RULES
FOR THE CLASSIFICATION
AND CONSTRUCTION
OF SHIPS
(Rev.2020)

Section

SECTION 1
General

1.1 Application

1.1.1 The present Chapter applies to equipment, arrangements and outfit of Ships navigating in a displacement condition. To hydrofoil boats, air cushion vehicles, gliders and other similar ships, unless expressly provided otherwise below, the requirements of this Chapter are applicable to the extent that is practicable and reasonable, and the equipment, arrangements and outfit of these ships are subject to special consideration by *ICS Class* in each case.

1.1.2 Ship's equipment, arrangements and outfit designed for special purpose (such as special anchor arrangements of dredgers, a deep-sea anchor arrangement for special purpose ships and similar arrangements) are not subject to supervision of *ICS Class*.

1.1.3 The present Chapter applies, as far as practicable and reasonable, to floating metallic wing-walled docks, unless expressly provided otherwise. These Rules do not specify conditions for mooring of floating docks in a particular place of operation and selection of types and characteristic *ICS Class* of the equipment, arrangements and outfit (anchor, mooring, etc.) used for this purpose.

1.2 Definitions and explanations

The definitions and explanations relating to the general terminology of the Rules are given in *General Regulations for the Supervision* and in *Chapter 1*.

For the purpose of this Chapter the following definitions have been adopted:

1.2.1 Waterlines:

.1 **Damage waterlines** are the waterlines of a damaged ship after flooding of corresponding separate compartments or their combinations as provided in *Chapter 5*.

.2 **Summer load waterline** is the waterline indicated by the upper edge of the line which passes through the center of the ring of the load line mark for a ship in upright position.

.3 **Summer timber load waterline** is the waterline-indicated by the upper edge of the assigned summed timber load line.

.4 **Deepest load waterline** is the waterline indicated by the upper edge of the assigned uppermost regional or seasonal load line, including fresh water load lines.

.5 **Deepest subdivision load waterline** is the uppermost waterline at which the requirements of *Ch 5* are still fulfilled.

1.2.2 Dimensions and draught of the ship

.1 **Length of Ship *L*** is taken as 96 per cent of the total length on a waterline at 85 per cent of the least moulded depth 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.
Where the stem contour is concave above that waterline, the length of the ship shall be measured form the vertical projection to that waterline of the aftermost point of the stem contour (above that waterline).
In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the design waterline.

.2 **Moulded draught *d*** is the vertical distance measured amidships from the top of the plate keel or from the point where the inner surface of the shell (outer surface in a ship with a non.metal shell) abuts upon the kar keel, to the summer lead waterline.

.3 **Moulded depth *D*** is the vertical distance measured amidships from the top of the plate keel, or from the point where the inner surface of the shell abuts upon the bar keel, to the top of the freeboard deck beam at side.

In ships having rounded gunwales, the molded, depth shall be measured to the point of intersection of the moulded lines of the freeboard deck and side, the lines extending as thought the gunwale were of angular design.
Where the freeboard deck is stepped in the longitudinal direction and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth shall be measured to a fine of reference extending from the lower part of the deck along a line parallel with the raised part.

.4 **Moulded breadth *B*** is the maximum breadth measured amidships from outside of frame to outside of frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material.

1.2.3 Superstructures, deckhouses

.1 **Superstructure** is a decked structure on the freeboard deckhouse, extending from side to side of the ship or with the side plating not being inboard of the shell plating more than 4 per cent of the breadth *B*.

.2 The superstructure may be either complete, i.e. extending over the entire ship's length *L*, or detached, i.e. extending only over a definite part of this length. Both complete and detached superstructures may be arranged either in a single or several tiers.

.3 **Deckhouse** is a decked structure on the freeboard or superstructure deck which is set in from the sides of the ship for more than 4 per cent of the breadth *B* and has doors, windows or other similar openings in the outer bulkheads. The deckhouses may be arranged in a single or several tiers.

.4 **Trunk** is a decked structure on the freeboard deck which is set in from the sides of the ship for more than 4 per cent of the breadth *B* and has no doors, windows or other similar openings in the outer bulkheads.

1.2.4 Tightness

.1 **Tight under pressure head up to** is the term pertaining to closing appliances of openings, which means that under specified pressure the liquid will not penetrate through the openings inside the ship.

.2 **Weathertight** is the term pertaining to closing appliances of openings in the above-water hull, which means that in any sea conditions water will not penetrate through the openings inside the ship. Such closing appliances shall withstand a hose test on condition that the outlet of the nozzle is at least 16 mm in diameter and the head in the hose provides for water jet ejected upwards of not less than 10 m in height, the distance from the nozzle to the tested portion being not more than 3 m.

1.2.5 Decks

.1 **Upper deck** is the uppermost continuous deck extending for the full length of the ship. The upper deck may be steppe

.2 **Raised quarter deck** is the after upper part of a stepped deck, the forward lower part of which is taken as a portion of the freeboard deck.

.3 **Freeboard deck** is the deck from which the freeboard is measured. In a ship having a discontinuous deck the lowest line of this deck and the continuation of that line parallel to upper part of the deck is taken as a freeboard deck.

.4 **Superstructure deck, deckhouse top or trunk deck** is the deck forming the top of a superstructure, deckhouse or trunk, respectively.

.5 **Superstructure deck or deckhouse top of the first, second, etc. tiers** is the deck forming the top of the superstructure or deckhouse of the first, second, etc. tiers, counting from the freeboard deck.

.6 **Bulkhead deck** is the deck up to which the main transverse watertight subdivision bulkheads are carried.
The bulkhead deck may be discontinuous, i.e. with a step or steps formed both by main transverse watertight bulkheads reaching the keel and transverse watertight bulkheads not reaching the keel.

.7 **Lower decks** are the decks below the upper deck.

.8 **Weather deck** is the deck which is completely exposed to the weather from above and from at least two sides.

1.2.6 Perpendiculars and main frame

.1 **Amidships** is at the middle of the ship's length *L.*

.2 **Forward and after perpendiculars** are the vertical fines passing in the center line at the fore and after ends of the ship's length *L*, respectively.

1.2.7 Ships type “A” and “B”

.1 **Type " A " ship** is a ship designed to carry only liquid cargoes in bulk, and in which cargo tanks have only small access openings closed by gasketed covers tight under an appropriate inner pressure of liquid which is carried in the tanks. Furthermore, a type "A" ship is to have some other features, as defined in the *Load Line Rules for Ships* which permit this ship to be assigned a freeboard based on *Tables 4.1.2.3, 6.4.2.2* or *6.4.3.2* of the above Rules.

.2 **Type " B " ship** is a ship which does not comply with the requirements regarding type "A" ships and which is assigned a freeboard based on *Table 4.1.3.2, 6.4.2.3* or *6.4.3.3* of the *Load Line Rules for Ships*.
A type "B" ship may not be classified as a type "A" ship even though, as a result of her features detailed in the *Load Line Rules*, a reduction in tabular freeboard is permitted up to the total difference between the values given *in Tables 4.1.2.3, 6.4.2.2, 6.4.3.2* and those in *Tables 4.1.3.2, 6.4.2.3, 6.4.3.3*, respectively, of the above Rules.

1.2.8 Active steering means are auxiliary means which develop a thrust at an angle to the center line plane of the ship at the zero or small speed, irrespective of the ship's propulsive device operation and which are provided with their own drive motor.

1.2.9 Steering gear

.1 **Main steering gear** is the machinery, rudder actuators, steering gear power units, if any, ancillary equipment and the means of applying torque to the rudder stock (e.g. tiller or quadrant) necessary for effecting movement of the rudder for the purpose of steering the ship under normal service conditions.

.2 **Auxiliary steering gear** is the equipment other than any part of the main steering gear necessary to steer the ship in the event of failure of the main steering gear, but not including the tiller, quadrant or components serving the same purpose.

.3 **Steering gear power unit**

- In the case of electric steering gear: an electric motor and its associated electrical equipment.

- In the case of electrohydraulic steering gear an electric motor and its associated equipment and connected pump.

- In the case of other hydraulic steering gear a driving engine and connected pump.

.4 **Power actuating system** is the hydraulic equipment provided for supplying power to turn the rudder stock, comprising a steering gear power unit or units, together with the associated pipes and fittings, and a rudder actuator. The power actuating systems may share common mechanical components, i.e. tiller, quadrant and rudder stock, or components serving the same purpose.

.5 **Steering gear control system** is the equipment by which orders are transmitted from the navigating bridge to the steering gear power units. Steering gear control systems comprise transmitters, receivers, hydraulic control pumps and their associated motors, motor controllers, piping and cables.

