks and leakage oil tanks which terminate in the engine room are to be provided with funnels and pipes for safe drainage in the event of possible overflow.

2.1.9 Wherever possible, the air pipes of feed water and distillate tanks should not extend into the open.

2.1.10 Where these tanks form part of the ship's shell the air pipes are to terminate within the engine room casing above the freeboard deck.

2.1.11 Where fuel day tanks are fitted with change-over overflow pipes, the change-over devices are to be so arranged that the overflow is led to one of the storage tanks.

2.1.12 The overflow pipes of tanks used alternatively for oil fuel and ballast water must be capable of being separated from the fuel overflow system.

Table 4.11 Minimum wall thicknesses of air, overflow, sounding and sanitary pipes

Pipe outside diameter [mm]	Minimum wall thickness [mm]		
	A	B	C
38 - 82.5	4.5	7.1	6.3
88.9	4.5	8	7.1
108	4.5	8	7.1
114.3	4.5	8	8
127 - 139.7	4.5	8.8	8
152.4 - 168.3	4.5	10	8.8
177.8	5	10	8.8
193.7	5.4	12.5	8.8
219.1	5.9	12.5	8.8
244.5-457.2	6.3	12.5	8.8

2.1.13 Overflow pipes are to be led either outside, or in the case of fuel oil or lubricating oil, to an over- flow tank of adequate capacity or to a storage tank having a space reserved for overflow purposes.

Overflow pipes are to be led to a high enough point above the deepest load waterline or, alternatively, non-return valves are to fitted where necessary, to prevent any risk of flooding due to hull damage.

2.1.14 Arrangements are to be made so that a compartment cannot be flooded from the sea through the overflow in the event of another compartment connected to the same overflow main being flooded. To this end, the openings of overflow pipes discharging overboard are as a rule to be placed above the deepest load waterline and are to be fitted where necessary with non-return valves on the plating, or, alternatively, overflow pipes from tanks are to be led to a point above the deepest load waterline.

2.1.15 Where the air and overflow pipes of several tanks situated at the ship's shell lead to a common line, the connections to this line are to be above the freeboard deck if possible but at least so high above the deepest load water line that should a leakage occur in one tank due to damage to the hull or listing of the ship, fuel or water cannot flow into another tank.

2.1.16 The air and overflow pipes of lubricating oil and fuel tanks shall not be led to a common line.

2.2 Number of air and overflow pipes

2.2.1 Air pipes are to be so arranged and the upper part of compartments so designed that air or gas likely to accumulate at any point in the compartments can freely evacuate. Therefore the number and arrangement of the air pipes is to be so performed that the tanks can be aerated and de-aerated without exceeding the tank design pressure by over- or under-pressure.

2.2.2 Air pipes are to be fitted opposite the filling pipes and/or at the highest parts of the compartments.

2.2.3 Where only one air pipe is provided, it is not to be used as a filling pipe.

2.2.4 Tanks which extend from side to side of the ship must be fitted with an air/overflow pipe at each corner. At the narrow ends of double bottom tanks in the forward and after parts of the ship, only one air/overflow pipe is sufficient.

2.3 Air pipe closing devices

Air/overflow pipes terminating above the open deck are to be fitted with approved air pipe heads.

To prevent blocking of the air pipe head openings by their floats during tank discharge the maximum allowable air velocity determined by the manufacturer is to be observed.

2.4 Special arrangements for air pipes of flammable oil tanks

2.4.1 Air pipes from fuel oil tanks are to discharge to a safe position on the open deck where no danger will be incurred from issuing oil or gases.

2.4.2 Air pipes of lubricating or hydraulic oil storage tanks not subject to flooding in the event of hull damage may be led to machinery spaces, provided that in the case of overflowing the oil cannot come into contact with electrical equipment, hot surfaces or other sources of ignition.

2.4.3 Air pipes of fuel oil service, settling and lubrication oil tanks likely to be damaged by impact forces are to be adequately reinforced.

2.4.4 Where fitted, wire gauze diaphragms are to be of corrosion resistant material and readily removable for cleaning and replacement. The clear area of such diaphragms is not to be less than the cross-sectional area of the pipe.

2.4.5 For tanks of less than 30 litres capacity, separate vent pipes may be dispensed if the filling pipe is suitably arranged.

2.5 Special arrangements for air pipes of black water tanks

Air pipes from black water tanks are to discharge to a naturally ventilated position on the open deck.

2.6 Structural details, air pipes

2.6.1 In each compartment likely to be pumped up, and where no overflow pipe is provided, the total cross-sectional area of air pipes is not to be less than 1,25 times the cross-sectional area of the corresponding filling pipes. However Table 16.23, 16.24 shall be complied with.

2.6.2 Air pipes with height exceeding 900 mm are to be additionally supported.

2.7 Hull integrity

Refer to Chapter 35-A Section 8 Hull Outfitting for hull integrity.

2.8 Overflow tanks

2.8.1 Overflow tanks are to have a capacity sufficient to receive the delivery of the pumps for at least 10 minutes.

2.8.2 Overflow tanks are to be fitted with an air pipe complying with provisions of this section which may serve as an overflow pipe for the same tank. When the vent pipe reaches a height exceeding the design head of the overflow tank, suitable means are to be provided to limit the actual hydrostatic head on the tank.

Such means are to discharge to a position which is safe in the opinion of the Society.

2.8.3 An alarm device is to be provided to give warning when the oil reaches a predetermined level in the tank, or alternatively, a sight-flow glass is to be provided in the overflow pipe to indicate when any tank is overflowing. Such sight-flow glasses are only to be placed on vertical pipes and in readily visible positions.

2.9 Structural details overflow pipes

2.9.1 In each compartment which can be pumped up, the total cross-sectional area of overflow pipes is not to be less than 1,25 times the cross-sectional area of the cor- responding filling pipes. However Table 16.23, 16.24 shall be complied with.

2.9.2 The cross-sectional area of the overflow main is not to be less than the aggregate cross-sectional area of the two largest pipes discharging into the main.

2.10 Overflow systems

2.10.1 Ballast water tanks

Proof by calculation is to be provided for the system concerned that under the specified operating conditions the design pressures of all the tanks connected to the overflow system cannot be exceeded.

2.10.2 Fuel oil tanks

The requirements to be met by overflow systems of heavy oil tanks are specified in the TL “Regulation for the Construction, Fitting and Testing of Closed Fuel Overflow Systems”.

For more details about air pipe closing devices see “Technical Circulars, Machinery, S-P 36/13 Air Pipe Closing Devices”.

2.10.2 The overflow collecting manifolds of fuel tanks are to be led at a sufficient gradient to an overflow tank of sufficient capacity.

The overflow tank is to be fitted with a level alarm which operates when the tank is about 1/3 full.

Table 4.12 Cross-Sectional areas of air and overflow pipes

Tank filling systems		Cross-sectional areas of air and overflow pipes	
		HB	**HTB**
Filling	by gravity	1/3 f per tank	-
	Pumping	-	1.25 f per tank (1)

HB = Air pipe
HTB = Air/overflow pipe
f = Cross-sectional area of tank filling pipe
(1) *1.25 f as the total cross-sectional area is sufficient if it can be proved that the resistance to flow of the air and overflow pipes including the air pipe closing devices at the proposed flow rate cannot cause unacceptably high pressures in the tanks in the event of overflow.*

2.10.3 The use of a fuel storage tank as overflow tank is allowable but requires the installation of a high level alarm and an air pipe with 1.25 times the cross-sectional area of the main bunkering line.

2.11 Determination of the pipe cross-sectional areas

2.11.1 For the cross-sectional areas of air and overflow pipes, see Table 4.12.

The minimum outside diameter of air and overflow pipes shall not to be smaller than 60.3 mm.

2.11.2 The minimum wall thicknesses of air and overflow pipes are to be in accordance with Tables 4.11 and 4.12, whereby A, B and C are the groups for the minimum wall thickness.

2.11.3 Pipe material is to be selected according to provisions of this section.

3. Sounding Pipes

3.1 General

3.1.1 Sounding pipes are to be provided for tanks, cofferdams and void spaces with bilge connections and for bilges and bilge wells in spaces which are not accessible at all times. Sounding pipes are to be located as close as possible to suction pipes.

On application, the provision of sounding pipes for bilge wells in permanently accessible spaces may be dispensed with.

3.1.2 Where the tanks are fitted with remote level indicators which are type-approved by TL the arrangement of sounding pipes can be dispensed with.

3.1.3 As far as possible, sounding pipes are to be laid straight and are to extend as near as possible to the bottom.

3.1.4 Sounding pipes which terminate below the deepest load waterline are to be fitted with self-closing shut-off devices. Such sounding pipes are only allowable in spaces which are accessible at all times.

All other sounding pipes are to be extended to the open deck. The sounding pipe openings must always be accessible and fitted with watertight closures.

3.1.5 Sounding pipes of tanks are to be provided close to the top of the tank with holes for equalizing the pressure.

3.1.6 In cargo holds, a sounding pipe is to be fitted to each bilge well.

3.1.7 Where level alarms are arranged in each bilge well of cargo holds, the sounding pipes may be dispensed with. The level alarms are to be separate from each other and are to be type approved by TL *(National Rules, if exist are to be observed).*

3.1.8 In cargo holds, fitted with non weather tight hatch covers, 2 level alarms are to be provided in each cargo holds, irrespective if sounding pipes are fitted. The level alarms are to be independent from each other and are to be type approved by TL.

3.1.9 Sounding pipes passing through cargo holds are to be laid in protected spaces or they are to be protected against damage.

3.2 Termination of sounding pipes

3.2.1 As a general rule, sounding pipes are to end above the watertight deck or in such case above the bulkhead or the freeboard deck in easily accessible places and are to be fitted with efficient, permanently attached, metallic closing appliances.

3.2.2 In machinery spaces and tunnels, where the provisions of item 2.2.1 cannot be satisfied, short sounding pipes led to readily accessible positions above the floor and fitted with efficient closing appliances may be accepted.

In ships required to be fitted with a double bottom, such closing appliances are to be of the self-closing type.

3.2 Sounding pipes for fuel, lubricating oil and thermal oil tanks

3.2.1 Sounding pipes which terminate below the open deck are to be provided with self-closing devices as well as with self-closing test valves.

3.2.2 Sounding pipes shall not to be located in the vicinity of firing plants, machine components with high surface temperatures or electrical equipment.

3.2.3 Where sounding pipes are used in flammable (except lubricating) oil systems, they are to terminate in the open air, where no risk of ignition of spillage from the sounding pipe might arise. In particular, they are not to terminate in accommodation, service, passenger or crew spaces. As a general rule, they are not to terminate in machinery spaces. However, where the Society considers that this requirement is impracticable, it may permit termination in machinery spaces on condition that the sounding pipes terminate not close to source of ignition and are to be fitted with automatic closing appliance.

3.2.4 Sounding pipes are not to be used as filling pipes.

3.3 Structural details, sounding pipes

3.3.1 Sounding pipes are normally to be straight. If it is necessary to provide bends in such pipes, the curvature is to be as small as possible to permit the ready passage of the sounding apparatus.

3.3.2 Doubling plates are to be placed under the lower ends of sounding pipes in order to prevent damage to the hull. When sounding pipes with closed lower ends are used, the closing plate is to have reinforced scantling.

3.3.3 Sounding pipes shall have a nominal inside diameter of at least 32 mm.

3.3.4 The nominal diameters of sounding pipes which pass through refrigerated holds at temperatures below 0ºC are to be increased to an inside diameter of 50 mm.

3.3.5 The minimum wall thicknesses of sounding pipes are to be in accordance with Table 4.11.

3.3.6 Pipe material is to be selected according to provisions of this section.

3.4 Closing appliances

3.4.1 Self-closing appliances are to be fitted with cylindrical plugs having counterweights such as to ensure automatic closing.

3.4.2 Closing appliances not required to be of the self-closing type may consist of a metallic screw cap secured to the pipe by means of a chain or a shut-off valve.

SECTION 5

HULL OPERATIONAL SYSTEMS

Page

A. General

1. Scope

This section is intended to define principles to be applied for safe operation of a ship including;

- Fuel oil systems
- Sea water and fresh water cooling systems
- Ballast systems
- Lubricating oil systems
- Hydraulic systems
- Starting, control and monitoring air systems
- Exhaust gas systems
- Ventilation systems

2. Application

Where any point not clearly clarified is encountered, Part B Chapter 4 Machinery Section 16 may be applied as applicable to ships less than 500 GT and as not causing any contradictions with the requirements stated below.

B. Fuel Oil Systems

1. Application

1.1 Requirements given under this subsection apply to oil fuel systems for the service of propulsion engines and auxiliary machines. Additional requirements for independent fuel oil tanks or fuel oil supply equipment forming part of engines, gas turbines and incinerators are not included in this section.

1.2 Where any point not clearly clarified is encountered, Part B Chapter 4 Machinery Section 2 G.2 and Section 16 G may be applied as applicable for ships less than 500 GT and as not causing any contradictions with the requirements stated in this subsection.
For ship having the navigation notation other than unrestricted navigation alternative arrangements may be agreed on a case-by-case basis.

2. Definitions

Fuel oil is considered to have a flashpoint (determined using the closed cup test) not less than 60°C, or not less than 43°C. Provisions of Section 1 item 11 shall be applied.

3. Design Principles

3.1 General

3.1.1 The entire oil fuel system is to be permanently installed.

3.1.2 Portable oil fuel tanks may be provided subject that they comply with requirements of Part A Chapter 1-Hull

3.1.3 Individual components of the system, as well as the whole system, are to be designed and installed to with- stand the combined conditions of pressure, vibration and movement encountered under normal operating conditions.

3.1.4 Fuel oil systems are to be so designed as to ensure the proper characteristics (purity, viscosity, pressure) of the fuel oil supply to engines and boilers.

3.1.5 Fuel oil systems are to be so designed as to prevent overflow or spillage of fuel oil from tanks, pipes, fittings, etc., fuel oil from coming into contact with sources of ignition and overheating and seizure of fuel oil.

3.1.6 For ships where fuel oil is used, the arrangements for the storage, distribution and utilisation of the fuel oil are to be such as to ensure the safety of the ship and persons on board. Relevant sections of this chapter shall be complied with.

3.1.7 Only pipe connections with metal sealing surfaces or equivalent pipe connections of approved design may be used for fuel injection lines.

3.1.8 Materials used for piping and equipment as well as general details are to be in compliance with relevant sections of this chapter

3.1.9 Materials and/or the surface treatment used for the storage and distribution of fuel oil are to be selected such that they do not introduce contamination or modify the properties of fuel.

3.1.10 Oil components under pressure are to be so located that in the event of a leakage the fuel oil cannot be pulverised onto the exhaust manifold.

3.1.11 Feed and return lines are to be designed in such a way that no unacceptable pressure surges occur in the fuel supply system. Where necessary, the engines are to be fitted with surge dampers approved by TL.

3.1.12 All components of the fuel system are to be designed to withstand the maximum peak pressures which will be expected in the system.

3.1.13 If fuel oil reservoirs or dampers with a limited life cycle are fitted in the fuel oil system the life cycle together with overhaul instructions is to be specified by the engine manufacturer in the corresponding manuals.

3.1.14 Oil fuel lines are not to be located immediately above or near units of high temperature, steam pipelines, exhaust manifolds, silencers or other equipment required to be insulated. As far as practicable, oil fuel lines are to be arranged far apart from hot surfaces, electrical installations or other potential sources of ignition and are to be screened or otherwise suitably protected to avoid oil spray or oil leakage onto the sources of ignition. The number of joints in such piping systems is to be kept to a minimum.

3.1.15 Alarms, indicators and automatic controls of systems related to internal combustion engines are to be in compliance with relevant sections of this chapter

3.1.15 Provisions are to be taken to the Surveyor satisfaction in order to minimize the risk of oil fuel spillage or leakage, and of accumulation of flammable vapours into the ship.

3.1.16 Fuel oil systems are to be fitted with when fuel oil overflow tank is fitted, a high level alarm or a sight glass is to be fitted and daily service tank is to be fitted with a low level alarm with a local indication.

3.1.17 The remote control arrangement of valves fitted on fuel oil tanks is to comply with 4.6.1. The positions of the remote controls are also to comply with TL Rules for Automation.

3.2. Shielding

3.2.1 Regardless of the intended use and location of internal combustion engines, all external fuel injection lines (high pressure lines between injection pumps and injection valves) are to be shielded by jacket pipes in such a way that any leaking fuel is safely collected, drained away unpressurized, and efficiently monitored and alarmed.

3.2.2 If pressure variations of > 20 bar occur in fuel feed and return lines, these lines are also to be shielded.

3.2.3 The high pressure fuel pipe and the outer jacket pipe have to be permanent assembly.

3.2.4 Where, pipe sheaths in the form of hoses are provided as shielding, the hoses must be suitable for this purpose and approved by TL.

3.3. Fuel leak drainage

Appropriate design measures are to be introduced to ensure generally that leaking fuel is drained efficiently and cannot enter into the engine lube oil system.

3.4. Heating, thermal insulation, re-circulation

Fuel lines, including fuel injection lines, to engines which are operated with preheated fuel are to be insulated against heat losses and, as far as necessary, provided with heating. Means of fuel circulation are also to be provided.

3.5. Fuel oil emulsions

For engines operated on emulsion of fuel oil and other liquids, it has to be ensured that engine operation can be resumed after failures to the fuel oil treatment system.

3.6. Passage through particular compartments

3.6.1 Fuel lines may not pass through tanks containing feed water, drinking water, lubricating oil or thermal oil and vice versa

3.6.2 The passage of fuel pipes through accommodations is to be reduced to a minimum. When this cannot be avoided, the piping arrangement shall have no mechanical connections.

3.6.3 Hot points and other sources of ignition, batteries, are to be kept clear from the vicinity of the oil fuel fittings, pumps and tanks.

3.6.4 Provisions are to be made to prevent overpressure in any oil tank or in any part of the fuel oil system. Any relief valve is to discharge to a safe position.

3.6.5 The ventilation of machinery spaces is to be sufficient under all normal conditions to prevent accumulation of oil vapour.

3.6.6 Spaces where fuel oil is stored or handled are to be readily accessible. Oil fuel valves, filters, strainers, pumps and other similar fittings are to be readily accessible for inspection and maintenance.

3.7. Pumps

The power supply to oil fuel transfer pumps and to other pumps of the oil fuel system as well as to oil fuel separators is to be capable of being stopped from outside the compartment where these equipments are located.

4. Oil fuel tanks and bunkers

4.1 General

4.1.1 Fuel oil tanks may be integral with the hull. Engine mounted integral tanks may be used only for small engines of 4 kW maximum installed in open areas and having a maximum capacity of 10 litres. For independent fuel oil tanks, refer to item 4.2.

4.1.2 Air, sounding and overflow pipes and level indication are to comply with relevant items of Section 4.

4.1.3 Daily service tanks are to be provided with drains permitting the evacuation of water and impurities likely to accumulate in the lower part of these tanks. These drains are to be fitted with self-closing valves or cocks.

4.2 Independent fuel oil tanks

4.2.1 Independent fuel oil tanks are to be made of steel material except when permitted in items 4.2.2 and 4.2.3:

4.2.2 Independent fuel oil tanks for second category fuel may be made of aluminium provided that the tanks are located outside the propulsion machinery spaces or, when located within such spaces, they are fire insulated equivalent to steel.

4.2.3 Independent fuel oil steel tanks, when intended for first category liquid fuel, must be effectively protected internally and externally against corrosion. Where galvanising is used it must be by the hot dipped process. Sheet steel tanks intended for second category liquid fuel must not be galvanised internally.

4.2.4 Independent fuel oil tanks are to be hydraulically tested prior to their installation inboard at a pressure of at least 0,24 bar for second category fuel oil and 0,36 bar for first category fuel oil steel tanks.

4.3 Construction and design

4.3.1 The scantling of oil fuel bunkers and tanks forming part of the ship's structure are to comply with the requirements stated in Part A Chapter 1 Hull, as amended.

4.3.2 Any metallic independent tank of a capacity more than 500 litres is to comply with relevant requirements of Part A Chapter 1 Hull, as amended.

4.3.2 For metallic tanks all joints and seams must be either brazed, welded or equivalent.

4.3.2 Any oil fuel tank which length is more than 1,0 m is to be provided with suitable baffle plates.

4.3.2 As a rule, for capacities of more than 75 litres, a suitable handhole or similar opening is to be provided to facilitate internal inspection and cleaning.

4.3.2 A sump or pocket in the tank bottom is to be provided for the collection of water, with drains fitted with self- closing valves or cocks.

4.4 Installation

4.4.1 Independent fuel tanks are to be permanently installed in such manner that they do not support decks, bulkheads or other structure. They are to be suitably sup- ported and fixed.

4.4.2 Fuel tanks are to be sited in well-ventilated locations.

4.4.3 Location of oil fuel tanks and bunkers is to be chosen in a way to avoid any abnormal rise in temperature in these capacities.

4.4.4 The use of free standing oil fuel tanks is not permitted where spillage, leakage or vapour there from can constitute a hazard by falling on heated surfaces or where there is a risk of ignition.

4.5 Tank Filling and Suction Lines

4.5.1 Fuel lines are to have a minimum of connections, all of which must be readily accessible. In these lines, soft solder connection is not to be used and piping is to be connected by metal to metal joint of the conical type or by other approved type

4.5.2 All fuel tanks are to be fitted with a permanent filling pipe, of approved type led from the weather deck to the top of the tank. The minimum internal diameter of filling pipes is 38 mm. Suitable coamings and drains are to be provided to collect any leakage resulting from filling operations.

4.5.3 The deck filling plate is to be watertight designed and permanently stamped with a means of identifying the type of fuel the tank contains. Separation between ventilation openings and fuel deck filling plate is to be at least 400 mm.

4.5.4 Fuel transfer, feed and booster pumps shall be designed for the proposed operating temperature.

4.5.5 At least two means of transfer are to be provided. One of these means is to be a power pump. The other may consist of a standby pump, or, alternatively an emergency connection to another suitable power pump.

Note: Where provided, purifiers may be accepted as means of transfer.

4.5.6 At least two means of oil fuel transfer are to be provided for filling the daily (service) tanks. Provisions are to be made to allow the transfer of fuel oil from any storage, settling or service tank to another tank.

4.5.7 Where a feed or booster pump is required to supply fuel to main or auxiliary engines, standby pumps shall be provided. Where, the pumps are attached to the engines, standby pumps may be dispensed with for auxiliary engines.

4.5.8 Fuel supply units of auxiliary diesel engine are to be designed such that the auxiliary engines start without aid from the emergency generator within 30 sec after black-out.

Note: To fulfil the above requirement for example the following measures could be a possibility:

- *Air driven MDO service pump*
- *MDO gravity tank*
- *Buffer tank before each auxiliary diesel engine*

4.5.9 Filling and suction lines from storage, settling and daily service tanks situated above the double bottom and from which in case of their damage fuel oil may leak, are to be fitted directly on the tanks with shutoff devices capable of being closed from a safe position outside the space concerned.

4.5.10 In the case of deep tanks situated in shaft or pipe tunnel or similar spaces, shut-off devices are to be fitted on the tanks. The control in the event of fire may be affected by means of an additional shut-off device in the pipe outside the tunnel or similar space.

If such additional shut-off device is fitted in the machinery space it shall be operated from a position outside this space.

4.5.11 Filling lines are to extend to the bottom of the tank. Alternatively, short filling lines directed to the side of the tank may be admissible.

4.5.12 Storage tank suction lines may also be used as filling lines.

4.5.13 Where filling lines are led through the tank top and end below the maximum oil level in the tank, a non-return valve at the tank top is to be arranged.

Note: For valves at the fuel tanks Part B Chapter 4 Machinery Section 16 V.2.2.2.7.5 may also be applied as applicable and as not causing any contradictions.

4.5.14 The inlet connections of suction lines are to be so arranged far enough from the drains in the tank that the water and impurities which have settled out will not enter the suctions

4.5.15 The valves requested in the items above are to be located on the tank or bulkhead itself. However, short distance pieces of rigid construction may be accepted, the length of which is not to exceed about 1,5 D of the pipe.

4.6 Remotely controlled valves

4.6.1 Every fuel oil pipe which, if damaged, would allow oil to escape from a storage, settling or daily service tank is to be fitted with a cock or valve directly on the tank capable of being closed from a safe position outside the space in which such tanks are situated in the event of a fire occurring in such space. For the release of remotely operated shut-off devices, see Part B Chapter 4 Machinery Section 18, B.10.

Shut-off devices on fuel oil tanks having capacity of less than 500 ℓ need not be provided with remote control.

4.6.2 Such valves and cocks are also to include local control and indicators are to be provided on the remote and local controls to show whether they are open or shut.

5. Oil fuel supply to engines

5.1 The suctions of engine fuel pumps are to be so arranged as to prevent the suction of gathered water and sludge likely to accumulate after decanting at the lower part of service tanks.

5.2 Internal combustion engines intended for main propulsion with an output of more than 375 kW are to be fitted with at least two filters, or similar devices, so arranged that one of the filters can be overhauled while the other is in use.

5.3 In case of two independent propulsion lines, one filter only for each engine could be accepted if it is demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring on one propulsion line.

5.4 Fuel filters are to be made of material highly resistant to mechanical impacts and thermal shocks.

5.5 Fuel filters must be fitted with drain plugs.

5.6 Filters must be tested to 2 bars or 1,5 times the design pressure, whichever is the greater.

5.7 When a fuel oil booster pump is fitted which is essential to the operation of the main engine with an output of more than 375 kW, a stand-by pump, connected ready for immediate use, is to be provided.

5.8 This pump could be omitted in case of two independent propulsion lines in which each engine is fitted with its own booster pump and it is demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring on one propulsion line.

5.9 Excess fuel oil from pumps or injectors is to be led back to the service or settling tanks, or to other tanks intended for this purpose.

5.10 For high pressure fuel oil pipes See Section 2

5.11 Manufacturers of purifiers for cleaning fuel and lubricating oil must be approved by TL.

5.12 Where fuel oil needs to be purified, at least two purifiers are to be installed on board, each capable of efficiently purifying the amount of fuel oil necessary for the normal operation of the engines.

Note:
On ships with a restricted navigation notation where fuel oil needs to be purified, one purifier only may be accepted.

5.13 Where a fuel purifier may exceptionally be used to purify lubricating oil the purifier supply and discharge lines are to be fitted with a change-over arrangement which prevents the possibility of fuel and lubricating oils being mixed. Suitable equipment is also to be provided to prevent such mixing occurring over control and compression lines.

5.14 The sludge tanks of purifiers are to be fitted with a level alarm which ensures that the level in the sludge tank cannot interfere with the operation of the purifier.

6. Other Requirements

6.1 For Ships of 12 m in length and over

Note: In addition to the requirements of this subsection B, following requirements apply to ships of 12 m in length and over are to be complied with.

6.1.1 Fuel oil systems are to be so designed that, in the event that any one essential auxiliary of such systems becomes inoperative, the fuel oil supply to engines can be maintained. Partial reduction of the propulsion capability may be accepted, however, when it is demonstrated that the safe operation of the ship is not impaired.

6.1.2 Fuel oil tanks are to be so arranged that, in the event of damage to any one tank, complete loss of the fuel sup- ply to essential services does not occur.

6.2 For Ships of 24 m in length and over

Note: In addition to the requirements of this subsection B and item 6.1, following requirements apply to ships of 12 m in length and over are to be complied with.

6.2.1 Fuel oil lines supplying propulsion machinery and those supplying auxiliary engines are to be independent.

6.2.2 Two fuel oil service tanks used on board necessary for propulsion and essential systems, or equivalent arrangements, are to be provided. The capacity of each one of these tanks is to be at least 4 h, enabling safe operation of the ship.

For ships with a restricted navigation notation, the capacity is to be defined on a case-by-case basis.

Note: The present Rule could not be complied with when the air pipe of the daily tank is duly protected against mechanical damage or if the daily tank is duly protected against water ingress through a damaged air pipe by means of water traps.

6.2.3 In multi-engine installations which are supplied from the same fuel source, means of isolating the fuel supply and spill piping to individual engines are to be provided. The means of isolation are not to affect the operation of the other engines and are to be operable from a position not rendered inaccessible by a fire on any of the engines.

C. Sea Water And Fresh Water Cooling Systems (1)

1. Purpose

Cooling systems are to be so arranged that temperature of the cooled media (lubricating oil, hydraulic oil, charge air, etc.) for propulsion machinery and essential equipment can be maintained within the limits defined by the manufacturer and therefore the main and auxiliary engines can be sufficiently cooled under all operating conditions including starting and manoeuvring and under the inclination angles and the ambient conditions specified in this Chapter

2. Sea water cooling systems

2.1 Diesel Engine Plants

2.1.1 Main propulsion plants are to be provided with main and stand-by cooling seawater pumps.

2.1.2 Where required, stand-by pumps are not to be connected to the sea inlet serving the other sea water pumps, unless the two sea inlets are connected by a cross-over.

2.1.3 The main cooling seawater pump may be attached to the propulsion plant. It is to be ensured that the attached pump is of sufficient capacity for the cooling seawater required by main and auxiliary engines over the whole speed range of the propulsion plant.

(1) *Air cooling systems will be given special consideration.*

The drive of the stand-by cooling seawater pump is to be independent of the main engine.

Main and stand-by cooling seawater pumps are each to be of sufficient capacity to meet the maximum cooling seawater requirements of the plant.

Alternatively, three cooling seawater pumps of the same capacity and delivery head may be arranged, provided that two of the pumps are sufficient to supply the required cooling water for full load operation of the plant at design temperature.

With this arrangement it is allowable for the second pump to be automatically put into operation only in the higher temperature range by means of a thermostat.

2.1.4 Ballast pumps or other suitable seawater pumps may be used as stand-by cooling water pumps. Pipe connections between those pipe lines need to be approved by TL.

2.1.5 Where cooling water is supplied by means of a scoop, the main and stand-by cooling water pumps are to be of a capacity which will ensure reliable operation of the plant under partial load conditions and astern operation. The main cooling water pump is to be automatically started as soon as the speed falls below that required for the operation of the scoop.

2.1.6 For plants with more than one engine and with separate cooling water systems, complete spare pumps on board may be accepted instead of stand-by pumps provided that the main seawater cooling pumps are so arranged that they can be replaced with the means available on board and if it is demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring on one propulsion line.

2.2 Auxiliary Engines

2.2.1 Auxiliary engines are to be provided with main and stand-by cooling seawater pumps.

2.2.2 Where a common cooling seawater pump is provided to serve more than one auxiliary engine, an independent stand-by cooling seawater pump with the same capacity is to be fitted.

Independently operated cooling seawater pumps of the main engine plant may be used to supply cooling water to auxiliary engines while at sea, provided that the capacity of such pumps is sufficient to meet the additional cooling seawater requirement.

2.2.3 If each auxiliary engine is fitted with an attached cooling seawater pump, no stand-by cooling seawater pumps need be provided.

2.3 Sea Connections, Sea Chests

2.3.1 At least two sea chests are to be provided. The sea chests are to be arranged either side of the ship. These sea inlets are to be distinct for the two means of cooling given in 2.1.1 and 2.2.1, but they may be cross connected by a cross pipe.

2.3.2 These sea inlets are to be as possible as low and one of them may be that of the ballast pump or of the general service pump. A sea inlet is considered as low provided it remains submerged under all normal navigating conditions

For service in shallow waters, it is recommended that an additional high seawater intake should be provided.

2.3.3 In ships having two or more propulsion engines, each with its own sea inlet, the second sea inlet may be omitted if it is demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring on one propulsion line.

2.3.4 It is to be ensured that the total seawater supply for the engines can be taken from only one sea chest.

2.3.5 Each sea chest is to be provided with an effective vent. The following venting arrangements will be approved:

- An air pipe of at least 32 mm. ID which can be shut-off and which extends above the bulkhead deck;

- Adequately dimensioned ventilation slots in the shell plating.

2.3.6 Steam or compressed air connections are to be provided for clearing the sea chest gratings. The steam or compressed air lines are to be fitted with shutoff valves fitted directly to the sea chests. Compressed air for blowing through sea chest gratings may exceed 2 bar only if the sea chests are constructed for higher pressures.

2.3.7 Where a sea chest is exclusively arranged as chest cooler the steam or compressed airlines for clearing as in 1.5, may with the agreement of TL be dispensed with.

2.4. Sea Valves

Sea valves are to be so arranged that they can be operated from above the floor plates.

Discharge pipes for seawater cooling systems are to be fitted with a shut-off valve at the shell plating

2.5 Strainer

The suction lines of the seawater pumps are to be fitted with strainers.

The strainers are to be so arranged that they can be cleaned during operation of the pumps.

Where cooling water is supplied by means of a scoop, strainers in the main seawater cooling line can be dispensed with.

2.6 Filters

2.6.1 Where propulsion engines and auxiliary engines for essential services are directly cooled by sea water, both in normal service and in emergency operating conditions, filters are to be fitted on the suction of cooling pumps.

2.6.2 When the output of the engine exceeds 375 kW, these filters are to be so arranged that they can be cleaned without interrupting the cooling water supply.

3. Fresh water cooling systems

3.1. General

3.1.1 Depending on the requirements of the engine plant, the following fresh water cooling systems are allowed:

- A single cooling circuit for the entire plant;
- Separate cooling circuits for the main and auxiliary plant;
- Several independent cooling circuits for the main engine components which need cooling (e.g. cylinders, pistons and fuel valves) and for the auxiliary engines;
- Separate cooling circuits for various temperature ranges.

3.1.2 Fresh water cooling systems are to be designed according to the applicable requirements of item 2. Where the engines are cooled by fresh water, the second means stated in item 2.1.3 may be omitted if a connection is fitted from the fresh water system to a suitable sea water system.

3.1.3 The cooling circuits are to be so divided that, should one part of the system fail, operation of the auxiliary systems can be maintained.

Change-over arrangements are to be provided for this purpose if necessary.

3.1.4 As far as possible, the temperature controls of main and auxiliary engines as well as of different circuits are to be independent of each other.

3.1.5 Where, in automated engine plants, heat exchanges for fuel or lubricating oil are incorporated in the cylinder cooling water circuit of main engines, the entire cooling water system is to be monitored for fuel and oil leakage.

3.1.6 Common cooling water systems for main and auxiliary plants are to be fitted with shut-off valves to enable repairs to be performed without taking the entire plant out of service.

3.2. Heat Exchangers, Coolers

3.2.1 The construction and equipment of heat exchangers and coolers are subject to the Chapter 4 Machinery Section 14.

3.2.2 The coolers of cooling water systems, engines and equipment are to be designed to ensure that the specified cooling water temperatures can be maintained under all operating conditions. Cooling water temperatures are to be adjusted to meet the requirements of engines and equipment.

3.2.3 Heat exchangers for auxiliary equipment in the main cooling water circuit are to be provided with by-passes if by this means it is possible, in the event of a failure of the heat exchanger, to keep the system in operation.

3.2.4 It is to be ensured that auxiliary machinery can be maintained in operation while repairing the main coolers. If necessary, means are to be provided for changing over to other heat exchangers, machinery or equipment through which a temporary heat transfer can be achieved.

3.2.5 Shut-off valves are to be provided at the inlet and outlet of all heat exchangers.

3.2.6 Every heat exchanger and cooler is to be provided with a vent and a drain.

3.2.7 Keel coolers, chest coolers

Coolers external to the hull (chest coolers and keel coolers) are to be fitted with isolating valves at the shell.

Arrangement and construction drawings of keel and chest coolers are to be submitted for approval.

Permanent vents for fresh water are to be provided at the top of keel coolers and chest coolers.

Keel coolers are to be fitted with pressure gauge connections at the fresh water inlet and outlet.

3.3. Expansion Tanks

3.3.1 Expansion tanks are to be arranged at sufficient height for every cooling water circuit. Different cooling circuits may only be connected to a common expansion tank if they do not interfere with each other. Care must be taken here to ensure that damage to or faults in one system cannot affect the other system.

3.3.2 Expansion tanks are to be fitted with filling connections, aeration/de-aeration devices, water level indicators and drains.

3.4. Fresh Water Cooling Pumps

3.4.1 Main and stand-by cooling water pumps are to be provided for each fresh water cooling system.

3.4.2 Main cooling water pumps may be driven directly by the main or auxiliary engines which they are intended to cool provided that a sufficient supply of cooling water is assured under all operating conditions.

3.4.3 The drives of stand-by cooling water pumps are to be independent of the main engines.

3.4.4 Stand-by cooling water pumps are to have the same capacity as main cooling water pumps.

3.4.5 When redundancy of pumps is not required, the pump connected to the cooling systems may be either independent or driven by the machine it serves.

3.4.6 Where according to the construction of the engines more than one water cooling circuit is necessary, a stand-by pump is to be fitted for each main cooling water pump.

3.4.6 For fresh cooling water pumps of essential auxiliary engines the rules for sea cooling water pumps in 2.2.2 may be applied.

3.4.7 A stand-by cooling water pump of a cooling water system may be used as a stand-by pump for another system provided that the necessary pipe connections are arranged. The shut-off valves in these connections are to be secured against unintended operation.

3.4.8 Equipment providing for emergency cooling from another system can be approved if the plant and system are suitable for this purpose.

3.4.9 For plants with more than one main engine, the rules for sea cooling water pumps in 2.1.6 may be applied.

3.4.10 Relief valves are to be fitted on the discharge of cooling pumps driven by main engines, except for centrifugal type pumps.

3.5. Temperature Control

Cooling water circuits are to be provided with temperature controls in accordance with the requirement. Control devices whose failure may impair the functional reliability of the engine are to be equipped for manual operation.

3.6. Preheating for Cooling Water

Means are to be provided for preheating fresh cooling water. Exceptions are to be approved by TL.

3.7. Emergency Generating Units

Internal combustion engines driving emergency generating units are to be fitted with independent cooling systems. Such cooling systems are to be made proof against freezing.

3.8. Cooling water supply for electrical main propulsion plants

For the cooling water supply for converters of electrical main propulsion systems, the Chapter 5 – Electrical Installations, Section 13 have to be observed.

D. Ballast Systems

1. General

1.1 Suctions in ballast water tanks are to be so arranged that the tanks can be emptied despite unfavourable conditions of trim and list that may be encountered during normal operation of the ship.

1.2 Ballast lines are to be entirely independent and distinct from lines conveying lubricating oil and fuel oil.

1.3 Ballast water pipes may not pass through drinking water, feed water, thermal oil or lubricating oil tanks.

1.4 Ballast systems in connection with bilge systems are to be so designed as to avoid any risk of undesirable communication between spaces or with the sea.

1.5 All tanks including aft and fore peak and double bottom tanks intended for ballast water are to be provided with suitable filling and suction pipes connected to a power driven pump of adequate capacity.

1.6 Alternative carriage of fuel oil, feed water and ballast water in the same tanks is generally not permitted.

However where a tank is used alternately for ballast water and fuel (change-over tank), the suction in this tank is to be connected to the respective system by three-way cocks with L-type plugs, cocks with open bottom or change-over piston valves. These must be arranged so that there is no connection between the ballast water and the fuel systems when the valve or cock is in an intermediate position. Change-over pipe connections may be used instead of the above mentioned valves. Each change-over tank is to be individually connected to its respective system.

1.7 Where ballast water tanks may be used exceptionally as dry cargo holds, such tanks are also to be connected to the bilge system.

1.8 Where, on cargo ships, pipelines are led through the collision bulkhead below the freeboard deck, a shut-off valve is to be fitted directly at the collision bulkhead inside the fore peak.

The valve must be capable of being remotely operated from above the freeboard deck.

Where the fore peak is immediately adjacent to a permanently accessible room (e.g. bow thruster room) which is separated from the cargo space, this shut-off valve may be fitted directly at the collision bulkhead inside this room without provision for remote control, provided this valve is always well accessible.

2. Anti-heeling arrangements

Anti-heeling arrangements, which may produce heeling moments of more than 10° according to Chapter 1 - Hull, Section 1, E.3, are to be performed 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 shall automatically shut down in the case of power supply failure;

  The position “closed” of the shut-off devices shall be indicated on the control stand by type approved end position indicators;

- Additionally, Chapter 5 – Electrical Installations, Section 7, G is to be observed.

3. Ballast Water Management

3.1 Ballast Water Exchange

3.1.1 For the “overflow method” separate overflow pipes or by-passes at the air pipe heads have to be provided. Overflow through the air pipe heads is to be avoided. Closures according to ICLL, but at least blind flanges are to be provided. The efficiency of the arrangement to by-pass the air pipe heads is to be checked by a functional test during the sea trials.

3.1.2 For the “Dilution method” the full tank content is to be guaranteed for the duration of the ballast water exchange. Adequately located level alarms are to be provided (e.g. at abt. 90 % volume at side tanks, at abt. 95 % at double bottom tanks).