1.3 Scope of supervision

1.3.1 General provisions on supervision of ship's equipment, arrangements and outfit are given in the *General Regulations for the Supervision* and in *Chapter 1*.

1.3.2 The following items included into ship’s equipment, arrangement and outfits are subject to the supervision by *ICS Class* during their manufacture:

1.3.2.1 Rudder and steering gear:

.1 Rudder stocks,

.2 Rudders,

.3 Nozzle rudders,

.4 Rudder axles,

.5 Pintles of rudders and nozzle rudders,

.6 Bushes of pintles

.7 Fastenings of rudder stocks, rudder stock with rudder or nozzle rudder, and also of rudder axle with stern frame (muff couplings, keys, bolts, nuts, etc.)

.8 Parts of the system of rudder stops.

.9 Rudder stock bearings

.10 Active means of the ship’s steering (only in the case specified in *2.1.3.2*)

1.3.2.2 Anchor arrangement:

.1 Anchor

.2 Chain cables or ropes

.3 Anchor stoppers

.4 Devices for securing and releasing the inboard end of chain cable or rope.

.5 Anchor hawse pipes

1.3.2.3 Mooring arrangement:

.1 Mooring ropes.

.2 Mooring bollards, belaying cleats, fairleaders, chocks, rollers and stoppers.

1.3.2.4 Towing arrangement:

.1 Tow lines.

.2 Towing bollards, bitts, fairleaders, chocks and stoppers;

.3 Tow hooks and towing rails with fastenings for their securing to ship's hull.

.4 Towing snatch-blocks.

.5 Towing arc.

1.3.2.5 Masts and rigging:

.1 Metals, wooden and glass-reinforced plastic spars.

.2 Standing ropes.

.3 Permanent attachments masts and decks (eyeplates, hoops, etc.).

.4 Loose gears of masts and rigging (shackles, tumbuckles, etc.).

1.3.2.6 Closing appliances of openings in hull, superstructures and deckhouses:

.1 Side and deck scuttles.

.2 Doors of cargo ports and other similar openings.

.3 Doors in superstructures and deckhouses.

.4 Companion hatches, skylights and ventilating trunks.

.5 Ventilators.

.6 Manholes to deep and other tanks

.7 Hatchway covers in dry cargo ships and tankers.

.8 Cargo tank hatchway covers in tankers.

.9 Doors in subdivision bulkheads.

1.3.2.7 Equipment of ship’s spaces:

.1 Ceiling and battens in cargo holds.

.2 Exit doors from ship’s spaces in escape routes.

.3 Stairways and vertical ladders.

.4 Guard rails, bulwark and gangways.

.5 Cellular guide members in the holds of container ships.

1.3.2.8 Emergency outfit:

.1 Collision mats.

2\. Tools.

.3 Materials.

1.3.2.9 Miscellaneous equipment:

.1 Chains of cargo handling appliances and of other gear.

.2 Ropes of cargo handling appliances and of other gear.

1.3.3 *ICS CLASS* supervision of the manufacture of items specified in *1.3.2.1.6*, *1.3.2.1.8*, *1.3.2.1.9*, *1.3.2.2.5*, *1.3.2.3.2*, *1.3.2.4.2*, *1.3.2.5*, *1.3.2.6.5*, *1.3.2.7* and *1.3.2.8* is confined to consideration of the relevant technical documentation.

1.3.4 For items specified in *1.3.2* the following documents shall be submitted to *ICS Class.*

.1 **Assemblies drawing.**

.2 **Calculations** (no approval stamps are needed).

.3 **Detail drawings** if parts or assemblies are not manufactured in accordance with standards and specifications approved by *ICS Class.*

1.3.5 The material of the roofs for the construction as specified in *Table 1.5.3* is to meet the requirements of *Chapter 13*. The material for parts of equipment, arrangements and outfit shall meet the conditions specified in the project documentation approved by *ICS Class* unless expressly provided otherwise in the Rules.
Welding of the parts for the construction of installations and equipment is to be performed in accordance with the requirements in *Chapter 14.*
The requirements of *Chapter 13*. The material for parts of equipment, arrangements and outfit shall meet the conditions specified in the project documentation approved by *ICS Class* unless expressly provided otherwise in the Rules.
Welding of the parts for the construction of installations and equipment is to be performed in accordance with the requirements in *Chapter 14.*

1.3.6 The following equipment, arrangements and outfit are subjected to supervision of *ICS Class* when the ship is under construction:

.1 Rudders and steering gear.

.2 Anchor arrangements.

.3 Mooring arrangements.

.4 Towing arrangements.

.5 Masts and rigging.

.6 Openings in hull, superstructures and deckhouses and their closing appliances.

.7 Arrangements and equipment of ship's spaces.

.8 Emergency outfits.

.9 Cellular guide members in the holds of container ships.

.10 Active means of the ship's steering (see *2.1.3).*

1.4 Ships intended to carry flammable liquids in bulk (<60°C)

1.4.1 In ships intended to carry in bulk flammable liquids having the flash point below 60º C no deck machinery is to be fitted directly on the decks being the top of cargo tanks and bunkers. In this case, the deck machinery is to be fitted on special foundations, the construction of which provides for free circulation of air underneath the machinery.

Table 1.3.5 Material of parts in the roofs for the constructions

Item	Part definition	Roofs
1	Rudder stock and nozzle rudders including flanges.	Steel forging.
2	Rudders including nozzle rudders [1]	Steel forging, rolled steel in plating and profiles.
3	Rudder axles including flanges.	Steel forging.
4	Pintles of rudders and nozzle rudders.	Steel forging.
5	Fastenings of rudder stocks, rudder stock with rudder or nozzle rudder, and also of rudder axle with stern frame (couplings, keys, bolts, nuts, etc)	Steel forging.
6	Tow hooks and towing rails 10 kN with fastenings for their securing for the ship's hull.	Steel forging rolled steel in plating and profiles.
7	Hatchways covers and doors of cargo ports. [1, 2]	Rolled steel in plating and profiles, laminating in plating of light alloy.
8	Doors of fast closing. [1, 2]	Steel forging, rolled steel in plating and profiles.
9	Anchors.	Steel forging.
10	Anchor chains and others.	Bar steel, steel forging.

NOTES:
[1] The rolling category of steel in platings and profiles in accordance with *Chapter 2, Table 1.2.3.1* as Group I, for vessels with ice strengthening to of category RHI, RH and H1, except for the closing of the hatchway covers of cargo ports, not placed in zones 1 and 2 (*Fig. 7.1.4*), is not to be less than B category.
[2] The welded structures and the welding are also to comply with the pertaining requirements of *Chapter 2, Subs 1.7.*

1.5 Working and allowable stresses

1.5.1 Wherever the working stresses are mentioned in the text of the present Chapter, they mean combined stresses σ_{com}, in MPa, calculated from the formula:

$$\sigma_{com} = \sqrt{\sigma^2 + 3\tau^2}$$

σ = normal stresses in the section under consideration, MPa;
τ = shear stresses in the section under consideration, MPa.

The strength conditions shall be checked against these stresses.

1.5.2 Allowable stresses with which the combined stresses are to be compared when verifying the strength conditions are specified in the present Chapter in fractions of the upper yield stress of the material used; the upper yield stress shall not be taken as more than 0,7 times the tensile strength of this material, unless expressly provided otherwise.

1.6 Design accelerations due to heave of the sea

1.6.1 The dimensionless, gravity related, design accelerations due to have of the sea as described in this Subsection are to be applied when determining the loads upon equipment,

arrangements and batches of cargo items carried by ships of unrestricted service and those of restricted area of navigation I. With regard to ships of other areas of navigation, accelerations may be applied different from those required herein which are to be substantiated by calculations approved by *ICS Class*

1.6.2 The dimensionless acceleration a, due to heave, pitch and roll normal to the water planes of the ship is to be deter-mined from the formula:

(Fig. 1.6.2-1)

$$a_z = \pm a_0 \sqrt{1 + \left(5{,}3 - \frac{45}{L}\right)^2 \left(\frac{x}{L} - 0{,}45\right)^2 \left(\frac{0{,}6}{C_B}\right)^{3/2}}$$

$$a_0 = 0{,}2\frac{V}{\sqrt{L}} + \frac{34 - 600/L}{L}$$

(Fig. 1.6.2-2)

V = maximum ahead speed, in knots, with the ship on summer load waterline on still water;
L = ship's length, in m;
x = longitudinal distance from the center of gravity of equipment, arrangement or batch of cargo items in question to the aft perpendicular;
C_B = block coefficient;
a_z = does not include the component of the static weight.