3.2 Ballast water treatment plants

Ballast water treatment plants are to be approved by a flag administration acc. to IMO Resolution MEPC 279(70). The obligation to install a ballast water treatment plant depends on the ballast water capacity and keel lying date of the ship (Refer to International Convention for the Control and Management of Ship’s Ballast Water and Sediments, 2004 – Regulation B-3).

4. Ballast Pumps

4.1 The arrangement of the bilge and ballast pumping system are to be such as to prevent the possibility of water passing from the sea and from water ballast spaces into machinery spaces, or from one compartment to another.

4.2 At least two power driven ballast pumps are to be provided.

4.3 Bilge pumps may be used for ballast water transfer provided the provisions of Section 4 B.2.1.8 are fulfilled.

4.4 Small tanks may be served by hand pumps.

5. Cross-Flooding Arrangements

5.1 As far possible, cross-flooding arrangements for equalizing of asymmetrical flooding in case of damage should operate automatically. Where the arrangement does not operate automatically, any shut-off valves must be capable of being operated from the bridge or another central location. The position of each closing device has to be indicated on the bridge and at the central operating location (see also Chapter 1 - Hull, Section 26, E.6 and Chapter 5 - Electrical Installations Section 7, H.).

5.2 The cross-flooding arrangements must ensure that in case of flooding equalization is achieved within 10 minutes.

5.3 Cross-flooding arrangements for equalizing of asymmetrical flooding in case of damage are to be submitted to TL for approval.

E. Lubricating Oil Systems

1. General Requirements

1.1 Lubricating oil systems are to be constructed to ensure reliable lubrication over the whole range of speed including starting, stopping and where applicable manoeuvring, for all inclinations and during run-down of the engines. Those system are also to be constructed to ensure adequate heat transfer and appropriate filtration of oil.

1.2 The arrangements for the storage, distribution and utilisation of oil used in pressure lubrication systems are to be such as to ensure the safety of the ship and persons on board and to minimise the risk of fire or explosion.

1.3 This section applies to lubricating oil systems serving diesel engines, reduction gears, clutches and controllable pitch propellers, for lubrication or control purposes.

1.4 Lubricating oil pipes are to be independent of any other fluid system.

1.5 The provisions for containment of flammable liquids in piping systems given in Section 4 of this Chapter 35-B are to be complied where applicable.

1.6 The use of sight-flow glasses in lubricating systems is permitted, provided that they are shown by testing to have a suitable degree of fire resistance.

2. Definitions

2.1 Priming pumps

Where necessary, priming pumps are to be provided for supplying lubricating oil to the engines.

2.2 Emergency lubrication

A suitable emergency lubricating oil supply (e.g. gravity tank) is to be arranged to come automatically into use in the event of a failure of the supply from the pumps.

2.3 Lubricating oil treatment

2.3.1 The equipment necessary (purifiers, automatic back-flushing filters, filters and free-jet centrifuges) for adequate treatment of lubricating oil is to be provided.

2.3.2 In the case of auxiliary engines running on heavy oil which are supplied from a common lubricating oil tank, suitable equipment is to be fitted to ensure that in case of failure of the common lubricating oil treatment system or ingress of fuel or cooling water into the lubricating oil circuit, the auxiliary engines required to safeguard the power supply in accordance with Chapter 5 - Electrical Installation Section 3, C. remain fully operational.

2. Lubricating Oil System Components

2.1 Lubricating oil circulating tanks and gravity tanks

2.1.1 For the capacity and location of these tanks see Part B Chapter 4 Machinery Section V, 3.

2.1.2 For ships where a double bottom is required the minimum distance between shell and circulating tank are to be at least 500 mm and more.

Where an engine lubricating oil circulation tank extends to the bottom shell plating on ships for which a double bottom is required in the engine room shut-off valves are to be fitted in the drain pipes between engine casing and circulating tank. These valves are to be capable of being closed from a level above the lower platform.

2.1.3 The suction connections of lubricating oil pumps are to be located as far as possible from drain pipes.

2.1.4 Where deep well pumps are used for main engine lubrication, they are to be protected against vibration through suitable supports.

2.1.5 The gravity tank is to be fitted with an overflow pipe which leads to the drain tank. Arrangements are to be made for observing the flow of excess oil in the overflow pipe.

2.2 Filling and suction lines

For filling and suctions pipes serving lubricating oil systems, provisions required for pipes those are serving the same purpose to oil fuel tanks and bunkers may be applied. Those requirements for filling and suction lines serving to oil fuel tanks and bunkers are given in subsection B.

2.3 Air and overflow pipes

For requirements that are applicable to air and overflow pipes serving lubricating oil systems, relevant items of Section 4 shall be applied.

2.4 Sounding pipes and level gauges

2.4.1 Safe and efficient means of ascertaining the amount of lubricating oil contained in the tanks are to be provided.

2.4.2 Sounding pipes are to comply with the relevant provisions of Section 4.

2.4.3 Oil-level gauges may be used in place of sounding pipes.

2.4.4 Gauge cocks for ascertaining the level in the tanks are not to be used.

2.5 Filters

2.5.1 In forced lubrication systems, a device is to be fitted which efficiently filters the lubricating oil in the circuit.

2.5.2 The filters provided for this purpose for main machinery and machinery driving electric propulsion generators are to be so arranged that they can be easily cleaned without stopping the lubrication of the machines.

2.5.3 Lubricating oil filters are to be arranged in the delivery pressure of the pumps.

2.5.4 Where filters are fitted on the discharge side of lubricating oil pumps, a relief valve leading back to the suction or to any other convenient place is to be provided on the discharge of the pumps.

2.5.5 Mesh size and filter capacity are to be in accordance with the requirements of the engine manufacturer.

2.5.6 In case of automatic back-flushing filters, it is to be ensured that a failure of the automatic back-flushing will not lead to a total loss of filtration.

2.5.7 Main lubricating oil filters are to be fitted with differential pressure monitoring. On engines provided for operation with gas oil only, differential pressure monitoring may be dispensed with. Back-flushing intervals of automatic filters provided for intermittent back-flushing are to be monitored.

2.5.8 For the protection of the lubricating oil pumps simplex filter of a minimum mesh size of 100 µ may be arranged on the suction side of the pumps.

Engines for the exclusive operation of emergency generators and emergency fire pumps may be fitted with simplex filters.

2.6 Lubricating oil coolers

It is recommended that turbine and large engine plants be provided with more than one oil cooler.

2.7 Oil level indicator

Machines with their own oil charge are to be provided with a means of determining the oil level from outside during operation. This requirement also applies to reduction gears, thrust bearings and shaft bearings.

2.8 Purifiers

The requirements in Part B Chapter 4 Machinery Section 16 G.8 apply as appropriate.

2.9 Remote control of valves

Lubricating oil tanks are to be fitted with remote controlled valves in accordance with the provisions for those valves serving the same purpose for oil fuel tanks and bunkers given in this section.

The remote controlled valves need not be arranged for storage tanks on which valves are normally closed except during transfer operation, or where it is determined that an unintended operation of a quick closing valve on the oil lubricating tank would endanger the safe operation of the main propulsion and essential auxiliary machinery.

3. Lubricating Oil Pumps

3.1 Main engines

3.1.1 Main and independent stand-by pumps are to be arranged.

Main engines with an output of more than 375 kW are to be provided with at least two power lubricating pumps, of such a capacity as to maintain normal lubrication with any one pump out of action.

Main pumps driven by the main engines are to be so designed that the lubricating oil supply is ensured over the whole range of operation.

3.1.2 In ships having two or more propulsion engines, each with its own lubrificating pump, the second pump may be omitted if it is demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring on one propulsion line

3.2 Auxiliary machinery

3.2.1 Diesel generators

3.2.1.1 For auxiliary engines with their own lubricating pump, no additional pump is required.

3.2.1.2 For auxiliary engines with a common lubricating system, at least two pumps are to be provided. However, when such engines are intended for non-essential services, no additional pump is required.

3.2.1.3 Where more than one diesel generator is available, stand-by pumps are not required.

Where only one diesel generator is available (e.g. on turbine-driven vessels where the diesel generator is needed for start up etc.) a complete spare pump is to be carried on board.

3.2.1.4 Where more than one diesel generator is available, diesel engine of the generator may be fitted with a simplex lubricating oil filter provided the arrangements are such that the cleaning can be readily performed by changeover to a standby unit without the loss of ship’s power required for operation.

3.2.1.5 Turbo generators and turbines used for driving important auxiliaries such as boiler feed water pumps etc. are to be equipped with a main pump and an independent auxiliary pump. The auxiliary pump is to be designed to ensure a sufficient supply of lubricating oil during the start up and run-down operation.

F. Hydraulic Systems

1. General

1.1 Scope

1.1.1 The requirements in this section should be applied to hydraulic systems used, for -unless otherwise specified- all hydraulic power installations intended for essential services. For example, to operate hatch covers, closing appliances in the ship's shell and bulkheads, and hoists.

1.1.2 Hydraulic power installations not serving essential services but located in spaces where sources of ignition are present are to comply with the provisions of 1.4.7 to 1.4.17

1.1.3 The requirements are to be applied in analogous manner to the ship's other hydraulic systems except where covered by the requirements in Section 16.

1.1.4 Additionally to this subsection, hydraulic installations intended for steering gear are to comply with the relevant provisions of Section 3.

1.2 Definitions

A power unit is the assembly formed by the hydraulic pump and its driving motor control and safety valves, oil reservoir and oil conditioning equipment

An actuator is a component which directly converts hydraulic pressure into mechanical action

1.3 Documents for approval

The diagram of the hydraulic system together with drawings of the cylinders and/or hydraulic motors containing all the data necessary for assessing the system, e.g. operating data, descriptions, materials used etc., are to be submitted in triplicate for approval.

1.4 Design principles

Note: *Part B Chapter 4 Machinery Section 10, A may be applied where any point not clearly clarified is encountered as applicable to ships less than 500 GT and as not causing any contradictions with the requirements stated in this subsection.*

1.4.1 As far as practicable, hydraulic systems are to be so designed as to avoid any overload of the system, maintain the actuated equipment in the requested position (or the driven equipment at the requested speed), avoid overheating of the hydraulic oil and prevent hydraulic oil from coming into contact with sources of ignition.

1.4.2 Hydraulic power installations with a design pressure of less than 2,5 MPa and hydraulic power packs of less than 5 kW will be given special consideration by the Society.

1.4.3 Hydraulic power installations with a design pressure exceeding 35 MPa will be given special consideration by the Society.

1.4.3 As a rule, hydraulic systems are to be so designed that, in the event that any one essential component becomes inoperative, the hydraulic power supply to essential services can be maintained. Partial reduction of the propulsion capability may be accepted, however, when it is demonstrated that the safe operation of the ship is not impaired.

1.4.4 When a hydraulic power system is simultaneously serving one essential system and other systems, it is to be ensured that operation of such other systems or a single failure in the installation external to the essential system is not detrimental to the operation of the essential system.

1.4.5 Provision of item 1.4.4 applies in particular to steering gear.

1.4.6 Hydraulic systems serving lifting or hoisting appliances, including platforms, ramps, hatch covers, lifts, etc., are to be so designed that a single failure of any component of the system may not result in a sudden undue displacement of the load or in any other situation detrimental to the safety of the ship and persons on board.

1.4.7 Oils used for hydraulic power installations are to have a flash point not lower than 150°C and be suitable for the entire service temperature range.

1.4.8 The hydraulic oil is to be replaced in accordance with the specification of the installation manufacturer.

1.4.9 Whenever practicable, hydraulic power units are to be located outside main engine rooms. Where this requirement is not complied with, shields or similar devices are to be provided around the units in order to avoid an accidental oil spray or jet on heated surfaces which may ignite oil.

1.4.10 Hydraulic power installations are to include at least two power units so designed that the services supplied by the hydraulic power installation can operate simultaneously with one power unit out of service. A reduction of the performance may be accepted.

1.4.11 Power hydraulic installations not supplying essential services may be fitted with a single power unit, provided that alternative means, such as a hand pump, are available on board.

1.4.12 Low power hydraulic installations not supplying essential services may be fitted with a single power unit.

1.4.13 Pressure reduction units used in hydraulic power installations are to be duplicated.

1.4.14 A device is to be fitted which efficiently filters the hydraulic oil in the circuit. Where filters are fitted on the discharge side of hydraulic pumps, a relief valve leading back to the suction or to any other convenient place is to be provided on the discharge of the pumps.

1.4.15 Where necessary, appropriate cooling devices are to be provided.

1.4.16 Safety valves of sufficient capacity are to be provided at the high pressure side of the installation. Safety valves are to discharge to the low pressure side of the installation or to the service tank.

1.4.17 Cocks are to be provided in suitable positions to vent the air from the circuit.

1.4.18 Provisions are to be made to allow the drainage of the hydraulic oil contained in the installation to a suitable collecting tank.

1.4.19 Arrangements are to be made for connecting a pressure gauge where necessary in the piping system.

1.4.20 Alarms and safeguards for hydraulic power installations intended for essential services, except steering gear, for which the provisions of Section 3 apply, are to be provided with low pump pressure alarm and low service tank level.

1.5 Hydraulic Tanks and Other Components

1.5.1 Hydraulic oil service tanks

Service tanks intended for hydraulic power installations supplying essential services are to be provided with at least a level gauge, a temperature indicator and a level switch.

The free volume in the service tank is to be at least 10% of the tank capacity.

1.5.2 Hydraulic oil storage tanks

Hydraulic power installations supplying essential services are to include a storage tank of sufficient capacity to refill the whole installation should the need arise case of necessity.

For hydraulic power installations of less than 5 kW, the storage means may consist of sealed drums or tins stored in satisfactory conditions.

1.5.3 Hydraulic accumulators

The hydraulic side of the accumulators which can be isolated is to be provided with a relief valve or another device offering equivalent protection in case of overpressure.

G. Starting, Control And Monitoring Air Systems

1. General

1.1 Compressed air systems are to be so designed that the compressed air delivered to the consumer is free from oil and water, as necessary and does not have an excessive temperature.

1.2 Compressed air systems are to be so designed as to prevent overpressure in any part of the systems.

1.3 Compressed air receivers are to comply with the requirements of Part B Chapter 4 Machinery Section 14.

1.4 Compressed air systems are to be so designed that, in the event of failure of the main air compressor intended for starting, control purposes or other essential services, such services can be restored rapidly.

1.5 Alarms and safeguards are to be provided for compressed air systems with low and high air pressure alarm after reducing valves low and high air vessel pressure.

Automatic pressure control is to be provided for maintaining the air pressure in the air receivers within the required limits.

2. Starting air systems

2.1. General

Engine starting equipment shall enable engines to be started up from "dead ship" condition according to Part B Chapter 4 Machinery Section 1, D.10.1 using only the means available on board.

2.2. Starting With Compressed Air

2.2.1 General

2.2.1.1 For main and auxiliary engines that are arranged for starting by compressed air, one or more power operated air compressors is/are to be fitted with a total capacity sufficient to supply within one hour the quantity of air needed to satisfy the provisions given in item 2.2.2.

At least one of the air compressors must be driven independently of the main engine and must supply at least 50% of the total capacity.

2.2.1.2 The total capacity of the starting air compressors is to be such that the starting air receivers designed in accordance with item 2.2, as applicable, can be charged from atmospheric pressure to their final pressure within one hour.

For calculation of starting air capacity, Chapter 4 Section 2 H.2.10 shall be applied.

2.2.1.3 Normally, compressors of equal capacity are to be installed. This does not apply to an emergency air compressor which may be provided to meet the requirement stated in item 1.

2.2.1.4 Where main engines are arranged for starting by compressed air, at least one air receiver is to be fitted with a capacity sufficient to provide without replenishment the number of starts required in item 2.2.2. It is also to take into account the air delivery to other consumers, such as control systems, whistle, etc., which are connected to the air receiver.

Ships with unrestricted navigation notation shall be fitted with at least two air receivers, each one of them having the capacity mentioned above.

2.2.1.5 If starting air systems for auxiliaries or for supplying pneumatically operated regulating and manoeuvring equipment or tyfon units are to be fed from the main starting air receivers, due attention is to be paid to the air consumption of this equipment when calculating the capacity of the main starting air receivers.

2.2.1.6 If the ship is fitted with an emergency generator set and if one of its means of starting is by compressed air, the following is to be complied with:

2.2.1.6.1 The starting air arrangement is to include a compressed air vessel, storing the energy dedicated only for starting of the emergency generator. The capacity of the compressed air available for starting purpose is to be sufficient to provide, without replenishment, at least three consecutive starts

2.2.1.6.2 The compressed air starting systems may be maintained by the main or auxiliary compressed air receivers through a non-return valve fitted in the emergency generator space, or by an emergency air compressor which, if electrically driven, is supplied from the emergency switchboard

2.2.1.6.3 All of these starting, charging and energy storing devices are to be located in the emergency generator space and is not to be used for any purpose other than the operation of the emergency generating set.

2.2.1.7 Other consumers with high air consumption apart from those mentioned in 2.2.1.5 may not be connected to the main starting air system. Separate air supplies are to be provided for these units. Deviations to this require the agreement of TL.

2.2.1.8 If auxiliary engines are started by compressed air, sufficient air capacity for three consecutive starts of each auxiliary engine is to be provided.

2.2.1.9 If starting air systems of different engines are fed by one receiver, it is to be ensured that the receiver air pressure cannot fall below the highest of the different systems minimum starting air pressures.

2.2.2 Number of starts

2.2.2.1 The total capacity of air receivers is to be sufficient to provide, without their being replenished, not less than 12 consecutive starts alternating between ahead and astern of each main engine of the reversible type, and not less than six starts of each main non-reversible type engine connected to a controllable pitch propeller or other device enabling the start without opposite torque.

The number of starts refers to the engine in cold and ready-to-start condition (all the driven equipment that cannot be disconnected is to be taken into account).

A greater number of starts may be required when the engine is in warm running condition.

At least 3 consecutive starts is to be possible for each engine driving electric generators and engines for other purposes.

The capacity of a starting system serving two or more of the above specified purposes is to be the sum of the capacity requirements.

2.2.2.2 For multi-engine propulsion plants, the capacity of the starting air receivers is to be sufficient to ensure at least 3 consecutive starts per engine. However, the total capacity is not to be less than 12 starts and need not exceed 18 starts.

2.2.3 Initial charge of starting air

2.2.3.1 The compressed air system for starting the main and auxiliary engines for essential services is to be so arranged that the initial charge of starting air can be developed on board ship without external aid. For this purpose, the following arrangements could be accepted:

- Where two electrical power operated air compressors are fitted in accordance with 2.1.1, the supply of one of them is by the emergency electric source of supply, or
- The presence of a diesel driven operated emergency air compressor started manually, or
- The presence of a manual compressor, or
- The presence of manual means of starting of the engine, or
- The presence of an additional electrical starting system.

Other arrangements will be reviewed on a case by case basis. In all cases, any emergency means of starting shall be capable of at least three consecutive starts of the engine within 1 hour and enabling the ship to regain propulsion and essential services.

3. Control and Monitoring Air Systems

3.1 General

3.1.1 At least one dedicated air vessel fitted with a non-return valve is to be provided for control and monitoring purposes.

3.1.2 Failure of the control air supply is not to cause any sudden change of the controlled equipment which may be detrimental to the safety of the ship.

3.1.3 When a pressure reducing valve is fitted, the design pressure of the piping system located on the low pressure side of the pressure reducing valve where no safety valve is provided is not to be less than the maximum pressure on the high pressure side of the pressure reducing valve.

3.1.4 Pressure reduction units used in control and monitoring air system intended for essential services are to be duplicated unless alternative means is provided to keep the essential services operable.

3.1.5 If only one air vessel is fitted on the air system supplying the air whistle, then an electrical air whistle should be added.

3.1.6 Arrangements are to be made to maintain the air pressure at a suitable value in order to ensure satisfactory operation of the installation.

3.1.7 Arrangements are to be made to ensure cooling, filtering and drying of the air prior to its introduction in the monitoring and control circuits.

4. Air compressors

4.1 This item 4 applies to reciprocating compressors of the normal marine types. Where it is intended to install compressors to which the following Rules and calculation formulae cannot be applied, TL requires proof of their suitability for shipboard use.

4.2 Air compressor design shall comply with Chapter 4 Section 2, L as applicable to ships less than 500 GT unless otherwise is agreed by TL.

4.3 Air compressor is to be fitted with a relief valve complying with Section 4 A.7.3.4.

4.4 Means are to be provided to prevent overpressure wherever water jackets or casings of air compressors may be subjected to dangerous overpressure due to leakage from air pressure parts.

4.5 Water space casings of intermediate cooler of air compressor are to be protected against any overpressure which might occur in the event of rupture of air cooler tubes.

4.6 Air compressors are to be fitted with a drain valve.

5. Compressed Air Lines

5.1 General Design Provisions

5.1.1 For prevention of overpressure, suitable pressure relief arrangements are to be provided for all systems. A safety valve is to be fitted behind each pressure-reducing valve. See also Part B Chapter 4 Machinery Section 18, G.1.1.6. Pressure lines connected to air compressors are to be fitted with non-return valves at the compressor outlet.

5.1.2 Only type-tested hose assemblies made of metallic materials may be used in starting air lines of diesel engines which are permanently kept under pressure.

5.1.3 Provisions are to be made to reduce to a minimum the entry of oil into air pressure systems and air compressor is to be located in spaces provided with sufficient ventilation.

5.1.4 Efficient oil and water separators, or filters, are to be provided on the discharge of compressors, and drains are to be installed on compressed air pipes wherever deemed necessary. For oil and water separators, see Chapter 4 Machinery Section 2, L.4.3.

5.1.5 The starting air line to each engine is to be fitted with a non-return valve and a drain.

5.1.6 Starting air lines may not be used as filling lines for air receivers.

5.1.7 Tyfons are to be connected to at least two compressed air receivers.

5.1.8 Pressure water tanks and other tanks connected to the compressed air system are to be considered as pressure vessels and must comply with the requirements in Chapter 4 Machinery Section 14 relating to the working pressure of the compressed air system.

5.1.9 For compressed air connections for blowing through sea chests refer to Chapter 4 Machinery Section 16 I.1.5.

5.1.10 For the compressed air supply to pneumatically operated valves and quick-closing valves refer to Chapter 4 Machinery Section 16 D.6.

5.1.11 For compressed air operated fire flaps of the engine room; D.6.5 is to be used analogously. These fire flaps are not to close automatically in case of loss of energy

5.1.12 Control air systems for essential consumers are to be provided with the necessary means of air treatment. Pressure reducing valves in the control air system of main engines are to be redundant.

5.1.13 All discharge pipes from starting air compressors are to be lead directly to the starting air receivers, and all starting pipes from the air receivers to main or auxiliary engines are to be entirely separate from the compressor discharge pipe system.

5.2 Protective devices for starting air mains

5.2.1 Non-return valves and other safety devices are to be provided on the starting air mains of each engine in accordance with the following provisions:

5.2.1.1 The main starting air arrangements for main propulsion or auxiliary diesel engines are to be adequately protected against the effects of backfiring and internal explosion in the starting air pipes. To this end, the following safety devices are to be fitted:

- An isolating non-return valve, or equivalent, at the starting air supply connection to each engine

- A bursting disc or flame arrester in way of the starting valve of each cylinder, for direct reversing engines having a main starting air manifold and at least at the supply inlet to the starting air manifold, for non-reversing engines.

  The bursting disc or flame arrester may be omitted for engines having a bore not exceeding 230 mm.

Other protective devices are to be specially considered by the Society.

The requirements of item 5.2.1.1 do not apply to engines started by pneumatic motors.

H. Exhaust Gas Systems

1. General

Exhaust gas systems are to be so designed as to limit the risk of fire, prevent gases from entering manned spaces and prevent water from entering engines.

2. General Design Principles

2.1 Exhaust systems are to be so arranged as to minimise the intake of exhaust gases into manned spaces, air conditioning systems and engine intakes.

2.2 The exhaust system is to be gastight throughout its passage inside the ship.

2.3 When piping is led through an accommodation, locker or similar compartment, it is to be of thick, corrosion resistant material, adequately insulated or to be routed in a gas-tight casing. Insulation of exhaust gas lines inside machinery spaces, see the requirements of Chapter 4 Machinery Section 18.

2.4 Engine exhaust gas pipes are to be installed separately from each other, taking the structural fire protection into account. Other designs are to be submitted for approval. The same applies to boiler exhaust gas pipes.

2.5 Account is to be taken of thermal expansion when laying out and suspending the lines.

2.6 Where exhaust pipes are led overboard, means are to be provided to prevent water from entering the engine. The pipes are to be looped or fitted with a suitable device such as a riser to prevent the return of water to the engine. Where a shut-off valve is fitted at the overboard discharge, means are to be provided to prevent the engine from being started when the valve is not fully open. Moreover this valve is to be readily operable from an accessible position. Outlet is to be fitted, where necessary, with a cowl or other suitable means which prevents the ingress of rain or snow.

2.7 Openings of exhaust gas pipes of emergency generator diesel engines shall have a height above deck that is satisfactory to meet the requirements of the LLC 1966 as amended 1988, Reg. 19(3).

2.8 Engine exhaust pipes are to be fitted with effective silencers or other suitable means are to be provided. Engine silencers are to be so arranged as to provide easy access for cleaning and overhaul.

2.9 Exhaust lines and silencers are to be provided with suitable drains of adequate size in order to prevent water flowing into the engine.

2.10 Where exhaust pipes are water cooled, they are to be so arranged as to be self-draining overboard.

2.11 Exhaust pipes and smoke ducts are to be so designed that any expansion or contraction does not cause abnormal stresses in the piping system, and in particular in the connection with engine turbo blowers. The devices used for supporting the pipes are to allow their expansion or contraction.

2.12 Exhaust gas systems are to be so designed that pressure losses in the exhaust lines do not exceed the maximum values permitted by the engine manufacturer.

2.13 Exhaust pipes of several engines are not to be connected together but are to be run separately to the atmosphere unless arranged to prevent the return of gases to an idle engine.

2.14 Chapter 35-A Hull Section 8 hull Integrity shall be complied with for hull integrity of exhaust system hull connections under freeboard deck.

2.15 When water-cooled exhaust gas pipes are used, a high temperature alarm must be fitted after the water injection device. Alternatively, an alarm of low sea water flow rate may be fitted.

2.16 For special Rules for tankers, refer to Chapter 4 Machinery Section 20, B.9.3. Engine exhaust gas lines are additionally subject to Chapter 4 Machinery Section 2, G. For special requirements for exhaust gas cleaning system see Chapter 4 Machinery Section 2, N.

3. Surface temperature

3.1 Exhaust gas pipes and silencers are to be either water cooled or efficiently insulated where their surface temperature may exceed 220°C, or they pass through spaces of the ship where a temperature rise may be dangerous.

3.2 The insulation of exhaust systems is to comply with the provisions for hot surfaces and fire protection given in Section 1.

3.3 If not oil-proof, the insulating material may be covered with an oil-proof material. If foamed plastic is used, it must be of a closed-cell type, resistant to oil, grease and be fire-resistant.

I. Ventilation Systems

1. General

As to prevent flammable vapours to accumulate and cause a possible explosion, spaces containing engines or other heat generating machinery shall be equipped with efficient ventilation systems.

2. Application

2.1 Requirements given below give a basis for ventilation systems of spaces containing propulsion engines or flammable products.

2.2 Applicable provisions of Part C Chapter 28 Ventilation and Part B Chapter 4 Machinery may also be applied in addition to the basic requirements given in this section as applicable for ships less than 500 GT and as not causing any contradictions with requirements given in this subsection.

3 General Design Principles

3.1 In general the shipboard machinery, equipment and appliances in machinery spaces are to be designed for continuous operation at maximum engine room air temperature.

3.2 Except where the machinery or fuel tank spaces are of open type **(1)**, they are to be provided with the necessary ventilation in accordance with the engine's air consumption and heat emission as specified by the engine manufacturer and the necessary ventilation to prevent the accumulation of oil flammable or explosive vapours.

3.3 The number of ventilation inlets, ventilators and exhaust openings in funnels shall be kept to a minimum, consistent with the needs of ventilation and the proper and safe working of the ship.

3.4 The ventilation systems for machinery spaces of category A shall be separated from the ventilation systems serving other spaces and shall be in general of the supply type. Other modes of operation may be applied upon special approval.

3.5 Machinery spaces of category A shall be adequately ventilated so as to ensure that when machinery or boilers therein are operating at full power

in all weather conditions which are encountered during service of the ship, an adequate supply of air is maintained to the spaces for the safety and comfort of personnel and the operation of the machinery. Any other machinery space shall be adequately ventilated appropriate for the purpose of that machinery space.

3.6 Air ducts close to electrical switchboards must be so installed and fitted with drains, where necessary that condensed water cannot enter the electrical installation.

3.7 Natural or mechanical ventilation are acceptable.

3.8 The ventilation is to be capable of operating with all access openings closed.

3.9 In general, ventilators necessary to continuously supply the machinery space shall have coamings of sufficient height to comply with LLC 1966 as amended 1988, Regulation 19(3), without having to fit weathertight closing appliances.

However, where due to ship size and arrangement this is not practicable, lesser heights for machinery space coamings, fitted with weathertight closing appliances in accordance with LLC 1966 as amended 1988, Regulation 19(4), may be permitted by the Administration in combination with other suitable arrangements to ensure an uninterrupted, adequate supply of ventilation to these spaces. The machinery spaces are those defined in SOLAS Regulation II-1/Reg. 3.16.

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(1) *A space may be considered as of open type when the space is located above the weather deck with openings at the top and the bottom and has at least 0,35 m^2 of area exposed to the atmosphere per cubic meter of its net volume provided that no long or narrow unvented spaces remain inside in which a flame front might propagate.*

3.10 Air intakes and air outlets are to be so arranged and located to prevent re-entry of exhausted fumes. They are to be located 40 cm from the gasoline fill and vent fittings.

3.11 The inlet air ventilation is to be located as far as practicable at the forward end of the space which is to be ventilated and led down to within the lowest part. The outlet is to be fitted at the opposite, as far as practicable, at the top of the space and terminated at the open air.

3.12 Where cowls or scoops are provided on any ventilation duct, the free area of the cowl or scoop is not to be less than twice the duct area. Where the cowls or scoops are screened, the mouth area is to be increased to compensate for the area of the screen wire.

Outlet ventilation ducts are not to discharge within one metre of possible source of ignition.

Precautions are to be taken to prevent recycling.

3.13 The means of closing of ventilation openings are to meet the requirements stated in Chapter 35-D Fire Safety. Mechanical ventilating fans are to be capable of being stopped from outside the space supplied by these ventilating fans.

3.14 Suitable arrangements shall be made to permit the release of smoke in the event of fire.

3.15 The provisions of (Hull Integrity) are to be complied with concerning height of ventilation coamings and closing appliances.

3.16 For the determination of the ventilation capacity the heat radiation of the equipment in the space and the required combustion air are to be considered.

The capacity and arrangement of ventilation systems/ducts is to ensure that accumulation of oil vapour is avoided under normal conditions.

Note :

The capacity requirements mentioned in item 3.16 are in general deemed to be met by using the calculations as per ISO Standard 8861 in the latest version.

3.17 In case that a gas fire-extinguishing system is provided for the machinery space it is recommended, that one of the engine room supply fans should be of reversible type and supplied from the emergency source of power supply to enable extraction of fire extinguishing gases, should the need arise.

3.18 Power driven fire closures for engine rooms containing combustion engines shall not close automatically in case of loss of energy (fail safe type) unless an uninterrupted, adequate air supply to the engine room can be maintained. This requirement is deemed to be met if e.g. a sufficient number of fire closures at air inlets and/or air outlets are of manual operated type. For a pneumatically operated system for fail safe type fire closures, the air supply may be from one air receiver located outside the machinery space with separated piping from air receiver to the fire closures

TÜRK LOYDU

Chapter 35 – C

Electrical Installations

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 IACS PR No.29 is on or after 1st of July 2015. 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 Terms and 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.

http:/www.turkloydu.org

SECTION 1

GENERAL RULES AND INSTRUCTIONS

Page

A. General

1. Scope and Application

1.1 These Construction Rules apply to design and construction of electrical and electronic installations and; material and equipment used in these installations on seagoing ships, classified by Türk Loydu (TL).

1.2 Where any point not clearly clarified is encountered, Part B Chapter 5 Electrical Installations may be applied as applicable to ships less than 500 GT and as not causing any contradictions with requirements stated in this Chapter 35-C.

1.3 Versions deviating from the Construction Rules may be approved if they have been tested for suitability and accepted as equivalent by TL.

The Society reserves the right, whenever deemed necessary or justified, to alter some requirements of the present Rules or to call new ones to take into consideration particular characteristics of a piece of equipment or of a definite installation. In particular, it may carry out a special examination of equipment, installation or project of installation, when these are based on new principles or arrangements not explicitly governed by the present Rules.

1.4 TL reserve the right to specify additional requirements to the Construction Rules where these are related to new systems or installations or where they are necessary because of new knowledge or operating experience.

Deviations from the Construction Rules may be approved where there are special reasons.

2. Design

2.1 Electrical installations shall be designed so that:

- The maintaining of normal operational and habitable conditions provided on board will be ensured without recourse to the emergency source of electrical power

- The operation of the equipment required for safety will be ensured under various emergency conditions

- The safety of crew and ship from electrical hazards will be ensured.

2.2 Further Rules and Standards to be considered

2.3 Further Rules and Guidelines of TL mentioned in this Chapter are to be observed.

2.4 If necessary, beside of the TL's rules, national regulations are to be observed as well.

2.5 Where the requirements for electrical equipment and facilities are not laid down in these Rules, decision shall be made, wherever necessary, regarding the use of other regulations and standards. These include e.g. IEC publications, especially all IEC 60092 publications.

3. Documents for approval

Part B Chapter 5 Section 1, C Documents shall be applied as applicable.

B. Definitions

Definitions given in this Chapter shall in general comply with Part B Chapter 5 Section 1, B and IEC standards. Where otherwise is stated in items given below, definitions given in this section shall apply.

1. Power Supply Installations

The power supply installations comprise all installations for the generating, conversion, storage and distribution of electrical energy.

2. Essential services

2.1 Services essential for the navigation, steering or manoeuvring of the ship, the safety of human life, and undertake activities connected with its operation, as far as class is concerned.

For ships of less than 24 m in length, essential services may include but are not limited to starting equipment of diesel engines, steering gear, bilge pumps, bilge level detection, lighting, navigation lights, radio communication equipment, fuel supply pumps, lubricating oil pumps and cooling water pumps for main and auxiliary engines, engine room fans if required for normal operation.

2.2 In addition to the paragraph above, for ships of 24 m in length and over, essential services may include but are not limited to following additional services, electric generator and associated power sources the above equipments, windlasses, fire detection and alarm system, fire extinguishing systems, ventilation fans for engine rooms, emergency battery charger, internal safety communication equipment.

3. Non-Essential Equipment

Non-essential equipment is equipment which is not listed in 2 respectively which does not fit into the definition of essential equipment.

4. Machinery Spaces

Machinery spaces are spaces in which machines and equipment are installed and which are accessible only to authorized persons, e.g. engine rooms.

4.1 Wet operating spaces

Wet operating spaces are spaces in which facilities may be exposed to moisture, e.g. main engine rooms.

4.2 Dry operating spaces

Dry operating spaces are spaces in which no moisture normally occurs, e.g. engine control rooms.

4.3 Locked electrical spaces

Locked electrical spaces are spaces which are provided with lockable doors and are intended solely for the installation of electrical equipment such as switchgear, transformers, etc. They have to be constructed as dry spaces.

4.4 Category A machinery spaces

Category A machinery spaces are spaces which contain internal combustion engines used for the main propulsion or other purposes and having a total power output of at least 375 kW, or which contain an oil-fired boiler or an oil-treatment plant. The trunks to such spaces are included.

5. Fire Subdivisions

Zone between boundaries for protection against propagation of fire.

6. Flame-Retardation of Individual Cables

Single cables and -wires are considered to be flame-retardant if they meet the test requirements of IEC publication 60332-1 regarding flame propagation.

7. Flame-Retardation of Cable Bunches

Cable bunches and wire bunches are considered flame-retardant if they are flame retardant as single cables, and laid bundled, meet the requirements of IEC publication 60332-3-21 with regard to flame propagation.

8. Fire-Resistant Cables

Fire-resistant cables are those which under the influence of flames demonstrate function-sustaining characteristics for a certain time, e.g. 3 h and meet the IEC publication 60331 test requirements.

9. Cable Bundles

Arrangement of two or more cables laid parallel and directly contiguous.

10. 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 operating conditions, cycles and running.

11. Protection Devices

Protective devices detect actual values, activate alarms in the event of limit-value infringement and prevent machinery and equipment being endangered. They automatically initiate curative measures or calls for appropriate ones.

12. Safety Devices

Safety devices detect critical limit-value infringements and prevent any immediate danger to persons, ship or machinery.

13. Safety Systems

Combination of several safety devices and/or protection devices into one functional unit.

14. Alarms

An alarm gives optical and acoustical warning of abnormal operating conditions.

15. Power Electronics

All equipment and arrangements for generation, transformation, switching and control of electrical power by the use of semi-conductor components.

16. Equipment of Power Electronics

All equipment which directly affect the flow of electrical energy; consist of the functional wired semi-conductor elements together with their protection and cooling devices, the semi-conductor transformers or inductors and the switchgear in the main circuits.

17. Electric Network

An electric network comprises all equipment/ installations connected together at the same rated voltage.

18. Low-voltage systems

Alternating current systems with rated voltages greater than 50 V r.m.s. up to 1000 V r.m.s. inclusive and direct current systems with a maximum instantaneous value of the voltage under rated operating conditions greater than 50 V up to 1500 V inclusive.

19. Safety voltage

Voltage which does not exceed 50 V AC r.m.s between conductors or between any conductor and earth, in a circuit isolated from the supply by means such as a safety isolating transformer, or convertor with separate windings.

Voltage which does not exceed 50 V DC between conductors, or between any conductor and earth, in a circuit which is isolated from higher voltage circuits.

Consideration should be given to the reduction of the limit of 50 V under certain conditions, such as wet surroundings or exposure to heavy seas or where direct contact with live parts is involved.

The voltage limit should not be exceeded either at full load or at no-load, but it is assumed, for the purpose of this definition, that any transformer or convertor is operated at its rated supply voltage.

20. Two-wire DC system

A DC system comprising two conductors only, between which the load is connected.

21. Single-phase two-wire AC system

A single-phase AC system comprising two conductors only, between which the load is connected.

22. Single-phase three-wire AC system

A single-phase AC system comprising two conductors and a neutral wire, the supply being taken from the two outer conductors or from the neutral wire and either outer conductor, the neutral wire carrying only the difference current.

23. Three-phase three-wire system

A system comprising three conductors connected to a three- phase supply.

24. Three-phase four-wire system

A system comprising four conductors of which three are connected to a three-phase supply and the fourth to a neutral point in the source of supply.

25. Three-phase five-wire system

A system comprising five conductors of which three are connected to a three-phase supply, the fourth to a neutral point in the source of supply and the fifth is the separate protective conductor.

26. Hull return system

A system in which insulated conductors are provided for connection to one pole or phase of the supply, the hull of the ship or other permanently earthed structure being used for effecting connections to the other pole or phase.

27. Earthed

An earthed system is connected to the general mass of the hull of the ship in such a manner as will ensure at all times an immediate discharge of electrical energy without danger.

A conductor is said to be "solidly earthed" when it is electrically connected to the hull without a fuse link, switch, circuit breaker, resistor, or impedance, in the earth connection.

28. Main source of electrical power

A source intended to supply electrical power to the main switchboard for distribution to all services necessary for maintaining the ship in normal operational and habitable condition.

29. Main switchboard

A switchboard which is directly supplied by the main source of electrical power and is intended to distribute electrical energy to the ship's services.

30. Emergency source of electrical power

A source of electrical power, intended to supply the emergency switchboard in the event of failure of the supply from the main source of electrical power.

31. Emergency condition

A condition under which any services needed for normal operational and habitable conditions are not in working order due to failure of the main source of electrical power.

32. Emergency switchboard

A switchboard which in the event of failure of the main electrical power supply system is directly supplied by the emergency source of electrical power and is intended to distribute electrical energy to the emergency services. The emergency switchboard may be supplied by the main switchboard under normal operation.

33. Normal operational and habitable condition

A condition under which the ship as a whole, the machinery, services, means and aids ensuring propulsion, ability to steer, safe navigation, fire and flooding safety, internal and external communications and signals, means of escape, and emergency boat winches, as well as the designed comfortable conditions of habitability are in working order and functioning normally.

34. Distribution board

A switchgear and control gear assembly arranged for the distribution of electrical energy to final circuits.

35. Engine negative terminal

Terminal on the engine to which the negative cable of a battery system is connected.

36. Final circuit

Portion of a wiring system extending beyond the final over current protection device for that circuit.

37. Overcurrent protection device

Device, such a fuse or circuit breaker, designed to interrupt the circuit when the current exceeds a predetermined value for a predetermined time.

38. Circuit breaker

Mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions, and also making, carrying for a specified time and breaking currents under specified abnormal conditions such as those of a short-circuit.

39. Generator

A device which creates DC or AC (alternator) power for distribution to the electrical system onboard a ship.

40. Generating set

A generating set is the combination of a generator with a driven engine which is not a main propulsion engine.

41. Fuse

Device that by fusing of one or more of its specifically designed and proportioned components, opens the circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device.

42. Protective conductor

Conductor provided for purposes of safety, for example, protection against electric shock by electrically connecting any of the exposed and extraneous conductive parts of electrical equipment of a ship with non-metallic hull to the ship's main earth.

In the case of a ship with metallic hull, exposed and extraneous conductive parts may be bonded to the ship's hull by permanent and reliable metal to metal joints of negligible impedance.

43. Bond

Connection of non-current carrying parts to ensure continuity of electrical connection, or to equalize the potential between parts comprising, for example, the armour or lead sheath of adjacent length of cable, the bulk- head, etc. For example bulkhead and cables in a radio- receiving room.

44. Neutral conductor

Conductor electrically connected to the neutral point and capable of contributing to the transmission of electrical energy.

45. Sheath

Uniform and continuous tubular covering of metallic or non-metallic material, generally extruded around one or more insulated conductors.

46. Vented battery

A vented batteries is one in which the cells allow products of electrolysis and evaporation to escape freely to the atmosphere and can receive additions to the electrolyte.

47. Valve regulated sealed battery

A valve regulated sealed battery is one in which the cells are closed but have a valve which allows the escape of gas if the internal pressure exceeds a predetermined value. The electrolyte cannot normally be replaced.

48. Cable trunking

System of enclosures comprising a base with a removable cover intended for the complete surrounding of insulated conductors, cables or cords and for the accommodation of other electrical equipment.

49. Captive-spade terminal

Conductor terminal component which is maintained in connection to the screw or stud even when the threaded terminal fastener is loose.

50. Accessible

Capable of being reached for inspection, removal or maintenance without removal of the permanent structure of the ship.

51. Readily accessible

Capable of being reached quickly and safely for effective use without the use of tools.

52. Certified safe-type equipment

Certified safe-type equipment is electrical equipment of a type for which a national or other appropriate authority has carried out the type verifications and tests necessary to certify the safety of the equipment with regard to explosion hazard when used in an explosive gas atmosphere. Certified safe-type equipment is to be designed and constructed to comply with IEC 60079 series.

C. Ambient Conditions

1. General

1.1 The selection, layout and arrangement of all shipboard machinery, equipment and appliances shall be such as to ensure faultless continuous operation. Therefore the manufacturer/supplier shall be informed by the user about the expected environmental conditions.

1.2 Care has to be taken of the effects on the electrical installations caused by distortions of the ship's hull.

1.3 For ships intended for operation only in specified zones, TL may approve deviating ambient conditions

2 Air temperatures

2.1 For ships engaged in unrestricted service, the ambient air temperature ranges shown in Table 1.1 are applicable in relation to the various locations of installation.

2.2 For ships engaged in service in specific zones, the Society may accept different ranges for the ambient air temperature (e.g. for ships operating outside the tropical belt, the maximum ambient air temperature may be assumed as equal to + 40°C instead of + 45°C).

Table 1.1 Ambient air temperature

Location	Min Temp. in °C	Max Temp. in °C
Enclosed spaces	+ 5	+45
Inside consoles or fitted on combustion engines and similar	+ 5	+55
Air conditioned areas	+ 5	+40
Exposed decks	-25	+45

3. Humidity

For ships engaged in unrestricted service, the humidity ranges shown in Table 1.2 are applicable in relation to the various locations of installation.

Table 1.2 Humidity

Location	Humidity
General	95% at 55°C
Air conditioned areas	Different values may be considered on a case by case

4. Sea water temperatures

The temperatures shown in Table 1.3 are applicable to ships engaged in unrestricted service.

Table 1.3 Water temperature

Coolant	Min Temp. in °C	Max Temp. in °C
Sea water	0	+32

For ships classed for service in specific zones, the Society may accept different values for the sea water temperature(e.g. for ships operating outside the tropical belt, the maximum sea water temperature may be assumed as equal to + 25°C instead of + 32°C).

5. Salt mist

The applicable salt mist content in the air is to be

1 mg/m^3.

6. Inclinations

The inclinations applicable are those shown in Table 1.4. The Society may consider deviations from these angles of inclination taking into consideration the type, size and service conditions of the ships.

7. Vibrations

In relation to the location of the electrical components, the vibration levels given in Table 1.5 are to be assumed. The natural frequencies of the equipment, their suspensions and their supports are to be outside the frequency ranges specified.

Where this is not possible using a suitable constructional technique, the equipment vibrations are to be dumped so as to avoid unacceptable amplifications.

Table 1.4 Inclination of ship

Type of machinery, equipment or component	Angles of inclination, in degrees (1)			
	Athwartship		Fore-and-aft	
	Static	Dynamic (4)	Static	Dynamic (5)
Machinery and equipment relative to main electrical power	15	22,5	5	7,5
Machinery and equipment relative to the emergency power installation and crew and passenger safety systems of the ship (e.g. emergency source of power, emergency fire pumps, etc.)	22,5 **(2)**	22,5 **(2)**	10	10
Switchgear and associated electrical and electronic components and remote control systems **(3)**	22,5	22,5	10	10

(1) *Athwartship and fore-and-aft angles may occur simultaneously in their most unfavourable combination.*

(2) *In the case of gas carriers or chemical tankers, the emergency power supply must also remain operable with the ship flooded to a final athwartship inclination up to a maximum of 30°.*

(3) *No undesired switching operations or functional changes may occur up to an angle of inclination of 45°.*

(4) *The period of dynamic inclination may be assumed equal to 10 s.*

(5) *The period of dynamic inclination may be assumed equal to 5 s.*

Table 1.5 Vibration levels

Location	Frequency range, in Hz	Displacement amplitude, in mm	Acceleration amplitude g
Machinery spaces, command and control stations, accommodation spaces, exposed decks, cargo spaces	from 2,0 to 13,2 from 13,2 to 100	1,0 −	− 0,7
On air compressors, on diesel engines and similar	from 2,0 to 25,0 from 25,0 to 100	1,6 −	− 4,0
Masts	from 2,0 to 13,2 from 13,2 to 50	3,0 −	− 2,1

D. Operating Conditions

1. Voltage and Frequency Variations

1.1 All electrical equipment supplied from the main or emergency systems shall be so designed and manufactured that it works faultlessly during the voltage and frequency variations occurring in the normal operation. The variations indicated in Table 1.6 are to be used as a basis.

1.2 Unless otherwise stated in national or international standards, all equipment shall operate satisfactorily with the variations from its rated value shown in Table 1.6 to 1.8 on the following conditions:

- For alternative current components, voltage and frequency variations shown in the Table 1.6 are to be assumed.

- For direct current components supplied by DC generators or converted by rectifiers, voltage variations shown in the Table 1.7 are to be assumed.

- For direct current components supplied by electrical batteries, voltage variations shown in the Table 1.8 are to be assumed.

1.3 Any special system, e.g. electronic circuits, whose function cannot operate satisfactorily within the limits shown in the Table, shall not be supplied directly from the system but by alternative means, e.g. through stabilized supply.

2. Mains Quality

2.1 In systems without substantial static converter load and supplied by synchronous generators, the total voltage harmonic distortion shall not exceed 5% and the single harmonic does not exceed 3% of the nominal voltage.

2.2 For components intended for systems fed by static converters, and/or systems in which the static converter load predominates, it is assumed that:

- The single harmonics do not exceed 5% of the nominal voltage up to the 15th harmonic of the nominal frequency, decreasing to 1% at the 100th harmonic (see Figure 1.1), and that

- The total harmonic distortion does not exceed 10%.

2.3 Higher values for the harmonic content (e.g. in electric propulsion plant systems) may be accepted on the basis of correct operation of all electrical devices.

Table 1.6 Voltage and frequency variations of power supply in AC

Quantity in operation	Variations	
	Continuous	Transient
Frequency	± 5%	± 10% (recovery time: 5 s)
Voltage	+ 6%, − 10%	± 20% (recovery time: 1,5 s)
Note: *For alternating current components supplied by emergency generating sets, different variations may be considered.*		

Table 1.7 Voltage variations in DC

Parameters	Variations
Voltage tolerance (continuous)	± 10%
Voltage cyclic variation	5%
Voltage ripple (AC r.m.s. over steady DC voltage)	10%

Table 1.8 Voltage variations for battery systems

Systems	Variations
Components connected to the battery during charging **(1)**	+30% to −25%
Components not connected to the battery during charging	+20% to −25%
(1) *Different voltage variations as determined by the charging/discharging characteristics, including ripple voltage from the charging device, may be considered.*	

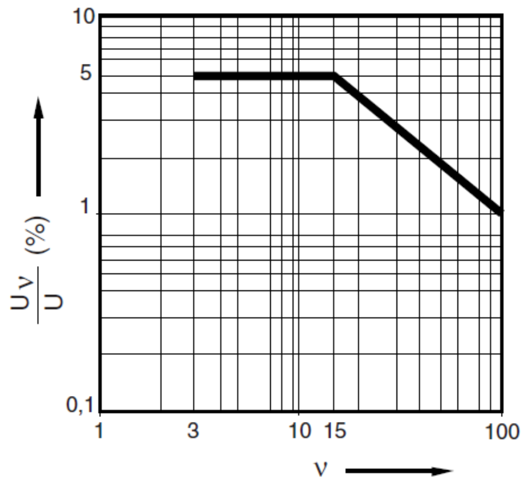


Figure 1.1 Limit values for the single harmonics in the supply voltage. U_v is the RMS value of the v-th order harmonic voltage

E. Electromagnetic compatibility

1. Electrical and electronic equipment on the bridge and in the vicinity of the bridge not required neither by classification rules nor by International Conventions are not to cause electromagnetic interference which may cause interference on required equipment.

2. For this purpose, IEC Publication 60533 - "Electromagnetic Compatibility of Electrical and Electronic Installations in Ships and of Mobile and Fixed Offshore Units" may be applied as applicable to ships less than 500 GT.

F. Materials

1. The materials used for electrical machines, switchgear and other equipment shall be resistant to sea air containing moisture and salt, seawater and oil vapours. They shall not be hygroscopic and shall be flame-retardant, moist resistant and self-extinguishing.

2. The evidence of flame-retardation and moisture resistance shall be according to IEC publication 60092-101 or other standards, e.g. IEC publications 60695-11-10 or UL 94. Cables shall correspond to the IEC publication 60332-1.

3. The usage of halogen-free materials is recommended.

4. Units of standard industrial type may be used in areas not liable to be affected by salty sea air subject to appropriate proof of suitability.

5. Materials with a high tracking resistance are to be used as supports for live parts.

6. Where the use of incombustible materials or lining with such materials is required, the incombustibility characteristics may be verified by means of the test cited in IEC Publication 60092-101 or in other recognised standards.

7. Insulated windings are to be resistant to moisture; sea air and oil vapour unless special precautions are taken to protect insulants against such agents.

8. The insulation classes given in Table 1.9 may be used in accordance with IEC Publication 60085.

Table 1.9 Insulation classes

Class	Maximum continuous operating temperature, in °C
A	105
E	120
B	130
F	155
H	180

9. The materials used for insulation of cables are to comply with IEC Publication 60092-351 and to have the thicknesses specified for each type of cable in the relevant standard. The maximum permissible rated temperature is specified for the various materials.

10. Material and thicknesses other than those in item 9 will be specially considered by the Society.

SECTION 2

POWER SUPPLY INSTALLATIONS

Page

A. Electrical Power Demand and Supply

1. Electrical Power Demand

1.1 A power balance of the electrical equipment has to be submitted to proof the sufficient ratings of units for the generating, storage and transformation of electrical energy.

1.2 The power demand has to be determined for the following operating conditions:

- Navigation at sea;

- Estuary trading and navigation close to " port

- Emergency power supply.

1.3 Extreme environmental conditions appropriate to the ship's area of operation are also to be taken into account, if any.

1.4 In compiling the power balance, all installed electrical consumers are to be tabulated together with an indication of their power inputs.

2. For the various operating conditions, attention is to be given to:

2.1 The full power input of all consumers continuously required for operation, except for those consumers which remain on standby and are used only when a similar consumer fails.

2.2 The power input of all temporarily used consumers multiplied by a diversity factor.

The consumers mentioned in 2.3 are excluded.

The diversity factor shall be applied only once during the calculation.

2.3 The full power input of consumers with a high power consumption relative to the main power supply, e.g. lateral thrusters.

2.4 Short-term peak loads caused, for example, by the automatic starting of large motors. Proof is required of reserve power.

2. Electrical Power Supply

2.1 Supply systems

2.1.1 The following distribution systems may be used:

2.1.1.1 on DC installations:

- Two-wire insulated

- Two-wire with negative earthed

2.1.1.2 on AC installations:

- Single-phase two-wire insulated

- Single-phase two-wire with neutral earthed

- Three-phase three-wire with neutral insulated or directly earthed

- Three-phase four-wire with neutral earthed (TN-C Type)

- Three-phase five-wire with neutral earthed (TN-S Type).

2.1.2 The hull return system of distribution is not to be used for voltage greater than 50 Volts.

2.1.3 The requirement of 2.1.2 does not preclude under conditions approved by the Society the use of limited and locally earthed system, or insulation level monitoring devices provided the circulation current does not exceed 30 mA under the most unfavourable conditions.

2.2 Maximum voltage

2.2.1 The maximum voltage for both alternating current and direct current low-voltage systems of supply for the ship's services are given in Table 2.1.

2.2.2 Voltages exceeding those shown will be specially considered in the case of specific systems.

2.2.3 For high voltage systems, Part B Chapter 5 Electrical Installations Section 8.

Table 1 Maximum permitted voltages

<table>
<tr><th colspan="2">Use</th><th>Maximum voltage V</th></tr>
<tr><td rowspan="6">For permanently installed and connected to fixed wiring</td><td>Power equipment</td><td>1000</td></tr>
<tr><td>Heating equipment (except in accommodation spaces)</td><td rowspan="2">500</td></tr>
<tr><td>Cooking equipment</td></tr>
<tr><td>Lighting</td><td rowspan="3">250</td></tr>
<tr><td>Space heaters in accommodation spaces</td></tr>
<tr><td>Control (1), communication (including signal lamps) and instrumentation equipment</td></tr>
<tr><td>For permanently installed and connected by flexible cable</td><td>Power and heating equipment, where such connection is necessary because of the application (e.g. for moveable cranes or other hoisting gear)</td><td>1000</td></tr>
<tr><td rowspan="4">For socket-outlets supplying</td><td>Portable appliances which are not hand-held during operation (e.g. refrigerated containers) by flexible cables</td><td>1000</td></tr>
<tr><td>Portable appliances and other consumers by flexible cables</td><td rowspan="2">250</td></tr>
<tr><td>Equipment requiring extra precaution against electric shock where a isolating transformer is used to supply one appliance (2)</td></tr>
<tr><td>Equipment requiring extra precaution against electric shock with or without a safety transformer (2)</td><td>50</td></tr>
<tr><td colspan="3">(1) For control equipment which is part of a power and heating installation (e.g. pressure or temperature switches for start/stop motors), the same maximum voltage as allowed for the power and heating equipment may be used provided that all components are constructed for such voltage. However, the control voltage to external equipment is not to exceed 500 V.
(2) Both conductors in such systems are to be insulated from earth.</td></tr>
</table>

B Sources of electrical power

1. Main Electrical Power Supply

1. Design

1.1 Every ship is to be provided with a main source of electrical power and associated switchboard with sufficient capacity to meet the requirements of the plant (i.e. for services necessary for maintaining the ship in normal operational conditions). This main source of electrical power shall consist of at least two mutually independent generating sets. For ships engaged in sheltered area service, refer to item 1.13.

1.2 Main source of power may be AC or DC system.

1.3 The capacity of the generating sets mentioned in 1.1 shall be such that, if any one generating set should fail or be shut down, the remaining generating capacity is sufficient to supply all those items of equipment which are needed, when navigating at sea, to ensure:

- Normal operational conditions of propulsion and safety of the ship,
- A minimum of comfortable conditions of habitability,
- Preservation of the cargo, as far as the equipment provided is part of the classification.
- Minimum comforts for living on board include at least adequate services for lighting, cooking, heating, domestic refrigeration, mechanical ventilation, sanitary and drinking water.

1.6 Notwithstanding the provisions of 1.3, all main generators may be taken into account when considering the operation of equipment to assist in manoeuvring the vessel (e.g. lateral thrusters) and when cooling down refrigerated cargo.

1.7 For ships with restricted zones of operation or intended for a special purpose, exemptions may be approved on an individual case basis.

1.8 The arrangements of the ship's main source of electrical power shall be such that operation in accordance with Section 1, A. 2. can be maintained regardless of the speed and direction of rotation of the main propulsion machinery or shafting.

1.9 Generators (AC or DC) driven by the propulsion machinery may be accepted as forming the main source of electrical power, if in all manoeuvring conditions including the propeller being stopped, the capacity of these generators is sufficient to provide the electrical power to comply with item 1.1. They are to be not less effective and reliable than the independent generating sets. One propulsion engine being unavailable is no to result in more than one generator being unavailable as well.

1.9 The ship machinery installations shall be so designed, that they can be brought to operation from dead ship condition.

Note: *"Dead ship" condition means that the complete machinery plant including the main source of electrical power is out of operation and auxiliary energy as compressed air, starting current from batteries etc. are not available for the restoration of the main power supply, for the restart of the auxiliaries and for the start-up of the propulsion plant. It is however assumed that the equipment for start-up of the emergency diesel-generator is ready for use.*

1.10 Emergency generators may be used for the raising of the dead ship condition where the independent emergency power supply is safeguarded at any time.

1.11 It is to be ensured that in the event of failure of the main electrical power supply (blackout), this supply shall be automatically restored to operation even without the aid of the emergency electrical power source.

1.12 If transformers, storage batteries with their charging equipment, converters and suchlike are essential components of the main electrical power supply, the availability of the entire supply system demanded shall remain guaranteed if any one unit breaks down.

1.13 In case of a ship engaged in sheltered area service, the main electric power source may only consist of one generator driven or not from the propulsion engine. In case this generator is unavailable, the electric services necessary to the propulsion and safety of the ship are to be supplied with a battery that may be the emergency source.

2. Emergency Electrical Power Supply

2.1. General Requirements

2.1.1 The emergency source of electrical power shall take over the supply of the emergency consumers in case of failure of the main source of electrical power. It shall be independent of the main source of electrical power.

Exceptionally, whilst the vessel is at sea, is understood to mean conditions such as

- Blackout situation
- Dead-ship situation
- Routine use for testing
- Short-term parallel operation with the main source of electrical power for the purpose of load transfer

2.1.2 The emergency source of power may be a generator set driven by an auxiliary engine with a fuel oil supply and a cooling system independent from the main engine or a storage battery.

2.1.3 The emergency source of power, associated distribution switchboard, and if any, transitional source of emergency power are to be located outside the engine room, above the uppermost continuous deck and are to be readily accessible from the open deck.

They are not to be located forward of the collision bulkhead.

2.1.4 In all cases the location of the emergency source of electrical power is to be such as to ensure that fire or other casualty in the space containing the main source of electrical power will not interfere with its continuous operation.

2.1.5 The capacity of the emergency source of electrical power must be sufficient to supply all those services which are essential for safety in an emergency:

2.1.5.1 Where the emergency source of electrical power is an accumulator battery, it is to be capable of carrying the emergency electrical load without recharging while maintaining the voltage of the battery through- out the discharge period within 12% above or below its nominal voltage, automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power; and immediately supplying at least those services specified in item 2.1.1 and Section 3.

An indicator is to be mounted in a continuously manned control position, to indicate when the battery constituting the emergency source of electrical power is being discharged.

2.1.5.2 Where the emergency source of electrical power is a generator, it is to be driven by a suitable prime mover with an independent supply of fuel, having a flash point (closed cup test) of not less than 43°C, started automatically upon failure of the main source of electrical power supply to the emergency switchboard unless a transitional source of emergency electrical power in accordance with 2.1.6 is provided. Where the emergency generator is automatically started, it is to be automatically connected to the emergency switchboard and provided with a dedicated fuel oil supply tank fitted with a low level alarm, arranged at level ensuring sufficient fuel oil capacity for the emergency services for the period of time as required in Section 3.

2.1.6 The transitional source of emergency electrical power where required in 2.1.5.2, is to consist of an accumulator battery so arranged to supply automatically in the event of failure of either the main or the emergency source of electrical power for half an hour at least the emergency lighting listed in Section 3.

2.1.7 Provided that suitable measures are taken for safeguarding independent emergency operation under all circumstances, the emergency generator may be used exceptionally and for short periods to supply non-emergency circuits.

2.1.8 For ships which need electrical power to restore propulsion, the capacity of the emergency source of power shall be sufficient to restore propulsion to the ship in conjunction with other auxiliary machinery, as appropriate, within 30 min. after black-out. It is assumed that starting energy is not available after blackout. For steam ships the 30 min. admit until start up of the first boiler, see also Part B Chapter 5 Electrical Installations Section 3 B.1.7 and 1.8.

2.1.9 For all equipment forming part of the emergency source of electrical power, provision shall be made for periodic functional tests, including especially the testing of automatic switching and starting devices. Such testing shall be possible without interfering with other aspects of the ship's operation.

2.1.10 For the rating and control of the emergency generators, the same principles apply as for the main generators in accordance with B. 2. Unlike in B. 2.4, voltage deviations of ± 3.5 % under steady conditions and of ± 4 % under transient conditions after 5 s are acceptable.

2.1.11 Regarding electric starting equipment see Part B Chapter 5 Electrical Installations Section 7, D. 6.

2.1.12 Where fins of stabilizing systems are in the area of embarking stations of life boats, these systems and indicators on the navigation bridge shall be connected to the emergency source of power.

3. Ships of less than 12 m in length

3.1 For ships whose length is less than 12 m, requirements above given for main and emergency power supplies may be omitted.

3.2 These ships are to be fitted with a source of electrical power of sufficient capacity to supply all essential services necessary for their normal operation. The source of power may consist of batteries and two DC or AC generators.

3.3 Where DC generators are provided, they are to be capable of supplying the total load and simultaneously be capable of charging the batteries to 80% charge within
10 hours.

3.4 Where AC power is provided, it may be done by one or a combination of the following means:

- One or more shore-power connections

- Inverter supplying AC power from the ship's DC system

- On-board AC generator(s) supplying the required system load.

3.5 Generator may be driven by its own prime mover, or be powered from propulsion machinery, or be a shaft generator.

3.6 For ships engaged in sheltered area service or with coastal area service, the main source of electrical power may consist of a single generator. In this case an alternative means of starting the generator is to be provided. In addition, in case this generator is unavailable, the electric services necessary to the propulsion and safety of the ship are to be supplied with a battery.

4. Ships of 24 m in length and over

4.1 Where transformers, converters or similar appliances constitute an essential part of the electrical system to ensure the supply to the propulsion, the steering of the ship, and for normal habitable conditions, the system is to be so arranged as to ensure the same continuity of supply as stated in this sub-article.

4.2 This may be achieved by arranging at least two three- phase or three single-phase transformers supplied, protected and installed as indicated in Figure 2.1, so that with any one transformer not in operation, the remaining trans- former(s) is (are) sufficient to ensure the supply to the above mentioned services stated in item 4.1. Each transformer required is to be located as a separate unit with separate enclosure or equivalent, and is to be served by separate circuits on the primary and secondary sides. Each of the primary and secondary circuits is to be provided with switchgears and protection devices in each phase.

Where special precaution are taken to rapidly replace the faulty transformer, i.e. less than 30 minutes, only one spare three-phase transformer or one spare single-phase element are required

Suitable interlocks or a warning label are to be provided in order to prevent accidence or repair of one single-phase transformer unless both switchgears are opened on their primary and secondary sides.

5. Diversity factors

5.1 General

5.1.1 The cables and protective devices of final circuits are to be rated in accordance with their connected load.

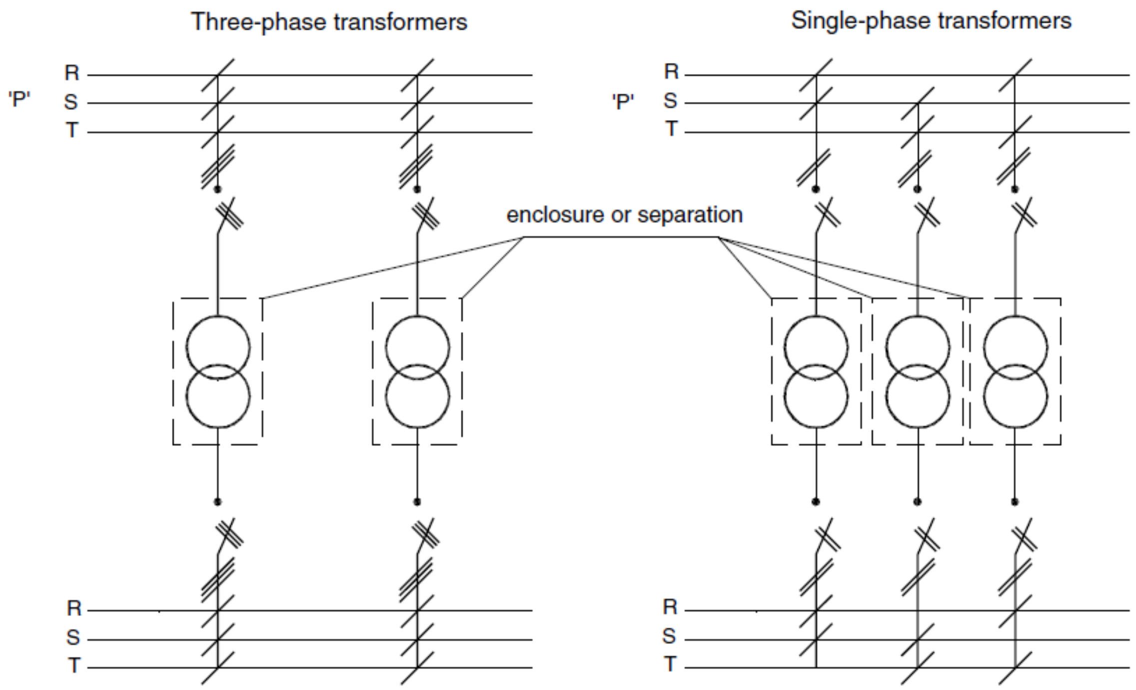
5.1.2 Circuits supplying two or more final circuits are to be rated in accordance with the total connected load subject, where justifiable, to the application of a diversity (demand) factor in accordance with 5.1.3 and 5.1.4.

Where spare-circuits are provided on a section or distribution board, an allowance for future increase in load is to be added to the total connected load, before the application of any diversity factor. The allowance is to be calculated on the assumption that each spare circuit requires not less than the average load on each of the active circuits of corresponding rating.

5.1.3 A diversity (demand) factor may be applied to the calculation of the cross-sectional area of conductors and to the rating of switchgear, provided that the demand conditions in a particular part of an installation are known or may reasonably be anticipated.

5.1.4 The diversity factor applied for motor power circuits is to be determined according to the circumstances. The normal full-load is to be determined on the basis of the name-plate rating.

Figure 2.1 Transformers - Continuity of supply



SECTION 3

POWER DISTRIBUTION

Page

A. Provisions for Distribution Systems

1. Earthed neutral systems

1.1 In earthed neutral systems, the source of power is connected directly to earth, and all exposed conductive parts of the installation are connected to the earthed point of the ship's power system by protective conductor(s) or via the hull for steel ships.

1.2 The neutral conductor is to be earthed only at the source of power, for example, at the onboard generator or secondary of transformer.

1.3 The ship's AC neutral is to be arranged to be earthed only at the shore-power source when the ship's AC system is supplied from shore (i.e. the ship's AC neutral is to be disconnected from the ship's earth when the shore power is connected), unless the ship is fitted with an isolating trans- former.

1.4 System is to be effected by means independent of any earthing arrangements of the non-current-carrying parts.

1.5 Earthed neutral systems are to be so designed that the potential earth fault current does not exceed the design capacity of any part of the system and is of sufficient magnitude to operate any protection.

Note: Where the neutral point is connected directly to earth, the earth loop impedance is to be low enough to permit the passage of current at least three times the fuse rating for fuse protected circuits or 1,5 times the tripping current of any circuit breaker used to protect the circuit.

1.6 In systems with earthed neutral if the selectivity is required in view of the shut-off of earth faults and additional current-limiting devices are mounted between the generator neutral-point and the ship's hull, this shall not impair the selective shut-off of faulty circuits.

1.7 In non-earthed systems, the generator neutral points shall not be connected together. The insulation resistance of a distribution system without earthing of the system is to be monitored and displayed. For tankers, see also Part B Chapter 5 Section 15.A.4.3.

2. Insulated systems

2.1 In insulated systems, the source of power is insulated from earth or connected to the earth through sufficiently high impedance.

2.2 Every insulated distribution system, whether primary or secondary, for power, heating or lighting, is to be provided with suitable means to monitor the insulation level to earth (i.e. the values of electrical insulation to earth).

Note: A primary system is one supplied directly by generators. Secondary systems are those supplied by transformers or convertors.

2.3 For ships of 24 m in length, the device required in item 2.2 is to be capable of continuously monitoring the insulation level to earth and of giving an audible and visual indication of abnormally low insulation values.

3. Supply systems with hull return

Note: Where the hull return system is used, if permitted, all final sub-circuits, i.e. all circuits fitted after the last protective device, shall be two-wire. The hull return is to be achieved by connecting to the hull one of the bus bars of the distribution board from which the final sub-circuits originate.

3.1 All final supply circuits shall have all-pole insulation. The return conductors are to be connected in the associated distribution switchboard to an insulated busbar, which is connected to the hull.

3.2 The connections to the hull shall have at least the same cross-section as the supply cable.

Bare wires shall not be used. Casings or their mounting bolts shall not be used as return conductors or to make their connection.

3.3 Up to 3 distribution switchboards may be supplied by a common supply cable.

4. Load Balancing in Three Phase Systems

Where, in three-phase systems, AC-consumers are connected between two outer conductors or one outer conductor and the neutral, the consumers are to be distributed in such a way that, under normal operating conditions, the loads on the individual outer conductors do not differ from each other by more than 15 % see Section 12,C.5.

5. Supply Cables

5.1 Essential Supply Cables

5.1.1 Primary and secondary essential equipment shall be preferably supplied direct from the main- or emergency switchboard in accordance with the Rules. Supply via distribution panels is only permissible if an equivalent safety of supply is guaranteed.

5.1.2 Primary and secondary essential equipment for the same function (e.g. main and stand-by lubricating oil pumps) are to be fed via two separate cables from the main switchboard or from two independent sub-distribution panels.

Exempt from this request are central power supplies for cargo refrigeration plants on refrigerated cargo vessels and systems for cargo maintaining on gas tankers.

Regarding supply to steering gear refer to Chapter 35-B Machinery Section 3.

5.2. Emergency Supply Cables

5.2.1 Emergency consumers shall be supplied directly from the emergency switchboard or via sub-distribution panels, to which only consumers in the relevant fire zone are connected.

5.2.2 In normal operation, the emergency switch-board shall be supplied by an interconnection feeder from the main switchboard. The feeder is to be protected against overcurrent and short circuits at the main switchboard and the feeder shall be automatically disconnected in the emergency switchboard if the supply from the main switchboard fails.

5.2.3 A return supply from the emergency switchboard to the main switchboard, e.g. when starting operation from dead ship condition or under observance of Section 3, D for harbour operations, is permitted. For return supply operation, the automatic feeder disconnection called for in 5.2.2 may be temporarily overridden.

6. AC distribution system

6.1 Where AC system is supplied by a combination of separate power sources (shore-power connection, on-board AC generator(s) or inverter), individual circuits are not to be capable of being energized by more than one source of electrical power at a time. The transfer from one power- source circuit to another is to be made by a means which opens all current-carrying conductors before closing the other source circuit, prevents arc-over between contacts and is interlocked by mechanical or electromechanical means. All current carrying conductors are to be broken simultaneously when changing power source.

Note: Two or more three-phase generators, when properly synchronised are to be treated as one source.

6.2 The current consuming units are to be so grouped in the final circuits that the load on each phase will, under normal conditions, be balanced as far as possible at the individual distribution and section boards as well as the main switchboard.

6.3 The continuity of supply is not to be impaired by load-produced harmonic distortion or high load charges.

7. DC distribution system supplied from batteries

7.1 Each battery or group of batteries is to be capable of being isolated from the DC system which is supplied, normally by a switch. Isolation switches are to be placed in a readily accessible location as closed as practical to the battery or group of batteries, but outside the battery compartment or container.

7.2 Remote controlled isolation switches are admitted providing they also permit safe manual control.

7.3 The following systems may be connected between the isolation switch and the battery:

- Electronic devices with protected memory and protective devices such as bilge pumps and alarms, if individually protected by a circuit breaker or fuse as close as practical to the battery terminal

- Ventilation exhaust blower of engine/fuel-tank compartment if separately protected by a fuse or circuit breaker as close as practical to the battery terminal

- Charging devices which are intended to be used when the ship is unattended (for example, solar panels, wind generator) if individually protected by a fuse or circuit breaker as close as practical to the battery terminal.

7.4 The minimum continuous rating of the battery selection/isolation switch is to be at least equal to the maximum current for which the main circuit breaker is rated and also the intermittent load of the starter motor circuit, or the cur- rent rating of the feeder conductor, whichever is less.

7.5 For systems where both positive and negative conductors are isolated from earth, double pole switches are to be used.

8. Emergency distribution of electrical power

8.1 Requirements of this sub-article may be omitted for ships of less than 12 m in length.

8.2 The emergency switchboard is to be supplied during normal operation from the main switchboard by an interconnector feeder which is to be adequately protected at the main switchboard against overload and short-circuit and which is to be automatically disconnected at the emergency switchboard upon failure of the main source of electrical power.

8.3 The emergency source of electrical power is to be capable of supplying simultaneously at least the following services for a period of 6 hours:

8.3.1 The emergency lighting to assist escape from all enclosed spaces and to illuminate the disembarkation positions and over the sides

8.3.2 The emergency lighting in the machinery spaces and navigation Bridge

8.3.3 The emergency lighting in the room which is located the engine room fixed-fire extinguishing system if any

8.3.4 The navigation lights and other lights required by the International Regulations for Preventing Collisions at Sea (COLREG) in force and/or by the Flag Authority

8.3.5 The ship's whistle if electrically powered

8.3.6 The radiocommunication equipment

8.3.7 The fire detection and fire alarm system if fitted on board

8.3.8 The control and alarm system of the fixed fire fighting system

8.3.9 General alarm system.

Note: Attention is drawn to compliance with possible national regulations.

8.4 In addition to item 5.3, for ships of 24 m in length and over, the emergency source of electrical power is to be capable of supplying simultaneously for a period of 6 hours following services:

- The means of communication between the navigation bridge and the steering gear compartment

- The means of communication between the navigating bridge and the position in the machinery space or control room from which the engines are normally controlled

- The emergency fire pump for ships greater than 24 m in length, if electrically driven.

8.5 The services to be supplied by the emergency source of power supply and the autonomy requested are recapitulated in Table 3.1.

Table 2.1 Services supplied by the emergency source of power

Services	All ships of 12 m in length and over (6 hours)	All ships of 24 m in length and over (6 hours)
Emergency lighting in spaces specified in A.8.3.1-A.8.3.3	X	X
Navigation lights and other lights required by COLREG and/or by the Flag Authority	X	X
Ship's whistle if electrically powered	X	X
Radiocommunication equipment	X	X
Fire detection and fire alarm system	X	X
Control and alarm system of the fixed fire fighting system	X	X
General alarm system	X	X
Means of communication between the navigation bridge and the steering gear compartment		X
Means of communication between the navigating bridge and the position in the machinery space or control room from which the engines are normally controlled		X
Emergency fire pump if electrically driven		X
Public address system or other effective means of communication		
Low-location lighting required for ships having the navigation notation coastal area and with more than 50 passengers, where electric type		

B. Power Distribution for Systems

Note: Emergency shutdown facilities placed outside the sites at which the equipment is installed are to be provided for the following consumers.

The consumers may be arranged in groups, provided that redundant consumers are allocated to at least two electrically independent groups.

Emergency shutdown facilities are to be provided for e.g.

- *Fuel pumps,*
- *Lubrication oil pumps,*
- *Oil burner plants,*
- *Separators,*
- *Fan motors,*
- *Boiler blowers,*
- *Auxiliary blowers for main engines,*
- *Thermal oil pumps,*

(see also Part B Chapter 4 – Machinery, Section 18).

1. Lighting Systems

1.1 Final circuits for lighting are not to supply appliances for heating and power. This requirement does not preclude the supply of cabin fans or socket-outlets from lighting circuits.

1.2 Final circuits for lighting supplying more than one lighting point and for socket-outlets are to be fitted with protective devices having a current rating not exceeding 16 A.

1.3 Main lighting installations shall be supplied from the main switchboard, emergency lighting installation from the emergency switchboard. The emergency source of lighting is to be independent of the general lighting system.

1.4 Lighting fittings in the main engine rooms of 12 metres and over are to be fed by at least two different final circuits in such a way that a failure of any one circuit does not reduce the lighting to an insufficient level. One of these circuits may be supplied from the emergency source of power.

1.5 In the areas listed below, the lighting shall be supplied by at least two separate fused circuits:

- Main engine rooms, service spaces and control stations;
- Large galleys,
- Passageways and alleys
- Stairways leading to the boat deck,
- Saloons and lounges for passengers and crew,
- Pump rooms on tankers.

1.6 The lighting fixtures shall be so arranged that sufficient illumination for orientation is maintained should one circuit fail.

1.7 Sockets outside the accommodation area shall be connected to separate circuits. When calculating the permissible connected load, one socket is equivalent to two lighting points.

1.8 The number of lighting points (lamps) connected to one final circuit shall not exceed:

- 10 lamps for voltages up to 55 V,
- 14 lamps for voltages over 55 V,
- 24 lamps for voltages over 125 V.

1.9 Switches shall simultaneously switch all non-earthed conductors. Single-pole switching of final circuits for lighting in systems with all conductors insulated is permitted only in the accommodation area.

2. Navigational Safety Systems

2.1 Navigation- and Signalling Lights

2.1.1 Every ship should be fitted with navigation lights in compliance with the requirements of the International Regulations for Preventing Collisions At Sea, 1972, as amended.

The construction and installation of navigation lights is to be to the satisfaction of the Appropriate Authority.

2.1.2 Navigation lights are to be connected separately to a dedicated distribution board placed in an accessible position on the ship and supplied from the main source of power.

2.1.3 Each navigation light is to be controlled and protected in each insulated pole by a double-pole switch and a fuse or, alternatively, by a double-pole circuit-breaker, fitted on the distribution board referred to in item 2.1.2.

2.1.4 For ships of 12 m in length and over, the following additional requirements are to be complied with:

2.1.4.1 Provision is to be made at position mentioned in item 2.1.2 to connect the navigation lights distribution board to the emergency source of power by means of a separate feeder and a manual or automatic changeover switch

2.1.4.2 When it is not possible to visually observe the operation of the navigation lights from the bridge deck, such lights are to be provided with an automatic indicator giving audible and/or visual warning in the event of failure of navigation light.

If a visual signal connected in series with the navigation light is used, means is to be provided to prevent the extinction of the navigation light due to the failure of the visual signal.

2.1.5 The masthead-light, sidelights- and stern light are separate to be supplied from the navigation lights controller. Each circuit shall be protected against overload and short circuit.

Masthead light(s), sidelights and a stern light shall be duplicated or be fitted with duplicate lamps.

The individual main- and reserve lights may have separate circuits in a common cable.

2.1.6 The navigation lights controller may be extended for the supply of the signalling lights specified in the "International Regulations for Preventing Collisions at Sea (COLREGs)".

Other consumers shall not be connected to this panel.

2.1.7 Navigation- and signal light controller shall be supplied from the main- and emergency electrical power source. An automatic switch over to the alternative source of power is permitted and to be alarmed.

2.1.8 A navigation lights controller should facilitate ON/OFF controls of individual Navigation lights.

2.1.9 Pre-programmed navigation lights group settings may be provided.

2.1.10 The navigation lights controller shall be provided with a device for each light which gives optical and acoustical alarm if the light disappears.