1.6.3 The dimensionless acceleration a_y due to transverse displacement, yaw and roll normal to the center line of the ship is to be determined from the formula:

$$a_y = \pm a_0 \sqrt{0{,}6 + 2{,}5\left(\frac{x}{L} - 0{,}45\right)^2 + K_1\left(1 + 0{,}6K_1\frac{z}{B}\right)^2}$$

(Fig. 1.6.3-1)

K_1 = coefficient of stability to be determined from the formula:

$$K_1 = \frac{13\overline{GM}}{B} \quad (1.6.3\text{-}2)$$

= If K_1 is determined from *formula* (*1.6.3-2*), is below 1,0, K_1, = 1,0 should be assumed for calculating a_y.
GM = transverse metacentric height of loaded ship when the volume and distribution of stores are such as to yield maximum GM, in m;
B = ship's breadth, in m;
z = vertical distance, in m, from the summer load waterline to the center of gravity of equipment, arrangement or batch of cargo items in question; z is positive above and negative below the summer load waterline;.

Factor a_y includes the component of the static weight in the transverse direction due to rolling.

1.6.4 The dimensionless acceleration a_x due to longitudinal displacement and pitch normal to the midship section plane is to be determined from the formula:

(Fig. 1.6.4-1)

$$a_x = \pm a_0 \sqrt{0{,}06 + K_2^2 - 0{,}25 K_2}$$

K_2 = factor determined from the formula:

$$K_2 = \left(0{,}7 - \frac{L}{1200} + 5\frac{z}{L}\right)\frac{0{,}6}{C_B} \quad (1.6.4\text{-}2)$$

a_x = includes the component of the static weight in the longitudinal direction due to pitching.

1.6.5 When determining leads it should be considered that the accelerations calculated using a_x , a_y and a_z act independently of each other.

SECTION 2

Rudder and steering gear

2.1 General provisions

2.1.1 Every ship, except for shipborne barges, is to be provided with a reliable device ensuring her steering and course keeping facilities. Such devices may be a rudder, a nozzle rudder, etc., approved by *ICS Class*. In the case of non-propelled vessels of the dredging fleet with regard to the area of navigation and service conditions *ICS Class* may allow to omit such device or provide only stabilizers. The navigation area and service conditions are to be taken into account when it is allowed to omit such device or to provide only stabilizers are subject to special consideration by *ICS Class* in each case

2.1.2 The present Section applies only to ordinay streamlined rudders or nozzle rudders with streamlined profiles and rigidly fixed stabilizers. Unusual rudders, nozzle rudders with steerable stabilizers, Voith-Schneider propellers, etc. are subject to special consideration by *ICS Class* in each case.

2.1.3 Active steering means

2.1.3.1 The active means of the ship's steering are the means supplementary to the regulated minimum (see *2.1.1*). They are considered by *ICS Class* only from the viewpoint of t he effect of their design, installation, etc. on the overall safety of the ship.

2.1.3.2 In exceptional cases, taking into account the ship's purpose, design features and intended service conditions, it may be permitted on agreement with *ICS Class* that the regulated steerability of the ship should provided at the low speed by simultaneous operation of the devices specified in 2.1.1 and the active means of the ship's steering, if it is demonstrated by the method recognized by *ICS Class* that the steerability will not then be worse than that ensured in case of fulfillment of the requirements of *2.10.3.6* with regard to *2.10.3.1*. In these cases, the active means of the ship's steering are subject to special consideration by *ICS Class*

2.1.4 The number of rudder pintles supporting the rudder is not regulated by *ICS Class*, except for icebreakers and ships of ice categories RHI, RH and H1 for which this number is to be not less than that given in ***Table 2.1.4.***

In icebreakers and ships of ice category RHI the nozzle rudders are not be fitted.
In ships of ice categories RH, and H1 the arrangement of the nozzle rudder without the lower pintle in the sole piece is not permitted.

2.1.5 Wherever the upper yield stress R_{eH}, of the material used enters into the Formula of this Section, the provisions of *1.5.2* shall be taken into account, but in all cases the upper yield stress R_{eH} of the material is not to be taken more than 390 MPa.

2.1.6 When checking the rudder pintles and rudder stock bearings for surface pressure, the latter is not to exceed the values indicated in ***Table 2.1.6.***

Table 2.1.4 Number for rudder pintles

Categories of icebreakers and ice strengthening in ships	Number of rudder pintles
RHI	3
RH	2
H1	1

Table 2.1.6 Surface pressure

Friction couple materials	Surface pressure *p*, MPa	
	Water lubrication	**Oil lubrication**
Stainless steel or bronze over lignum vitae	2,4	-
Stainless steel or bronze over tectolite or synthetic materials	On special agreement with ICS CLASS	-
Stainless steel over bronze or vice versa	6,9	-
Steel over white metal	-	4,4

2.2 Initial design data

2.2.1 The initial design data specified in this Section are valid only for the choice of scantlings of ordinary rudders and nozzle rudders with rigidly fixed stabilizers and cannot be used for determination of steering gear output characteristICS Class.

Methods of determination of these characteristICS Class are not regulated by *ICS Class*, and the relevant calculations are not subject to approval by *ICS Class*.

The steering gear is checked by *ICS Class* during sea trials of the ship to make sure that the steering gear output characteristics comply with the requirements of *2.9.2*, *2.9.3* and *2.9.8*.

2.2.2 Rudder force and rudder torque

2.2.2.1 The rudder force F, kN, for the ahead condition is to be determined from the formula:

$$F = F_1 + F_2 \qquad \textbf{(Fig. 2.2.2.1-1)}$$

F_1, F_2 = in kN, are determined from the formula:

$$F_1 = 5{,}59 \cdot 10^{-3} k_1 k_2 (6{,}5 + \lambda)(b_1 - C_B)^2 AV^2$$

(Fig. 2.2.2.1-2)

$$F_2 = 0{,}177 k_1 (6{,}5 + \lambda) \frac{T}{D_p^2} A_p$$

(Fig. 2.2.2.1-3)

k_1 = factor equal to:
1,0 for rectangular and trapezoidal rudders, except for rudders behind the rudder post;
0,95 for semispade rudders (rudders of types I, II, VII and VIII in *Fig. 2.2.4.1*);
0,89 for rudders behind the rudder post (rudders of types IV, X and XIII in *Fig. 2.2.4.1*);

k_2 = factor equal to:
1,0 for rudders operating directly behind the propeller;
1,25 for rudders not operating directly behind the propeller;

λ = value detained from the formula:

$$\lambda = h_r^2 / A_t \qquad (2.2.2.1\text{-}4)$$

h_r = mean height of the rudder part abaft the center line of the rudder stock, m;

A_t = sum of the rudder area and lateral area of the rudder horn or rudder post, if any, within the height H, in m². In case of no rudder horn or rudder post, the value of A_t, is taken as A in the calculations;

A = rudder area, in m²;

A_p = portion of the rudder area in the wake of the propeller when the rudder is in the non-reversed position, m²;

b_1 = value equal to:
2,2 for rudders situated at the center plane of the ship;
2,32 for side rudders;

C_B = block coefficient with the ship on the summer load waterline;

V = maximum ahead speed with the ship on the summer load waterline, in knots;

T = propeller thrust at the speed V, kN, (see *2.2.2.6*);

D_p^2 = propeller diameter, m.

2.2.2.2 The value of the force F specified in *2.2.2.1* is not to be taken less than F_3, in kN, determined from the formula:

$$F_3 = k_3 A \qquad \textbf{(Fig. 2.2.2.2)}$$

k_3 = factor equal to:
81 for ships of ice category RHI;
66 for ships of ice category RH;
53 for ships of ice category H1;
18 for other ships.

When the value of the force F_3 is greater than that of the force F specified in *2.2.2.1*, in subsequent calculations the value of F_3 is taken instead of F, and the value F_2 is taken equal to zero.

2.2.2.3 For the ahead condition the rudder torque M_t, in kN.m, is not to be taken less than determined from the formula:

$$M_t = F \frac{A}{h_r}\left(0{,}35 - \frac{A_1}{A}\right) \qquad \textbf{(Fig. 2.2.2.3)}$$

A_1 = portion of the rudder area forward of the center line of the rudder stock, in m².

2.2.2.4 For the astern condition the rudder torque M_{as}, in kN·m, is not to be taken less than determined from the formula:

$$M_{as} = k_4 \frac{A^2}{h_r}\left(0{,}7 - \frac{A_1}{A}\right)\upsilon_{as}^2 \qquad \textbf{(Fig. 2.2.2.4)}$$

k_4 = factor equal to:
0,185 for rudders operating directly behind the propeller;
0,139 for rudders not operating directly behind the propeller;

υ_{as} = maximum specification speed of the ship for the astern condition, but not less than $0{,}5\upsilon$, knots.