Where the monitoring device is connected in series with the navigation light, it shall be ensured that a failure of the device does not cause the navigation light to disappear.

2.1.11 A navigation lights controller shall present the status of all navigation lights in a logical presentation, meeting the requirements set out in IMO Resolution MSC.191(79).

2.1.12 All indicators of a navigation lights controller shall be dimmable. The brightness of a display, if fitted, shall be controllable.

2.1.13 To prevent shortage of luminous intensity of LEDs (Light Emitting Diodes) an alarm function should be activated to notify the Officer of the Watch that the luminous intensity of the light reduces below the level required by COLREGs or LEDs shall only be used within the lifespan (practical term of validity) specified by the manufacturer to maintain the necessary luminous intensity of LEDs. The specifications in the certificate of conformity for navigation lights are to be observed.

2.1.14 Where navigation lights are supplied from the main source of electrical power, the voltages at the lamp-holders shall not permanently deviate by more than 5 % above or below the rated voltage.

Where, in the event of a failure of the main electric power, navigation lights are supplied from the emergency source of electrical power, the voltages at the lamp-holders may temporarily deviate by up to 10 % above or below the rated voltage.

2.2. Radio and Navigational Equipment

2.2.1 The main- and emergency electrical power sources shall at any time maintain a sufficient supply of power to operate the radio equipment and to charge all reserve power sources for the radio equipment.

2.2.2 The radio and navigational equipment shall be directly supplied from both the main source of electrical power and the emergency source of electrical power by separate power supply circuits.

2.2.3 The power distribution for radio equipment shall be independent of that for the navigational equipment. The circuits from both the main and the emergency source of electrical power shall be terminated either in one or two distribution panels. If one distribution panel is used, the two circuits supplying the panel shall be provided with splitter feeding into two separate bus bars, one for the radio equipment and one for the navigational equipment. The panel(s) shall be located at the navigating bridge or other suitable position on the bridge deck.

2.2.4 Facilities shall be provided in each distribution panel for changing over between the main source of electrical power and the emergency source of electrical power. It is preferable that changeover be initiated automatically. If a single distribution panel is used for both the radio and the navigational equipment, separate change over switches shall be provided.

2.2.5 Failure of any power supply shall initiate an alarm at the navigational bridge

2.2.6 A reserve source or sources of energy shall be provided to supply radio equipment, for the purpose of conducting distress and safety radio communications, in the event of failure of the ship's main and emergency sources of electrical power.

2.2.7 Further stipulations for the reserve source of energy are to be taken from the SOLAS Convention, Chapter IV and relevant IMO guidelines, as applicable and also Appendix II of this Chapter 35 shall be taken into consideration.

2.2.8 Main navigational equipment includes, in particular, the steering stand and the compass, radar and direction-finding equipment.

2.2.9 Where radio equipment requires an uninterrupted input of information from the ship's navigational equipment, it will be necessary for the equipment providing the data to be supplied from the same distribution board bus bar serving the radio equipment.

3. Control-, Monitoring- and Ship's Safety Systems

Ships of 12 m in length and over are to be equipped with a system enabling the general broadcast of an alarm. This alarm may consist of the ship's whistle or siren, provided it can be heard in all parts of the ship when sailing.

3.1 The supply of control-, monitoring- and ship's safety systems shall comply with the following requirements:

3.1.1 These systems shall be supplied by their own circuits.

Provision shall be made for the selective disconnection of the separate circuits in case of a short circuit.

3.1.2 A common distribution network with back-up batteries may be used to supply systems which are required to remain operative even if the main source of electrical power fails. Such a network shall have two supply units comprising either:

3.1.3 A power supply unit with a capacity sufficient for all the connected consumers together with a charger which, acting in buffer operation with the back-up battery, is capable of supplying continuously all the connected consumers and maintain the battery in the charged condition; or

3.1.4 Two chargers which meet the conditions stated in 3.1.3.

3.2 With regard to residual ripple, the supply facilities specified in 3.1.3 and 3.1.4 shall be designed to ensure trouble-free operation of the connected systems even when the battery is temporarily disconnected.

3.3 One of the power supply units or chargers shall be supplied directly from the main switchboard.

3.4 Failure of the power supply units and chargers shall be signalled visually and audibly.

3.5 Battery chargers with a charging capacity of P $\geq$ 2 kW shall be tested at the maker's works in the presence of a Surveyor.

3.6 Alarm is to be given to the navigating bridge in case of flooding into the machinery space situated below the load line.

3.7 The ship's sound signaling system shall remain operative if the electrical main power supply fails.

4. Communications

4.1 Communications between the navigating bridge and the engine room:

4.1.1 At least two independent means are to be provided for communicating orders from the navigating bridge to the position in the machinery space or in the control room from which the speed and the direction of the thrust of the propellers are normally controlled

4.1.2 The two means for communicating orders are to be fed by independent power supply

4.1.3 One of the two means for communicating orders required in item a) may be portable for the ships of less than 24 m in length

4.1.4 For ships of less than 12 m in length, only one means may be acceptable.

4.2 One means of communication is to be provided between the navigating bridge and the steering gear room. This means of communication may be portable for ships of less than 24 m in length.

5. Supply of motors

5.1 A separate final circuit is to be provided for every motor required for an essential service and for every motor rated at 1 kW or more.

5.2 Each motor is to be provided with controlgear ensuring its satisfactory starting.

Direct on line starters are accepted if the voltage drop does not exceed 15% of the network voltage.

6. Specific requirements for special power services

6.1 The motors driving fans, oil fuel transfer pumps, and other pumps of the fuel oil system as well as the oil fuel separators are to be provided with remote control.

6.2 The means provided for stopping the power ventilation of the machinery spaces are to be entirely separate from the means provided for stopping ventilation of other places.

C. Shore Connection

1. Where arrangements are made for supplying the electrical installation from a source on shore or elsewhere, a suitable connection box is to be installed on the ship in a convenient location to receive the flexible cable from the external source.

2. Permanently fixed cables of adequate rating are to be provided for connecting the box to the main switchboard.

3. Terminal boxes for shore supply shall be linked to the ship's system by permanently laid cables. Switching-on of the shore supply shall only be possible if the switches of the main generators have been shut-off. Short-term parallel operation of the ship's mains and the shore mains for load transfer is permissible.

4. Where necessary for systems with earthed neutrals, the box is to be provided with an earthed terminal for connection between the shore's and ship's neutrals or for connection of a protective conductor.

5. The connection box is to contain a circuit-breaker or a switch-disconnector and fuses.

The shore connection is to be protected against short-circuit and overload however, the overload protection may be omitted in the connection box if provided on the main switchboard.

6. Means are to be provided for checking the phase sequence of the incoming supply in relation to the ship's system.

7. The cable connection to the box is to be provided with at least one switch-disconnector on the main switch- board or close to the main switchboard.

8. The shore connection shall be switchable and it shall be protected against short circuit and overload.

The terminal box for shore connection shall be provided at least with short-circuit protection. The shore connection is to be provided with an indicator at the main switchboard in order to show when the cable is energised.

9. The following details shall be indicated on a plate fitted to the shore connection box; voltage system and rated voltage, and the frequency in the case of alternating current. At the connection box a notice is to be provided giving full information on the nominal voltage and frequency of the installation.

10. The switch-disconnector on the main switchboard is to be interlocked with the main generator circuit-breakers in order to prevent its closure when any generator is supplying the main switchboard.

11. Adequate means are to be provided to equalise the potential between the hull and the shore when the electrical installation of the ship is supplied from shore (i.e. A device for connecting a protective conductor or a potential equalizer has to be provided, if required).

12. Facilities shall be provided to compare the polarity (in the case of direct current) and the phase sequence (in the case of three-phase alternating current) of the shore supply with those of the ship's mains.

D. Electrical Starting of Engines

1. General

1.1 Provision is to be made to maintain the stored energy of starting batteries at all times

1.2 Unless specified in item 2.3, the starting batteries are only to be used for starting and for the engine's alarm and monitoring (also compare with item 4.3).

2. Main engine starting system

2.1 Where main internal combustion engine is arranged for electrical starting, at least two separate batteries are to be fitted. It is to be possible to select which battery or group of battery is used for the starting. Each battery or group of batteries is to be of a sufficient capacity for ensuring at least the six consecutive start attempts of the main propulsion engine.

2.2 For multi-engine propulsion plants with electric starting device, each main engine may be equipped with only one starting battery, provided that each battery is capable of being connected via a changeover switch and fixed cables to the starting system of the other main engine. The arrangement is to be such that the connection of the batteries in parallel can be avoided.

The capacity of the batteries is to be sufficient to ensure at least 3 consecutive starts per engine. However, the total capacity is not to be less than 12 starts and need not exceed 18 starts.

2.3 One of the batteries or group of batteries requested in item 2.1 and item 2.2 may also be used for supplying the ship's electrical services of all ships less than 12 m in length, or all ships less than 24 m in length, or all ships engaged in sheltered area service.

Capacity of starting batteries used for supplying other services is to be designed accordingly.

2.4 It is to be possible to select which battery or group of batteries is used for which service and also to connect both battery groups in parallel in an emergency to assist engine start.

Note: Service selection function may be combined with the isolation function required in A.8.2.

3. Auxiliary engines starting system

Electrical starting arrangements of generating sets used for the propulsion, steering or safety of the ship are to have two separate storage batteries or may be supplied by two separate circuits from main engine storage batteries when these are provided. In the case of a single auxiliary engine, one battery is acceptable. The combined capacity of the batteries is to be sufficient for at least three starts for each engine.

4. Emergency generating sets

For starting arrangements of emergency generating sets, following requirements apply:

4.1 Emergency generating sets are to be capable of being readily started in their cold condition at a temperature of 0°C. If this is impracticable, or if lower temperatures are likely to be encountered, provision acceptable to the Society is to be made for the maintenance of heating arrangements, to ensure ready starting of the generating sets

4.2 Each emergency generating set arranged to be automatically started is to be equipped with starting devices approved by the Society with a stored energy capability of at least three consecutive starts.

The source of stored energy is to be protected to preclude critical depletion by the automatic starting system, unless a second independent means of starting is provided. In addition, a second source of energy is to be provided for an additional three starts within 30 minutes, unless manual starting can be demonstrated to be effective

4.3 All of these starting, charging and energy storing devices are to be located in the emergency generator space; these devices are not to be used for any purpose other than the operation of the emergency generating set.

SECTION 4

INSTALLATION OF ELECTRICAL EQUIPMENT

Page

A. Definitions

1. Main generating station is the space where the main source of electrical power is situated.

2. Main source of electrical power is a source intended to supply electrical power to the main switchboard for distribution to all services necessary for maintaining the ship in normal operational and habitable condition.

3. Machinery space, is to be taken as extending from the moulded base line to the margin line and between the extreme main transverse watertight bulkheads, bounding the spaces containing the main and auxiliary propulsion machinery, boilers serving the needs of propulsion, and all permanent coal bunkers. In the case of unusual arrangements, the Administration may define the limits of the machinery space.

4. Main switchboard is a switchboard which is directly supplied by the main source of electrical power and is intended to distribute electrical energy to the ship's services.

5. The degree of protection of the enclosures and the environmental categories of the equipment are to be appropriate to the spaces or areas in which they are located. Refer to Section 8 of this Chapter 35-C.

6. Except where the installation of equipment for explosive gas atmosphere is provided for by the Rules, areas with a risk of explosion are spaces where electrical equipment is not to be installed in which flammable gases or vapours are liable to accumulate.

B. Location of Electrical Systems

1. Main Electrical Systems

1.1 The main generators shall be installed in the main engine room or in a particular auxiliary machinery room, e.g. within the space bounded by the watertight main-bulkheads.

Note: Partition bulkheads between these main bulkheads are not considered as separations provided they have access openings.

1.2 The arrangement of the main electrical system is to be such that a fire or other casualty in spaces containing the main source of electrical power, associated converting equipment, if any, the main switchboard and the main lighting switchboard will not render inoperative the emergency electric lighting system and the other emergency services other than those located within the spaces where the fire or casualty has occurred.

2. Emergency electrical system

2.1 The emergency source of power, associated distribution switchboard, and if any, transitional source of emergency power are to be located outside the engine room, above the uppermost continuous deck and are to be readily accessible from the open deck. They are not to be located forward of the collision bulkhead.

2.2 In all cases the location of the emergency source of electrical power is to be such as to ensure that fire or other casualty in the space containing the main source of electrical power will not interfere with its continuous operation.

2.3 The arrangement of the emergency electrical system is to be such that a fire or other casualty in spaces containing the emergency source of electrical power, associated converting equipment, if any, the emergency switchboard and the emergency lighting switchboard will not render inoperative the main electric lighting system and the other primary essential services supplied by the main source of power other than those located within the spaces where the fire or casualty has occurred.

3. Emergency battery

3.1 No accumulator battery fitted in accordance with the provisions of Section 2 B.2 shall be installed in the same space as the emergency switchboard.

3.2 Accumulator batteries fitted in accordance with the provisions of Section 2 B.2 and connected to a charging device of power of 2 kW or less may be accepted in the same space as the emergency switchboard but outside the emergency switchboard to the satisfaction of the Society.

4. Switchboards

4.1 General

4.1.1 Switchboards are to be so arranged as to give easy access as may be needed to apparatus and equipment, without danger to personnel.

4.1.2 An unobstructed space is to be left in front of the switchboards wide enough to allow access for operation and maintenance.

4.1.3 When the voltage exceeds the safety voltage, non-conducting mats or gratings are to be provided at the front of the switchboard and also at the rear if access to the rear is provided. The insulated mats or gratings are to be oil-resist- ant and non-slippery.

4.1.4 Piping and conduits are not to be installed directly above or in the vicinity of switchboards. Where this is unavoidable, pipes and conduits are to have welded joints only or to be provided with protection against spray from pressurised liquids or dripping.

4.1.5 If installed on the floor above the bilge, the main switchboard shall be completely closed from below.

4.1.6 The heat generated in the switchgear shall be removed.

4.1.7 The floor in front of, and where necessary behind, main switchboards with an operating voltage of more than 50 V shall be provided with an appropriately insulating covering, or insulating gratings or mats (e.g. according IEC publication 61111) shall be in place.

4.1.8 The operational space behind open switchboards shall be erected as a separated electrical service room. A label notifying this fact shall be fitted.

4.2 Main Switchboards

4.2.1 The main switchboard is to be so placed relative to one main generating station that, as far as practicable, the integrity of the normal electric supply may be affected only by a fire or other casualty in one space.

4.2.2 The installation of the switchboard in a control room in the same fire section or in a room separated by a partition bulkhead with sufficient access opening is not to be considered as separating the switchboard from the generators.

4.3 Emergency switchboard

4.3.1 The emergency switchboard shall be installed as near as is practicable to the emergency source of electrical power. The place of installation shall satisfy the same conditions as apply to the installation of the emergency generator.

4.3.2 Where the emergency source of electrical power is a generator, the emergency switchboard shall be located in the same space unless the operation of the emergency switchboard would thereby be impaired.

4.3.3 Where the emergency source of electrical power is an accumulator battery it shall not be installed in the same space as the emergency switchboard

4.4 Distribution Switchboards

4.4.1 Distribution switchboards supplying essential equipment and associated transformers, converters and similar equipment may be installed, if:

- The conditions as required for main generators/main switchboards are fulfilled,

- They are installed in the same fire section respectively in the same watertight compartment like the essential equipment itself.

4.4.2 Distribution boards containing multipole switches for the control of power and lighting circuits in bunkers and cargo spaces are to be situated outside such spaces.

4.4.3 The distribution board for navigation lights is to be placed in an accessible position on the bridge.

4.4.4 Cubicles and niches housing distribution panels shall be made of incombustible material or be protected by a lining of metal or some other fireproof material.

4.4.5 The doors of cubicles and niches shall be provided with a name plate identifying the distribution panel inside. Adequate ventilation shall be ensured.

C. Storage Batteries

1. General

1.1 Storage batteries shall be installed in such a way that persons cannot be endangered and equipment cannot be damaged by exhausted gases or leaked-out electrolytes.

1.2 Starter batteries are to be located as close as practicable to the engine or engines served.

1.3 Accumulator batteries shall not be located in sleeping quarters except where hermetically sealed to the satis- faction of the Society.

1.4 Storage batteries shall be so installed as to ensure accessibility for changing of cells, inspection, testing, topping-up and cleaning.

1.5 Storage batteries are to be suitably housed, and compartments (rooms, lockers or boxes) used primarily for their accommodation are to be properly constructed and efficiently ventilated so as to prevent accumulation of flammable gas.

1.6 Storage batteries shall not be installed in the accommodation area or in cargo holds. An exception may be granted for gastight cells, such as those used in emergency lamps, where charging does not result in the development of harmful gases.

1.7 Storage batteries shall not be installed in positions where they are exposed to excessively high or low temperatures, water spray, moist, dust, condensation or other factors liable to impair their serviceability or shorten their service life or accelerate deterioration. The minimum degree of protection required is IP 12.

1.8 Lead-acid batteries and alkaline batteries are not to be installed in the same compartment (room, locker, box), unless of valve-regulated sealed type.

1.9 Where vented batteries are fitted in machinery spaces, drip trays or containers resistant to the effects of the electrolyte are to be provided.

1.10 Switches and fuses or other equipment, which may generate sparks are not to be placed in battery compartments or containers.

1.11 When installing storage batteries, attention is to be paid to the capacity of the associated chargers. The charging power is to be calculated as the product of the maximum charger current and the rated voltage of the storage battery.

1.12 Depending on the operating mode, application and duty of the storage battery to be charged, and on the mode of the charging (charger characteristic), and by agreement with TL, the calculation of the charging capacity need not be based on the maximum current.

1.13 Storage batteries are to be provided with overload and short-circuit protection nearby where they are installed. Exceptions are made for batteries for preheating and starting of internal combustion engines, but their cabling shall be made short-circuit proof.

1.14 Applied materials shall comply with Section 1.J.

1.15 Storage batteries shall be prevented from sliding. The constraints shall not hinder ventilation.

1.16 Storage batteries are subject to recycling.

1.17 On tankers, storage batteries shall not be installed in the cargo area.

2. Ventilation of Spaces Containing Batteries

2.1 General requirements

2.1.1 A vented battery is one in which the cells have a cover provided with an opening through which products of electrolysis and evaporation are allowed to escape freely from the cells to atmosphere.

2.1.2 All battery-installations, except for gastight batteries, in rooms, cabinets and containers shall be constructed and ventilated in such a way as to prevent the accumulation of ignitable gas mixtures.

2.1.3 Gastight NiCd-, NiMH- or Li- batteries need not be ventilated.

2.2 Charging Power

2.2.1 The charging power for automatic IU-charging shall be calculated as follows:

$$P = U \cdot I$$

$I = 8 \cdot K/100$ for Pb- batteries

$I = 16 \cdot K/100$ for NiCd- batteries

P = Charging power [W]

U = Rated battery voltage [V]

I = Charging current [A]

K = Battery capacity [Ah]

2.2.2 The gassing voltage shall not be exceeded. If several battery sets would be used, the sum of charging power has to be calculated.

2.3 Ventilated spaces with battery charging power up to 0.2 kW (Small vented batteries)

2.3.1 Batteries connected to a charging device of power less than 0,2 kW calculated from the maximum obtainable charging current and the nominal voltage of the battery (hereafter referred to as "small batteries") are to be arranged in the same manner as moderate or large batteries, or without a box or locker, provided they are protected from falling objects, or in a box in a ventilated area.

2.3.2 Boxes for small batteries may be ventilated only by means of openings near the top to permit escape of gas.

2.3.3 Lead batteries with a charging power up to 0.2 kW may be installed in switchboards without separation to switchgear and without any additional ventilation, if:

- The batteries are valve regulated (VRLA), provided with solid electrolyte
  - The battery cases are not closed completely (IP 2X is suitable)
- The charger is regulated automatically by an IU-controller with a maximum continuous charging voltage of 2.3 V/cell and rated power of the charger is limited to 0.2 kW.

2.4 Ventilated spaces with battery charging power up to 2 kW (Moderate vented batteries)

2.4.1 Batteries connected to a charging device of power between 0,2 kW and 2 kW calculated calculated from the maximum obtainable charging current and the nominal voltage of the battery (hereafter referred to as "moderate batteries") are to be arranged in the same manner as large batteries or placed in a box or locker in suitable locations such as machinery spaces, storerooms or similar spaces. In machinery spaces and similar well-ventilated compartments, these batteries may be installed without a box or locker provided they are protected from falling objects, dripping water and condensation where necessary.

The unenclosed installation (IP 12) in well ventilated positions in machinery spaces is permitted. Otherwise batteries shall be installed in ventilated battery cabinets or containers.

2.4.2 Rooms, lockers or boxes assigned to moderate batteries are to be provided with natural ventilation or mechanical exhaust ventilation, except for batteries installed without a box or locker in well-ventilated spaces.

2.4.3 The provisions of items 2.4.1 and 2.4.2 also apply to several batteries connected to charging devices of total power between 0,2 kW and 2 kW calculated for each one from the maximum obtainable charging current and the nominal voltage of the battery

2.4.4 The free air volume in the room shall be calculated depending on battery size as follows:

$$V = 2.5 \cdot Q \qquad Q = f \cdot 0.25 \cdot I \cdot n$$

V = Free air volume in the room [m3]

Q = Air quantity [m3/h]

n = Number of battery-cells in series connection

f = 0.03 for lead batteries with solid electrolyte

f = 0.11 for batteries with fluid electroltye

If several battery sets would be installed in one room, the sum of air quantity shall be calculated.

2.4.5 Where the room volume or the ventilation is not sufficient, enclosed battery cabinets or containers with natural ventilation into suitable rooms or areas shall be used.

2.4.6 The air ducts for natural ventilation shall have a cross-section as follows, assuming an air speed of 0.5 m/s:

$A = 5.6 \cdot Q$

A = Cross-section [cm2]

The required minimum cross-sections of ventilation ducts are shown in Table 2.1.

Table 2.1 Cross-sections of ventilation ducts

Calculation based on battery charging power (automatic IU- charging)			
Battery Charging power P [W]	Ventilation duct cross-section [cm^2]		
	Lead battery "Solid electrolyte VRLA"	Lead battery "Fluid electrolyte"	Nickel-Cadmium battery
< 500	40	60	80
500 < 1000	60	80	120
1000 < 1500	80	120	180
1500 < 2000	80	160	240
2000 < 3000	80	240	Forced ventilation
> 3000	forced ventilation		

Small air ducts and dimensions of air inlet and outlet openings shall be calculated based on lower air speed.

2.5 Ventilated rooms with battery charging power more than 2 kW (Large vented batteries)

2.5.1 Batteries connected to a charging device of power exceeding 2 kW, calculated from the maximum obtainable charging current and the nominal voltage of the battery (hereafter referred to as "large batteries") are to be installed in a room assigned to batteries only.
Where this is not possible, they may be arranged in a suitable locker on deck.

2.5.2 Batteries exceeding charging power of 2 kW shall be installed in closed cabinets, containers or battery rooms with mechanical ventilated to open deck area. Lead batteries up to 3 kW may be ventilated by natural means. Natural ventilation may be employed for boxes located on open deck.

2.5.3 The provisions of items 2.5.1 and 2.5.2 also apply to several batteries connected to charging devices of total power exceeding 2 kW calculated for each one as stated in item 2.5.1.

2.6 Ventilation requirements

2.6.1 The ventilation of battery compartments is to be independent of ventilation systems for other spaces.

2.6.2 The ventilation arrangements for installation of vented type batteries are to be such that the quantity of air expelled (by natural or forced ventilation) is at least equal to:

$Q = 110 \cdot n \cdot I$ where

n = Number of cells in series

I = Maximum current delivered by the charging equipment during gas formation, but not less than 25 per cent of the maximum obtainable charging current in amperes

Q = Quantity of air expelled in litres/hr.

2.6.3 The quantity of air expelled (by natura lor forced ventilation) for compartments containing valve-regulated sealed batteries may be reduced to 25 per cent of that given above.

Note: A valve-regulated battery is one in which cells are closed but have an arrangement (valve) which allows the escape of gas if the internal pressure exceeds a predetermined value.

2.6.3 Ducts are to be made of a corrosion-resisting material or their interior surfaces are to be painted with corrosion- resistant paint.

2.6.4 Ventilation inlet and outlet openings shall be so arranged to ensure that fresh air flows over the surface of the storage battery. For this purpose, air inlet openings shall be arranged below and air outlet openings shall be arranged above.

2.6.5 Adequate air inlets (whether connected to ducts or not) are to be provided near the floor of battery rooms or the bottom of lockers or boxes (except for that of small batteries).

Air inlet may be from the open air or from another space (for example from machinery spaces).

2.6.6 If batteries are installed in several floors, the free distance between them shall be at least 50 mm.

Devices which obstruct the free passage of air, e.g. fire dampers and safety screens, shall not be mounted in the ventilation inlet and outlet ducts of battery rooms.

2.6.7 Air ducts for natural ventilation shall lead to the open deck directly.

2.6.8 Exhaust ducts of natural ventilation systems:

- are to be run directly from the top of the compartment to the open air above (they may terminate in the open or in well-ventilated spaces)

- are to terminate not less than 90 cm above the top of the battery compartment

- are to have no part more than 45° from the vertical

- are not to contain appliances (for example for barring flames) which may impede the free passage of air or gas mixtures.

Where natural ventilation is impracticable or insufficient, mechanical exhaust ventilation is to be provided.

2.6.9 In mechanical exhaust ventilation systems:

- electric motors are to be outside the exhaust ducts and battery compartment and are to be of safe type if installed within 3 m from the exhaust of the ventilation duct
- fans are to be so constructed and of a material such as to render sparking impossible in the event of the impeller touching the fan casing

- steel or aluminium impellers are not to be used

- the system is to be interlocked with the charging device so that the battery cannot be charged without ventila- tion (trickle charge may be maintained)

2.6.10 For natural ventilation systems for deck boxes:

- holes for air inlet are to be provided on at least two opposite sides of the box

- the exhaust duct is to be of ample dimensions

- the duct is to terminate at least 0,90 m above the box in a goose-neck or mushroom-head or the equivalent

- the degree of protection is to be in accordance with Section 8.

2.7. Cooling system

2.7.1 No additional heat sources shall be installed in spaces of storage batteries. Cabinets or battery rooms shall be equipped with controlled heating systems if applicable.

2.7.2 Redundant cooling or ventilation systems shall be provided including monitoring and alarm in case of abnormal operation.

2.7.3 Preferably air- or liquid flow monitoring devices shall be provided. Differential pressure indicators are not recommended.

2.8 Protection

2.8.1 A ground fault detection system shall be provided for the DC network.

2.8.2 Management-, monitoring- and protection systems shall be provided. These systems are subject to TL type approval and shall include the following functions at least:

– Control and monitoring during charging, discharging and operation

– Protection against overcharging, discharging and against deep discharge

2.8.3 An independent temperature monitoring system shall be provided. This monitoring shall give an alarm if temperature difference between the inner of cabinets or battery rooms and the environmental is too large.

2.8.4 A documentation shall be submitted to verify safe operation of the battery system and relating to the personal protection.

2.9 Installation and maintenance

2.9.1 The manufacturer instructions regarding installation, maintenance, operation and cooling of the battery system are to be observed.

2.9.2 Positive (+) and negative (-) wiring shall have equal wire length.

2.9.3 It is recommended to check periodically cable connections and to use e.g. an infrared (IR) camera to detect hot spots in the battery system if any.

2.10 Equipment in Cabinets and Battery Rooms

2.10.1 During charging, discharging or internal failures storage batteries could generate and release explosive gases.

2.10.2 Only explosion-protected lamps, switches, fan motors and space-heating appliances shall be installed in battery rooms. The following minimum requirements shall be observed:

- Explosion group II C

- Temperature class T 1

Other electrical equipment is permitted only with the special approval of TL.

2.10.3 Where leakage is possible, the inner walls of battery-rooms, boxes and cupboards, and all supports, troughs, containers and racks, shall be protected against the injurious effects of the electrolyte.

2.10.4 Electrical equipment shall be installed in cabinets or battery rooms only when it is unavoidable for operational reasons.

2.11 Emergency Power Supply

The location in which storage batteries for the emergency power supply are installed shall fulfil the same conditions as required for the installation of the emergency generator.

2.12 Batteries for Starting of Internal Combustion Engines

Batteries for starting of internal combustion engines shall be installed near the engine. For the rating of the batteries, see Part B Chapter 4 - Machinery, Section 2, H.3.

2.13. Caution Labels

The doors or the covers of battery rooms, cupboards or boxes shall be fitted with caution labels prohibiting the exposure of open flames and smoking in, or close to, these spaces.

D. Converters & Transformers

1. Semiconductor power converters

1.1 Converters/inverters are to be installed such that the circulation of air around them is not impeded and so that the air temperature at their cooling inlet air does not exceed the ambient temperature.

1.2 Converters/inverters are not to be mounted near sources of heat such as engine exhaust pipes.

2. Transformers

2.1 Transformers are to be installed in readily accessible and well-ventilated locations. Their connections are to be protected against mechanical damages, condensation and corrosion as may be reasonably expected.

2.2 The location of transformers for main electrical power supply shall fulfil the same conditions as those applying to the installation of the main generators.

2.3 The location in which transformers for the emergency electrical power supply are installed shall satisfy the same conditions as apply to the installation of the emergency generator.

E. Electronics

1. Power electronic equipment and central units for information processing shall be installed in readily accessible and adequately ventilated spaces.

2. The heat generated in the unit shall be removed in a suitable manner. Where electronic equipment is installed in engine rooms or other spaces with enhanced danger of pollution and corrosion, air filters shall be provided if necessary.

SECTION 5

ELECTRICAL EQUIPMENT

Page

A. General

1. All devices, instruments and operating devices and enclosures shall be permanently identified by name plates comprising manufacturer's name, model number or designation, electrical rating, in volt and ampere or volt and watt, phase and frequency, if applicable and certified safe type, if applicable.

2. Wherever possible, clear text shall be used. Fuse current ratings are to be stated. The set points of adjustable protective devices are to be marked. The rated operating parameters of all measuring instruments shall be marked in red either on the scales or on plates fixed nearby.

3. All nuts and screws used in connection with current carrying parts and working parts are to be effectively locked and all screwed joints and connections shall be secured against self-acting loosening.

4. All electrical apparatus is to be so constructed as not to cause injury when handled or touched in the normal manner.

5. Enclosures for electrical equipment are to be of an adequate mechanical strength and rigidity.

6. All conductors shall be secured jig-proof and are to be kept away from sharp edges. Conductors leading to equipment mounted in doors are to be laid tension-free.

7. Main and emergency switchboards shall be fitted with insulation hand rails or handles.

8. All components including their connections have to be accessible for the purposes of maintenance, repair and replacement.

9. The design of electrical equipment is to allow accessibility to each part that needs inspection or adjustment, also taking into account its arrangement on board.

10. Large doors in switchboards shall be fitted with arresting devices.

11. Electrical components mounted in the doors of switchboards, e.g. switchgear, measuring devices and fuses for voltages over 50 V, shall be safeguarded against accidental contact. Such doors are to be earthed.

12. Where fuses are fitted above switchgear or bare connecting wires or leads, measures are to be taken to ensure that falling parts (e.g. fuse cartridges) cannot come into contact with live components.

13. Operating devices and fuses shall be safely accessible.

14. For circuit breakers and load-switches, the minimum distances above the arc chutes specified by the manufacturers are to be maintained.

15. Knife-type fuses for supply-circuits are only permitted if they can be safely withdrawn and inserted.

16. Ventilation is to be adequate to maintain the ambient temperature at or below the maximum at which the equipment is designed to operate.

17. All equipment is generally to be provided with suitable, fixed terminal connectors in an accessible position for convenient connection of the external cables.

B. Application

1. In addition to provisions of this section, Chapter 35-C Electrical Installations Section 8 - Measures for Protection of Electrical Systems and Section 9 – Tests shall also be applied for the equipment referred in this Section.

C. Switchboards

1. Main Switchboards

1.1 General

1.1.1 Switchboards or enclosures containing switchboards are to be constructed of durable, flame-retard- ant, moisture-resistant materials which are not subject to deterioration in the atmosphere and the temperatures to which they are likely to be exposed. In addition, mechanical features of the materials are to be suitable for the service conditions.

1.1.2 The large switchboards are to be provided with insulated handrails or handles fitted in an appropriate position at the front of the switchboard.

1.1.3 Observation of the measuring and indicating devices and operation of the switchgear shall be possible from the front side of the switchboard with the doors closed.

1.1.4 All parts of the switchboard are to be readily accessible for maintenance, repair or replacement. In particular, fuses are to be able to be safely inserted and withdrawn from their fuse-bases. All parts which require operation in normal use are to be placed on the front.

1.1.5 No live part is to be installed on the front of the switchboards without protection.

1.1.6 Where the aggregate capacity of generators connected to the main busbars exceeds 100 kVA, a separate cubicle for each generator is to be arranged with flame- retardant partitions between the different cubicles. Similar partitions are to be provided between the generator cubicles and outgoing circuits.

Each source circuit breaker surrounded by metal barriers to provide physical isolation between generators and between generator circuit breakers and outgoing circuits may be considered as an alternative solution.

1.1.7 Connections for cables and busbars are to be protected against loosening due to vibration.

1.1.8 Each switch or control is to be marked to indicate its use, unless the purpose of the switch is obvious and its mistaken operation will not cause a hazardous condition. Switching devices are to be so designed and arranged that when in the off position they cannot accidentally move sufficiently to close the circuit.

1.1.9 Switchboards with both DC and AC electrical systems are to be fitted with a partition to separate the AC and DC sections from each other as mentioned in Section 4.

1.1.10 In plants where the main source of electrical power is necessary for the propulsion of the ship, the main busbar shall be capable to be subdivided into at least two parts which shall normally be connected by circuit breakers or other approved means.

Other approved means can be achieved by:

- Circuit breaker without tripping mechanism, or
- Disconnecting link or
- Switch

by which bus bars can be split easily and safely.

Common bolted links between single busbar or switchboard sections (e.g. for transportation) do not fulfil these requirements.

1.1.11 A single disconnecting device is sufficient if this device is provided within separate switchboard panel without other installations or in an equivalent bounded section (Refer to Figure 5.1).

Otherwise two disconnecting devices are required in different switchboard panels (Refer to Figure 5.2).

1.1.12 In case of removable or movable links, these devices shall be easily accessible and simple to handle. Tools for operating shall be located nearby.

1.1.13 As far as is practicable, the connection of generating sets and other duplicated consumers shall be equally divided between the main bus bar sections.

1.1.14 The consumers may, for instance, be grouped as follows:

Table 5.1 Grouping of consumers (example)

Consumers 1	Consumers 2
Lubricating oil pump 1	Lubricating oil pump 2
Cooling water pump 1	Cooling water pump 2
Lighting 1	Lighting 2
etc.	etc.

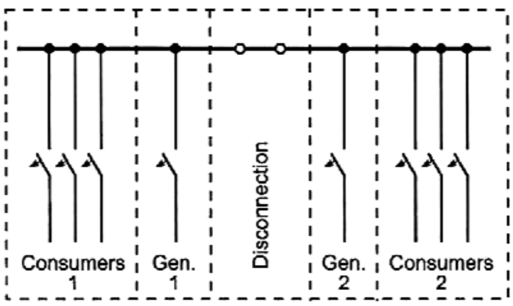


Figure 5.1 Example for arrangement of a main busbar disconnection and division of consumers

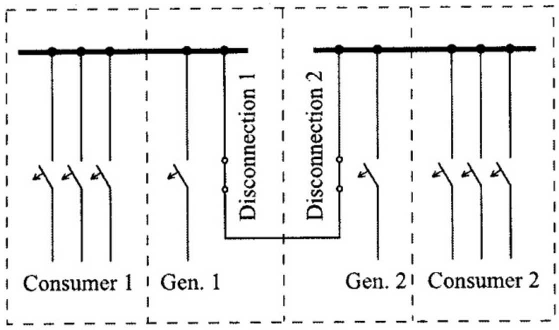


Figure 5.2 Example for arrangement of two disconnecting devices and division of consumers

1.2 Busbars

1.2.1 Busbars are to be dimensioned in accordance with IEC Publication 60092-302. Busbars and their connection are to be made of copper and are to be designed to withstand mechanical stresses due to short-circuit. Maximum temperature rise is to be 45°C.

1.2.2 Parallel-run busbars of the same phase are to be installed not less than one bar thickness apart. Earth conductors, neutral conductors of three-phase mains and equalization lines between compound-wound generators shall have at least half the cross-section of the phase conductor.

1.2.3 Bare busbars are to comply with the minimum clearances and creepage distances given in Table 5.2.

Clearance is the distance between two conductive parts along a string stretched the shortest way between such parts. Creepage distance is the shortest distance along the surface of an insulating material between two conductive parts.

Table 5.2 Clearances and creepage distances

Rated insulation voltage, in V	Minimum clearance, in mm	Minimum creepage distance, in mm
≤ 250	15	20
> 250 to ≤ 690	20	25
> 690 to < 1000	25	35

1.2.4 Cross-sections of connection bars and wires to equipment shall be of such size as to avoid thermal over-loading of the equipment at full load as well as in the event of a short-circuit.

1.2.5 Busbars are to be mounted in such a way that they withstand the stresses caused by short-circuit currents and maintain the required clearance and creepage distances relative to other voltage-carrying or earthed components.

1.3 Auxiliary circuits

1.3.1 Auxiliary circuits relative to essential services are to be designed in such a manner that, a single fault in such circuits does not impair the operation of other essential services.

1.3.2 Common auxiliary circuits for groups of consumers are permitted only when the failure of one consumer jeopardizes the operation of the entire system to which it belongs.

1.3.3 The supply of auxiliary circuits by specifically arranged control distribution systems will be specially considered by the Society.

1.4 Measuring and monitoring devices for generators

1.4.1 General

1.4.1.1 The following circuits shall be supplied from the generator side, and shall be separately protected against short circuits:

- Generator protection devices, and the undervoltage trip of the generator circuit breaker,
- Measuring instruments,
- Indicating lights,
- Diesel-engine speed-adjusting equipment,

The power supply from the governor could be used, if an electronically governor is installed

- Motor drive for circuit breaker.

1.4.1.2 A manual operation is to provide for generator circuit breaker. It shall be independent and overriding.

1.4.1.3 Normal full load values are to be marked in red on the instrument scale for all indicating instruments and appropriate labels are to be fixed to digital instruments when employed.

Where circuit breakers are used, the following shall be provided:

- 1 indicating light: circuit breaker connected,
- 1 indicating light: circuit breaker released.

1.4.1.4 A primary system is one supplied directly by generators. Secondary systems are those supplied by transformers or convertors. Each secondary distribution system is to be provided with one voltmeter.

1.4.1.5 Switchboards are to be fitted with means for monitoring the insulation level of insulated distribution systems.

1.4.1.6 The main switchboard is to be fitted with a voltmeter or signal lamp indicating that the cable between the shore- connections to main switchboard is energised.

1.4.1.7 For each DC power source (e.g. convertors, rectifiers and batteries), one voltmeter and one ammeter are to be provided, except for DC power sources for starting devices.

1.4.1.8 The main switchboard and the main distribution panel have to be fitted with ammeters for major consumers, unless these are already mounted on the consumers themselves. It is permissible for one ammeter to be switched-over to a number of circuits.

1.4.2 AC Generator

1.4.2.1 Each AC generator not operated in parallel, except single-phase generators smaller than 2 kVA, is to be provided with at least:

- 1 voltmeter
- 1 ammeter in each phase or one ammeter with a selector switch which enables to read the current in each phase
- 1 frequency meter for generators rated more than 15 kVA.

1.4.2.2 Each AC generator operated in parallel is to be provided with at least:

- 1 wattmeter capable of indicating reverse power up to 15% of the rated full load of the generator
- 1 ammeter in each phase conductor (or one ammeter with a selector switch to permit the measurement of current in each phase).

For paralleling purpose, the following are to be provided:

- 2 voltmeters
- 2 frequency meters
- 1 synchronising device comprising either a synchronoscope and lamps, or an equivalent arrangement.

One voltmeter and one frequency meter are to be connected to the busbars; the other voltmeter and frequency meter are to have a selector switch to permit measurement of the voltage and frequency of any generator.

When generators are running in parallel in installations with the neutral earthed, it is necessary to ensure that the equalising current caused by harmonics does not exceed harmful values. Reference is to be made to guidance from generator manufacturer.

1.4.3 DC Generator

1.4.3.1 At least the following are required for each direct-current generator of 2 kW output or more:

- 1 voltmeter,
- 1 ammeter.