2.2.2.5 For the astern condition the rudder force F_{as}, in kN, is to be determined from the formula:

$$F_{as} = M_{as} \frac{h_r}{A\left(0{,}7 - \frac{A_1}{A}\right)} \qquad \textbf{(Fig. 2.2.2.5)}$$

When determining the bending moments and reactions of the supports according to the provisions of *2.2.4* to *2.2.7* for the astern condition, the force F_{as}, should be considered as the force F_1, and the value of F_2 is then taken equal to zero.

2.2.2.6 In case reliable data are not available on the value of the propeller thrust mentioned in *2.2.2.1*, the value of T, in kN, may be determined from the formula:

-for fixed-pitch propellers:

$$T = 0{,}0441\left(\frac{30{,}6N_e}{nH_1\sqrt[3]{z\phi}} - n^2 D_p^4\right) \qquad \textbf{(Fig. 2.2.2.6-1)}$$

-for controllable-pitch propellers:

$$T = 0{,}0441\left(\frac{110N_e}{\upsilon(b_1 - C_B)\sqrt[3]{z}} - n^2 D_p^4\right) \qquad \textbf{(Fig. 2.2.2.6-2)}$$

N_e = nominal total output of the propulsion plant of the ship divided by the number of the propellers, kW;

n = number of propeller revolutions per second, s^{-1};

H_1 = propeller pitch at the zero thrust, in m, determined from the formula:

$$H_1 = H + \frac{0{,}055D_p}{\phi + 0{,}3}; \quad (2.2.2.6\text{-}3)$$

H = design propeller pitch, m;

ϕ = blade area ratio

z = number of propeller lades.

2.2.3 Nozzle rudder force and torque

2.2.3.1 The total force F, in kN, acting on the nozzle rudder and stabilizer is not to be taken less than determined from the formula:

$$F = F_n + F_{st} \qquad \textbf{(Fig. 2.2.3.1-1)}$$

F_n = force acting on the nozzle, in kN;
F_{st} = $F_s t$ force acting on the stabilizer, in kN.
F_n *and* $F_s t$, are determined from the Formula:

$$F_n = 9{,}81 \cdot 10^{-3} pD_n l_n V_1^2$$ **(Fig. 2.2.3.1-2)**

$$F_{st} = 9{,}81 \cdot 10^{-3} qmA_{st} l_n V_1^2$$ **(Fig. 2.2.3.1-3)**

D_n = inner minimum nozzle rudder bore, m;
l_n = nozzle rudder length, m;
A_{st} = area of nozzle rudder stabilizer, m^2;
V_1 = speed, in knots, determined from the formula:
$V_1 = V \cdot (1 - w)$ (2.2.3.1-4)
w = average wake factor. In case reliable experimental data are not available, the wake factor may be determined from the formula:
$w = 0{,}165 C_B^n \sqrt{\sqrt[3]{\Delta / D_p}}$ (2.2.3.1-5)

C_B = block coefficient of the ship;
Δ = volume displacement, m^3, with the ship on summer load waterline;
n = number of propellers;
D_p = propeller diameter, m;
V = maximum ahead speed, in knots, with the ship on summer load waterline; this speed is not to be taken less than:
17 knots for ships of ice category RH,
14 knots for ships of ice category H1,
11 knots for other ships;

p, q = coefficients determined from the Formula:

$$p = 78{,}4 - 55{,}6\sqrt{\lambda_n} + \left(44{,}0 - 33{,}4\sqrt{\lambda_n}\right) C_{HB}$$
(Fig. 2.2.3.1-6)

$$q = 7{,}43 - 5{,}72\lambda_n + \left(2{,}82 - 2{,}2\lambda_n\right) C_{HB}$$
(Fig. 2.2.3.1-7)

C_{HB} being determined from the formula:

$$C_{HB} = 9{,}38T / \left(D_p^2 V_1^2\right)$$ **(Fig. 2.2.3.1-8)**

T = propeller thrust at speed υ, kN;
D_p = propeller diameter, in m;
λ_n = is determined from the formula:
$\lambda_n = l_n / D_n$; (2.2.3.1-9)

m = coefficient determined from the formula:
$m = 4{,}5 - 0{,}12\left(\lambda_{st} - 5{,}43\right)^2$;
(2.2.3.1-10)
λ_{st} = is determined from the formula:
$\lambda_{st} = h_{st} / l_{st}$; (2.2.3.1-11)
h_{st} = height of nozzle rudder stabilizer, in m;
l_{st} = length of nozzle rudder stabilizer, in m.

2.2.3.2 A points situated at the level of the longitudinal axis of the nozzle rudder at the distance r_n, from the nozzle rudder leading edge should be considered as a point of application of force F_n,. The distance r_n, , in m, is not to be less than determined from the formula:

$$r_n = l_n\left(bk + c\right)$$ **(Fig. 2.2.3.2-1)**

k = coefficient determined from the formula
$k = l_{r.s} / l_n$
$l_{r.s}$ = distance between the center line of the rudder stock and the leading edge of the nozzle rudder, in m;
b, c = coefficients determined from the formula:
$b = 0{,}796 - 0{,}011\left(C_{HB} - 7{,}18\right)^2$; (2.2.3.2-3)
$c = 0{,}1585 - 0{,}0916\sqrt{C_{HB}}$ (2.2.3.2-4)

A point situated at the level of the nozzle rudder longitudinal axis at the distance r_{st} , from the stabilizer leading edge should be considered as a point of application of force F_{st},. The distance r_{st}, , in m, is not to be less than determined from the formula:

$$r_{st} = 0{,}25 l_{st}$$ **(Fig. 2.2.3.2-5)**

2.2.3.3 The total torque M_t, in kN.m, for the nozzle rudder is to be determined from the formula:

$$M_t = M_n - M_{st}$$ **(Fig. 2.2.3.2-1)**

M_n = torque of force F_n, in kN.m;
M_{st} = torque of force F_{st}, in kN.m;
= M_n and M_{st} are determined from the formula:
$M_n = F_n\left(l_{r.s} - r_n\right)$, (2.2.3.3-2)
$M_{st} = F_{st}\left(a + r_{st}\right)$, (2.2.3.3-3)
a = distance between the center line of the rudder stock and the leading edge the stabilizer, m.

2.2.4 Bending moments and reactions of supports for rudders of types I – IV, VI – XII and nozzle rudders of type V *(Fig. 2.2.4.1)*

2.2.4.1 The design values of the bending moments and reactions of supports are to be determined from the formula of this Chapter depending on the types of the rudders shown in *fig. 2.2.4.1* having regard to the provisions of *table 2.2.4.1* as well as the type and location of the steering gear as specified in *2.2.4.2*.

Table 2.2.4.1 Design value of load

Type of rudder (see *fig 2.2.4.1*)	Design value of load Q_2	Design value of load Q_1
I, II, VII y VIII	$Q_2 = \left(\frac{F_1}{A} + \frac{F_2}{A_B}\right) \cdot A_n$	$Q_1 = F - Q_2$
III-VI and IX-XII	$Q_2 = 0$	

NOTES:
1. The value A_1, is the portion the semispade rudder area below the lower pintle (below *section 4* in *Fig. 2.2.4.1*), m².
2. For nozzle rudders of type V the design value of the ratio $I_{r.s}/I_r$, is taken equal to zero.
3. The force *F* is taken in accordance with the provisions of *2.2.2* for rudders and of *2.2.3* for nozzle rudders.

2.2.4.2 The transverse force *P*, in kN, created on the rudder stock by steering gear (quadrant steering gears, steering gears with single-arm tillers and similar steering gears) is determined from the formula:

$$P = M_t / r_1$$

M_t = rudder torque, kN.m, specified in *2.2.2.3* and *2.2.3.3*. When considering the astern running of the ship, the rudder torque M_t, is taken as the value M_{as} specified in *2.2.2.4*;

r_1 = radius of the steering gear quadrant or tiller resultant force arm measured from the center line of the rudder stock, m.

Depending on the location of the steering gear quadrant or tiller indicated in *Fig. 2.2.4.2* the value *P* for Case I is taken as P_I and the value P_{II}, is taken equal to zero. For Case II the value *P* is taken as P_{II} and the value P_I is taken equal to zero.
For Case II the value of *P* is taken as P_{II}, and the value of P_I is taken equal to zero. The values of P_I or P_{II}, are assumed to be positive when the quadrant or tiller are located forward of the rudder stock center line and they are assumed to be negative when the quadrant or tiller are located aft of the rudder stock center line.

For steering gears the rudder torque of which is transmitted to the rudder stock by a pair (or pairs) of forces (four-piston, rotary vane steering gears or similar) the values of P_I and P_{II}, are taken equal to zero.