1.4.3.2 Generators for parallel operation are to be provided with one voltmeter for each generator (or one voltmeter and a change-over switch for its connection to each generator), one ammeter for each generator and one voltmeter for each section of busbar

1.4.3.3 For compound-wound generators fitted with equalizer connections, the ammeter is to be connected to the pole opposite to that connected to the series winding of the generator.

1.5 Switchgear and fuses for equipment

Each supply line run from the main switchboard shall be provided with a circuit breaker with overcurrent and short-circuit protection, or with a fuse for each non-earthed conductor and an all-pole switch or with a contactor with control switch.

Where fuses and switches are used, the sequence bus bar-fuse-switch is to be used. The specified sequence may be changed where motor switches of utilization category AC-23 A are used as load switches, provided that the switches are weld proof in the event of a short circuit.

The rated peak withstand current (dynamic limiting current) of switches shall be greater than the cut-off current of the associated fuse in the event of a short circuit.

For steering gear, refer to Chapter 35-B Machinery Section 3.

2. Emergency Switchboards

2.1 The requirements for main switchboards apply in analogous manner to emergency switchboards.

2.2 Control and supply circuits of the emergency electrical power plant shall be so switched and protected that interruptions or short circuits caused by fire or another event,

- In a space housing the main generators and/or the main switchboard, or

- In a category A machinery space do not impair the operating ability of the emergency source of electrical power. Where necessary, the emergency switchboard has to be fitted with isolating switches.

3. Distribution Panels

3.1 Distribution panels are to be equipped with the necessary devices for the protection of the connected circuits and for the supply of consumers.

3.2 Feeder circuits with fuses shall be switched with load switches. In the case of feeder circuits with fuses up to 63 A, load switches may be dispensed with if each connected equipment can be disconnected by a switch fitted nearby.

3.3 For navigation lanterns panel, see Part B Chapter 4 Machinery Section 4, I. 6.

3.4 Distribution panels for the supply of power to container sockets, see Part B Chapter 4 Machinery Section 11, C. 4.

D. Alternating and Direct Current Generators

1. General

1.1 All machines of 100 kW and over, intended for essential services are to be type approved or case-by-case approved and surveyed by the TL during testing and, if appropriate, during manufacturing. Tested machines are to be individually certified by the Society.

An alternative inspection scheme may be agreed by the Society with the manufacturer whereby the attendance of the Surveyor will not be required as indicated above.

1.2 All machines of less than 100 kW intended for essential services are to be type approved or manufactured according to recognized international or national standards.

Individual works' certificate is to be issued by the manufacturer and detailed test report submitted to the Society.

1.3 For rotating machines intended for non essential services, individual works' certificate and detailed test report are to be made available and submitted upon request.

1.4 Bed plates and framework of machines or generating sets are to be efficiently earthed; no insulating material is to be placed between the prime movers and the alternators and generally between the prime movers and the driven machines, unless there is one efficient earthing of each part.

1.5 Insulation materials for windings and other current carrying parts are to comply with relevant requirements of Section 1.

2. AC generators

2.1 AC generators are in general to comply with the relevant requirements of IEC Publication 60092-301. Where contradiction occurs between the requirements below and those belonging to the aforementioned standard, the standard shall take precedence.

2.2 Alternators are to be so constructed that when started up, they take up the voltage without the aid of an external electrical power source.

2.3 The combined prime mover, transmission system and generator are to be designed to withstand without damage the effects of the most onerous short-circuit condition at the generator terminals when running at rated voltage and speed.

2.4 The apparent power of three-phase generators shall be such that no inadmissible voltage drops occur in the ship's mains due to the normal starting currents of motors. The start-up of the motor with the greatest starting current shall not give rise to a voltage drop causing other consumers to malfunction. Where a number of generators operate in parallel, this condition shall continue to be met when the largest generator is not in operation.

2.5 The voltage wave form is to be approximately sinusoidal, with a maximum deviation from the sinusoidal fundamental curve of 5% of the peak value. The RMS values of the phase voltages shall not differ from each other by more than 0.5 % under balanced load conditions.

2.6 When AC generators are operated in parallel, the reactive loads of the individual generating sets are not to differ from their proportionate share of the total reactive load by more than 10% of the rated reactive power of the largest machine, or 25% of that of the smallest machine, whichever is the lesser.

2.7 Generators and their exciters are to be rated in such a way that:

2.7.1 The generator can be loaded for two minutes at 150 % of its rated current with a power factor of 0.5 lagging (inductive) and still deliver approximately its rated voltage

2.7.2 The equipment is short-circuit-proof even having regard to the time lag of the generator circuit breakers necessary to the selectivity of the system.

2.8 Regulating conditions

Each generator is to be provided with automatic means of voltage regulation.

Under balanced load conditions, three-phase generators and their exciters are required to meet the following conditions:

2.8.1 Steady regulating conditions

With the generator running at rated speed, the voltage shall not deviate from the rated value by more than ± 2.5 % from no-load up to the rated output and at the rated power factor after the transient reactions have ceased. These limits may be increased to ± 3.5% for emergency sets.

2.8.2 Transient regulating conditions

With the generator running at rated speed and rated voltage, the voltage shall neither fall below 85 % nor exceed 120 % of the rated value when symmetrical loads of specified current and power factor are suddenly applied or removed. The voltage shall regain its rated value ± 3 % in 1.5 seconds. For emergency sets, these values may be increased to plus or minus 4% in not more than 5 s, respectively.

If no particular requirements are specified for the load changes, the above conditions are to be satisfied when the generator, running idle and excited to its rated voltage, is suddenly loaded to 60 % of its rated current with a power factor of < 0.4 (lagging), and, after steady-state operation has been achieved; the load is suddenly switched off again.

2.8.3 Steady short-circuit current

With a terminal short circuit on three phases, the steady short-circuit current shall not be less than three times the rated current. The generator and its exciter shall be capable of with-standing the steady short-circuit current for two seconds without damage.

3. DC generators

3.1 Compound generators or shunt-wound generators with automatic voltage regulators are to be preferred for sets supplying ship’s mains.

3.2 DC generators are generally alternators with integral rectifiers and regulators fitted to the propulsion machinery.

3.3 The voltage regulation is to be ensured with, if necessary, the use of an automatic voltage regulator, particularly in the case of generator driven by a propulsion engine.

For generators of a power higher than 20 kW and less than 50 kW, the regulation is at least such that, in case of sudden removal of half the rated load, the speed remaining constant, the voltage increase remains lower than 8% in the case of shunt wound generators and 4% in the case of compound wound generators.

4. Prime movers

4.1 Prime movers for driving generators are to comply with the relevant requirements of Rules for Ships less than 500 GT Chapter 2 Machinery Section 2 Internal Combustion Engines. However for any point not defined in abovementioned reference, Part B Chapter 5 Section 3 B.3 may be referred, as applicable.

4.2 When generators are to operate in parallel, the characteristics of speed governors are to comply with 2.6.

5. Generators Driven by the Main Propulsion Plant (e.g. Shaft-Driven Generators)

The generators driven by the propulsion engine, by a geared shaft or by an auxiliary set intended for another purpose, are to be designed with consideration of the modifications of the number of revolutions which may occur in service.

Requirements given in Part B Chapter 5 Section 3 B.4 may be taken as a reference, as applicable.

E. Power Transformers

1. Transformers used for power, lighting and as static convertors, starting transformers, static balancers, saturable reactors and transductors, including single-phase transformers rated at less than 1kVA, and three-phase transformers rated at less than 5 kVA, are to comply with IEC 60092-303. Where any contradiction occurs between the standard and the requirements below, the standard shall take precedence.

Transformers complying with other recognized international standards will be specially considered by the Society.

2. Transformers intended for parallel operation shall be so designed that over the whole load range the load on no transformer deviates by more than 10 % of its nominal current from the percentage share calculated for it.

Each transformer required is to be located as a separate unit with separate enclosure of equivalent, and is to be served by separate circuits on the primary and secondary sides.

3. Each primary circuit is to be provided with switch-gear and protection devices in each phase.

4. Each of the secondary circuits is to be provided with a multipole isolating switch. Transformers supplying bow thruster are excluded

5. Power transformers are to be provided with overload and short circuit protection. When transformers are connected in parallel, tripping of the protective devices at the primary side has to automatically trip the switch connected at the secondary side.

6. In installations where feedback is possible transformers shall be switchable at both, the primary and secondary side.

7. Transformers with liquids containing polychlorinated biphenyl's (PCB) are not to be used.

8. Transformers, except those for motor starting, are to be double wound (two or more separate windings).

9. Transformers are normally to be of the dry, air cooled type. When a forced air cooling system is used, an alarm is to be activated in the event of its failure.

10. Transformers are to have enclosures with a degree of protection as given in Section 8.

F. Converters/inverters

1. Converters/inverters are to comply with the relevant requirements of IEC Publication 60092-304.

Converters/inverters complying with other recognized international standards will be specially considered by the Society.

2. Converters/inverters are to be so constructed that they may be removed without dismantling the complete unit.

3. Natural air-cooling units are to be designed with sufficient ventilation openings or with sufficient cooling surface to dissipate the heat so that totally enclosed equipment operates within the design temperature limits.

G. Batteries and chargers

1. General

1.1 The requirements of this Article apply to permanently installed storage batteries and are not applicable to portable batteries.

1.2 In addition to these requirements, where any point not clearly stated or clarified is encountered, Part B Electrical Installations Section 2, C shall be taken as a reference, as applicable.

1.3 Storage batteries may be of the lead-acid or nickel-alkaline type, due consideration being given to the suitability for any specific application.

Other types of storage batteries of satisfactorily proven design (e.g. silver/zinc) may be accepted provided they are suitable for shipboard use to the satisfaction of the Society.

1.4 Cells are to be assembled in suitable crates or trays equipped with handles for convenient lifting.

1.5 Battery terminal connectors which depend on tension for mechanical connection to the terminal are not to be used.

2. Battery Systems

2.1 A battery system is an interconnection of storage batteries wired in series, parallel or as a combination of both connections. These systems are installed in cabinets or battery rooms.

2.2 Only storage batteries of same electrochemical characteristics, type, brand and year of construction shall be connected to a battery system. The selected configuration of a battery system shall not be changed.

2.3 Only authorised personal shall have access to locked cabinets or battery rooms. Safety measures are to be taken against electric shock.

2.4 Storage batteries shall withstand internal- and external short circuits. The level of expected short circuit current shall be considered for the DC network design and its switching and protection devices.

2.5 Disconnecting devices shall be provided to isolate conductors of battery systems from circuits and if applicable from protected earth.

2.6 Battery systems for redundant installations shall not be installed in the same cabinet or battery room. The requirements of redundancy shall be applied to the auxiliary systems and cooling systems as well.

2.7 Battery systems for emergency supply shall not be installed in the same cabinet or battery room as storage batteries for other consumers.

2.8 Battery systems shall be labelled. Access hatches or other openings to cabinets or battery rooms shall give instructions to personnel safety

3. Vented batteries

3.1 A vented battery is one in which electrolyte can be replaced and in which the cells have a cover provided with an opening through which products of electrolysis and evaporation are allowed to escape freely from the cells to atmosphere during periods of charge and overcharge.

3.2 Vented batteries are to be constructed to withstand the movement of the ship and the atmosphere (salt mist, oil etc.) to which they may be exposed.

3.3 Battery cells are to be so constructed as to prevent spilling of electrolyte at any inclination of the battery up to 40° from the vertical.

3.4 It is to be possible to check the electrolyte level and the ph.

4. Valve-regulated sealed batteries

4.1 A valve-regulated battery is one in which cells are closed but have an arrangement (valve) which allows the escape of gas if the internal pressure exceeds a predetermined value. The cells cannot normally receive addition to the electrolyte.

The cells of batteries which are marketed as “sealed” or “maintenance free” are fitted with a pressure relief valve as a safety precaution to enable uncombined gas to be vented to the atmosphere; they should more properly be referred to as valve-regulated sealed batteries. In some circumstances the quantity of gas vented can be up to 25% of the equivalent vented design. The design is to take into consideration provision for proper ventilation.

4.2 Cell design is to minimise risks of release of gas under normal and abnormal conditions.

5. Chargers

5.1 Charger equipment shall be suitable for the type of storage batteries, the required charging characteristic and the selected connection.

5.2 Charging equipment shall be so rated that discharged storage batteries can be charged to 80 % of their rated capacity within a period not greater than 10 hours without exceeding the maximum permissible charging currents.

5.3 Only automatic chargers shall be used with charging characteristics adapted to the type of batteries.

5.4 Chargers are to incorporate a voltage regulator and a charge indicator. Protection against overcharging and reversal of the charging current are to be provided.

5.5 If consumers are simultaneously supplied during charging, the maximum charging voltage shall not exceed the rated voltage described on Section 1 Table 1.8.

The power demand of the consumers shall be considered for the selection of the chargers.

5.6 Chargers with a charging power above 2 kW shall be tested in presence of a TL Surveyor.

5.7 Battery chargers are to be constructed to simplify the maintenance operation. Indications are to be provided to visualise the proper operation of the charger and for troubleshooting.

5.8 Charge regulators used with a wind generator or photo voltaic cells are to be specially designed for use in such systems. When used to charge battery installations, they are to be set so that the gassing voltage of the battery to which they are connected cannot be exceeded.

SECTION 6

LIGHTING AND SOCKET OUTLETS AND HEATING & COOKING APPLIANCES

Page

A. General

1. The design and construction of lighting systems and socket-outlets may conform to Part B Chapter 5 Electrical Installations Section 3, C. (for Emergency lighting), Section 4, H. and I. (for Power supply, final sub circuits, navigation lights and signalling lights) Section 20, H. (for Construction of socket-outlets) Section 20, I. (for Construction of lighting fixtures), as applicable to ships less than 500 GT and as not to cause any contradictions with the requirements given in this section.

2. The use of lighting fixtures and socket-outlets currently employed on shore is permitted in accommodation spaces, day rooms and service rooms.

B. Lighting Installations

1. Design and Construction

1.1 A sufficient number of lighting fixtures shall be provided to achieve a good level of illumination.

1.2 A main lighting system shall be installed which is supplied from the main electrical power source and illuminates all areas accessible to the passengers and crew.

1.3 The arrangement of the main- and emergency lighting systems (sources of electrical power, associated transformers, switchboards and central lighting distribution panels) shall be such that a fire or other incident does not cause the failure of both systems, i.e. the aforementioned components of the main and emergency lighting systems shall not be located in the same rooms.

1.4 Following a failure of the main power supply, the emergency lighting system shall cut in automatically. Local switches may be provided only where the ability to switch off the emergency lighting is required, e.g. in the wheelhouse.

1.5 Emergency lighting fixtures shall be marked as such for easy identification.

2. Cargo holds, bunkers and pipe tunnels

2.1 For a permanently installed lighting system, switches with clearly marked positions or indicating lights shall be provided for each final sub-circuit or for each area.

2.2 The lighting fixtures shall be provided with unbreakable covers and so mounted that they cannot be damaged when work is being carried out.

2.3 Lighting fixtures in cargo holds shall be installed in such a way that, when properly used, there is no overheating of the lighting fixtures or their surroundings, even when the ship is loaded.

3. Lighting fittings

3.1 Lighting fittings are to comply with IEC Publications 60092-306. Where any point relating with lighting fittings is not specified in IEC 60092-306, TL Rules Part B Chapter 5 Section 11 shall apply as applicable.

3.2 Lighting fittings complying with other standards are to be specially considered by the Society.

3.3 Lighting fittings likely to be exposed to risk of mechanical damage are to be either protected against such damage or to be specially robust construction. The construction and installation of luminaries are to be appropriate to their location and environment.

C. Plugs and socket-outlets

1. Plugs and socket-outlets shall conform to TL Rules Part B Chapter 5 Section 11, C as applicable and not contradicting with the requirements given below.

2. Where an earthed system is used, plug and socket outlets of the earthing type are to be arranged with a terminal provided for the protective conductor.

3. Socket-outlets rated over 16 A are to be normally provided with a switch.

4. The supply for socket-outlets in the accommodation, day rooms and service rooms (250 V) are to be run from lighting distribution panels. The maximum fuse rating for a circuit is 16 A.

5. Where socket-outlets are supplied at different voltages, the socket-outlets and plugs are to be designed in such a way that an incorrect connection cannot be made.

6. Socket outlets and matching plugs used on DC systems are to be to be different from and not to be interchangeable with those used in the AC system on the ship.

7. For the sockets of distribution systems with different voltages and/or frequencies, non interchangeable plugs and socket outlets shall be used.

8. Plug-in connections shall not be installed below the floor in engine rooms or boiler rooms.

9. Socket outlets for power circuits over 16 A AC or 10 A DC shall be interlocked in such a way that the plug can be neither inserted nor withdrawn when the socket contacts are live.

D. Electrical heating and cooking appliances

1. Heating and cooking appliances shall comply with TL Rules Part B Chapter 5 Section 20, J as applicable and not contradicting with the requirements given below.

2. The casing or enclosure of space heaters is to be so designed that clothing or other flammable material cannot be placed on them.

3. The temperature of the external surface of space heaters is not to exceed 60°C.

4. Space heaters are to be provided with a temperature limiting device without automatic reconnection which automatically trips all poles or phases not connected to earth when the temperature exceeds the maximum permissible value.

5. Live parts of cooking appliances are to be protected such that any foods or liquids which boil over or spill do not cause short-circuits or loss of insulation

SECTION 7

ELECTRICAL CABLES

A. General

1. Application

Where any point not clearly clarified is encountered, Part B Chapter 5 Electrical Installations Section 12 and Section 20.F may be applied as applicable and not causing any contradictions with requirements stated in this section.

2. Insulation and Earthing

2.1 All electrical cables and wiring external to equipment are to be at least of a flame-retardant type, in accordance with IEC Publication 60332-1.

2.2 All cables and wiring external to equipment are to be so installed as not to impair their original flame-retarding properties. To this end, only cables which have been tested in accordance with IEC Publication 60332-3 Category A or an equivalent test procedure can be installed in bunches.

2.3 Cables having insulating materials with different maximum permissible conductor temperatures are not to be bunched together. Where this is not practicable, the size of these cables is to be sufficient to ensure that no cable can reach a temperature higher than its rating.

In addition to 2.1, when cables are laid in bunches; cable types are to be chosen in compliance with IEC Publication 60332-3-22 Category A.

2.4 Where necessary for specific applications such as radio frequency or digital communication systems, which require the use of particular types of cables, the Society may permit the use of cables which do not comply with the provisions of 2.1.

2.5 Where fireproof cables shall be used, it is permitted to use cables with retention of insulating capability in accordance with IEC publication 60331.

2.6 Cables manufactured in accordance with the relevant recommendations of IEC Publications of the series 60092-3 (i.e. 60092-350, 60092-352, 60092-353, 60092-354, 60092-360, 60092-370, 60092-376) will be accepted by TL provided that they are tested to its satisfaction (normally type approval of those cables are accepted).

2.7 Cable and insulated wires other than those specified in IEC Publications are subject to special consideration by the Society in each case and will be accepted provided they are in accordance with an acceptable and relevant international or national standard.

2.8 The internal radius of bend for the installation of cables is to be chosen according to the type of cable as recommended by the manufacturer.

2.9 All metal coverings of cables are to be earthed at both ends. Earthing at one end is admitted where it is required for technical or safety reasons. The electrical continuity of all metal coverings of cables throughout the length of the latter, particularly at joints and tappings, is to be ensured.

2.10 Metal casings, conduits and trunking are to be effectively earthed.

2.11 Flexible cables constructed according to national standards are to be specially considered by the Society.

2.12 Cables and their connections to submerged bilge pumps are to be capable of operating under a head of water equal to their distance below the bulkhead deck. The cable is to be impervious-sheathed and armoured and is to be installed in continuous lengths from above the bulkhead to the motor terminals.

2.13 For installation in switchboards and other enclosures for equipment, single-core cables may be used without further protection (sheath). Other types of flame-retardant switchboard wiring may be accepted at the discretion of the Society.

3. Terminations

3.1 Terminations in all conductors are to be so made as to retain the original electrical, mechanical, flame-retarding properties of the cable.

3.2 The dimensions and design of cable sockets and clamps are to be such that the maximum current likely to flow through them will not cause the rated operating temperature of the cable insulation to be exceeded.

3.3 The means of fixing of conductors and terminals are to be capable of withstanding the thermal and dynamic effects of short-circuits.

3.4 Screw-clamp or screwless terminals are to conform to IEC 60947-7-1. Other terminals are to be of the ring or captive-spade type, not dependent on screw or nut tightness alone for retention on the screw or stud. Captive-spade terminals are to be of the self-locking type.

3.5 The ends of every conductor are to be securely terminated by a means which contains all the strands of the conductor.

3.6 All conductors attached to stud or screw connections are to be fitted with suitable terminals (i.e. no bare wires attached to stud or screw connections).

3.7 The number of wires terminated in the same cable socket or clamp is not to exceed the maximum number recommended by the accessory manufacturer.

3.8 Exposed shanks of terminals are to be protected against accidental shorting by the use of insulating barriers or sleeves, except those in the protective conductor system.

4. DC and AC segregation

A DC circuit is not to be contained in the same wiring system as an AC circuit, unless one of the following methods of separation is used:

4.1 For a multicore cable or cord, the cores of the DC circuit are separated from the cores of the AC circuit by an earthed metal screen of equivalent current-carrying capacity to that of the largest core in either circuit

4.2 The cables are insulated for their system voltage and installed in separate compartments of a cable ducting or trunking system

4.3 The cables are installed on a tray or ladder where physical separation is provided by a partition

4.4 Physically separate conduit, duct, trunking or routing systems are used for DC and AC systems

4.5 The DC and AC conductors are fixed directly to a surface and separated by at least 100 mm.

5. Identification and Approval

5.1 Each cable shall be marked for type and for name of the manufacturer.

5.2 Fire non propagating cables are to be clearly labelled with indication of the standard according to which this characteristic has been verified and, if applicable, of the category to which they correspond.

5.3 The cores of multicore cables and wires shall have a permanent marking. In multicore cables and wires where the cores are arranged in a number of concentric layers, two adjacent cores in each layer shall be coloured differently from each other and from all other cores, unless the individual cores are other-wise unambiguously identified, e.g. by printed numbers.

5.4 Protective earth conductors shall have green/yellow colour coding.

5.5 Cables and wires are subject to mandatory type approval by TL.

5.6 Proof is required by the manufacturer by issue of workshop test reports stating that the continuous production is made in conformity to relevant standards and is verified by individual and sample tests for each production length of cables. These reports shall record any deviations from the standards.

5.7 The application of cables and wires without type-approval is subject to an agreement with TL in every case. Individual and sample tests performed at the manufacturer's works on each lengths delivered are required for these cables.

B. Material and Structure

1. Conductors

1.1 Conductors are to be stranded and of annealed electrolytic copper according to IEC 60092-350. In ships of aluminium construction, conductors are to conform at least to Class 2 upstream of transformers to avoid functioning as an earth electrode.

1.2. If the insulation consists of natural- or synthetic rubber vulcanized with sulphur, the individual conductor wires shall be tinned.

1.3. The conductors of movable wires shall be finely stranded.

1.4. The conductors of permanently laid cables and wires shall be made of stranded copper conductors (class 2) or flexible stranded copper conductors (class 5).

1.5. Solid conductors up to 4 mm^2 in cross-section are permitted for the final sub circuits of room lighting and space heating systems in the accommodation and for special cables of TV and multimedia applications.

2. Insulation

The materials used for insulation shall be of standardized types for which the maximum permissible temperatures at the conductors during undisturbed operation are specified.

C. Protective Covering, Braids And Sheaths

1. Cables fitted on decks exposed to the weather, in damp and wet locations (for example, bathroom), in refrigerated spaces, in machinery spaces and wherever water condensation or harmful vapour (including oil vapour) may be present, are to have a water resistant sheath.

2. Polyvinyl chloride (PVC), chlorosulphonated-polyethylene (CSP) and polychloroprene (PCP) sheaths are considered as water resistant in this context, although not suitable for permanent immersion in liquids. However such sheaths are to be avoided where they are likely to come into contact with and chemically react with polyurethane foam thermal insulating material.

3. Only materials of a standardized type shall be used for non-metallic sheaths. In all cases the thermal stability of the compounds used shall correspond to that of the insulating material.

4. Single-core cables shall have a suitable separating layer of filler material or foil over the core insulation. Multicore cables shall have a common core covering made of filler material or shall have a wrap-ping and sheath.

5. An impervious sheath is not required for single-core cables installed in tubes or ducts inside accommodation spaces, in circuits with maximum system voltage 250V.

6. In selecting the protective covering, due consideration is to be given to the mechanical strength required to withstand handling during installation and working conditions when in service.

7. If the mechanical strength of the protective covering is considered insufficient, the cables are to be mechanically protected (e.g. by an armour or by installation inside pipes or conduits).

8. PVC insulated cables are not to be used on decks exposed to the weather of ships engaged in unrestricted navigation.

9. Braids shall be made of corrosion-resistant material such as copper or copper alloy or of material treated to prevent corrosion, e.g. galvanized steel.

10. Outer metallic wire braids shall have a coating of protective paint, which shall be lead-free and flame-retardant. The paint shall be of sufficiently low viscosity when applied to enable it to penetrate readily into the wire braid. When dry, it shall not flake off when the cable is bent around a mandrel with a diameter of 15 times that of the cable.

D. Cable Trays / Protective Casings / Conduits Made of Plastics Materials

1. Cable trays, protective casings or conduits made of plastics materials (thermoplastic or thermosetting plastic material) are to be type tested.

2. Non-metallic cable trays or protective casings or conduits made are to be flame retardant. Where used on open deck, they are to be protected against U.V. light.

3. The load on the non-metallic cable trays is to be as recommended by the manufacturer.

E. Cable Runs

1. Cable runs are to be as short and direct as possible, well supported, and designed to avoid areas having a increased fire risk and areas where there is a risk of mechanical damage.

2. Cable runs are to be selected so as to avoid action from condensed moisture and from dripping of liquids.

They are to be routed away from exhaust pipes and other heat sources which can damage the insulation.

The minimum clearance of the cables is 50mm from water-cooled exhaust components and 250mm from dry exhaust components.

3. Cables are to be routed above anticipated levels of bilge water and in other areas where water may accumulate, or at least 25 mm above the level at which the automatic bilge-pump switch activates.

4. Connection and draw boxes are to be accessible.

5. When it is essential that a circuit functions for some time in case of a fire and it is unavoidable to carry the cable for such a circuit through a high fire risk area (e.g. cables connecting fire pumps to the emergency switchboard), the cable is to be of a fire-resistant type or adequately protected against direct exposure to fire.

6. For the installation of cables in the vicinity of radio equipment or of cables belonging to electronic control and monitoring systems, steps are to be taken in order to limit the effects of unwanted electromagnetic interference (screening and/or twisted pairs, separation).

All cables between antennas and transmitters are to be routed separately of any other cable.

7. In the case of essential services requiring a duplicate supply (e.g. steering gear circuits), the supply and associated control cables are to follow different routes which are to be as far apart as practicable, separated both vertically and horizontally.

8. Cables and wiring serving essential or emergency power, lighting, internal communications or signals are, so far as is practicable, to be routed clear of high fire risk areas (e.g. galleys, machinery spaces), except for supplying equipment in those spaces.

F. Cable Support and Protection

1. Conductors that are not sheathed are not to be accessible and are to be supported throughout their length on cable trays, in cable conduits, ducting pipes or trunking, or by individual supports at maximum intervals of 300 mm. Each conductor longer than 300mm installed separately is to have a cross-section of at least 1mm².

Use of non-sheathed conductors is to be limited to ships of less than 24 m in length or for relatively small circuits.

2. Cables exposed to risk of mechanical damage are to be protected by metal casing, profiles, pipes or other equivalent means, unless the cable covering (e.g. sheath or armour) provides adequate mechanical protection.

3. Cables are to be installed and supported in such manner as to avoid chafing or other damage.

4. When cables are fixed by means of clips or straps made from a material other than metal and these cables are not laid on top of horizontal cable supports (e.g. in the case of vertical installation), suitable metal clips or saddles spaced not more than 1 metre apart are to be used in addition in order to prevent the release of cables during a fire.

5. The supports (tray plates, separate support brackets or hanger ladders) and the corresponding accessories are to be of robust construction and of corrosion-resistant material or suitably treated before erection to resist corrosion.

When cables are installed directly on aluminium structures, fixing devices of aluminium or suitably treated steel are to be used.

6. With the exception of cables installed in pipes, conduits, trunkings or special casings, cables are to be fixed by means of clips, saddles or straps of suitable material, in order to tighten the cables without their coverings being damaged.

7. Cable clips or straps made from a material other than metal are to be manufactured of a flame-retardant material.

G. Penetration of Bulkheads and Decks

1. If cables and conductors have to pass without adequate support through non-watertight bulkheads and generally through holes drilled in sheets of structural steel, these holes are to be fitted with glands or bushings.

Materials used for glands and bushings are to be resistant to corrosion and are not to damage the cable or the ship's structure.

2. Cable penetrations are not to impair the effectiveness of fire protection, watertightness or gas-tight of decks and bulkhead.

H. Rating, Protection and Installation of Circuits

1. Individual Consumers and Rating of Final Sub circuits

1.1 Cables shall be rated according to the expected operating load based on the connected load and the mode of operation of the consumers. The values shown on the name plate of a consumer are valid.

1.2 The following loads are to be assumed for 250 V AC lighting circuits and socket-outlet circuits:-

For each lighting point, at least 100 W,

- For each socket-outlet, at least 200 W.

2. Consideration of a Diversity Factor for Group Supply Cables

2.1 If all the connected consumers in a part of the system are not simultaneously in operation, a diversity factor may be used for determining the cross-section.

A diversity factor is the ratio of the highest operating load expected under normal operating conditions to the sum of the rated loads of all the connected consumers.

2.2 The load ascertained by the application of a diversity factor shall be deemed to be the continuous load for the determination of the cross-section.

2.3 The diversity factors shown in Table 7.1 may be applied to the rating of cables used to supply groups of winches.

The values given in the Table 7.1 shall be related to the rated motor current, or, in the case of motors with several different outputs, to the current corresponding to the highest output.

2.4 Group supply feeders for hydraulic winches shall be rated for the installed power without the application of a diversity factor.

2.5 The cross-section of group supply feeders for cargo cranes shall be determined in the same way as for cargo winches.

2.6 For cargo cranes with one drive motor, the supply cable shall be rated according to the current rating of the maximum load capacity.

2.7 Where cargo cranes have more than one motor, the feeder cable to an individual crane can be rated as follows:

The value of the current used for cross-section determination shall be equal to 100 % of the output of the lifting motors plus 50 % of the output of all the other motors. With this calculated current the cross-section of the cable shall be selected for continuous operation.

2.8 If current diagrams for the various operating conditions of cranes or groups of winches have been ascertained, the average current based on the diagram may be used instead of application of a diversity factor.

Table 7.1 Diversity factors during operation with winches

Number of winches	The following values shall be used for determining the cable cross-section	
	Winches with DC motors	**Winches with induction motors**
2	100 % of the largest motor + 30 % of the second motor, or, with identical motors, 65 % of their combined full current	100 % of the largest motor + 50 % of the second motor, or, with identical motors 75 % of their combined full load current
3	100 % of the largest motor + 25 % of the remaining motors, or, with identical motors 50 % of their combined full current	100 % of the largest motor + 50 % of the remaining motors, or, with identical motors 67 % of their combined full current
4	100 % of the largest motor + 20 % of the remaining motors, or, with identical motors 40 % of their combined full current	100 % of the largest motor + 50 % of the remaining motors, or, with identical motors 62 % of their combined full current
5	100 % of the largest motor + 20 % of the remaining motors, or, with identical motors 36 % of their combined full current	100 % of the largest motor + 50 % of the remaining motors, or, with identical motors 60 % of their combined full current
6 and more	33 % of the combined full load current	58 % of the combined full load current

2.9 Cross-sections of group supply feeders for refrigerated container socket-outlets are to be designed in accordance with power calculation considering the corresponding diversity factor (see Part B Chapter 5 Electrical Installations Section 3,B).

3. Cables Overload Protection

3.1 Cables shall be protected against short circuit and overcurrent.

3.2 Rating and setting of the protection devices shall be in compliance with the requirements in Part B Chapter 5 Electrical Installations Section 4.

3.3 Cables protected against overcurrent at the consumers side require only short-circuit protection at the supply side.

For steering gear, refer to Chapter 35-B Machinery Section 3.

3.4 Exciter cables for DC motors and DC generators operating in parallel shall not be fused.

Exciter cables for individually connected DC generators and synchronous three-phase alternators shall be fused only if there are special reasons for it, e.g. where the cables are passing through various compartments of the ship.

4. Current carrying capacity

4.1 The calculated current shall be equal to, or smaller than, the permissible current for the chosen conductor cross-section.

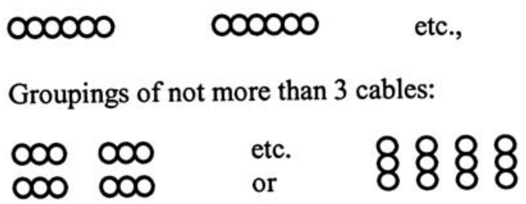
4.2 The current carrying capacity for cables in continuous service, for various insulating materials are given in Table 7.2.

The values are based on the maximum permissible service temperature of the conductor also indicated therein and on an ambient temperature of 45°C. For temperature class of 75°C or 85°C, refer to IEC 60092-201.

4.3 The current carrying capacity cited in 4.2 is applicable, with rough approximation, to all types of protective covering (e.g. both armoured and non-armoured cables).

4.4 When the actual ambient temperature obviously differs from 45°C, the correction factors shown in Table 7.3 may be applied to the current carrying capacity in Table 7.2.

4.5 The current-carrying capacities listed in Table 7.2 apply to flat cable configurations containing not more than 6 cables laid side by side, or to groupings of not more than 3 cables or insulated wires, as follows.
Flat arrangement:



The triple groups shall be laid in each direction with a spacing corresponding to at least one outer diameter of the largest cable or largest insulated wire.

4.6 If the specified configurations cannot be adhered to, or the passage of cooling air is not assured, the current-carrying capacity shall be reduced to 85 % of the values given in the tables, and the over-current protection shall be modified accordingly.

Exceptions are made for bundles of cables and insulated wires which are not part of the same circuit and/or which will not be loaded with their rated currents simultaneously.

4.7 Where a cable is intended to supply a short-time load for 1/2-hour or 1-hour service (e.g. mooring winches or bow thruster propellers), the current carrying capacity obtained from Table 7.2 may be increased by applying the corresponding correction factors given in Table 7.4.
In no case a period shorter than 1/2-hour is to be used, whatever the effective period of operation.

4.8 Cables with conductors of cross-section less than 10mm^2 are not to be connected in parallel.

The current-carrying capacity of cables connected in parallel is the sum of the current ratings of all parallel conductors, provided that the cables have equal impedance, cross-section and rated conductor temperatures. They shall be common fused.

Refer to the recommendations of clause 28 of IEC 60092-352 relating to special precautions for single-core cables for AC wiring

5. Rating on the Basis of Voltage Drop

5.1 Under normal service conditions, the voltage drop between the busbars (main/emergency switch-board) and the consumers shall not exceed 6 %, or 10 % in the case of battery-supplied networks of 50 V or less. Navigation lights are subject to the requirements of Part B Chapter 5 Electrical Installations Section 4, I. 6.

5.2 Where short-term peak loads are possible, for instance due to starting processes, it is to ensure that the voltage drop in the cable does not cause malfunctions.

6. Consideration of current peaks

The cross-section shall be so chosen that the conductor temperatures do not exceed the maximum limits specified below neither under short-circuit nor start-up conditions:

for PVC (60 °C)	150 °C
for PVC (75 °C)	150 °C
for EPR (EPM or EPDM)	200 °C
for XLPE (VPE)	250 °C
for silicone (95 °C)	according to specification
The figures in brackets are the permissible operating temperatures at the conductor in continuous operation.	

7. Minimum Cross-Sectional Areas and Their Current-Carrying Capacity

7.1 In general the minimum allowable conductor cross- sectional areas are those given in Table 7.5.

7.2 The nominal cross-sectional area of the neutral conductor in three-phase distribution systems is to be equal to at least 50% of the cross-sectional area of the phases, unless the latter is less than or equal to 16 mm^2. In such case the cross-sectional area of the neutral conductor is to be equal to that of the phase.

7.7.3 For the nominal cross-sectional area of protective conductor, see Section 8.

Table 7.2 Current carrying capacity, for continuous service, in amps

Nominal Cross section, in mm^2	Cable insulation											
	1 General purpose			2 Heat resistant			3 EPR and			4 Silicone rubber and		
	Temperature class 60°C			Temperature class 70°C			Temperature class 90°C			Temperature class 95°C		
	1 core	2 cores	3, 4 cores	1 core	2 cores	3, 4 cores	1 core	2 cores	3, 4 cores	1 core	2 cores	3, 4 cores
1	8	7	6	12	10	8	18	15	13	20	17	14
1,5	10	9	7	15	13	11	23	20	16	26	22	18
2,5	17	14	12	21	18	15	40	26	21	32	27	22
4	23	20	16	29	25	20	51	34	28	43	37	30
6	29	25	20	37	31	26	52	44	36	55	47	39
10	40	34	28	51	43	36	72	61	50	76	65	53
16	54	46	38	68	58	48	96	82	67	102	87	71
25	71	60	50	90	77	63	127	108	89	135	115	95
35	88	75	62	111	94	78	157	133	110	166	141	116
50	110	94	77	138	117	97	196	167	137	208	177	146
70	135	115	95	171	145	120	242	206	169	256	218	179
95	164	139	115	207	176	145	293	249	205	310	264	217
120	189	161	132	239	203	167	339	288	237	359	305	251
150	218	185	153	275	234	193	389	331	272	412	350	288
185	248	211	174	313	266	219	444	377	311	470	400	329
240	292	248	204	369	214	258	522	444	365	553	470	387
300	336	286	235	424	360	297	601	511	421	636	541	445

Table 7.3 Correction factors for various ambient air temperatures

Maximum conductor temperature °C	Correction factors for ambient air temperature of:										
	35°C	40°C	45°C	50°C	55°C	60°C	65°C	70°C	75°C	80°C	85°C
60	1,29	1,15	1,00	0,82	-	-	-	-	-	-	-
70	1,18	1,10	1,00	0,89	0,77	0,63	-	-	-	-	-
75	1,15	1,08	1,00	0,91	0,82	0,71	0,58	-	-	-	-
85	1,12	1,06	1,00	0,94	0,87	0,79	0,71	0,61	0,50	-	-
90	1,10	1,05	1,00	0,94	0,88	0,82	0,74	0,67	0,58	0,47	-
95	1,10	1,05	1,00	0,95	0,89	0,84	0,77	0,71	0,63	0,55	0,45

Table 7.4 Correction factors for 1/2-hour and 1-hour service

Nominal cross-sectional area, in mm^2	Half-hour service	One-hour service
1 to 10	1,06	1,06
16	1,09	1,06
25	1,19	1,08
35	1,34	1,14
50	1,55	1,25

Table 7.5 Minimum nominal cross-sectional areas

Service	Nominal cross-sectional	
	External wiring In mm^2	Internal wiring in mm^2
Power, heating and lighting systems	1,0	1,0
Control circuits for power plant	1,0	1,0
Control circuits other than those for power plant	0,75	0,5
Control circuits for telecommunications, measurement, alarms	0,5	0,2
Telephone and bell equipment, not required for the safety of the ship or crew calls	0,2	0,1
Bus and data cables	0,2	0,1

I. Choice of Cables

1. Rated voltage of any cable is to be not lower than the nominal voltage of the circuit for which it is used. For AC systems following minimum voltage ratings are 1000 V for 120/230 V systems and 1000 V for 440 V three phases systems.

2. The nominal cross-sectional area of each cable is to be sufficient to satisfy the following conditions with reference to the maximum anticipated ambient temperature:

- The current carrying capacity is to be not less than the highest continuous load carried by the cable
- The voltage drop in the circuit, by full load on this circuit, is not to exceed the limits specified in items 3 and 4
- The cross-sectional area calculated on the basis of the above is to be such that the temperature increases which may be caused by overcurrents or starting transients do not damage the insulation.

The highest continuous load carried by a cable is to be calculated on the basis of the power requirements and of the diversity factor of the loads and machines supplied through that cable.

3. For AC systems, the cross-sectional area of conductors are to be so determined that the voltage drop from the emergency switchboard busbars to any point in the installation, under normal conditions of service with maximal current, does not exceed 6% of the nominal voltage.

4. For DC systems supplied from batteries, the voltage drop to any point in the installation is not to exceed 10% of the nominal voltage.

For circuits of navigation lights, the voltage drop is not to exceed 5% of the rated voltage under normal conditions.

For circuits to navigational equipment, communication equipment, windlass and engine starting the cross section areas are to be determined to restrict the voltage drop to the minimum specified by the equipment manufacturer.

The voltage drop in DC conductor(s) between the generator(s) and the batteries is not to exceed 1% of the rated voltage during charging.

J. Various Appliances

1. Lighting fittings

1.1 Lighting fittings are to be so arranged as to prevent temperature rises which could damage the cables and wiring and as to prevent surrounding material from becoming excessively hot.

1.2 Lighting fittings are to be secured in place such that they cannot be displaced by the motion of the ship.

2. Heating appliances

2.1 Space heaters are to be so installed that clothing, bedding and other flammable material cannot come in contact with them in such a manner as to cause risk of fire. To this end, for example, hooks or other devices for hanging garments are not to be fitted above space heaters or, where appropriate, a perforated plate of incombustible material is to be mounted above each heater, slanted to prevent hanging anything on the heater itself.

2.2 Space heaters are to be so installed that there is no risk of excessive heating of the bulkheads or decks on which or next to which they are mounted.

2.3 Combustible materials in the vicinity of space heaters are to be protected by suitable incombustible and thermal-insulating materials.

3. Magnetic compass

Cables and equipment are to be placed at a such distance from the compass, or are to be so screened, that the interfering external magnetic field is negligible, causing a compass deviation of no more than 30’ when the circuits are switched on or off under maximum load.

4. Socket-outlets

Socket-outlets provided for the galley area are to be located so that the appliance cords may be plugged in with- out crossing above a galley stove or sink or across a traffic area

SECTION 8

MEASURES FOR PROTECTION OF ELECTRICAL SYSTEMS

Page

A. General Precautions

1. The protection of electrical equipment against foreign bodies, water and oil or oil vapours shall be appropriate to the particular place of installation.

The grade of protection of the equipment shall also be ensured during operation. Covers fitted at the place of installation are also regarded as a means of protection.

2. Enclosures for electrical equipment are to be mounted so that the equipment will not be affected by the distortions, vibrations and movements of the ship's structure that occur during normal operation of the ship.

3. If electrical fittings are attached to structures of another metal, for instance aluminium, suitable provision is to be made to prevent galvanic corrosion.

4. Equipment is to be so installed that sufficient space is available for inspection and maintenance as required for all its parts.

5. Energized parts of electrical equipment are to be guarded against accidental contact by the use of enclosures. Access to energized parts of the electrical system is to require the use of hand tools or have a protection of at least IP2X.

6. The degrees of protection are to be in accordance with IEC Publication No. 60529 for equipment in general and IEC Publication No. 60034-5 for rotating machines.

7. Depending on its location, electrical equipment is to have, as a minimum, the degree of protection specified in Table 8.1.

Cable entrance is not to impair the degree of protection of the relevant enclosure.

Electrical equipment is not to be installed below floor plates in engine rooms, except as, indicated in Table 8.1.

8. In addition to the requirements of item 5 above, equipment installed in spaces with an explosion hazard is also subject to the provisions given in subsection G.

9. Wherever possible, cable entries are to be positioned on the bottom of equipment and enclosures and are to have an IP rating equal to that of the equipment enclosure.

If location of cable entries on the sides or top of an enclosure is unavoidable, they are not to alter the IP of the equipment enclosure.

10. Socket outlets installed in locations subject to rain, spray or splashing (open deck) are to be IP56 or to enclosed in IP 56 enclosures, as a minimum, when not in use. When the appropriate plug is connected the outlet is to maintain IP 56.

11. Socket outlets installed in areas subject to flooding or momentary submersion are to be in IP67 enclosure, as a minimum, also maintaining IP67 when an appropriate plug is inserted.

12. Exceptions and notes to the indications in Table 8.1:

- The minimum degree of protection of the terminal boxes of machines in wet operating spaces is IP 44.

- In drain wells and other installation places, where temporary flooding has to be assumed, the minimum degree of protection required for all electrical equipment is IP 56.

- Spaces subject to an explosion or fire hazard shall additionally comply with the relevant provisions of this section, as well as with applicable items of Part B Chapter 5 Electrical Installations Sections 15, 16 and 17

- For the degrees of protection for the equipment of watertight doors, see Part B Chapter 5 Section 14, D.7.

- Motors and associated control and monitoring equipment: IP X7

- Door position indicators: IP X8

- Door-closure warning devices: IP X6

- For the degrees of protection for measuring chamber of smoke detectors: IP 42

- For the degrees of protection in the adjacent area of direct spray of the FWBLAFFS: IP 44

- For the degrees of protection for bathrooms and shower rooms in zone 0, 1, 2 see Part B Chapter 5 Section 11, C.2.2.

13. Pipe work and air ducts shall be so arranged that the electrical systems are not endangered.

14. If the installation of pipes and ducts close to the electrical systems are unavoidable, the pipes shall not have any flanged or screwed connections in this area.

15. Are flanged or screwed connections installed, if e.g. heat exchanger as integrated components of the electrical equipment are used, the flanged or screwed connections shall be protected with a shield or screen against leakage and condensed water.

16. The water supply lines and recirculating lines shall be fitted with shut-off valves.

17. Heat exchangers are preferably to be installed outside rooms containing major electrical equipment such as switchboards, transformer, etc.

18. If possible the piping for cooler and heat exchangers shall be installed through the deck under the heat exchanger.

Table 8.1 Minimum required degrees of protection for electrical equipment

LOCATION	ELECTRICAL EQUIPMENT							
	Switchboard and control gear	Generators	Motors	Transformers	Luminaires	Instrument	Switches	Accessories
Dry accommodation spaces	IP 20	–	IP 20	IP 20	IP 20	IP20	IP 20	IP 20
Closed navigation bridge	IP 20	–	IP 20	IP 20	IP 20	IP20	IP 20	IP 20
Steering gear room (above floor)	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 44
Control rooms	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 44
General store	–	–	IP 22	–	IP 44	–	IP 44	IP 44
Provision rooms	–	–	IP 22	–	IP 44	–	IP 44	IP 44
Bathrooms and/or showers	–	–	–	–	IP 44	–	IP 55	IP 55
Engine (above floor)	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 44	IP 44
Damp or humid spaces	IP 44	IP 44	IP 44	–	IP 44	IP 44	IP 55	IP 55
Ventilation ducts	–	–	IP 22	–	–	–	–	–
Engine room (below floor)	–	–	IP X8	–	IP X8	IP X8	IP X8	–
Galleys and laundries	IP 44	–	IP 44	IP 44	IP 44	IP 44	IP 44	IP 44
Open decks	IP 56	–	IP 56	–	IP 56	IP 56	IP 56	IP 56

19. The flow rate and leakage of coolants of machines and static converters with closed cooling systems in electric cabinet rooms shall be monitored and alarmed. The air ducts shall be provided with inspection holes for visual observation of the heat exchanger.

20. A failure of cooling shall be alarmed.

21. It is ensure that leakage or condensation of water does not cause an electrical failure to the liquid cooled power equipment. Leakage and condensation of water shall be monitored. The cooling medium of direct cooled systems shall be monitored regarding their insulating capacity.

22. Further requirements in of Part B Chapter 5

Electrical Installations Section 2, F.1.3, Section 6, D, Section 13, H.2 and Section 20, A.1.3.3 are to be observed, as applicable for ships less than 500 GT and as not contradicting with the requirements given in this section.

23. Equipment is to be installed so as not to cause, or at least so as to reduce to a minimum, electromagnetic interference. Refer to subsection E. Electromagnetic Compatibility (EMC)

B. Protection against Electric Shock

1. General

1.1 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.

1.2 Electrical facilities shall be so designed that, when they are used properly, persons cannot touch, or come dangerously close to live parts. However 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 and in systems using safety voltage protection against direct contact may be dispensed with.

1.3 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,
- Protection by extra-low voltage,
- Protection by electrical separation for supplying one consuming device only (voltage not exceeding 250V),
- Protective insulation (double insulation),
- 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. Protective earthing

2.1 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 ship'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 also Part B Chapter 5 Electrical Installations Section 12, D.

2.2 The following points are to be noted with regard to the use of earthing conductors:

2.2.1 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.

2.2.2 A conductor normally carrying current shall not be used simultaneously as an earthing conductor, nor may it be connected with the latter to the ship's hull. The green/yellow coded core shall not be used as a current-carrying conductor.

2.2.3 The cross-section of the earthing conductor shall at least conform to the values indicated in Table 8.1.

2.2.4 Machines and devices which are insulated mounted are to be earthed by flexible cables, wires or stranded copper straps.

2.2.5 Earth wires should be in accessible locations to permit their ready examination and to enable their disconnection for testing of insulation. Connections of earthing conductors shall be protected against corrosion.

Table 8.1 Cross-sections for earthing conductors

<table>
<tr><th rowspan="2">Cross-section of outer conductor [mm²]</th><th colspan="3">Minimum cross-section of earthing conductor</th></tr>
<tr><th>In insulated cables [mm²]</th><th>Separately laid [mm²]</th><th>Flexible 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 of outer 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>

2.2.6 Insulated mounted structures and aluminium structures shall be connected to the ship'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.

C. Earthing of non-current carrying parts

The purpose of earthing and bonding of non-current-carrying parts of an electrical system is to reduce the danger of shock to personnel and to minimise damage to equipment from the effects of earth currents. These can occur from failures of insulation of live conductors, induced volt- ages and currents.

1. Parts which are to be earthed

1.1 All exposed non-current carrying conductive parts of both fixed and portable electrical machines or equipment which are liable under fault conditions to

become live and similar parts inside non-metallic enclosures are to be connected to earth unless the machines or equipment are:

- supplied at a voltage not exceeding 50 V direct current or 50 V root mean square between conductors, achieved without the use of auto-transformers (safety voltage); or

- supplied at a voltage not exceeding 250 V by safety isolating transformers supplying only one consuming device only; or

- constructed in accordance with the principle of double insulation (Class II) as per IEC 60536 or equivalent insulation intended to prevent the appearance of dangerous voltages on its accessible parts due to a fault in the basic insulation.

2. Earthing connection

2.1 All exposed non-current carrying conductive parts are to be connected to earth either via the protective conductors (which may be separate from neutral conductor (TN-S) or not separate (TN-C)) or by direct connection to the hull for metallic ships.

2.2 The nominal cross-sectional area of bonding and protective conductors is to be not less than that required in Table 8.2.
Precautions are to be taken for design of cross sectional area of protective conductors for components producing harmonic distortion.

3. Earthed distribution system

3.1 The AC protective conductor(s) are to be provided with a final connection to the hull for metallic

Table 8.2 Cross-sectional area of protective and bonding conductors

Type of earthing connection		Cross-sectional area of associated current carrying conductor	Minimum cross-sectional area of copper earthing connection
1	Protective conductor in flexible cable or flexible cord	any	Same as current carrying conductor up to and including 16 mm^2 and one half above 16 mm^2 but at least 16 mm^2
2	Protective conductor incorporated in fixed multicore cable	any	- a cross-section equal to that of the main conductors if the latter is less than or equal to 16 mm^2, subject to a minimum of 1,5 mm^2 - a cross-section of not less than 50% of the cross-section of the
3	Protective conductor provided by single core cable	any	- a cross-section equal to that of the current carrying conductor if the latter is less than or equal to 16 mm^2 - a cross-section of not less than 50% of the cross-section of the
4	Separate fixed bonding conductor	> 1,5 mm^2 but ≤ 120 mm^2	One half the cross-sectional area of the current carrying conductor, subject to a minimum of 2.5 mm^2
		> 120 mm^2	70 mm^2

hull ships or to the external main earthing plate required in 3.2 for ships with non metallic hull.

Connection is to be effected at one point only by means independent of any earthing arrangements of non-current carrying parts.

On larger ships a main earth conductor bar may be used to connect all protective conductors at one location before the final connection is made.

3.2 Earthing of non metallic hull ships is to be made by an external earthing plate of copper or other conducting material compatible with sea water, and having a surface area of not less than 0,25 m^2. This plate is to be secured to the outside of the hull in an area reserved for this purpose and located below the light-load water line so that it is immersed under all conditions of heel.

For metallic ships, and particularly those of aluminium alloy, control systems of internal combustion engines are to be insulated from engine earth.

3.3 The earthing connection is to be made at a location above any anticipated water accumulation in an accessible position where it may readily be inspected and disconnected for insulation testing.

4. Bonding connections

4.1 The earth bonding is to be such as to give substantially equal potential and sufficiently low earth fault loop impedance to ensure correct operation of protective devices.

4.2 Every earthing conductor is to be made of copper or other corrosion-resistant material and is to be securely installed and protected, where necessary, against damage and electrolytic corrosion.

4.3 Extraneous conductive parts which are connected to hull of a steel ship by permanent and reliable metal to metal joints of negligible impedance need not be bonded by separate earthing conductors.

4.4 All bonding conductors for AC and DC installations are to be identified by green with yellow stripes insulation or may be uninsulated. Conductors with green with yellow stripes insulation are not to be used for current-carrying conductors.

4.5 Metals used for earth or earth bond terminal studs, nuts and washers are to be corrosion-resistant and galvanically compatible with the conductor and terminal. Aluminium and unplated steel are not to be used for studs, nuts and washers in electrical circuits. No more than four conductors are to be secured to one earth or earth bond one terminal stud.

4.6 For ships of 24 m in length and over, the means of bonding, where possible, is to be separate from that provided at the ships hull for radio, radar and communication circuits to minimise possible interference.

D. Electrical protection

1. Protection against overcurrent

1.1 Every circuit is to be protected against overload and short circuit by a fuse or circuit-breaker.

An overcurrent is a current exceeding the nominal current.

A short-circuit is the accidental connection by a relatively low resistance or impedance of two or more points in a circuit which are normally at different voltages.

Overload is an operating condition in an electrically undamaged circuit which causes an overcurrent.

1.2 Selection, arrangement and performance of the various protective devices are to provide complete and coordinated automatic protection to ensure as far as possible:

- The continuity of service so as to maintain, through coordinated and discriminative action of the protective devices, the supply of circuits not directly affected by a fault

- Elimination of the effect of faults to reduce damage to the system and the hazard of fire as far as possible.

1.3 Devices provided for overload protection are to have a tripping characteristic (overcurrent-trip time) adequate for the overload ability of the elements of the system to be protected and for any discrimination requirements.

1.4 Each overcurrent protective device is to be selected such that:

- Its nominal current or current setting is not less than the design current of the circuit

- Its nominal current or current setting does nor exceed the lowest current-carrying capacity of any of the conductors in the circuit

- The overload current causing operation does not exceed 1.45 times the lowest current carrying capacity of any of the conductors of the circuit

- Its rated short-circuit breaking and making capacity are equal to or in excess of, the calculated short-circuit current at the point at which the device is installed. If the short-circuit breaking or making capacity is less, then the protective device is to be backed up by a fuse or circuit breaker in accordance with IEC 60092-202.

1.5 The protection of the emergency circuit is to be such that a failure in one circuit does not cause a loss of other emergency services.

1.6 The use of fuses up to 320 A for overload protection is permitted. When fuses are used, spare fuses are to be available onboard the ship.

1.7 Circuit-breakers and fuses are to be of a type approved by Society in accordance with the appropriate IEC publications.

2. Localisation of protection

2.1 Short-circuit protection is to be provided for every non-earthed conductor.

2.2 Overload protection is to be provided for every non earthed conductor; nevertheless, in insulated single-phase circuits or insulated three-phase circuits having substantially balanced loads, the overload protection may be omitted on one conductor.

2.3 Overcurrent and fault current protective devices are not to interrupt protective conductors.

2.4 Electrical protection is to be located as close as possible to the origin of the protected circuit.

3. Protection of generators

3.1 DC or AC generators are to be protected against short-circuits and overloads by multipole circuit breakers.

The positive conductors of output circuits of self limiting DC generators and battery chargers not exceeding 2 kW do not require fuses or circuit breakers.

3.2 For generators with a rated output equal or less than 50 kW DC or 50 kVA AC which are not arranged to operate in parallel, a multipole switch with a fuse in each insulated phase on the generator side may be accepted.

Fuse rating is to be maximum 110% of the generator rated current and the trip of contactor is to be short-time delayed, with a maximum delay of 500 ms.

3.3 Generators of more than 50 kW DC or 50 kVA AC are to be provided with circuit-breaker in its output fitted with each of the following:

- Thermal overload protection (for example, 15 s)

- Short-circuit protection (for example, 500 ms)

- Time-delayed under voltage release (for example, 500 ms).

Thermal devices are not to be used for generator over-current protection.

Undervoltage protection should trip the breaker if the voltage falls to 70%-35% of the rated voltage and prevent the closing of the circuit-breaker if the generator voltage does not reach a minimum of 85% of the rated voltage.

3.4 Generators intended for parallel operation are to be provided with reverse power protection. The tripping of the generator circuit-breaker is to be time delayed (for example, 5 s to 15 s).

Recommended value to be considered for the setting of the reverse-power protection: 8-15%.

3.5 For emergency generators the overload protection may, instead of disconnecting the generator automatically, give a visual and audible alarm in permanently attended space (for example, navigation bridge).

3.6 For ships of 24 m in length and over, where the main source of electrical power is necessary for the propulsion of the ship, load shedding or other equivalent arrangements are to be provided to protect the generators against sustained overload.

Load shedding is to be automatic and should concern nonessential loads only.

A visual and audible alarm is to be activated at the navigation bridge in case of load shedding.

4. Protection of final circuits

4.1 Each final circuit connected to a distribution board or switchboard is to be protected against overload and short circuit by multipole circuit breaker or switch and fuses on each non-earthed conductors unless otherwise specified in these Rules or where the Society may exceptionally otherwise permit.

4.2 Final circuits which supply one consumer with its own overload protection (for example motors) or consumers which cannot be overloaded (for example permanently wired heating circuits and lighting circuits), may be provided with short-circuit protection only.

4.3 Circuits for lighting are to be disconnected on both non-earthed conductors. Single pole disconnection of final circuits with both poles insulated is permitted only in dry accommodation spaces.

5. Protection of motors

5.1 Motors of rating exceeding 1 kW and all motors for essential services are to be protected individually against overload and short-circuit. The short-circuit protection may be provided by the same protective device for the motor and its supply cable (refer to item 4.2).

5.2 For motors intended for essential services, the overload protection may be replaced by an overload alarm (for steering gear motors refer to relevant items of Chapter 35-B Machinery).

5.3 The protective devices are to be designed so as to allow excess current to pass during the normal accelerating period of motors according to the conditions corresponding to normal use.

5.4 The protective devices are to be adjusted so as to limit the maximum continuous current to a value within the range 105%-120% of the motor's rated full load current.

6. Protection of storage batteries

6.1 Batteries are to be protected against overload and short-circuit by means of fuses or multipole circuit breakers placed as closed as practicable to the batteries but outside the battery compartment or container.

Overcurrent protection may be omitted for the circuit to the starting devices when the current drawn is so large that is impracticable to obtain short-circuit protection.

6.2 Emergency batteries supplying essential services are to have short-circuit protection only.

7. Protection of transformers

7.1 The primary winding side of power transformers is to be protected against short-circuit and overload by means of a multipole circuit-breakers or switches and fuses. The protective device is to be adjusted at no more than 125% of the rated primary current of the transformer.

7.2 The protection against short-circuit is to be such as to ensure the selectivity between the circuits supplied by the secondary side of the transformer and the feeder circuit of the transformer.

8. Protection of measuring instruments, pilot lamps and control circuits

8.1 Measuring circuits and devices (voltmeters, insulation monitoring devices etc.) and pilot lamps are to be protected against short-circuit by means of multipole circuit-breakers or fuses.

The protective devices are to be placed as near as possible to the tapping from the supply.

8.2 Control circuits and control transformers are to be protected against overload and short-circuit by means of multipole circuit-breakers or fuses on each pole not connected to earth.

Overload protection may be omitted for transformers with a rated current of less than 2 A on the secondary side.

The short-circuit protection on the secondary side may be omitted if the transformer is designed to sustain permanent short-circuit current.

9. Special applications

Circuits which supply safety equipment, such as radio, navigation and navigational aids, are to be individually protected against short-circuits by means of circuit breakers or fuses. These circuits are to be clearly identified.

E. Electromagnetic Compatibility (EMC)

1. Electrical and electronic equipment shall not be impaired in their function by electromagnetic energy. General measures are to extend with equal importance over:

- Decoupling of the transmission path between source of interference and equipment prone to interference

- Reduction of the causes of interference sources,

- Reduction of the susceptibility to interference.

2. All electrical and electronic appliances installed on the bridge and vicinity of the bridge other than mandatory navigation and communication equipment having been type tested according to IEC 60945, as well as loose equipment placed on board by the builders or owners shall have been EMC tested for Conducted and Radiated Emission.

Note: Bridge and vicinity of the bridge covers deck and bridge zone, i.e.

- *The wheelhouse including bridge wings.*

- *Control rooms, characterized by equipment for intercommunication, signal processing, radio communication and navigation, auxiliary equipment.*

- *Area in close proximity to receiving and/or transmitting antennas and large openings in the metallic structure (equipment beyond 5 meters need not be considered for this purposes).*

3. The following are acceptable for the bridge and deck zone test standards:

- IEC 60945 Maritime navigation and radio communication equipment and systems – General requirements – Methods of testing and required test results

- IEC 60533 Electrical and electronic installations in ships – Electromagnetic Compatibility

Equipment need be tested for Conducted and Radiated Emission only.

Note: Equipment having been type tested for EMC in accordance with other appropriate standards will have to be considered. In particular the level of radiated emission in the frequency band from 156 to 165 MHz and the location of the equipment shall be evaluated.

IEC standard 60533 gives guidance to type of equipment and applicable tests.

4. Passive-EM equipment, defined below, which is excluded from the scope of the EMC since it is considered not liable to cause or be susceptible to disturbances need not to be tested but shall be provided with an exemption statement.

Note: Equipment is considered a passive-EM equipment if, when used as intended (without internal protection measures such as filtering or shielding) and without any user intervention, it does not create or produce any switching or oscillation of current or voltage and is not affected by electromagnetic disturbances.

Example of equipment which include no active electronic part:

- Cables and cabling systems, cables accessories.

- Equipment containing only resistive loads without any automatic switching device; e.g. simple domestic heaters with no controls, thermostat, or fan.

- Batteries and accumulators.

5. All electrical and electronic appliances installed on the bridge and vicinity of the bridge other than mandatory navigation and communication equipment having been type tested according to IEC 60945, as well as loose equipment placed on board by the builders or owners shall be listed and be provided with at least the following information. The list and the evidence of equipment are to be kept onboard.

- Equipment description

- Manufacturer

- Type / model

- Evidence of EMC compatibility which may be; type approval certificate covering EMC requirements for bridge installations, Test certificate or report / conformity statement or exemption statement.

6. The requirements for electrical and electronic equipment regarding immunity and emissions of electromagnetic influence can be taken from TL's "Regulations for the Performance of type Tests, Part 1".

7. Electrical and electronic equipment on board ships required neither by classification rules nor by international conventions, liable to cause shall electromagnetic disturbance be of a type which fulfils the test requirements of TL's "Regulations for the Performance of type Tests, Part 1".

F. Protective Measures for Electrical Cables and Wires

1. Application

Cables and conductors shall conform to the requirements stated in Chapter 35-C Electrical Installations Section 7, I and where any point not clearly clarified in this Section is encountered, Part B Chapter 5 Section 20, F shall be referred to as applicable to ships less than 500 GT and as not contradicting with the requirements of this Chapter.

2. Rated Voltage

The rated voltage of a cable shall be not less than the operating voltage of the relevant circuit.

In insulated distribution systems, the outer conductor voltage of the system shall be deemed to be the rated voltage of the cable between a conductor and the ship's hull.

3. Temperatures

At places where higher ambient temperatures are expected, cables shall be used whose permissible temperature is at least 10 K above the maximum anticipated ambient temperature.

A correction of the permissible current rating shall be made in accordance with Section 7 Table 7.3.

Cables on diesel engines, turbines, boilers etc., where there is danger of excessive heating, shall be so routed that they are protected against inadmissible external heating stress, or cables are to be used which are approved for the maximum arising ambient temperature.

4. Mechanical Protection

The choice of cables shall consider the mechanical stressing, refer to Section 7, F and where any point not clearly clarified in this reference is encountered, Part B Chapter 5 Section 20, D shall be referred to as applicable to ships less than 500 GT and as not contradicting with the requirements of this Chapter.

5. Mobility

5.1 Machines or equipment mounted on vibration absorbers (rubber or springs) shall be connected with cables or wires of sufficient flexibility and installed with compensating bends.

5.2 Mobile equipment shall be connected via flexible cables, e.g. of type HO7RN-F, CENELEC HD 22 or equivalent.

For voltages above 50 V, flexible connecting cables or wires intended for equipment without double insulation shall also include an earthing conductor.

The earthing conductor shall have a green/yellow coloured marking.

5.3 For mobile parts of installations or lifting wheelhouses supplied via scissor-type cable supports, suspended loops, festoon systems etc., the use of suitable, flexible cables is required.

6. Application of Cables and Wires

Cables and wires shall be used according to the application categories, Section 7.

7. Lightning Protection

7.1 Application

IEC publication 60092-401 shall be referred to as applicable to ships less than 500 GT and as not contradicting with the requirements of item 7.

7.2 General Provisions

7.2.1 Non metallic hull ships are to be provided with lightning conductor. The lower end of the lightning conductor is to be connected to an earthing plate of copper or other conducting material compatible with sea water, not less than 0,25 m^2 in surface area, secured to the outside of the hull in an area reserved for this purpose and located below the light-load water line so that it is immersed under all conditions of heel. The earthing plate for the lightning conductor is to be additional to, and separate from, the earthing plate.

7.2.2 In metallic hull ships fitted with non-metallic masts, a lightning conductor is to be provided. The lower end of the lightning conductor is to be earthed to the hull.

7.2.3 In metallic hull ships, if there is electrical continuity between hull and lightning protective masts or other metallic superstructure of adequate height, no additional lightning protection is required.

7.2.4 Lightning conductors are to be made of copper (strip or stranded) and are not to be less than 70 mm^2 in cross section. They are to be secured to a copper spike not less than 12 mm in diameter, projecting at least 300 mm above the top of the mast. The lower end of the conductor is to be earthed.

7.2.4 Lightning conductors are to be installed external to the ship and should run as straight as possible. Sharp bends are to be avoided.

7.2.5 Only bolted, riveted or welded joints are to be used.

G. Explosion Protection

1. General

1.1 Electrical equipment which is intended for use in explosive gas atmospheres or which is installed where flammable gases, vapours or explosive dusts are liable to accumulate, such as in spaces containing petrol-powered machinery, petrol fuel tank(s), or joint fitting(s) or other connection(s) between components of a petrol system, and in compartments or lockers containing LPG cylinders and/or pressure regulator, are to conform to the IEC 60079 series.

For ships less than 24 metres in length ISO 8846, ISO 10239 and ISO 9094-1 and 2 may be applied.

1.2 For explosion protection, Part B Chapter 5 Electrical Installations Section 1 K.3 may be taken as a reference as applicable to ships less than 500 GT and as not contradicting with the requirements of this Chapter.

Application and exemptions of these requirements shall be agreed with TL on case by case basis.

2. Electrical installations in battery rooms

2.1. Only lighting fittings may be installed in compartments assigned solely to large vented storage batteries.

The associated switches are to be installed outside such spaces.

Electric ventilator motors are to be outside ventilation ducts and, if within 3 m of the exhaust end of the duct, they are to be of an explosion-proof safe type. The impeller of the fan is to be of the non-sparking type.

Overcurrent protective devices are to be installed as close as possible to, but outside of, battery rooms.

Electrical cables other than those pertaining to the equipment arranged in battery rooms are not permitted.

2.2 Electrical equipment for use in battery rooms is to have minimum explosion group IIC and temperature class T1.

2.3 Standard marine electrical equipment may be installed in compartments assigned solely to valve-regulated sealed storage batteries.

3. Electrical installations in paint stores or enclosed spaces leading to paint stores

3.1 Electrical equipment is to be installed in paint stores and in ventilation ducts serving such spaces only when it is essential for operational services.

Certified safe type equipment of the following type is acceptable:

- Certified intrinsically-safe apparatus Ex(i)
- Certified flameproof Ex(d)
- Certified pressurised Ex()
- Certified increased safety Ex(e)
- Certified specially Ex(s).

Cables (through runs or termination cables) of armoured type or installed in metallic conduit are to be used.

3.2 Switches, protective devices and motor control gear of electrical equipment installed in a paint store are to interrupt all poles or phases and are preferably to be located in a non hazardous space.

3.3 Electrical equipment for use in paint stores is to have minimum explosion group IIB and temperature class T3.

3.4 In the areas on open deck within 1 m of inlet and exhaust ventilation openings of paint stores or 3 m of exhaust mechanical ventilation outlets of such spaces, following electrical equipment may be installed:

- Electrical equipment with the type of protection as permitted in paint stores, or

- Equipment of protection class Exn, or

- Appliances which do not generate arcs in service and whose surface does not reach unacceptably high temperature, or

- Appliances with simplified pressurised enclosures or vapour proof enclosures (minimum class of protection IP55) whose surface does not reach unacceptably high temperature

- Cables as specified in item 3.1.

3.5 Enclosed spaces giving access to paint stores may be considered as non-hazardous, provided that:

- The door to the paint store is a gastight door with self- closing devices without holding back arrangements

- The paint store is provided with an acceptable, independent, natural ventilation system ventilated from a safe area

- Warning notices are fitted adjacent to the paint store entrance stating that the store contains flammable liquids.

The paint stores and inlet and exhaust ventilation ducts under 3.4 are classified as Zone 1, and areas on open deck under 3.4 are classified as Zone 2 as defined in IEC standard 60092-502.

A watertight door may be considered as being gastight.

4. Protection against combustible dust hazard

4.1 Electrical appliances intended for use in areas where a combustible dust hazard may be present are to be arranged with enclosures having a degree of protection and maximum surface temperature suitable for the dust to which they may be exposed.

Where the characteristics of the dust are unknown, the appliances are to have a degree of protection IP6X. For most dusts a maximum surface temperature of 200°C is considered adequate.

SECTION 9

TESTS

Page

A. General

1. The following Rules apply to the testing of electrical and electronic installations, equipment and components.

2. Within the framework of their general quality assurance programme, manufacturers shall ensure that the products they manufacture conform to the specified requirements.

3. Records shall be made, containing quality-assurance measures and tests and shall be handed over to TL on request.

4. For certain installations, before a new installation, or any alteration or addition to an existing installation is put into service, the electrical equipment and components is to be tested in accordance with C, D and E to the satisfaction of the Surveyor in charge.

Such tests are intended to indicate the general condition of the installation at the time of completion; however satisfactory results do not in themselves necessarily ensure that the installation is satisfactory in all respects.

5. The tests and items for testing specified in this section constitute minimum requirements.

TL reserves the right to demand that tests also be performed on other items, either on board or in the manufacturer's works.

6. For appliances of a new type or for equipment which is being used for the first time on ships with TL class, additional tests and trials are to be agreed between the manufacturer and TL, if the circumstances this require.

7. It is the aim of the tests to verify conformity with the requirements covered by the Rules for Construction, and to prove the suitability of equipment for its particular application.

8. Tests are divided into:

- Examinations of the technical documentation, see B.

- Tests in the manufacturer's works, see C.

- Tests on board, see D.

- Tests for type approvals, see E.

9. Tests are to be performed to the satisfaction of the Surveyor in charge, by visual inspection or by means of a tester, to verify that the metal coverings of cables and associated metal pipes, conduits, trunking and casings are electrically continuous and effectively earthed and to verify that all protective conductors and bonds are connected to the frame of the apparatus and to the hull or earthing plate, and that earth contacts in socket- outlets are connected to earth. The maximum value of the resistance to earth is to be 1,0 Ω.

B. Examinations of Technical Documentation

1. The list of documents subject to approval is specified in Section 1.

2. The documents which have been examined and approved shall be presented to the Surveyor on request.

C. Tests in the Manufacturer's Works

1. Tests in the Presence of a TL Surveyor

1.1 The tests shall be carried out as to ensure compliance with requirements stipulated in Chapter 35-D and the approved documents. They shall be performed in accordance with a recognized standard.

1.2 Machines, appliances and installations subject to testing in accordance with 2 and 3 are to be tested in the presence of a TL surveyor unless the preconditions for one's own responsibility tests by the manufacturer are fulfilled, see 4.

2. Insulation resistance

2.1 Insulation-testing instruments

2.1.1 It is recommended that insulation resistance be measured by self contained instruments such as a direct reading ohmmeter of the generator type, applying a voltage of at least 500 V. The test voltage for system rated less than 230 V is to be limited to twice the rated voltage of the equipment being tested. The insulation resistance is to be recorded together with the ambient temperature and the relative humidity at the time of the test.

Any electronic devices present in the installation are to be disconnected prior to the test in order to prevent damage.

The measurement is to be taken when the deviation of the measuring device is stabilised.

2.2 Switchboards

2.2.1 Before switchboards or panel boards and distribution boards are put into service, the insulation resistance between all current carrying parts and earth or between each polarity and the other polarities (between each busbar and earth and between each insulated busbar and the busbars connected to the other poles (or phases)) is to be measured. The insulation resistance is to be not less than 1 MΩ.

2.2.2 The voltage test is to be followed by measurement of the resistance of insulation. The insulation resistance measurement is to be performed at a DC voltage of at least 500 V.

In large installations, the switchboard may be divided into a number of test sections for this purpose.

2.2.3 This test is to be performed with all circuit-breakers and switches open, all fuse-links for pilot lamps, earth fault- indicating lamps, voltmeters, etc. removed and voltage coils temporarily disconnected where otherwise damage may result.

2.3 Lighting and power circuits

2.3.1 A test for insulation resistance between all insulated poles (or phases) and earth and, where practicable, between poles (or phases), is to be applied to all permanent wiring. A minimum value of 1 MΩ is to be obtained.

2.4 Generators and motors

2.4.1 The insulation resistance of generators and motors, is to be measured in normal working condition with all parts in place.

2.4.2 The test is to be carried out at operating temperature immediately after running with normal load.

2.4.3 The embedded temperature sensors of the machine, if any, are connected to earth during testing.

2.4.4 The insulation resistance of generator and motor is to be at least 1 MΩ.

2.5 Internal communication circuits

2.5.1 Circuits operating at a voltage of 50 V and above are to have an insulation resistance between conductors and between each conductor and earth of not less than 1 MΩ.

2.5.2 For circuits operating at validates below 50 V, the insulation resistance is not to be less than 0,33 MΩ.

2.5.3 If necessary, any or all appliances connected to the circuit may be disconnected while the test is being conducted.

3. Machines, Appliances and Installations Subject to Testing

3.1 Generators and motors for electric propulsion plants

3.1.1 For scope of tests, applicable provisions of Part B Chapter 5 Electrical Installations Section 20, A to ships less than 500 GT may be applied however any contradiction to the provisions below or IEC Publication 60092-301 shall be avoided.

3.1.2 All machines are to be tested by the manufacturers. The manufacturer is to issue a test reports giving, inter alia, information concerning the construction, type, serial number, insulation class and all other technical data rele- vant to the machine, as well as the results of the tests required.

Such test reports are to be provided to the Society, for machine intended for essential services. For other machines, these test reports are to be made available upon request of the Society.

3.1.3 Machines of 100 kW and over, intended for essential services are to be surveyed by the Society during testing in compliance with an approved procedure.

3.1.4 All tests are to be carried out according to IEC Publication 60092-301.

3.1.5 Generators and motors for essential equipment, or if they are necessary for the preservation of the cargo/ship's safety, e.g. for class notation YST, RCP, circulating pumps for sea operation etc. P ≥ 100 kW/ kVA,

3.2 Power electronics

3.2.1 For scope of tests, applicable provisions of Part B Chapter 5 Electrical Installations Section 6, G to ships less than 500 GT may be applied however any contradiction to the provisions below shall be avoided. For electric propulsion plants, Part B Chapter 5 Electrical Installations Section 13, K may be applied.

3.2.2 For essential equipment P ≥ 50 kW/ kVA,

3.2.3 For battery charging P ≥ 2 kW.

Refer to applicable provisions of Part B Chapter 5 Electrical Installations Section 21, C.2.2 applicable to ships less than 500 GT regarding tests in the manufacturer's works of battery chargers.

3.3 Switchboards

3.3.1 General

For scope of tests, refer to Part B Chapter 5 Electrical Installations Section 5, H and Section 8, D and check list for switchboards as applicable to ships less than 500 GT and as not contradicting with requirements of this Section.

3.3.1.1 Switchboards are normally to be subjected to the tests specified in this Section prior installation on board. The manufacturer is to issue the relative test reports providing information concerning the construction, serial number and technical data relevant to the switchboard, as well as results of the tests required

3.3.1.2 The following are subject to testing in the presence of a **TL** Surveyor:

- Main switchboards,
- Emergency switchboards,
- Switchboards for electric propulsion plants
- Switchboards for operation of equipment with class notation, e.g. cargo-refrigerating systems YST,
- Distribution switchboards with connected power ≥ 500 kW,
- Switchboards for electrical propulsion plants,
- Starters and controls for boiler and thermal oil systems.
- Starters for motors in accordance with 3.1.5.

TL reserves the right to stipulate a factory test for other switchboards.

3.3.1.3 Testing is to comprise at least the following:

- Checking of manufacture according to the approved drawings. The components and materials used shall conform to the Rules.
- Testing of functional performance on the basis of a test schedule and the approved drawings, as far as is feasible.
- High-voltage test

The main and auxiliary circuits are to be tested with AC voltage given in Table 9.1 and Table 9.2, at a frequency between 25 and 100 Hz of approximately sinusoidal form.

The test voltage is to be applied between all live parts connected together and earth or between each polarity and all the other polarities connected to earth for the tests. The prescribed test voltage is to be maintained for 1 minute.

During this test, all interrupting and protective devices are to be closed; measuring instruments and relays may however be disconnected and tested separately in accordance with the appropriate requirements.

Test voltage for main circuits has to be determinded according to Table 9.1.

Test voltage for auxiliary circuits has to be determinded according to Table 9.2.

For the verification of dielectric property of type-approved switchgear the test voltage for routine tests may be reduced to 85% of the values according to Table 9.1 and 9.2.

Table 9.1 Testing voltage for main circuits

Insulation rated voltage (V)	**AC test voltage (rms), (V)**
Ui ≤ 60	1000
60 < Ui ≤ 300	2000
300 < Ui ≤ 660	2500
660 < Ui ≤ 800	3000

Table 9.2 Testing voltage for auxiliary circuits

Insulation rated voltage (V)	**AC test voltage (V)**
Ui ≤ 12	250
12 < Ui ≤ 60	500
Ui > 60	2 Ui + 1000 with a minimum of 1500

3.4 Transformers

3.4.1 All transformers intended for essential services are to be tested by the manufacturers. The manufacturer is to issue a test reports giving, inter alia, information concerning the construction, type, serial number, insulation class and all other technical data relevant to the transformer, as well as the results of the tests required.

Such test reports are to be made available to the Society.

3.4.2 Tests of transformers of 100 kW and over (60 kVA when single phase) intended for essential services are to be attended by a Surveyor of the Society in accordance with an approved procedure.

3.4.3 Tests are to be carried out according to the requirements of IEC 60076 and 60726.

3.4 Steam boiler and thermal oil systems

For scope of tests, applicable provisions of Part B Chapter 5 Electrical Installations Section 5, H to ships less than 500 GT may be applied

3.5 Electrical propulsion plants

For scope of tests, applicable provisions of Part B Chapter 5 Electrical Installations Section 13 to ships less than 500 GT may be applied

3.6 Computer systems

For scope of tests, applicable provisions of Part B Chapter 5 Electrical Installations Section 10 to ships less than 500 GT may be applied

4. One's Own-Responsibility Tests Made by the Manufacturers

4.1 The products under 3.1.5; 3.2.2, 3.2.3 and 3.3.4, 3.3.5, 3.3.6 may be tested on the manufacturer's own responsibility if the following preconditions are fulfilled:

- A QM system recognized by TL is available.

- TL has carried out type tests of the products.

- The one's-own responsibility tests have been agreed with TL.

4.2 Reference is made to the "Regulations for the Inspection of Mechanical and Electrotechnical Products".

D. Tests on Board

1. General

1.1 The tests are divided into:

- Tests during construction/installation (refer to item 2),
- Tests during dock trials (refer to item 3),
- Tests during sea trials (refer to item 4).

1.2 Where it is deemed necessary by the attending Surveyor, the voltage drop on consuming devices is to be measured to verify that the permissible limits .