2.2.4.3 In the Formula of the present Chapter the numerical indices of symbols of the bending moments *(M_l, M_2, M_3, M_4)* and reactions of supports (R_1, R_2, R_4) correspond to the number of the support or section given in *Fig. 2.2.4.1* and *2.2.4.2* for the relevant type of the rudder.

2.2.4.4 Unless expressly provided otherwise, in the Formula of the present Chapter the linear dimensions shown in Fig. 2.2.4.1 *Fig. 2.2.4.1* and *2.2.4.2* are to be taken in meters, and the forces, in kN.

2.2.4.5 The design values of the bending moments and reactions of supports may be taken less than those specified in *2.2.4.1* on condition that the detailed calculation is submitted where due consideration is given to the flexibility of the rudder supports and to the non-uniformity of the force distribution over the rudder area.

2.2.4.6 For Case I of the quadrant steering gear or tiller location (see *Fig. 2.2.4.2*) the design value of bending moment M_l , in kN.m, in section I of the rudder stock (at the upper bearing) is to be determined from the formula:

$$M_1 = P_1 / 7 \quad \textbf{(Fig 2.2.4.6)}$$

P_t = see *2.2.4.2* and *2.2.4.4.*
l_7

For Case II of the steering gear quadrant or tiller location M_l is taken equal to zero.

2.2.4.7 The design value of the bending moment M_2, in kN.m, acting in *Section 2* of the rudder stock (at the lower bearing for rudders of types I-VI; in the rudder stock and rudder body coupling for rudders of types VII-XII) is to be determined from the formula:

$$M_2 = \frac{1}{8} Q_1 h \frac{k_5}{k_7} - \frac{1}{2} Q_2 c \frac{k_6}{k_7} - \frac{1}{2} P_I l_7 \frac{k_8}{k_7} + \frac{1}{2} P_{II} l_8 \frac{k_9}{k_7}$$

(Fig. 2.2.4.7-1)

Q_1; Q_2 = loads determined in accordance with *Table 2.2.4.1*;
P_I: P_{II} = forces determined in accordance with *2.2.4.2*;
h; c; l_7; l_8 = linear dimensions (see *2.2.4.4*);
k_5; k_6; k_7; k_8; k_9; = factors determined from the Formula:

(Fig. 2.2.4.7-2)

$$k_5 = 2 \cdot \left(\frac{e}{h}\right)^2 \cdot \left(3 + \frac{e}{h}\right) + \left(1 + 5 \cdot \frac{e}{h}\right) \cdot \frac{I_{r,s}}{I_r} + 12 \cdot \left(1 + 2 \cdot \frac{e}{h}\right) \frac{I_{r,s} \cdot \alpha_4}{h^3}$$

(Fig. 2.2.4.7-3)

$$k_6 = \left(\frac{e}{h}\right)^2 \cdot \left(3 + \frac{e}{h}\right) + \left(1 + 3 \cdot \frac{e}{h}\right) \cdot \frac{I_{r,s}}{I_r} - 6 \cdot \left(1 + \frac{l_2}{c}\right) \frac{I_{r,s} \cdot \alpha_4}{h^3}$$

(Fig. 2.2.4.7-4)

$$k_7 = \left(1 + \frac{e}{h}\right)^2 \cdot \left(1 + \frac{e}{h} + \frac{l_1}{h}\right) - 1 + \frac{I_{r,s}}{I_r} + 3 \cdot \frac{I_{r,s} \cdot \alpha_4}{h^3}$$

(Fig. 2.2.4.7-5)

$$k_8 = \frac{l_1 \cdot l_2^2}{h^3}$$

(Fig. 2.2.4.7-6)

$$k_9 = \frac{l_1 \cdot l_2^2}{h^3} \cdot \left(1 - \frac{l_8^2}{l_1^2}\right)$$

e = linear dimensions (see *2.2.4.4*);
l_1 = linear dimensions (see *2.2.4.4*);
l_2 = linear dimensions (see *2.2.4.4*);
$I_{r,s}$ = mean moment of inertia of the rudder stock cross-section, cm^4;
I_r = mean moment of inertia of the rudder cross-section at the portion between Sections 3 - 4 (rudder types I - VI) or between Sections 2 - *4* (rudder VII - XII), cm^4;
α_4 = coefficient determined in accordance with the provisions *of 2.2.4.17 - 2.2.4-21* depending on the type of the rudder, m^3/cm^4.

2.2.4.8 The design value of the bending moment M_3, in kN.m, acting in Section 3 of the rudder stock (in the rudder stock and rudder body coupling for rudders of types I - VI) is to be determined from the formula:

$$M_3 = M_2 \cdot \frac{h}{l_2} + Q_2 \cdot c \cdot \frac{e}{l_2} - \frac{1}{2} \cdot Q_1 \cdot h \cdot \frac{e}{l_2}$$ **(Fig. 2.2.4.8)**

2.2.4.9 The design value of the bending moment M_4, in kN.m, acting in Section 4 of the rudders of types I, II, VII and VIII is to be determined from the formula:

$$M_4 = Q_2 \cdot c$$ **(Fig. 2.2.4.9)**

For rudders of these types the value of M_4 is taken as the bending moment acting in any rudder cross-section above support 4 of the rudder. For other rudders the value of the bending moment M_4 is taken equal to zero.