2. Tests during Construction

2.1 During the period of construction of the ship, the installations shall be checked for conformity with the documents approved by TL and with the Rules for Construction.

2.2 Test certificates for tests which have already been performed shall be presented to the Surveyor on request.

2.3 Protective measures shall be checked:

- Protection against foreign bodies and water;
- Protection against electric shock, such as protective earthing, protective separation or other measures as listed in Section 1,
- Measures of explosion protection. The design shall conform to the details on form “Details about the construction of electrical equipment in hazardous areas”, submitted by the shipyard for approval.

2.4 Testing of the cable network

Inspection and testing of cable installation and cable routing with regard to:

2.4.1 Acceptability of cable routing with regard to:

- Separation of cable routes,
- Fire safety,
- The reliable supply of emergency consumers.

2.4.2 Selection and fixation of cables,

2.4.3 Construction of watertight and fireproof bulkhead and deck penetrations,

2.4.4 Insulation resistance measurement,

3. Tests during Dock Trials

3.1 General

3.1.1 Proofs are required of the satisfactory condition and proper operation of the main and emergency power supply systems, the steering gear and the aids of manoeuvring, as well as of all the other installations specified in the Rules for Construction.

3.1.2 Unless already required in the Rules for Construction, the tests to be performed shall be agreed with the Surveyor to TL in accordance with the specific characteristics of the subject equipment.

3.2 Generators

3.2.1 A test run of the generator sets and as far as possible of the shaft generators shall be conducted under normal operating conditions and shall be reported on form “Shipboard Test of the Electrical Power Supply”.

3.2.2 For ships, where electrical power is necessary to restore propulsion, it shall be proved that after black-out and dead ship condition the propulsion to the ship in conjunction with required machinery can be restored within 30 min. after black-out.

3.3 Storage batteries

The following shall be tested:

- Installation of storage batteries,

- Ventilation of battery rooms and boxes, and cross-sections of ventilation ducts,

- Storage-battery charging equipment,

- The required caution labels and information plates.

The battery autonomy is to be verified on board in accordance with the operating conditions.

3.4 Switchgear

3.4.1 All switchboard or panel boards and distribution boards are to be loaded as near as practicable to their normal working load in order to ensure that no overheating occurs due to faulty connections or incorrect rating.

3.4.2 When found necessary by the attending Surveyor, switches, circuit-breakers and controls are to be operated on load to test their suitability and to demonstrate that the operation of overcurrent, under-voltage protective devices are electri- cally and mechanically satisfactory. The workshop test is generally considered sufficient to ensure that such apparatus will perform as required while in operation.

3.4.3 The following items shall be tested:

- Accessibility for operation and maintenance,

- Protection against the ingress of water and oil from ducts and pipes in the vicinity of the switchboards, and sufficient ventilation,

- Equipment of main and emergency switchboards with insulated handrails, gratings and insulating floor coverings,

- Correct settings and operation of protection devices and interlocks.

- Independent manual operation of generating sets from common external voltage and automation systems (manual operation means local start/stop and speed setting as well as voltage control, protection devices and synchronizing from switchboard).

TL reserves the right to demand the proof of selective arrangement of the ship supply system.

3.5 Power electronics

The following items shall be tested:

- Ventilation of the place of installation,

- Function of the equipment and protection devices.

3.6 Power plants

The following items shall be tested:

3.6.1 Motor drives together with the driven machines, which shall, wherever possible, be subjected to the most severe anticipated operating conditions. This test shall include a check of the settings of the motors' short-circuit and over current protection devices.

3.6.2 The emergency remote shutdowns of equipment such as:

- Engine room fans

- Fuel pumps

- Separators

- Boiler blowers, etc.

3.6.3 Closed loop controls, open loop controls and all electric safety devices.

3.7 Control, monitoring and ship's safety systems

For these systems operational tests shall be performed.

3.8 Electrical propulsion plants

Regarding scope of tests see Part B Chapter 5 Electrical Installations Section 13 as applicable to ships less than 500 GT and as not contradicting with the requirements of this section.

3.9 Computer systems

Regarding scope of tests see Part B Chapter 5 Electrical Installations Section 10 as applicable to ships less than 500 GT and as not contradicting with the requirements of this section.

4. Tests during the Sea Trial

4.1 Rating of the main- and emergency electrical power supplies

4.1.1 During the sea trial it shall be proved that the main and emergency electrical power supplies are adequately rated and all control and monitoring devices are functioning according to their assignments.

4.1.2 The satisfactory operation of the emergency source of power, when required, is to be tested. In particular, the automatic starting and the automatic connection to the emergency switchboard, in case of failure of the main source of electrical power, are to be tested.

4.2 Operating reliability during navigation

4.2.1 Tests shall be carried out to determine whether all the machines, equipment etc. constituting the electrical installation operates satisfactorily at all revolutions of the main engine, particularly during engine and steering gear manoeuvres.

4.2.2 Tests shall be carried out on the restoration of the main and emergency electrical power supplies following a black-out during navigation.

4.2.3 Tests shall be made of network quality in distribution systems supplied by semiconductor converters and in distribution systems with prevailing load consumptioned by semiconductor converters.

4.2.4 Following tests apply only to ships of 24 m in length and over:

4.2.4.1 Generating sets are to be run at full rated load to verify that the following are satisfactory:

- electrical characteristics

- commutation (if any)

- lubrication

- ventilation

- noise and vibration level.

4.2.4.2 Suitable load variations are to be applied to verify the satisfactory operation under steady state and transient conditions of:

- voltage regulators

- speed governors.

4.2.4.3 Generating sets intended to operate in parallel are to be tested over a range of loading up to full load to verify that the following are satisfactory:

- parallel operation

- sharing of the active load

- sharing of the reactive load (for a.c. generators).

Synchronising devices are also to be tested.

4.2.4.4 The satisfactory operation of the following protective devices is to be verified:

- overspeed protection

- overcurrent protection (Simulated tests may be used to carry out this check where appropriate).

- any other safety devices

4.2.4.5 For sets intended to operate in parallel, the correct operation of the following is also to be verified:

- reverse-power protection for a.c. installations (or reverse-current protection for d.c. installations)

- minimum voltage protection.

4.2.4 Electrical propulsion plants

Regarding scope of tests see Part B Chapter 5 Electrical Installations Section 13 as applicable to ships less than 500 GT and as not contradicting with the requirements of this section.

4.3 Requirements for ships of 12 m in length and over

4.3.1 In addition to applicable requirements of item 4, following items are applicable to ships of 12 m in length and over:

4.3.2 Electrical equipment is to be operated under normal service conditions (though not necessarily at full load or simultaneously) to verify that it is suitable and satisfactory for its purpose.

4.3.3 Motors and their starters are to be tested under nor- mal operating conditions to verify that the following are satisfactory:

- power
- operating characteristics
- commutation (if any)
- speed
- direction of rotation
- alignment.

4.3.4 Lighting fittings, heating appliances etc. are to be tested under operating conditions to verify that they are suitable and satisfactory for their purposes.

4.3.5 Each system is to be tested to validate its suitability and to verify its operation to specification. Particular atten- tion should be paid to the testing of communication systems, emergency lighting and fire detection and alarm system.

4.3.6 The remote stops foreseen are to be tested.

E. Type Approvals

1. General

1.1 The installations, equipment and assemblies mentioned in this subsection are subject to mandatory type-approval.

Type approval of the following components are essential:

- electrical cables
- switching devices (circuit-breakers, contactors, disconnectors, etc.) and overcurrent protective devices
- computer based systems used for tasks essential to safety
- electric rotating machines of 100 kW and over, intended for essential services.

1.2 Case by case approval based on submission of adequate documentation and execution of tests may also be granted at the discretion of the Society.

1.3 Type tests shall be coordinated by staff members of the Head Office and carried out in accordance with the relevant standards in the manufacturer’s works or, by agreement, in suitable institutions and in the presence of a staff member of the Head Office. The scope of the tests shall be agreed with TL.

1.4 Type approvals are carried out according to the “Test Requirements for Electrical Electronic Equipment and Systems ” and in this defined standards.

Type approved installations, apparatuses and assemblies shall be used within the scope of valid Construction Rules only. The suitability for the subject application shall be ensured.

1.5 Requirements related to type approval of equipment given in Part B Chapter 5 Electrical Installations may be applied as applicable to ships less than 500 GT and as not contradicting with the requirements given in this Section or referred standards.

1.6 Instead of the stipulated type approvals in well-founded cases routine tests in the presence of a Surveyor to TL may be carried out. An agreement with TL prior to testing is required.

2. Cables and accessories

2.1 Cables and insulated wires

2.1.1 If not specified in the standards, the following tests shall be performed as an additional requirement:

Ozone tests on cable sheaths whose basic material consists of natural- or synthetic rubber. Test conditions shall be:

- Ozone concentration: 250 - 300 ppm
- Temperature: (25 ±2) °C
- Duration: 24 h

The test shall be carried out in accordance with IEC publication 60811-403.

Other equivalent test methods may be agreed with TL.

The test is passed satisfactory if no cracks will be discovered visible to the naked eye.

2.2 Individual tests on non-type-tested cables and wires shall be performed in the manufacturer's works in the presence of a Surveyor.

The scope of the tests shall be agreed with TL in advance.

The following tests shall be carried out at least:

- Conductor resistance,
- Dielectric strength,
- Insulation resistance,
- Dimensions and construction of samples,
- Mechanical strength characteristics of samples

2.2 Cable accessories

- Sealing compounds and packing systems for bulkhead- and deck penetrations
- Busbar trunking systems for the installation
- Cable trays/protective casings made of plastic materials are to be type tested in accordance with IACS UR E 16.

For guidance on testing, refer to IACS REC 73.

3. Switchgear

The following devices and components are subject to mandatory type-approval:

- Circuit-breakers, load switches, disconnect, switches and fuses for direct connection to the main busbars or non-protected distribution busbars of main, emergency and propulsion switchboards.
- Generator protection devices
- Standardized switchgear units manufactured in series with reduced clearance- and creepage distances, see Section 5 Table 5.2 Clearances and creepage distances.

4. Generator- / mains supply protection devices

- Short-circuit protection,
- Overcurrent protection,
- Reverse power protection,
- Automatically synchronizing device,
- Under frequency protection,
- Over- and under voltage protection,
- Differential protection,
- Earth fault monitoring

5. Steering gear and rudder-propeller systems

5.1 Input devices such as:

- Phase failure relays,
- Level sensors.

5.2 Steering gear control systems with all components important for the function, e.g.

- Steering mode selector switch,
- Follow up / none follow up control devices.

5.3 Variable pitch propeller controls with all components important for the functioning.

6. Machinery control systems

- Open and closed loop control for speed and power of internal combustion engines (main and auxiliary engines) and electrical actuators
- Safety devices,
- Safety systems.

7. Ship's control- and safety systems

- Fire detection- and alarm systems,
- Suction-type smoke-detection systems,
- Loading instrument (loading computer, see Part A Chapter 1 - Hull, Section 6, H 5.),
- Automatic stop devices and control units for heel compensation systems, see Part B Chapter 5 Electrical Installations Section 7, G.
- Flame detectors, remotely control valves, control electronics and fire detection systems for fixed water based local application fire-fighting systems, FWBLAFFS, see Section 9, D.
- Combustion engine crankcase oil mist detection monitoring device/system.

8. Tankers

- Tank level gauging equipment,
- Tank level alarm equipment,
- Overfill protection devices,
- Tank pressure monitoring systems,
- Required gas detectors and -systems.

9. Water ingress detection system for bulk carriers

10. Electrically supplied LLL -systems

11. Computer systems

12. Installations for automated and/or remotely controlled systems

Refer to Part B Chapter 4-1, Automation as applicable.

13. Monitoring-, protection- and management systems of battery systems

TÜRK LOYDU

Chapter 35 – D

Fire Safety

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 IACS PR No.29 is on or after 1st of July 2015. 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 Terms and 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.

http:/www.turkloydu.org

SECTION 1

GENERAL, DEFINITIONS AND APPLICATION

A. General

1. Application

1.1 The requirements of this Chapter apply to fire prevention, fire suppression and fire protection on cargo vessels of less than 500 Gross Tonnage.

1.2 The fire safety objectives of this chapter are to:

- prevent the occurrence of fire and explosion;
- reduce the risk to life caused by fire;
- reduce the risk of damage caused by fire to the vessel, its cargo and the environment;
- contain, control and suppress fire and explosion in the compartment of origin; and
- provide adequate and readily accessible means of escape for crew.

2. Applicable Rules

The subsequent requirements and Sec 2 to Sec 9 of the present Chapter are applicable.

3. Documentation to be submitted

Documentation required with regard to provisions stated in this Chapter and which shall be extracted from Chapter 1 Hull Section 21 Structural Fire Protection and Chapter 4 Machinery Section 18 Fire Protection and Fire Extinguishing Equipment shall be submitted for approval.

4. Type approved products

4.1 Ships of less than 12 m in length

The following materials, equipment, systems or products in general used for fire protection are to be type approved by the Society, except for special cases for which the acceptance may be given for individual ships on the basis of suitable documentation or ad hoc tests:

- Fixed powder fire-extinguishing systems, including the powder
- Sprinkler heads for automatic sprinkler systems
- Sensing heads for automatic fire alarm and fire detection systems
- Equivalent water-mist automatic sprinkler systems
- Equivalent fixed gas fire extinguishing systems.

4.2 Ships of 12 m in length and over

The following materials, equipment, systems or products in general used for fire protection are to be type approved by the Society, except for special cases for which the acceptance may be given for individual ships on the basis of suitable documentation or ad hoc tests:

- Fire-resisting and fire-retarding divisions (bulkheads or decks) and associated doors
- Materials with low flame spread characteristics when they are required to have such characteristics
- Non combustible materials
- Non-readily igniting materials for primary deck coverings
- Sprinkler heads for automatic sprinkler systems
- Nozzles for fixed pressure water-spraying fire-extinguishing systems for machinery spaces, boiler rooms and vehicle spaces

- Sensing heads for automatic fire alarm and fire detection systems
- Fixed fire detection and fire alarm systems
- Fire dampers
- Equivalent water-mist fire extinguishing systems
- Equivalent fixed gas fire extinguishing systems
- Equivalent water-mist automatic sprinkler systems.

4.3 As regards the granting of type approval, the requirements of the relevant TL Rule, apply. The Society may request type approval for other materials, equipment, systems or products required by the applicable provisions for ships or installations of special types

5. Definitions

Despite this Chapter encompasses ships less than 500 GT, definitions of terms given in this Chapter shall mainly comply with SOLAS Chapter II-2 Regulation 3 Definitions.

SECTION 2

FIRE SAFETY MEASURES

Page

A. Structural Fire Protection Measures

1. Minimum Fire Integrity of Bulkheads and Decks

1.1 Minimum fire integrity of bulkheads and decks shall be as prescribed in Table 2.1 (as a summary). However for application of integrity requirements for bulkheads and decks, Section 4 of this chapter shall also be referred to.

1.2 Divisions used to separate spaces not mentioned in Table 21.7 shall be of non-combustible material.

In ships of less than 500 gross tonnage it is allowed to install non-combustible bulkheads, linings and ceilings with combustible covering at most 2 mm thick except corridors, stairway enclosures as well as control stations where thickness of covering shall not exceed 1,5 mm.

2. Machinery Space Boundaries

2.1 Category ‘A’ machinery spaces and the engine spaces, as well as their funnels are to be enclosed by A-60 Class divisions, where adjacent to accommodation spaces, control stations, corridors and staircases, service spaces of high fire risk and by A-0 Class divisions elsewhere. Their enclosure should not be permeable to oil fuel and oil fuel vapours. The divisions used to separate spaces, not mentioned above, should be of non-combustible material.

2.2 On ships constructed in materials other than steel, appropriate fire insulation is also to be fitted on all the boundaries surrounding the galley, the machinery spaces of category A or engine spaces (including the pillars, the upper deck and lateral exterior boundaries from 300 mm below the water line in the lightweight condition up to the deck forming the upper boundary).

[Item]	Space	Separation By	From Space
1	Machinery spaces of category A	A-60	Accommodation / control stations / corridors / staircases / service spaces of high fire risk / ro-ro spaces / vehicle spaces
2	Machinery spaces of category A	A-0	Other than above [item 1]
3	Galley	A-0	Unless specified otherwise
4	Service spaces of high fire risk	B-15	Unless specified above [item 1]
5	Corridor, Staircase	B-0	Unless specified above [item 1]
6	Cargo Space (other than ro-ro spaces and vehicle space)	A-0	Unless specified above [item 1]
7	Ro-ro space and vehicle space (except weather deck)	A-60	Control stations/machinery spaces of category ‘A’
8	Ro-ro space and vehicle space (except weather deck)	A-0	Unless specified above [item 1]

3. Material

3.1 Material of hull, superstructures, structural bulkheads, decks and deckhouses

3.1.1 The hull, superstructure, structural bulkheads and decks other than fire divisions, deckhouses and pillars are to be constructed of steel or other equivalent material. For the purpose of applying the definition of steel or other equivalent material, as given in SOLAS, the 'applicable fire exposure' should be one hour. Alternatively, the use of combustible materials may be permitted if precautions are taken to preserve the hull integrity in case of fire in machinery spaces of category A, engine spaces or other spaces of high fire risk.

3.1.2 Stairways should be enclosed, at least at one level, by divisions and doors or hatches, in order to restrict the free flow of smoke to other decks in the vessel and the supply of air to the fire. Doors forming such enclosures should be self-closing.

3.1.3 Openings in 'A' Class divisions should be provided with permanently attached means of closing which should be at least as effective for resisting fires as the divisions in which they are fitted.

3.1.4 Interior stairways serving machinery spaces, accommodation spaces, service spaces or control stations should be of steel or other equivalent material.

3.1.5 Doors should be self-closing in way of Category 'A' machinery spaces and galleys, except where they are normally kept closed.

3.1.6 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 should be made to ensure that the fire resistance is not impaired. Arrangements should also prevent the transmission of heat to un-insulated boundaries at the intersections and terminal points of the divisions and penetrations by insulating the horizontal and vertical boundaries or penetrations for a distance of 450 mm.

3.1.7 Machinery spaces of category A and engine spaces are to be ventilated to prevent the build-up of explosive gases.

3.1.8 In cargo ships of less than 300 gross tonnage, storerooms for flammable materials and substances may be arranged in way of accommodation spaces, but not adjacent thereto. Where a separate storeroom for flammable liquids is impeded, it is permissible to store them in steel ventilated lockers or cases. Such lockers or cases shall not be adjacent to the accommodation spaces and their doors shall open outwards.

3.2 Other Provisions for Materials

3.2.1 Paints, varnishes and other finishes used on exposed interior surfaces should not be capable of producing excessive quantities of smoke, toxic gases or vapours and should be of the low flame spread type in accordance with the IMO FTP Code, Annex 1, Parts 2 and 5.

3.2.2 Except in cargo spaces or refrigerated compartments of service spaces, insulating materials should be non-combustible.

3.2.3 Where pipes penetrate 'A' or 'B' Class divisions, the pipes or their penetration pieces should be of steel or other approved materials having regard to the temperature and integrity Recommendations such divisions are required to withstand.

3.1.4 Pipes conveying oil or combustible liquids through accommodation and service spaces should be of steel or other approved materials having regard to the fire risk.

3.1.5 Materials readily rendered ineffective by heat should not be used for overboard scuppers, sanitary discharges and other outlets which are close to the waterline, and where the failure of the material in the event of fire would give rise to the danger of flooding.

3.1.6 Primary deck coverings within accommodation spaces, service spaces and control stations should be of a type which will not readily ignite, or give rise to toxic or explosive hazards at elevated temperatures in accordance with the IMO FTP Code, Annex 1, Parts 2 and 6.

3.1.7 Materials used for insulating pipes, etc., in machinery spaces and other compartments containing high fire risks should 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 should be kept to the minimum quantity practicable and their exposed surfaces should have low flame spread characteristics.

3.3 Insulation materials

3.3.1 Ships of less than 12 m in length

For ships which engine space is protected by a fixed fire- extinguishing system, materials used for the insulation of the engine space are to be:

- either self-extinguishing. This property may be determined by means of the oxygen index (OI) method (criteria: OI > 21 at 60 °C) in accordance with ISO 4589-3 or by means of another recognized standard, or

- covered by an intumescent cover material to the satisfaction of the Society.

For ships which engine space is not protected by a fixed fire- extinguishing system, [2.3.2] applies.

3.3.2 Ships of 12 m in length and over

Except in cargo spaces or refrigerated compartments of service spaces, insulating materials are to be non-combustible.

In spaces where penetration of oil products is possible, the surface of the insulation should be impervious to oil or oil vapours. Insulation boundaries should be arranged to avoid immersion in oil spillage.

Vapour barriers and adhesives used in conjunction with insulation, as well as insulation of pipe fittings for refrigeration systems and chilled water piping for air conditioning systems, need not be of non-combustible materials, but they are to be kept to the minimum quantity practicable and their exposed surfaces are to have low flame-spread characteristics.

4. Fire divisions

4.1 Fire divisions, where required, are to be constructed in accordance with the following requirements.

4.2 Fire divisions are to be constructed of steel or any equivalent material, if it can be demonstrated by means of a type test that the material by itself, or due to non-combustible insulation provided, has fire resistance properties equivalent to the properties of the A-class (60 minutes fire integrity) or B-class (30 minutes fire integrity) fire division required by these Rules.

4.3 Fire divisions other than steel

Insulation is to be such that the temperature of the structural core does not rise above the point at which the structure would begin to lose its strength at any time during the exposure to the standard fire test (60 minutes for A-class equivalence, 30 minutes for B-class equivalence).

- Aluminium alloy structures

The insulation is to 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

4.4 Equivalent A class fire divisions without testing

A fire-resisting bulkhead may be considered to be equivalent to A class without testing, if its composition is one of the following:

- An uninsulated steel plate minimum 4,0 mm thick complying with table below is regarded as equivalent to A-0 class

Classification	Definition
A-0 Class Bulkhead	A steel bulkhead having dimensions not less than those given below: - plating thickness: 4 mm - 60x60x5 stiffeners with spacing 600 mm or structural equivalent
A-0 Class Deck	A steel deck having dimensions not less than those given below: - plating thickness: 4 mm - 95x65x7 stiffeners with spacing 600 mm or structural equivalent

- A steel plate minimum 4,0 mm thick insulated with minimum 50 mm of non-combustible rock wool (minimal density: 96 kg/m^3; welded pins spacing: maximum 300 mm): equivalent to A-30, A-15 and A-0 class

- An aluminium alloy plate minimum 5,5 mm thick insulated with 80 mm of non-combustible rock wool (minimal density: 96 kg/m3; welded bi-metallic pins spacing: maximum 300 mm): equivalent to A-30, A-15 and A-0 class

4.5 Equivalent B class fire divisions without testing

A fire-resisting bulkhead may be considered to be equivalent to B class without testing, if its composition is one of the following:

- An uninsulated steel plate minimum 2,0 mm thick: equivalent to B-0 class

- A steel plate insulated with minimum 30 mm of non- combustible rock wool (minimal density: 96 kg/m^3): equivalent to B-15 and B-0 class

- An aluminium alloy plate with 50 mm of non-combustible rock wool (minimal density: 96 kg/m^3): equivalent to B-15 and B-0 class

B. Other ignition sources

1. Space heaters

Space heaters, if used, are to be fixed in position and so constructed as to reduce fire risks to a minimum. The design and location of these units should be such that clothing, curtains, or other similar materials cannot be scorched or set on fire by heat from the unit.

2. Arrangement for gaseous fuel for domestic purposes

Where gaseous fuel is used for domestic purposes, the arrangements for the storage, distribution and utilization of the fuel should be specially considered.

3. Oil fuel arrangements

3.1 In a cargo vessel in which oil fuel is used, the arrangements for the storage, distribution and utilization of the oil fuel should be such as to ensure the safety of the vessel and persons on board.

3.2 Oil fuel tanks situated within the boundaries of Category 'A' machinery spaces should not contain oil fuel having a flashpoint of less than 60°C.

3.3 Oil fuel, lubricating oil and other flammable oils should not be carried in forepeak tanks.

3.4 For vessels of 24 m or more, and as far as practicable:

- oil fuel lines shall be arranged far apar
from hot surfaces, electrical installations or other sources of ignition and shall be screened or otherwise suitably protected to avoid oil spray or oil leakage onto the

sources of ignition. The number of joints in such piping systems shall be kept to a minimum.

- surfaces with temperatures above 220°C which may be impinged as a result of a fuel system failure shall be properly insulated. Precautions shall be taken to prevent any oil that may escape under pressure from any pump, filter or heater from coming into contact with heated surfaces.

- External high-pressure fuel delivery lines between the high pressure fuel pumps and fuel injectors shall be protected with a jacketed piping system capable of containing fuel from a high-pressure line failure. A suitable enclosure on engines having an output of 375 kW or less having fuel injection pumps serving more than one injector may be used as an alternative to the jacketed piping system.

4. Primary deck coverings

Primary deck coverings, if applied within accommodation and service spaces and control stations are to be of approved material which will not readily ignite, this being determined in accordance with the Fire Test Procedures Code.

5. Surface materials and adhesives

5.1 Ships of 12 m in length and over

Surface materials and adhesives used in conjunction with fire insulation are to have low flame spread characteristics (in accordance with FTP Code, Part 5).

5.2 Ships of 24 m in length and over

Exposed surfaces (paint or other finishings) in interior stairways and corridors used for escape routes are to have low flame spread characteristics and are not to be capable of producing excessive quantities of smoke, toxic gases or vapours (in accordance with FTP Code, Part 2 and Part 5).

SECTION 3

FIRE DETECTION AND ALARM

Page

A. Application

Where any point not clearly clarified is encountered, relevant items of Part B Chapter 5 Electrical Installations Section 9 D may be applied as applicable however as not causing any contradictions with the requirements stated in this section.

B. Fixed Fire Detection and Fire Alarm Systems

1. General

1.1 Any fixed fire detection and fire alarm system is to be capable of immediate operation at all times and they are not to be used for any other purpose.

1.2 Fire detection and fire alarm systems are subject to mandatory type-approval.

1.3 An approved and fixed fire detection system should be installed in all Category ‘A’ machinery spaces and cargo pump rooms (refer to subsection D).

1.4 For small engine rooms, a fire detection control panel is not required. The type-approved fire detectors may be directly connected to a type-approved audible and visual alarm sounder.

1.5 The central fire alarm panel shall be located on the bridge or in the main fire control station. One indicating unit shall be placed on the bridge if the central fire alarm panel in not located there.

1.5 Identificating devices, central fire alarm panel or fire indicator board shall indicate the section in which a fire detector has been activated. At least one indicating unit shall be so located that it is at all times accessible to responsible crew members.

1.6 On the fire indicating units or on the central fire alarm panel, clear information shall be provided showing which rooms are monitored, and where the individual sections are located.

1.7 The fire detection system shall be self-monitored. Faults, such as a supply failure, short circuit or wire break in detection loops, the removal of a detector from its base and earth fault in detection loops with all-pole insulation shall be optically and audibly signalled at the central fire alarm panel. Fault alarms shall be acknowledgeable and distinguishable from a fire alarm.

1.8 Short circuit or disconnection of the signal transfer between the fire detection system and the controller of fire safety systems, fire alarm systems or alarm devices shall be provided.

1.9 The emission of audible and optical alarms shall continue until they are acknowledged at the central fire alarm panel. If only a repeater installed on the bridge, the acknowledgement of the audible alarm on the fire indicating unit shall be independent from the central fire alarm panel. Acknowledgement shall not disconnect the detection loop, nor shall it suppress further alarm signals in other detection loops.

1.10 The control panel shall clearly distinguish between normal, alarm, acknowledged alarm, fault and silenced conditions.

1.11 The fixed fire detection and fire alarm systems shall be arranged to automatically reset to the normal operating condition after alarm and fault conditions are cleared.

1.12 The central station shall be provided with means for testing and disconnecting of individual detectors or detector loops. When a particular detector/detector loop is disconnected, this shall be clearly recognizable. Means for such recognition shall be provided for each loop.

1.13 The failure or disconnection of one detector loop shall not affect the operation of another detector loop.

Note: Loop means an electrical circuit linking detectors of various sections in a sequence and connected (input and out-put) to the indicating unit(s).

1.14 The simultaneous response of detectors shall not impair the operation of the system.

1.15 The system and equipment are to be suitably designed to withstand supply voltage variation and transients, ambient temperature changes, vibration, humidity, shock, impact and corrosion normally encountered in ships.

1.16 The first initiated fire alarm is not to prevent any other detector from initiating further fire alarms, and

1.17 No loop is to pass through a space twice. When this is not practical (e.g. for large public spaces), the part of the loop which by necessity passes through the space for a second time is to be installed at the maximum possible distance from the other parts of the loop.

2. Power Supply

The fire detection and fire alarm system shall be supplied from the main- and emergency source of electrical power. The supply is to be provided by separate feeders reserved solely for that purpose. Should one supply fail, automatic change-over to the other power supply shall take place in, or close to, the central fire alarm panel. The changeover shall be signalled optically and audibly.

3. Detectors

3.1 Detectors are to be operated by heat, smoke or other products of combustion, flame, or any combination of these factors. Detectors operated by other factors indicative of incipient fires may be considered by the Society provided that they are no less sensitive than such detectors. Flame detectors are only to be used in addition to smoke or heat detectors.

3.2 Smoke detectors required in all stairways, corridors and escape routes within accommodation spaces shall be certified to operate before the smoke density exceeds 12.5 % obscuration per metre, but not until the smoke density exceeds 2 % obscuration per metre, when tested according to standards EN 54 and IEC 60092-504. Smoke detectors to be installed in other spaces are to operate within sensitivity limits to the satisfaction of the Society having regard to the avoidance of detector insensitivity or oversensitivity.

3.3 Heat detectors shall be certified to operate at a temperature of between 54°C and 78°C when the temperature rises to those limits at a rate of rise less than 1 °C per minute, when tested according to standards EN 54 and IEC 60092-504. In case of a faster temperature rise a higher threshold value may be permitted by agreement with TL.

3.4 In rooms with specially high ambient temperatures (e.g. drying rooms), the operation temperature of heat detectors may be up to 130°C, and up to 140°C in saunas.

3.5 All detectors are to be of a type such that they can be tested for correct operation and restored to normal surveillance without the renewal of any component.

3.5 Detectors are to be grouped into sections.

Note: Section means group of fire detectors as shown in the indicating unit(s) required in item C.3

3.5.1 A section of fire detectors which covers a control station, a service space or an accommodation space is not to include a machinery space of category A. For fixed fire detection and fire alarm systems with remotely and individually identifiable fire detectors, a loop covering sections of fire detectors in accommodation, service spaces and control stations is not to include sections of fire detectors in machinery spaces of category A.

3.5.2 Where the fixed fire detection and fire alarm system does not include means of remotely identifying each detector individually, no section covering more than one deck within accommodation spaces, service spaces and control stations is normally to be permitted except a section which covers an enclosed stairway. In order to avoid delay in identifying the source of fire, the number of enclosed spaces included in each section is to be limited as determined by the Society. In no case more than fifty enclosed spaces are to be permitted in any section. If the system is fitted with remotely and individually identifiable fire detectors, the sections may cover several decks and serve any number of enclosed spaces.

3.6 The detectors are to be mounted in such a way that they can operate properly. Mounting places near beams, ventilators, ventilation ducts or other positions where the operation of detectors may be impaired or where mechanical damage is expected, shall be avoided.

Detectors mounted to the ceiling shall generally be placed at least 0.5 m. away from bulkheads, except in corridors, lockers and stairways.

The maximum monitored area, respectively the maximum distance between detectors shall not exceed the following values:

- Heat detectors 37 m^2 or distance not more than 9 m,

- Smoke detectors 74 m^2 or distance not more than 11 m.

The distance from bulkheads shall not exceed:

- 4.5 m. for heat detectors,

- 5.5 m. for smoke detectors.

4. Electrical wiring

4.1 Electrical wiring which forms part of the system is to be so arranged as to avoid galleys, machinery spaces of category A and other enclosed spaces of high fire risk except where it is necessary to provide for fire detection or fire alarms in such spaces or to connect to the appropriate power supply.

4.2 A loop of fire detection systems with a zone address identification capability is not to be damaged at more than one point by a fire.

C. System control

1. The activation of any detector or is to initiate a visual and audible fire signal at the control panel and indicating units. If the signals have not received attention within two minutes, an audible alarm is to be automatically sounded throughout the crew accommodation and service spaces, control stations and machinery spaces of category A. This alarm sounder system need not be an integral part of the detection system.

2. The control panel is to be located on the navigation bridge or in the continuously manned central con- trol station.

3. Indicating units are, as a minimum, to denote the section in which a detector has been activated. At least one unit is to be so located that it is easily accessible to responsible members of the crew at all times. One indicating unit is to be located on the navigation bridge if the control panel is located in the main fire control station.

4. Clear information is to be displayed on or adjacent to each indicating unit about the spaces covered and the location of the sections.

5. Power supplies and electric circuits necessary for the operation of the system are to be monitored for loss of power or fault conditions as appropriate. Occurrence of a fault condition is to initiate a visual and audible fault signal at the control panel which is to be distinct from a fire signal.

D. Engine spaces and machinery spaces of category A

1. The fixed fire detection and fire alarm system required in sub item B are to be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in spaces of restricted height and where their use is specially appropriate, detection systems using only thermal detectors are not to be permitted.

2. The detection system is to initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places to ensure that the alarms are heard and observed on the navigation bridge and by a responsible engineer officer. When the navigation bridge is unmanned, the alarm is to sound in a place where a responsible member of the crew is on duty.

E. Protection of accommodation and service spaces

1. A fixed fire detection and alarm system is not required to be installed in accommodation and service spaces onboard ships. However, if such a system is installed, it should comply with sub item B.

F. Testing

1. Suitable instructions and component spares for testing are required.

2. The function of fixed fire detection and fire alarm systems required by the relevant Sections are to be tested under varying conditions of ventilation after installation.

3. The function of fixed fire detection and fire alarm systems are to be periodically tested to the satisfaction of the Society by means of equipment producing hot air at the appropriate temperature, or smoke or aerosol particles having the appropriate range of density or particle size, or other phenomena associated with incipient fires to which the detector is designed to respond.

SECTION 4

STRUCTURAL FIRE PROTECTION

Page

A. General

1. Application

For application of this Section 4, Section 2 A. is also to be referred to, as applicable.

2. Coastal area and sheltered area

For ships engaged in coastal area or sheltered area service, the following requirements apply:

2.1 For ships of less than 12 m in length:

- If the engine space is protected by a fixed fire-extinguishing system, no specific fire insulation is required. The exposed surfaces should comply with the requirements of Section 2, A.3.3.

- If no fire-extinguishing system is fitted in the engine space, the boundaries of the engine space should be at least equivalent to B-15 class divisions

2.2 For ships of 12 m in length and over and of less than 24 m in length:

- The boundaries of the engine space should be at least equivalent to B-15 class divisions. Where adjacent spaces have little or no fire risk, no fire division is required.

- As a rule, the wheelhouse should be separated from adjacent spaces by B-15 class divisions and doors (B-0 may be accepted instead of B-15 where spaces are protected by the fire detection system).

However small mess room may be included in the wheelhouse without any division under the following conditions:

- The surface of the mess room does not exceed 20 m^2

- This space is not fitted with any berth

- The electrical equipment installed is limited to the one authorized in accommodation spaces

- The mess room is fitted with a fire detector giving an alarm at the wheelhouse when activated

- The whole area (wheelhouse + mess room) is to be insulated as a control station from the adjacent spaces.

2.3 For ships of 24 m in length and over:

Sub item B applies, provided class division A-60 is replaced by class division A-30 in Table 4.1 and Table 4.2.

B. Fire integrity of bulkheads and decks

1. General

Ships are to be subdivided into spaces by thermal and structural divisions having regard to the fire risk of the space.

2. Provisions related to fire integrity

2.1 Bulkheads within accommodation areas

Bulkheads required to be B class divisions within accommodation and service spaces are to extend from deck to deck except and to the shell or other boundaries. However, when continuous B class ceilings or linings are fitted on both sides of the bulkhead, the bulkhead may terminate at the continuous ceiling or lining.

2.2 Fire integrity of bulkheads and decks

2.2.1 The minimum fire integrity of bulkheads and decks is to be as prescribed in Table 4.1 and Table 4.2

2.2.2 The following requirements govern application of the tables:

2.2.2.1 Table 4.1 and Table 4.2 apply, respectively, to the bulkheads and decks separating adjacent spaces

2.2.2.2 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 (11) below.

Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of the present Section, or where it is possible to assign two or more classifications to a space, it is to 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 and decks of such smaller rooms is to be as prescribed in Table 4.1 and Table 4.2.

The title of each category is intended to be typical rather than restrictive. The number in paren- theses 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

Accommodation spaces, excluding corridors and stairways

(4) Stairways

Interior stairways, lifts, totally enclosed emergency space 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

(7) Other machinery spaces

Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces)

Machinery spaces excluding machinery spaces of category A

(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 lockers and store-rooms 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. 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

Oil fuel tanks forming part of the ship's structure

Air spaces (the space outside superstructures and deckhouses)

(11) Vehicle, special category and ro-ro spaces

Vehicle, special category and ro-ro spaces.

2.2.2.3 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.

2.3 Protection of stairways

Stairways should be enclosed, at least at one level, by divisions and doors or hatches, in order to restrict the free flow of smoke to other decks in the ship and the supply of air to the fire. Doors forming such enclosures should be self-closing.

Table 4.1 Fire integrity of bulkheads separating adjacent spaces - unrestricted navigation

SPACES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
CONTROL STATIONS (1)	C **(1)**	B-0	A-60 **(4)**	B-0	A-0 **(4)**	A-60	A-0 **(4)**	A-0	A-60 **(2)**	–	A-60
CORRIDORS (2)		C **(1)**	B-0	B-0	B-0	A-60	A-0 **(4)**	A-0	A-0 **(2)**	–	A-0
ACCOMMODATION SPACES (3)			C **(1)**	B-0	C **(1)**	A-60	C **(1)**	A-0	A-0 **(2)**	–	A-0
STAIRWAYS (4)				B-0	B-0	A-60	A-0 **(4)**	A-0	A-0 **(2)**	–	A-0
SERVICE SPACES (LOW RISK) (5)					C **(1)**	A-0	C **(1)**	A-0	A-0 **(2)**	–	A-0
MACHINERY SPACES OF CATEGORY A (6)						–	A-0	A-0	A-60	A-0 **(3)**	A-60
OTHER MACHINERY SPACES (7)							C **(1)**	A-0	A-0 **(2)**	–	A-0
CARGO SPACES (8)								–	A-0	–	A-0
SERVICE SPACES (HIGH RISK) (9)									C **(1)**	A-0 (3)	A-0
OPEN DECKS (10)										–	A-0
RO-RO AND VEHICLE SPACES (11)											–

(1) *If a fire detection and alarm system or a sprinkler system is installed in both concerned spaces, no specific requirement is imposed upon bulkheads or decks.*

(2) *For spaces other than galleys or spaces containing flammable products like paint stores and fitted with fire detection, B-0 may be accepted.*

(3) *See item (2.4).*

(4) *If a fire detection and alarm system or a sprinkler system is installed in both concerned spaces, B-0*

Table 4.2 Fire integrity of decks separating adjacent spaces - unrestricted navigation

SPACES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONTROL STATIONS (1)	C **(1)**	B-0	A-0 **(4)**	B-0	B-0	A-60	B-0	A-0	A-0 **(2)**	–	A-60
CORRIDORS (2)	B-0	B-0	B-0	B-0	B-0	A-60	B-0	A-0	B-0	–	A-0
ACCOMMODATION SPACES (3)	A-60 **(2)**	B-0	A-0 **(1)**	B-0	C **(1)**	A-60	C **(1)**	A-0	A-0 **(2)**	–	A-0
STAIRWAYS (4)	B-0	B-0	B-0	B-0	B-0	A-60	B-0	A-0	B-0	–	A-0
SERVICE SPACES (LOW RISK) (5)	A-0 **(2)**	B-0 **(1)**	B-0 **(1)**	B-0 **(1)**	C **(1)**	A-0	C **(1)**	A-0	C **(1)**	–	A-0
MACHINERY SPACES OF CATEGORY A (6)	A-60	A-60	A-60	A-60	A-60	–	A-60	A-60	A-60	A-0 **(3)**	A-60
OTHER MACHINERY SPACES (7)	A-0 **(2)**	A-0 **(4)**	A-0 **(4)**	A-0 **(4)**	C **(1)**	A-0	C **(1)**	A-0	A-0 **(2)**	–	A-0
CARGO SPACES (8)	A-0 **(2)**	A-0	A-0	A-0	A-0	A-0	A-0	–	A-0	–	A-0
SERVICE SPACES (HIGH RISK) (9)	A-60 **(2)**	A-0 **(2)**	A-0 **(2)**	A-0 **(2)**	A-0 **(2)**	A-60	A-0 **(2)**	A-0	C **(1)**	A-0 **(3)**	A-0
OPEN DECKS (10)	–	–	–	–	–	–	–	–	–	–	–
RO-RO AND VEHICLE SPACES (11)	A-60	A-0	A-0	A-0	A-0	A-60	A-0	A-0	A-0	A-0	–

The notes of Table 4.1 apply to this Table, as appropriate.