Figure 2.2.4.1 Types of rudder

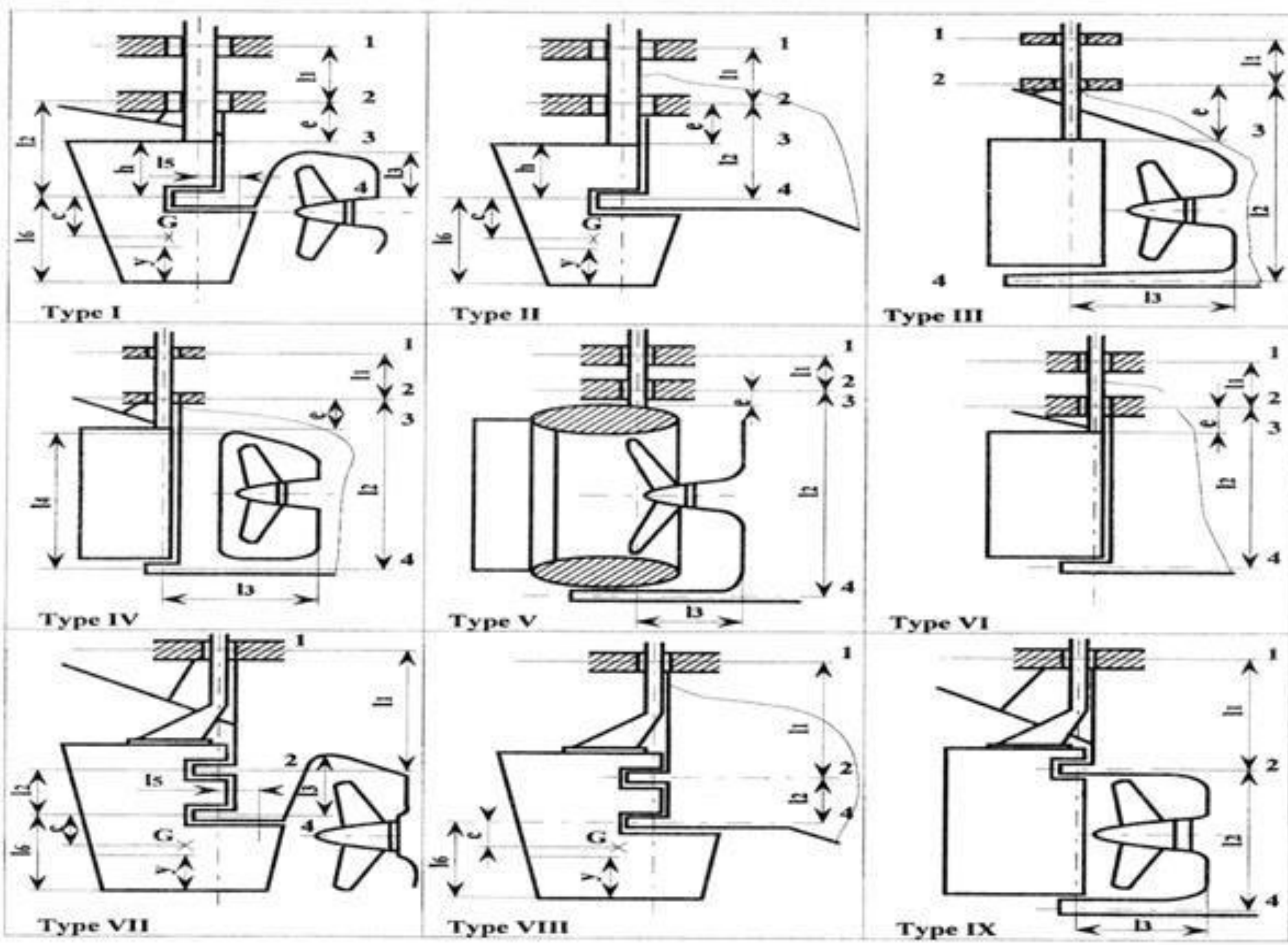
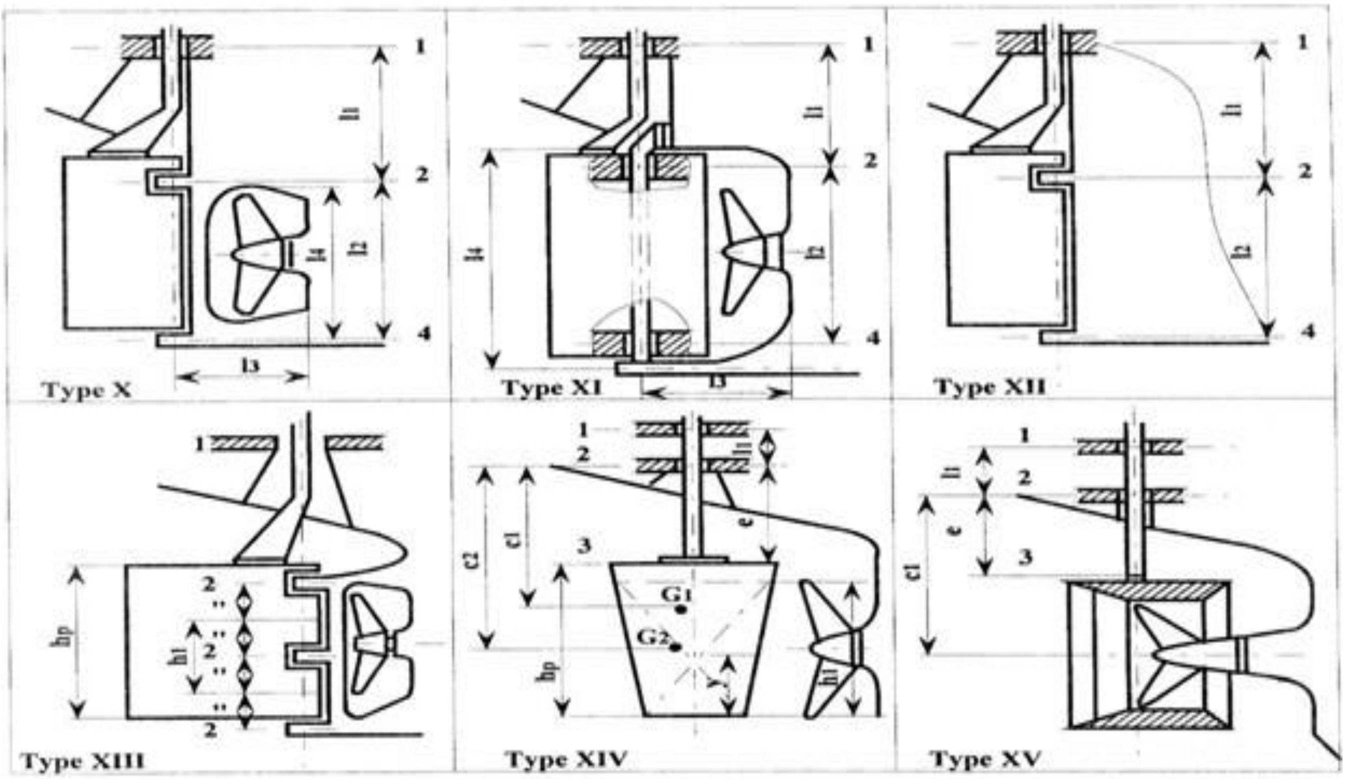


Figure 2.2.4.1 Types of rudder

Figure 2.2.4.1 Types of rudder (Cont.)



NOTES:

1. G - Gravity center of the semispade rudder area lying below section 4;

2. G_1 - Gravity center of the total rudder area;

3. G_2 - Gravity center of the part of the rudder area coming under the propeller wash.

4. For rudder types VII - XII, the design value of the *l* dimension is adopted equal to zero;
For rudder types III - XII, the design value of the *h* dimension is adopted $h = l_2 - e$

Figure 2.2.4.1 Types of rudder (Cont.)

Figure 2.2.4.2 Distance of the steering gear

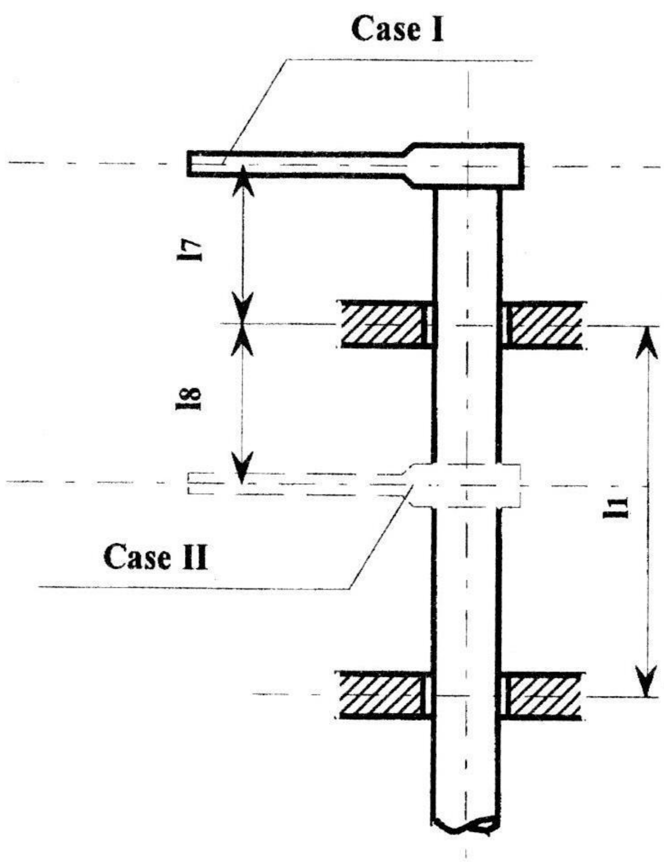


Figure 2.2.4.2 Distance of the steering gear

2.2.4.10 The design value of the reaction R_1, in kN, of support I of the rudder (of the upper bearing) is to be determined from the formula:

$$R_1 = \frac{M_2}{l_1} - P_I \cdot \left(I + \frac{l_7}{l_1} \right) - P_{II} \cdot \left(I - \frac{l_8}{l_I} \right)$$

(Fig. 2.2.4.10)

2.2.4.11 The design value of the reaction R_2, in kN, of support 2 of the rudder (of the lower bearing for rudder types I - VI, of the upper bearing of the rudder axle for rudder type XI, of the upper pintle of rudders for types VII - X and XII) is to be determined from the formula:

$$R_2 = -M_2 \cdot \left(\frac{I}{l_1} + \frac{I}{l_2} \right) - \frac{I}{l_2} \cdot Q_1 \cdot \frac{h}{l_2} + Q_2 \cdot \frac{c}{l_2} + P_I \cdot \frac{l_7}{l_I} - P_{II} \cdot \frac{l_8}{l_I}$$

(Fig. 2.2.4.11)

2.2.4.12 The design value of the reaction R_4, in kN, of support 4 of the rudder (of the lower pintle) is to be determined from the formula:

$$R_4 = \frac{M_2}{l_2} - \frac{1}{2} \cdot Q_1 \cdot \left(1 + \frac{e}{l_2} \right) - Q_2 \cdot \left(I + \frac{c}{l_2} \right)$$

(Fig. 2.2.4.12)

2.2.4.13 The design value of the bending moment M_r**,** in kN.m, acting in the considered section of the lower part of the semispade rudder body (below section 4 shown in *Fig. 2.2.4.1* for rudder types I, II, VII and VIII) is to be determined from the formula:

$$M_f = \frac{1}{2} \cdot Q_2 \cdot \frac{y^2}{l_6}$$

(Fig. 2.2.4.13)

y = linear dimensions (see *2.2.4.4*);
l_6 = linear dimensions (see *2.2.4.4*).

2.2.4.14 The design value of the bending moment M_r**,** in kN.m, acting in any cross-section of the rudders of types III, IV, VI and IX – XII is to be determined form the formula:

$$M_r = \frac{1}{2} \cdot M_2 \cdot \frac{h}{l_2} \cdot \left(2 - \frac{h}{l_2} - \frac{M_2}{Q_1 \cdot l_2} \right) - \frac{1}{8} \cdot Q_1 \cdot h \cdot \left(2 - \frac{h}{l_2} \right)^2$$

(Fig. 2.2.4.14)

2.2.4.15 The design value of the bending momen $M_{r.a}$, in kN.m, acting in the section of the rudder axle near its flange is to be determined from the formula:

$$M_{r.a} = R_4 \cdot l_4 \cdot \left[0{,}42 \cdot \frac{(l_4 - l_2)}{l_4} + 0{,}24 \cdot \frac{l_3}{l_4} \cdot \frac{I_{r.p}}{I_{ts}} + 0{,}15 \cdot \left(\frac{l_3}{l_4} \right)^2 \right]$$

(Fig. 2.2.4.15)

l_3 = linear dimension (see *2.2.4.4*);
l_4 = linear dimension (see *2.2.4.4*);
$I_{r.p}$ = mean moment of inertia of the rudder axle or rudder post cross-section, cm^4;
I_s = mean moment of inertia of the sole piece cross-section, cm^4.

2.2.4.16 For Case II of the steering gear quadrant quadrant or tiller location (see *Fig. 2.2.4.2*) the design value of the bending moment M_s, in kN.m, acting in the section of the rudder stock in way of the quadrant or tiller location is to be determined from the formula: **I**: Comprises high-sea navigation up to 200 miles from a shelter place, and a distance of not more than 400 miles between 2 shelter places.

$$M_s = R_1 \cdot l_8$$ **(Fig. 2.2.4.16)**

For Case I of the steering gear quadrant or tiller location M_s, is taken equal to zero.

2.2.4.17 The coefficient α_4, in m^3/cm^4, for rudders of types I and VII (for the horn of the semispade rudder) is to be determined from the formula:

$$\alpha_4 = \frac{1{,}07 \cdot l_3^3}{3 \cdot I_1} \cdot \left(4 - 3 \cdot \frac{b_{ho}}{b_{h1}}\right) + \frac{1{,}3 \cdot l_5^2 \cdot l_3}{I_2} \cdot \left(1 + \frac{b_{h1}}{b_{h0}}\right) \cdot \frac{b_{h1}}{b_{h0}}$$

(Fig. 2.2.4.17)

l_5 = linear dimensions (see *2.2.4.4*);

I_1 = moment of inertia of the rudder horn cross-section at its root about the axis parallel to the centre plane of the ship, cm^4;

b_{h0} = maximum width of the horizontal section of the rudder horn at the lower pintle (Section 4 in *Fig 2.2.4.1*), m;

b_{h1} = maximum width of the horizontal section of the rudder horn at its root, m;

I_2 = polar moment of inertia of the rudder horn cross-section at its root, cm^4, determined from the formula:

$$I_2 = \frac{4 \cdot \left(A_{r.h}\right)^2}{\sum_{i=1}^{n} \frac{l_{fi}}{S_{fi}}} \quad (2.2.4.17\text{-}2);$$

$A_{r.h}$ = area enclosed by the center line of the rudder horn plating (with the cross-section at the horn root), cm^2;

l_{fi} = length of the center line of the rudder horn plating (in the cross-section at the horn root) of the given thickness, cm;

S_{fi} = thickness of the considered portion of the rudder horn plating with the length l_{fi}, cm;

n = number of portions of the rudder horn plating with the length l_{0i} and thickness S_{fi}.

2.2.4.18 The coefficient α_4, in m^3/cm^4, for rudders of types III, V and IX (for the solepiece) is to be determined from the formula:

$$\alpha_4 = \frac{l_3^3}{3 \cdot I_{s1}} \left(4 - 3 \cdot \frac{b_{s0}}{b_{s1}}\right) \qquad \textbf{(Fig. 2.2.4.18)}$$

I_{s1} = moment of inertia of the sole piece cross-section at its root about the vertical axis, cm^4;

b_{s0} = width of the sole piece cross-section at the rudder or nozzle rudder pintle, cm;

b_{s1} = width of the sole piece cross-section at its root, cm.

2.2.4.19 The coefficient α_4, in m^3/cm^4, for rudders of types IV and X (for the rudder post with the sole piece) is to be determined from the formula:

$$\alpha_4 = \frac{l_3^3}{3 \cdot I_s} \cdot \left(0{,}075 \cdot \frac{I_s}{I_{cr.p}} + 0{,}334 \cdot \frac{l_4}{l_3}\right) \quad (2.2.4.19)$$

2.2.4.20 The coefficient α_4, in m^3/cm^4, for rudders of type XI (for rudder axle with the sole piece) is to be determined from the formula:

$$\alpha_4 = \frac{l_3^3}{3 \cdot I_{ts}} \cdot \left\{ \left(0{,}075 \cdot \frac{I_s}{I_{cr.p}} + 0{,}334 \cdot \frac{l_4}{l_3}\right) - 0{,}282 \cdot \frac{\left(l_4 - l_2\right)}{l_4} \cdot \left[1{,}55 \cdot \frac{l_4}{l_3} + 0{,}053 \left(\frac{l_4}{l_3}\right)^2 + \frac{\left(l_4 - l_2\right)}{l_4} \cdot \frac{I_s}{I_{cr.p}}\right] \right\}$$

(Fig. 2.2.4.20)

2.2.4.21 The coefficient α_4 for rudders of types II, VI, VIII and XII is to be taken equal to zero.

2.2.5 Bending moments and reactions of supports for rudder type *(Fig.2.2.4.1)*

2.2.5.1 The requirements of *2.2.4.2* to *2.2.4.6* and *2.2.4.16* are also applicable to the rudders of type XIII.

2.2.5.2 The design value of the bending moment acting in way of the rudder stock and rudder body coupling is to be taken equal to zero.

2.2.5.3 The design value of the bending moment M_r, in kN.m, acting in any cross-section of the rudder is to be taken from the formula:

$$M_t = 0{,}1 \cdot F \cdot \frac{h_i^2}{h_t} \qquad \textbf{(Fig. 2.2.5.3)}$$

F = force determined according to the provisions of *2.2.2.1*, *2.2.2.2* and *2.2.2.5*, kN;

h_i and h_r = linear dimensions (see *2.2.4.4*); in this case, the greater of the value h_i is to be taken as the design value.

2.2.5.4 The design value of the reaction R_1 of support 1 of the rudder (of the upper bearing) is to taken equal to zero.

2.2.5.5 The design value of the reaction R_2 , in kN, of support 2 of the rudder (of any pintle) is to be determined from the formula:

$$R_2 = F \cdot \frac{h_i}{h_r} \quad \textbf{(Fig. 2.2.5.5)}$$

2.2.6 Bending moments and reactions of supports for rudder type XIV (Fig. 2.2.4.1)

2.2.6.1 The requirements of *2.2.4.2* to *2.2.4.6* and *2.2.4.16* are also applicable to the rudders of type XIV.

2.2.6.2 The design value of the bending moment m^2, in kN.m, acting in Section 2 of the rudder stock (at the lower bearing) is to be determined from the formula:

$$M_2 = F_1 \cdot c_1 + F_2 \cdot c_2 \quad \textbf{(Fig. 2.2.6.2)}$$

F_1 and F_2 = forces determined according to the provisions of *2.2.2.1; 2.2.2.2* and *2.2.2.5*, kN;
c_1; c_2 = linear dimensions (see 2.2.4.4), m.

2.2.6.3 The design value of the bending m^3 , in kN.m, acting in Section 3 of the rudder stock (in the rudder stock and rudder body coupling) is to be determined from the formula:

$$M_3 = F_1 \cdot (c_1 - e) + F_2 \cdot (c_2 - e) \quad \textbf{(Fig. 2.2.6.3)}$$

e = linear dimension (see *2.2.4.4*), m.

2.2.6.4 The design value of the bending moment M_r, in kN.m, acting in the considered section of the rudder body is to be determined from the Formula:

-for sections with $y < h_i$

$$M_t = \frac{1}{2} \cdot \left(\frac{F_1}{h_r} + \frac{F_2}{h_1} \right) \cdot y^2 \quad \textbf{(Fig. 2.2.6.4-1)}$$

-for sections with $y \geq h_1$

$$M_f = \frac{1}{2} \cdot \frac{F_1}{h_r} \cdot y^2 + F_2 \cdot \left(y - \frac{1}{2} \cdot h_1 \right) \quad \textbf{(Fig. 2.2.6.4-2)}$$

h_r = linear dimension (see *2.2.4.4*), m;
h_1 = linear dimension (see *2.2.4.4*), m;
y = linear dimension (see *2.2.4.4*), m.