2.4 Protection of high fire risk spaces and oil fuel tanks forming part of the ship's structure

A-0 divisions are required in the following cases:

- Boundaries of spaces category 6, 9 and 11 situated below the freeboard deck

- Boundaries of oil fuel tanks forming part of the ship's structure when situated adjacent to or above spaces of category 6, 9 and 11.

Note: *For the purpose of this requirement, category 9 is limited to galleys or spaces containing flammable products like paint stores.*

C. Penetrations in fire-resisting divisions and prevention of heat transmission

1. Penetrations in A and B class divisions or equivalent

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

2. Prevention of heat transmission

2.1 In approving structural fire protection details, the Administration has to have regard to the risk of heat transmission at intersections and terminal points of required thermal barriers. The insulation of a deck or bulkhead is to be carried past the penetration, intersection or terminal point for a distance of at least 450 mm in the case of steel and aluminium structures. If a space is divided with a deck or a bulkhead of A class standard having insulation of different values, the insulation with the higher value is to continue on the deck or bulkhead with the insulation of the lesser value for a distance of at least 450 mm.

D. Protection of openings in fire- resisting divisions

1. Openings in bulkheads and decks

1.1 Openings in A class divisions or equivalent

1.1.1 Openings are to be provided with permanently attached means of closing which are to be at least as effective for resisting fires as the divisions in which they are fitted

1.1.2 The construction of doors and door frames in A class divisions or equivalent, with the means of securing them when closed, is to 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, this being determined in accordance with the Fire Test Procedures Code. Such doors and door frames are to be constructed of steel or other equivalent material.

Watertight doors need not to be insulated if constructed of steel or equivalent material

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

1.2 Openings in B class divisions

1.2.1 Doors and door frames in B class divisions and means of securing them are to provide a method of closure which is to have resistance to fire equivalent to that of the divisions, this being determined in accordance with the Fire Test Procedures Code, except that ventilation openings may be permitted in the lower portion of cabin, mess and dayroom doors in corridor bulkheads. Where such opening is in or under a door, the total net area of any such opening or openings is not to exceed 0,05 m^2. All ventilation openings are to be fitted with a grill made of non-combustible material. Doors are to be non-com- bustible.

1.3 Openings in machinery space and galley boundaries

1.3.1 Doors fitted in machinery spaces of category A and galley boundaries should be self-closing except where they are watertight and normally kept closed.

1.3.2 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.

1.4 Windows and side scuttles

1.4.1 Windows and side scuttles in bulkheads within accommodation and service spaces and control stations are to be so constructed as to preserve the integrity requirements of the type of bulkheads in which they are fitted, this being determined in accordance with the Fire Test Procedures Code.

1.4.2 Windows should not be fitted in machinery spaces boundaries. This does not preclude the use of glass in control rooms within the machinery spaces.

E. Ventilation systems

1. The main inlets and outlets of all ventilation systems are to be capable of being closed from outside the spaces being ventilated. The means of closing are to be easily accessible as well as prominently and permanently marked and are to indicate whether the shut-off is open or closed.

2. Power ventilation of accommodation spaces, service spaces, cargo spaces, control stations and machinery spaces is to be capable of being stopped from an easily accessible position outside the space being served. This position is not to be readily cut off in the event of a fire in the spaces served.

3. The ventilation systems serving galley exhaust ducts, are, in general, to be separated from the ventilation systems 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 if an automatic fire damper is to be fitted in the galley ventilation duct near the ventilation unit. Ventilation exhaust ducts serving galleys are to be of non-combustible material.

4. Ventilation systems serving Category 'A' machinery spaces should be independent of systems serving other spaces.

5. Ventilation ducts for Category 'A' machinery spaces, ro-ro spaces and vehicle spaces should not pass through accommodation spaces, galleys, service spaces or control stations, unless the ducts are constructed of steel and arranged to preserve the integrity of the division.

6. Ventilation ducts for accommodation spaces, service spaces or control stations should not pass through Category 'A' machinery spaces or galleys unless the ducts are constructed of steel and arranged to preserve the integrity of the division.

7. For ships of 24 m in length and over, where exhaust ducts from galley ranges pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges are to be constructed of A class divisions or equivalent. Each exhaust duct is to be fitted with:

- A grease trap readily removable for cleaning

- A fire damper located in the lower end of the duct and, in addition, a fire damper in the upper end of the duct

- Arrangements, operable from within the galley, for shutting off the exhaust fans, and

- Fixed means for extinguishing a fire within the duct.

8. Ventilation arrangement for store rooms containing highly flammable products should be specially considered. For this purpose ventilation system independent of systems serving other spaces is to be provided. Ventilation is to be arranged at high and low levels and the inlets and outlets of ventilators are to be positioned in safe areas and fitted with spark arresters.

9. Ventilation should be provided to prevent the accumulation of gases that may be emitted from batteries.

10. Ventilation openings may be fitted in and under the lower parts of cabin, mess and dayroom doors in corridor bulkheads. The total net area of any such openings is not to exceed 0,05 m^2. Balancing openings or ducts between two enclosed spaces are prohibited except for openings as permitted by item B.1.2.1.

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

12. Skylights should be of steel and are not to contain glass panels. Suitable arrangements should be made to permit the release of smoke, in the event of fire, from the space to be protected.

13. Means of control should be provided for:

- Opening and closure of skylights, closure of openings in funnels which normally allow exhaust ventilation, and closure of ventilator dampers

- permitting the release of smoke

- closing power-operated doors or actuating release mechanism on doors other than power-operated watertight doors

- stopping ventilating fans, and

- stopping forced and induced draught fans, oil fuel transfer pumps, oil fuel unit pumps and other similar fuel pumps.

14. The controls required in item 13 should be located out- side the space concerned, where they will not be cut off in the event of fire in the space they serve. Such controls and the controls for any required fire-extinguishing sys- tem should be situated at one control position or grouped in as few positions as possible. Such positions should have a safe access from the open deck.

15. Fire dampers including their relevant means of operation are to be tested in accordance with the Fire

Test Procedures Code.

16. Ventilation ducts are to be of non-combustible material. However, short ducts, not generally exceeding

2 m in length and with a free cross-sectional area not exceeding 0,02 m^2, need not be non-combustible, subject to the following conditions:

- The ducts are made of a material which has low flame spread characteristics
- The ducts are only used at the end of the ventilation device, and
- The ducts are not situated less than 600 mm, measured along the duct, from an opening in A or B class division, including continuous B class ceiling.

17. For ventilation ducts penetrations through A and B class divisions, see item C.1.

SECTION 5

FIRE EXTINGUISHING

Page

A. Scope of Fire Extinguishing Equipment

1. Purpose

The purpose of this Section is to suppress and swiftly extinguish a fire in the space of origin and applicable to all ships irrespective of their navigation notation, except where notified. For this purpose, the following functional properties should be met:

- Fixed fire extinguishing systems should be installed, as applicable, having due regard to the fire growth potential of the protected spaces; and

- Fire extinguishing appliances should be readily available.

2. General

2.1 Any ship is to be equipped with a general water fire extinguishing system and with portable and mobile extinguishers

2.2 In addition, depending on their nature, size and the propulsion power installed, spaces subject to a fire hazard are to be provided with fire extinguishing equipment.

2.3 For design of equipment and medium of fixed gas fire extinguishing systems, see also FSS Code Chapter 5.2.1.1.

2.4 Unless otherwise specified, this equipment is normally to be sited outside the spaces and areas to be protected and, in the event of a fire, must be capable of being actuated from points which are always accessible.

2.5 Arrangements for fire protection, detection and extinction in vessels not fitted with propelling machinery should be specially considered in each case and should depend on the size and purpose of the vessel and the presence of accommodation spaces, machinery and combustible materials on board.

3. Application

Where any point not clearly clarified is encountered, Part B Chapter 4 Machinery Section 18 and IMO FSS Code shall be applied, as applicable and as not causing any contradictions with the requirements stated in this section.

4. Fixed Fire-extinguishing arrangements in Category 'A' machinery spaces

Machinery spaces of category 'A' on vessels with length greater than or equal to 24 m and operating in unrestricted or restricted waters, should be provided with an approved fixed fire-extinguishing system. On vessels operating in protected areas may be exempted from this requirement.

5. Fixed Fire-extinguishing systems

Fixed fire-fighting systems where required, should be in accordance with the requirements of the IMO FSS Code.

6. Protection of paint lockers and flammable liquid lockers

The requirements for the protection of paint lockers and flammable liquids lockers should be specially considered.

7. Fixed fire-extinguishing systems not required by this section

If such a system is installed, it should be of an approved type.

B. Water supply systems

1 General

1.1 Ships are to be provided with fire pumps, fire mains, hydrants and hoses complying with the applicable requirements of this Section.

For ships of less than 12 m in length, equivalent means of fire-fighting may be accepted on a case by case basis.

2. Fire pumps

Generally one main power pump and one portable fire pump should be provided as specified below

2.1 Capacity

The total capacity of the main fire pump(s) need not exceed 25 m^3/h and is not to be less than:

$$Q = \left[0{,}145 \cdot \sqrt{L_C \cdot (B + D)} + 2{,}170\right]^2$$

where:

Q = Total capacity (in m^3/hour)

L_C = Freeboard length (in m)

B = Greatest moulded breadth of ship (in m)

D = Moulded depth to bulkhead deck (in m).

2.2 Pumps accepted as fire pumps

Sanitary, ballast, bilge or general service pumps may be accepted as fire pumps, provided that they are not normally used for pumping oil and that, if they are subject to occasional duty for the transfer or pumping of oil fuel, suitable change-over arrangements are fitted.

2.3 Power pumps

A power pump is a fixed pump driven by a power source other than by hand.

Where a centrifugal pump is provided in order to comply with the present sub-article, a non-return valve should be fitted in the pipe connecting the pump to the fire main.

Relief valves should be provided in conjunction with any fire pump if the pump is capable of developing a pressure exceeding the design pressure of the water service pipes, hydrants and hoses. These valves should be so placed and adjusted as to prevent excessive pressure in any part of the fire main system.

2.4 Portable fire pumps

2.4.1 Portable fire pumps should comply with the following:

- The pump should be self-priming

- The total suction head and the net positive suction head of the pump should be determined taking account of actual operation, i.e. pump location when used

- The portable fire pump, when fitted with its length of discharge hose and nozzle, should be capable of maintaining a pressure sufficient to produce a jet throw of at least 12 m, or that required to enable a jet of water to be directed on any part of the engine room or the exterior boundary of the engine room and casing, whichever is the greater

- Except for electric pumps, the pump set should have its own fuel tank of sufficient capacity to operate the pump for three hours. For electric pumps, their batteries should have sufficient capacity for three hours.

- Except for electric pumps, details of the fuel type and storage location should be carefully considered. If the fuel type has a flashpoint below 60°C, further consideration to the fire safety aspects should be given

- The pump set should be stored in a secure, safe and enclosed space, accessible from open deck and clear of the Category A machinery space

- The pump set should be easily moved and operated by two persons and be readily available for immediate use

- Arrangements should be provided to secure the pump at its anticipated operating position(s)

- The overboard suction hose should be non-collapsible and of sufficient length, to ensure suction under all operating conditions. A suitable strainer should be fitted at the inlet end of the hose

- Any diesel-driven power source for the pump should be capable of being readily started in its cold condition by hand (manual) cranking. If this is impracticable, consideration should be given to the provision and maintenance of heating arrangements, so that readily starting can be ensured

2.4.2 Alternatively to the requirements of item 2.4.1, a fixed fire pump may be fitted, which should comply with the following:

- The pump, its source of power and sea connection should be located in accessible positions, outside the compartment housing the main fire pump

- The sea valve should be capable of being operated from a position near the pump

- The room where the fire pump prime mover is located should be illuminated from the emergency source of electrical power, and should be well ventilated

- If a pump is required to supply water for a fixed fire- extinguishing system in the space where the main fire pump is situated, it should be capable of simultaneously supplying water to this system and the fire main at the required rates

- The pump may also be used for other suitable purposes, subject to the approval in each case

- Pressure and quantity of water delivered by the pump should be sufficient to produce a jet of water, at any nozzle, of not less than 12 m in length. For ships of less than 24 m in length, the jet of water may be specially considered

2.4.3 For ships of less than 24 m in length, the following relaxation may be accepted:

- If the ship is not fitted with a fire-extinguishing system in the engine room, the portable fire pump may be a hand pump, provided that the pressure and quantity of water delivered by this pump is sufficient to produce a jet of water of not less than the length indicated in item a), third item of the bulleted list.

- If the ship is fitted with a fire-extinguishing system in the engine room, the portable fire pump may be omitted.

2.4.4 Means to illuminate the stowage area of the portable pump and its necessary areas of operation should be provided from the emergency source of electrical power.

3. Fire main and hydrants

3.1 General

Materials are to be in compliance with Part A Chapter 2 Material. Where steel pipes are used, they should be galvanized internally and externally. Cast iron pipes are not acceptable. The pipes and hydrants should be so placed that the fire hoses may be easily coupled to them. The arrangement of pipes and hydrants should be such as to avoid the possibility of freezing. In ships where deck cargo may be carried, the positions of the hydrants should be such that they are always readily accessible and the pipes should be arranged, as far as practicable, to avoid risk of damage by such cargo. There should be complete interchangeability of hose couplings and nozzles.

3.2 Fire main

3.2.1 The diameter of the fire main should be based on the required capacity of the fixed main fire pump(s) and the diameter of the water service pipes should be sufficient to ensure an adequate supply of water for the operation of at least one fire hose

3.2.2 The wash deck line may be used as a fire main provided that the requirements of this sub-article are satisfied

3.2.3 All exposed water pipes for fire-extinguishing systems should be provided with drain valves for use in frosty weather. The valves should be located where they will not be damaged by cargo.

3.3 Pressure in the fire main

When the main fire pump is delivering the quantity of water required by 2.1, or the fire pump described in

2.4.2, through the fire main, fire hoses and nozzles, the pressure maintained at any hydrant should be sufficient to produce a jet throw at any nozzle of not less than 12 m in length (for ships of less than 24 m in length, the jet of water may be specially considered).

3.4 Isolating valve

Where a fixed fire pump is fitted outside the engine room, in accordance with 2.4.2:

3.4.1 An isolating valve should be fitted in the fire main so that all the hydrants in the ship, except that or those in the Category A machinery space or engine space, can be supplied with water. The isolating valve should be located in an easily accessible and tenable position out- side the Category A machinery space or engine space; and

3.4.2 The fire main should not re-enter the machinery space downstream of the isolating valve.

Short lengths of suction or discharge piping may penetrate the machinery space, provided they are enclosed in a substantial steel casing or are insulated to A-60 class standards. The pipes shall have substantial wall thickness, but in no case less than 11 mm, and shall be welded except for the flanged connection to the sea inlet valve.

3.5 Fire hydrants

3.5.1 Number and position of hydrants

- For ships of less than 24 m in length, the number and position of the hydrants should be such that at least one jet of water may reach any part normally accessible to the crew, while the ship is being navigated and any part of any cargo space when empty. Furthermore, such hydrants should be positioned near the accesses to the protected spaces (at least one hydrant should be provided in each Category A machinery space

- For ships of 24 m in length and over, the number and position of hydrants should be such that at least two jets of water not emanating from the same hydrant, one of which should be from a single length of hose, may reach any part of the ship normally accessible to the crew while the ship is being navigated and any part of any cargo spaces when empty. Furthermore, such hydrants should be positioned near the accesses to the protected spaces. Other requirements specified by the Administration may be considered

Note: A valve should be fitted at each fire hydrant so that any fire hose may be removed while the fire pump is at work.

3.5.2 Pipes and hydrants

3.5.2.1 Materials readily rendered ineffective by heat should not be used for fire mains. Where steel pipes are used, they should be galvanized internally and externally. Cast iron pipes are not acceptable. The pipes and hydrants should be so placed that the fire-hoses may be easily coupled to them. The arrangement of pipes and hydrants should be such as to avoid the possibility of freezing. In vessels where deck cargo may be carried, the positions of the hydrants should be such that they are always readily accessible and the pipes should be arranged, as far as practicable, to avoid risk of damage by such cargo. There should be complete interchangeability of hose couplings and nozzles.

3.5.2.2 A valve should be fitted at each fire hydrant so that any fire-hose may be removed while the fire pump is at work.

3.5.2.3 Where a fixed fire pump is fitted outside the engine room, in accordance with 2.4:

3.5.2.3.1 An isolating valve should be fitted in the fire main so that all the hydrants in the vessel, except that or those in the Category 'A' machinery space, can be supplied with water. The isolating valve should be located in an easily accessible and tenable position outside the Category 'A' machinery space; and

3.5.2.3.2 The fire main should not re-enter the machinery space downstream of the isolating valve.

3.6 Fire hoses and nozzles

3.6.1 General specifications

Fire hoses should be of approved non-perishable material. The hoses should be sufficient in length to project a jet of water to any of the spaces in which they may be required to be used. Their length, in general, is not to exceed 18 m. Each hose should be provided with a nozzle and the necessary couplings. Fire hoses, together with any necessary fit- tings and tools, should be kept ready for use in conspicuous positions near the water service hydrants or connections.

3.6.2 Number of fire hoses

3.6.2.1 For ships of less than 24 m in length, one hose should be provided for each hydrant. In addition one spare hose should be provided onboard

3.6.2.2 Ships of 24 m in length and over should be provided with fire hoses the number of which should be one for each 30 m length of the ship and one spare, but in no case less than three in all. Unless one hose and nozzle is provided for each hydrant in the ship, there should be complete interchangeability of hose couplings and nozzles.

3.6.3 Size and type of nozzles

3.6.3.1 For the purpose of this Section, standard nozzle sizes are 12 mm, 16 mm or 19 mm, or as near thereto as possible, so as to make full use of the maximum discharge capacity of the fire pump(s).

3.6.3.2 For accommodation and service spaces, the nozzle size need not exceed 12 mm

3.6.3.3 The size of nozzles used in conjunction with a portable fire pump need not exceed 12 mm

3.6.3.4 Nozzles should be of an approved dual-purpose type (i.e. spray/jet type) incorporating a shut-off.

C. Portable fire extinguishers

1. Type and design

1.1 Portable fire extinguishers should be of approved type and design.

1.2 The extinguishing media employed should be suitable for extinguishing fires in the compartments in which they are intended to be use.

1.3 The extinguishers required for use in the machinery spaces of ships using oil as fuel should be of a type discharging foam, carbon dioxide gas, dry powder or other approved media suitable for extinguishing oil fires.

1.4 A spare charge should be provided for each required portable fire-extinguisher that can be readily recharged on board. If this cannot be done, duplicate extinguishers should be provided.

1.5 Capacity

1.5.1 The capacity of required portable fluid extinguishers should not exceed 13,5 litres without being less than 9 litres. Other extinguishers should be at least as portable as the 13,5 litre fluid extinguishers, and should have a fire-extinguishing capability at least equivalent to a 9 litre fluid extinguisher

1.5.2 The following capacities may be taken as equivalents:

- 9 litre fluid extinguisher (water or foam)
- 5 kg dry powder
- 5 kg carbon dioxide.

2. Arrangement of fire extinguishers

2.1 Accommodation spaces, service spaces and control stations should be provided with a sufficient number of portable fire extinguishers to ensure that at least one extinguisher will be readily available for use in every compartment of the crew spaces. In any case, their number should be not less than three, except where this is impractical for very small ships, in which case one extinguisher should be available at each deck having accommodation or service spaces, or control stations.

2.2 The number of portable fire extinguishers is to be as described in Table 5.1

Table 5.1: Number of portable fire extinguishers

SPACE	NUMBER
Accommodation and service spaces	
Ships of 12 m in length and over	≥ 3
Ships of less than 12 m in length	≥ 1
Machinery spaces	
One extinguisher per every 375 kW of internal combustion engine power	2 ≤ N ≤ 6
Note: Portable fire extinguishers of the carbon dioxide type are not to be located or provided for use in accommodation spaces, except for use at the wheelhouse.	

2.3 The extinguishers should be stowed in readily accessible positions and should be spread as widely as possible and not be grouped.

2.4 One of the portable fire extinguishers intended for use in any space is to be stowed near the entrance to that space.

D. Fixed fire-extinguishing systems

1. Types of fixed fire-extinguishing systems

1.1 A fixed fire-extinguishing system required in item 2 should be in accordance with the requirements of the Part B Chapter 4 Machinery Section 18.

1.2 Where a fixed fire-extinguishing system not required by this Chapter is installed, it should be in accordance with Part B Chapter 4 Machinery

2. Fire-extinguishing arrangements in machinery spaces

2.1 Ships of 12 m in length and over

Engine spaces or machinery spaces of Category A on ships of 12 m in length and over should be provided with an approved fixed fire-extinguishing system, as specified in 1.1.

2.2 Ships of less than 12 m in length

Engine spaces on ships of less than 12 m in length and operating in unrestricted area should be provided with an approved fixed fire-extinguishing system, as specified in 1.1.

Engine spaces on ships of less than 12 m in length and operating in coastal area or in sheltered area may be exempted from this recommendation.

2.3 Closing appliance for fixed gas fire-extinguishing system

Where a fixed gas fire-extinguishing system is used, openings which may admit air to, or allow gas to escape from, a protected space is to be capable of being closed from out- side the protected space.

2.4 Storage rooms of fire-extinguishing medium

When the fire-extinguishing medium is stored outside a protected space, it shall be stored in a room which is located behind the forward collision bulkhead, and is used for no other purposes. Any entrance to such a storage room shall preferably be from the open deck and shall be independent of the protected space. If the storage space is located below deck, it shall be located no more than one deck below the open deck and shall be directly accessible by a stairway or ladder from the open deck. Spaces which are located below deck or spaces where access from the open deck is not provided shall be fitted with a mechanical ventilation system designed to take exhaust air from the bottom of the space and shall be sized to provide at least 6 air changes per hour. Access doors shall open outwards, and bulkheads and decks, including doors and other means of closing any opening therein, which form the boundaries between such rooms and adjacent enclosed spaces, shall be gastight.

2.5 The fixed fire-extinguishing system should generally be activated manually. However, automatic activation may be acceptable if it is installed in such a small engine space that it is not possible for someone to enter it. In this case, ventilation fans stops, closure of openings and fuel oil pump stops should also be activated automatically upon fixed fire-extinguishing system activation and means for manual activation of the system are to be additionally available.

E. Other requirements

1. Fire blanket

A fire blanket should be provided.

2. Fire-fighter’s outfit (which includes an axe)

All cargo vessels greater than or equal to 24 m should carry at least one firefighter's outfit complying with the Requirements of the IMO FSS Code.

3. Spaces containing flammable liquid

Paint lockers shall be protected by:

- A carbon dioxide system, designed to give a minimum volume of free gas equal to 40% of the gross volume of the protected space

- A dry powder system, designed for at least 0,5 kg powder/m^3

- A water spraying or sprinkler system, designed for 5 l/min/m². Water spraying systems may be connected to the fire main of the ship, or

- A portable carbon dioxide fire extinguisher sized to provide a minimum volume of free gas equal to 40% of the gross volume of the space. A discharge port shall be arranged in the locker to allow the discharge of the extinguisher without having to enter into the protected space. The required portable fire extinguisher shall be stowed adjacent to the port, or

- A port or hose connection may be provided to facilitate the use of fire main water.

In all cases, the system shall be operable from outside the protected space.

4. Deep-fat cooking equipment

Deep-fat cooking equipment is to be fitted with the following:

- An automatic or manual fire-extinguishing system tested to an international standard

- A primary and backup thermostat with an alarm to alert the operator in the event of failure of either thermostat arrangements for automatically shutting off the electrical power upon activation of the fire-extinguishing system

- An alarm for indicating operation of the fire-extinguishing system in the galley where the equipment is installed, and

- Controls for manual operation of the fire-extinguishing system which are clearly labelled for ready use by the crew.

SECTION 6

ESCAPE

A. General

1. Purpose

The purpose of this Section is to provide means of escape so that persons onboard can safely and swiftly escape to the lifeboat and liferaft embarkation deck. For this purpose, the following functional requirements should be met:

- Safe escape routes should be provided;
- Escape routes should be maintained in a safe condition, clear of obstacles; and
- Additional aids for escape should be provided as necessary to ensure accessibility, clear marking, and adequate design for emergency situations.

2. Application

Where any point not clearly clarified is encountered, Part A Chapter 1 Hull Section 21 C.11 shall be applied as applicable however as not causing any contradictions with the requirements stated in this section.

B. General requirements

1. Unless expressly provided otherwise in this section, at least two widely separated and ready means of escape are to be provided from all spaces or groups of spaces.

2. Lifts are not to be considered as forming one of the means of escape as required by this section.

3. Escape routes are to be maintained in a safe condition, clear of obstacles. Any furniture fitted along the escape routes is to be secured in place to prevent shifting.

4. Provisions given in sub section C are applicable for ships of 12 m in length and over. In addition to general provisions of this subsection B, one single escape route can be accepted for spaces corridor when the door is opened, and

1.3.2 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 for access.

where the maximum travel distance to the door is less than 5 m and the escape route does not pass through the cooking area nor the engine space for ships of less than 12 m in length.

C. Means of escape from control stations, accommodation spaces and service spaces

1. General requirements

1.1 There should be at least two means of escape, as widely separated as possible, from each section of accommodation and service spaces and control stations:

1.1.1 The normal means of access to the accommodation and service spaces below the open deck should be arranged so that it is possible to reach the open deck without passing through spaces containing a possible source of fire (e.g. machinery spaces, storage spaces of flammable liquids).

Exceptionally, the Society may dispense with one of the means of escape for service spaces that are entered only occasionally, provided that the escape route does not pass through the galley, a machinery space or a watertight door.

1.1.2 The second means of escape may be through portholes or hatches of adequate size and preferably leading directly to the open deck.

1.1.3 Dead-end corridors having a length of more than 7 m are not accepted.

1.2 Unless expressly provided otherwise in this Section, a corridor, lobby, or part of a corridor from which there is only one route of escape is to be prohibited.

1.3 Doors in escape routes are, in general, to open in way of the direction of escape, except that:

1.3.1 Individual cabin doors may open into the cabins in order to avoid injury to persons in the

1.4 Stairways, ladders and corridors serving crew spaces and other spaces to which the crew normally have access should be arranged so as to provide ready means of escape to a deck from which embarkation into survival craft may be effected.

1.5 It should be possible to open all doors from either side. In the direction of escape, it should be possible to open all doors without any key.

D. Means of escape from machinery spaces

1. Means of escape from each machinery space are to comply with the provisions of this subsection.

2. Where the machinery space is below the bulkhead deck, the two means of escape are to consist of either:

2.1 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, or

2.2 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.

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

4. The Society may dispense with one means of escape when the small size of the machinery space makes it impracticable.

5. Two means of escape are to be provided from a machinery control room located within a machinery space, at least one of which leading to a safe position outside the machinery space.

6. On all ships, within the machinery spaces, emergency escape breathing devices are to be situated ready for use at easily visible places, which can be reached quickly and easily at any time in the event of fire. The location of emergency escape breathing devices is to take into account the layout of the machinery space and the number of persons normally working in the spaces. The number and location of these devices are to be indicated in the fire control plan. Emergency escape breathing devices are to comply with the FSS Code.

SECTION 7

FIRE CONTROL PLANS

Page

A. Fire Control Plans and Booklets

1. General

1.1 Application

1.1.1 This section applies to all ships of 12 m in length and over, except that item 2.2.1 applies only to ships of 24 m in length and over.

1.1.2 Relevant items of Part B Chapter 4 Machinery Section 1 and Part B Chapter 5 Electrical Installations Section 1 are also to be referred to.

2. Fire control plans

2.1 Description of plans

2.1.1 General arrangement plans are to be permanently exhibited for the guidance of the ships' officers, using symbols that are in accordance with IMO Resolution A.952(23), which shows clearly for each deck the control stations, the various fire sections enclosed by steel or A class divisions, the sections enclosed by B class divisions together with particulars of the:

- Fire detection and fire-alarm systems
- Fixed fire-fighting system
- Fire-extinguishing appliances
- Means of access to different compartments, decks, etc.
- Position of the fireman's outfits
- Ventilating system, including particulars of the fan control positions, the position of dampers and identification numbers of the ventilating fans serving each section; and
- Location and arrangement of the emergency stop for the oil fuel unit pumps and for closing the valves on the pipes from oil fuel tanks.

2.1.2 Alternatively, at the discretion of the Society, the afore mentioned details of 2.1.1 may be set out in a booklet, a copy of which is to be supplied to each officer, and one copy is at all times to be available on board in an accessible position.

2.1.3 The plans and booklets should be kept up to date, any alterations being recorded thereon as soon as practicable. Description in such plans and booklets should be in the official language of the Flag State and in the language as shown in the following Table (If the language is neither English nor Turkish, a translation into one of those languages is to be included). In addition, instructions concerning the maintenance and operation of all the equipment and installations on board for the fighting and containment of fire should be kept under one cover, readily available in an accessible position.

SERVICE RESTRICTIONS	LANGUAGE
UNRESTRICTED	English
RESTRICTED/ PROTECTED	Official language(s) of the Administration(s) concerned with the ship's service, or language(s) recognized by such Administration(s) (possibly English) However, description in such plans and booklets for ships engaged in domestic service only may be in the official language of the Flag State only.

2.2 Location of the fire control plan

2.2.1 In all ships of 24 m in length and over, a duplicate set of fire-control plans or a booklet containing such plans should be permanently stored in a prominently marked weathertight enclosure outside the deckhouse for the assistance of shoreside firefighting personnel.

SECTION 8

ADDITIONAL FIRE SAFETY MEASURES FOR TANKERS

Page

A. General

1. Application

1.1 The additional requirements for tankers of SOLAS Chapter II-2 should apply to tankers carrying crude oil and petroleum products having a flash point not exceeding 60°C (closed cup test), as determined by an approved flash point apparatus, and a Reid vapor pressure which is below atmospheric pressure, and other liquid products having a similar fire hazard.

1.2 Tankers carrying petroleum products having a flashpoint exceeding 60°C (closed cup test), as determined by an approved flashpoint apparatus, should comply with the subsection B.

1.3 Where any point not clearly clarified is encountered, Part B – Chapter 4 Machinery Section 20 may be applied as applicable however not causing any contradictions with requirements stated in this section.

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B. Cargo area deck protection

1. At least one mobile foam appliance should be provided for use on the cargo tank deck including the cargo manifolds. It should be capable of simple and rapid operation. Where the appliance is of the inductor type it should comply with item B.2. Self-contained appliances should have a foam solution capacity of at least 135 litres.

2. A portable foam applicator unit should consist of an air foam nozzle of an inductor type capable of being connected to the fire main by a fire hose, together with a portable tank containing at least 20 litres of foam-making liquid and one spare tank. The nozzle should be capable of producing effective foam, suitable for extinguishing an oil fire, at the rate of at least 1,5 m^3/min.

3. The type of foam used should be suitable for the cargoes to be carried

SECTION 9

ALTERNATIVE DESIGN AND ARRANGEMENTS

Page

A. Purpose

The purpose of this Section should provide a methodology for alternative design and arrangements for fire safety.

B. General

1. Fire safety design and arrangements may deviate from Chapter 35-D Fire Safety, provided that the design and arrangements meet the fire safety objectives described in subsection C.

2. When fire safety design or arrangements deviate from the other Sections of this Chapter, engineering analysis, evaluation and approval of the alternative design and arrangements should be carried out in accordance with the present Section.

Note: *Reference may be made to MSC/Circ. 1002, as amended, "Guidelines on alternative design and arrangements for fire safety".*

C. Fire safety objectives

The fire safety objectives are to:

- Prevent the occurrence of fire and explosion
- Reduce the risk to life caused by fire
- Reduce the risk of damage caused by fire to the ship, its cargo and the environment
- Contain, control and suppress fire and explosion in the compartment of origin, and
- Provide adequate and readily accessible means of escape for crew and passengers.

D. Alternative design and arrangements

1. Engineering analysis

The engineering analysis should be prepared and submitted to the Society, based on the guidelines developed by the International Maritime Organization and should include, as a minimum, the following elements:

- Determination of the ship type and space(s) concerned
- Identification of the requirement(s) with which the ship or the space(s) will not comply
- Identification of the fire and explosion hazards of the ship or the space(s) concerned:
- Identification of the possible ignition sources
- Identification of the fire growth potential of each space concerned
- Identification of the smoke and toxic effluent generation potential for each space concerned
- Identification of the potential for the spread of fire, smoke or of toxic effluents from the space(s) concerned to other spaces
- Determination of the required fire safety performance criteria for the ship or the space(s) concerned:
- Performance criteria should be based on the fire safety objectives (see subsection C)
- Performance criteria should provide a degree of safety not less than that achieved in Chapter 35-D Fire Safety, and
- Performance criteria should be quantifiable and measurable
- Detailed description of the alternative design and arrangements, including a list of the assumptions used in the design and any proposed operational restrictions or conditions, and
- Technical justification demonstrating that the alternative design and arrangements meet the required fire safety performance criteria.

2. Evaluation of the alternative design and arrangements

2.1 The engineering analysis required in item D.1 should be evaluated and approved by Society, taking into account the guidelines developed by the International Maritime Organization.

2.2 A copy of the documentation, as approved by the Society, indicating that the alternative design and arrangements comply with the present Section should be carried onboard the ship.

3. Re-evaluation due to change of conditions

If the assumptions and operational restrictions that were stipulated in the alternative design and arrangements are changed, the engineering analysis should be carried out under the changed condition and should be approved by the Society.

APPENDIX- I

LIFE SAVING APPLIANCES

1. The minimum requirements for the carriage of life saving equipment are specified in the Table AI-1 unless specified otherwise by the Administration.

2. The equipment specified in the Table A-1, should comply with the IMO Life Saving Appliances Code or specified otherwise by the Administration.

TL Additional Rule "Unified Interpretations for Life Saving Appliances" may be referred to as applicable to the ships less than 500 GT and as not causing any contradictions with requirements stated below.

3. In the table below, "✓" indicates items to be provided. However where notes of this table is affixed to "✓" symbol, this note is also to be taken into consideration.

Table AI-1 – Life Saving Appliances for Ships less than 500 GT

Item	Life Saving Appliance	Service Zone		
		Unrestricted	Restricted	Protected
1	All cargo vessels excluding tankers, chemical tankers and gas carriers should be provided with liferafts on each side of the vessel capable of accommodating the total number of persons on board.	✓**(1)**	✓ **(1)**	✓ **(2)**
2	Oil tankers, chemical tankers and gas carriers carrying cargoes having a flashpoint not exceeding 60 °C (closed-cup test), not engaged on International voyages, should be provided with totally enclosed fire protected lifeboats capable of accommodating the total number of persons on board on each side of the vessel or a single free-fall lifeboat.	✓	✓	✓
3	Chemical tankers and gas carriers, not engaged on International voyages, carrying cargoes emitting toxic vapours or gases should carry lifeboats as above with the addition of a self contained air support system.	✓	✓	✓
4	Oil tankers, chemical tankers and gas carriers, not engaged on International voyages, should in addition be provided with life-rafts for 200% of the persons on board in the case of a free-fall lifeboat or 100% in the case of davit launched lifeboats which should be capable of being launched on each side of the vessel.	✓	✓	✓

5	All cargo vessels should be provided with a rescue boat and launching appliance, a lifeboat may be accepted as a rescue boat provided that it also complies with the Recommendations for a rescue boat.	- ✓ *(if length greater than 20m)* - ✓ **(3)** *(if length under/equal 20m)*	✓ **(3)**	-
6	A satellite EPIRB complying with GMDSS Requirements, appropriate to the sea area within which the vessel operates.	✓	✓ **(4)**	✓ **(4)**
7	A radar transponder complying with GMDSS Requirements.	✓	✓	-
8	At least 2 two-way portable VHF radiotelephone apparatus complying with GMDSS Requirements.	✓	✓	-
9	A minimum of 6 lifebuoys, 2 fitted with a self-activating smoke and light signal, 2 with a self-igniting light and 2 with a buoyant lifeline.	✓	✓	✓
10	A lifejacket for each of the persons on board, and in addition a minimum of two lifejackets for persons on watch. All life jackets should be fitted with an approved lifejacket light.	✓	✓	✓
11	An immersion suit to be provided for each person on board, which may include those provided for the rescue boat crew.	✓ **(5) (6)**	✓ **(5) (6)**	✓ **(5) (6)**
12	Rocket parachute flares.	12	12	6
13	Line-throwing apparatus.	1	1	-
14	General emergency alarm.	✓	✓ **(7)**	✓ **(7)**
15	Muster lists, operating instruction etc. as applicable	✓	✓ **(8)**	✓ **(8)**

(1) *If such liferafts cannot be readily transferred for launching on either side of the vessel, then liferafts capable of accommodating 150% the total number of persons on board should, where practicable considering vessel's size, be provided on each side.*

The arrangement should be such that in the event of failure or loss of any one liferaft, sufficient liferafts remain, on each side of *the vessel capable of accommodating the total number of persons on board.*

All liferafts should be provided with a hydrostatic or similar automatic release to enable the liferafts to float free in the event of the vessel sinking.

(2) *Vessels operating within the extended protected waters should, where practicable, be provided with liferafts on each side.*

Vessels operating within protected waters should, where practicable, be provided with at least one liferaft capable of accommodating the total number of persons on board. Craft of 24 m or less may be provided with buoyant apparatus or additional lifebuoys (1 per 2 persons) in place of liferafts.

(3) *Wherever practicable vessels should be provided with a rescue boat or on smaller vessels a suitable inflated boat with engine, however, the design and operational Recommendations of some vessels such as small tugs may preclude this.*

(4) *If the vessel operates within an area designated as A1 a VHF EPIRB may be provided in place of the satellite EPIRB in accordance with GMDSS Recommendations.*

(5) *Immersion suits and thermal protective aids may be omitted on vessels operating permanently between the latitudes 20°N and 20°S or within other defined areas where water temperatures and climatic conditions are satisfactory to the administration.*

(6) *Each person assigned to crew the rescue boat, including combined lifeboat/rescue boats, should be provided with an immersion suit.*

Where totally enclosed lifeboats and/or davit launched liferafts are provided a minimum of 3 immersion suits should be provided.

Vessels provided with throw overboard liferafts should be provided with immersion suits for each person on board, which may include those provided for the rescue boat crew, unless exempted by 5) above or especially protected service.

Thermal protective aids should be provided in accordance with SOLAS Requirements where they form part of a lifeboat and liferaft equipment.

(7) *General emergency alarm may be omitted where the design of the vessel is such as to make it unnecessary.*

(8) *The extent to which such notices are required and can be posted is dependent upon the size and type of vessel.*

APPENDIX- II

RADIO INSTALLATIONS

1. The minimum requirements for the radio installations are specified in the Table AII-1 unless specified otherwise by the Flag Administration.

2. In the table below, "✓" indicates items to be provided.

Table AII-1 – Radio Installations for Ships less than 500 GT

Item	Radio Installation	Service Zone		
		Unrestricted	Restricted	Protected
1	GMDSS Requirements as contained in SOLAS IV as amended, appropriate to the sea area involved, A1, A2, A3 and A4, should apply to all vessels 300 GT and above regardless of service area and to all vessels regardless of size engaged on unrestricted service.	✓	✓	✓
2	Vessels engaged on restricted service should comply as above when 300 GT and above, for vessels less than 300 GT GMDSS Requirements appropriate to the sea area involved should be complied with unless otherwise specified by the Administration	-	✓	-
3	Vessels engaged on protected service should comply as above when 300 GT and above, for vessels less than 300 GT GMDSS Requirements appropriate to the sea area involved should be complied with unless otherwise specified by the Administration.	-	-	✓

APPENDIX- III

NAVIGATIONAL EQUIPMENT

The requirements, as specified in SOLAS 1974, as amended, Chapter V, as applicable based on ship's size, should be complied with unless the Flag Administration specifies otherwise.

APPENDIX- IV

PREVENTION OF COLLISIONS

The Requirements, as specified by the Convention on International Regulations for Preventing Collisions at Sea (COLREG, 1972) as amended, should be complied with.

TL Additional Rule “Unified Interpretations for Implementation of COLREG” may be referred to as applicable to the ships less than 500 GT and as not causing any contradictions.