2.2.6.5 The design value of the reaction R_1, in kN, of support *1* of the rudder (of the upper bearing) is to be determined from the formula:

$$R_1 = F_1 \cdot \frac{c_1}{l_I} + F_2 \cdot \frac{c_2}{l_I} - P_I \cdot \left(I + \frac{l_7}{l_I} \right) - P_{II} \cdot \left(I - \frac{l_8}{l_I} \right)$$

(Fig. 2.2.6.5)

l_I = linear dimension (see *2.2.4.4*), en m.

2.2.6.6 The design value of the reaction R_2, in kN, of support 2 of the rudder (of the lower bearing) is to be determined from the formula:

$$R_2 = F_1 \cdot \left(I + \frac{c_1}{l_1} \right) + F_2 \cdot \left(I + \frac{c_2}{l_1} \right) - P_I \cdot \frac{l_7}{l_I} + P_{II} \cdot \left(\frac{l_8}{l_I} \right)$$

(Fig. 2.2.6.6)

2.2.7 Bending moments and reactions of supports for nozzle rudders of type XV (*Fig 2.2.4.1)*

2.2.7.1 The requirements of *2.2.4.2* to *2.2.4.4*, *2.2.4.6* and *2.2.4.16* are also applicable to the nozzle rudder of type XV.

2.2.7.2 The design value of the bending moment M_2, in kN.m, acting in Section 2 of the rudder stock (at the lower bearing) is to be determined from the formula:

$$M_2 = F \cdot c_1 \quad \textbf{(Fig. 2.2.7.2)}$$

F = force determined according to the provisions of *2.2.3.1*, kN;
c_1 = linear dimension (see *2.2.4.4*), in m.

2.2.7.3 The design value of the bending moment M_3, in kN.m, acting in Section 3 of the rudder stock (at the rudder stock and nozzle rudder coupling) is to be determined from the formula:

$$M_3 = F \cdot (c_1 - e) \quad \textbf{(Fig. 2.2.7.3)}$$

e = linear dimension (see *2.2.4.4*), m.

2.2.7.4 The design value of the reaction R_1, in kN, of support 1 (of the upper bearing) is to be determined from the formula:

$$R_1 = F \cdot \frac{c_1}{l_1} - P_I\left(1 + \frac{l_7}{l_1}\right) - P_{II} \cdot \left(1 - \frac{l_8}{l_1}\right) \quad \textbf{(Fig. 2.2.7.4)}$$

l_1 = linear dimension (see 2.2.4.4), m.

2.2.7.5 The design value of the reaction R_2, in kN, of support 2 (of the lower bearing) is to be determined from the formula:

$$R_2 = F \cdot \left(1 + \frac{c_1}{l_1}\right) - P_I \cdot \frac{l_7}{l_1} + P_{II} \cdot \left(\frac{l_8}{l_1}\right) \quad \textbf{(Fig. 2.2.7.5)}$$

2.2.8 The design values of bending moments and reactions of supports for the steering gears which differ from those indicated in *fig. 2.2.4.1* are subject to special consideration by *ICS Class*.

2.3 Rudder Stock

2.3.1 The diameter of the rudder head d_o, in cm, is to be not less than the greater value determined from the formula:

$$d_o = k_{10} \cdot \sqrt[3]{\frac{M_t}{R_{eH}}} \qquad \textbf{(Fig. 2.3.1)}$$

k_{10} = factor equal to:
26,1 for the ahead condition;
23,3 for the astern condition;

M_t = torque according to *2.2.2.3, 2.2.2.4* or *2.2.3.3*, kN.m;
R_{eH} = upper yield stress of the rudder stock material, MPa.

2.3.2 Under combined action of the torque and bending moment the working stress (see 1.5.1) acting in rudder stock sections 1, 2 or 3 shown in Fig. 2.2.4.1 for the appropriate type of the rudder are not to exceed 0.5 times the upper yield stress for the ahead condition and 0.7 times the upper yield stress of the material for the stem condition (see 1.5.2 and 2.1.5). In this case, the normal stress a and the sheer stress τ, , in MPa are to be determined from the formula:

$$\sigma = 10{,}2 \cdot 10^3 \frac{M_b}{d_i^3} \qquad \textbf{(Fig. 2.3.2-1)}$$

$$\tau = 5{,}1 \cdot 10^3 \cdot \frac{M_t}{d_i^3} \quad \textbf{(Fig. 2.3.2-2)}$$

M_b = bending moment acting in the considered section of the rudder stock (M_1, M_2 or M_3) determined according to the provisions of *2.2.4* to *2.2.7* for the appropriate type of the rudder, kN.m;
d_1 = diameter of the rudder stock in the considered section, cm.

2.3.3 The change in the rudder stock diameter between the adjacent sections specified in *2.3.1* and *2.3.2* is not to be more sudden than that permitted by the linear law.
Where the change of the rudder stock diameter is stepped, the steps are to be provided with fillets having as large radius as practicable. The transition of the rudder stock into the flange is to be carried out with a radius of fillet of not less than 0,12 times the diameter of the rudder stock in way of the flange.

2.4 Rudder and nozzle rudders

2.4.1 Ordinary rudders

2.4.1.1 The thickness of the streamlined rudder side plating s, in mm, is to be not less than determined from the formula:

$$s = ak_{11} \cdot \sqrt{\frac{98 \cdot d + k_{12} \cdot \left(\frac{F_1}{A} + k_{13} \cdot \frac{F_2}{A_p}\right)}{R_eH}} + 1{,}5$$

(Fig. 2.4.1.1)

d = draught of the ship, in m;
$F_1; F_2$ = forces according to *2.2.2.1* and *2.2.2.2*, kN; for A and A_p, see *2.2.2.1*;
a = distance between horizontal or vertical web plates, whichever is the less, m;
k_{11} = factor determined from the formula: (2.4.1.1-2)
R_{eH} = upper yield stress of the rudder plating material, MPa;
b = distance between horizontal or vertical web plates whichever is the greater, m;

k_{12} = factor equal to:
18,6 for the rudder plating within 0,35 of the rudder length from its leading edge;
8,0 for the rudder plating within 0,65 of the rudder length from its rear edge;

k_{13} = factor equal to:
1 for the rudder plating in the wake of the propeller (when rudder is in the non-reversed position);
0 for the rudder plating beyond the wake of the propeller (when rudder is in the non-reversed position).

2.4.1.2 In any case, the thickness of the streamlined rudder side plating S_{min}, in mm, is to be not less than determined from the Formula:

- for ships of less than 80 m in length:

$$S_{min} = 21{,}5 \cdot \frac{L+51}{L+240} \quad \textbf{(Fig. 2.4.1.2-1)}$$

- for ships of 80 m in length and over:

$$S_{min} = 24 \cdot \frac{L+37}{L+240} \quad \textbf{(Fig. 2.4.1.2-2)}$$

where: L = length of the ship, m.

2.4.1.3 For the ship assigned an ice category the thickness of the rudder side plating in way of the ice belt is to be not less than that of the ice belt of the shell plating in the after part of the ship, specified in *Chapter 2*, *rule 3.10.4.1* of, with the frame spacing being equal to the distance between the vertical web plates of the rudder.

2.4.1.4. The streamlined rudder side plating is to be stiffened from the inside by horizontal and vertical web plains. The thickness of the web plates is to be not less than that of the rudder side plating. or third annual survey.

The side plating and web plates are to be welded together by fillet or plug welds with slots of linear form. Dimensions of elements of plug welds are selected according to *Chapter 2*, *rule 1.7.5.13*. The thickness of the steel flats is to be not less than that of the rudder side plating

The horizontal and vertical web plates are to be provided with sufficient number of openings for free drainage of water which may penetrate inside the rudder.

2.4.1.5 The streamlined rudders are to be provided with top and bottom plates, the thickness of which is to be not less than 1,2 times the greater value of the side plating thickness according to *2.4.1.1*. The top and bottom plates are to be fitted with drain plugs of corrosion-resistant metal

2.4.1.6 The corners of the openings (in way of the pintles) in the side plating of the semi spade rudder are to be rounded off. The radius of curvature is to be not less than 2 times the side plating thickness in this area, and the free edge of the rudder side plating is to be thoroughly stripped.

2.4.1.7 Near the rotation axis of the streamlined rudder one or several vertical web plates are to be provided ensuring the general strength of the rudder body. The section modulus of these web plates, including the effective flanges, is to be such that the normal stresses in the considered section are not more than 0,5 times the upper yield stress of the material of the rudder side plating (see *1.5.2*).

The normal stresses σ, in MPa, are to be calculated from the formula:

$$\sigma = \frac{1000 \cdot M_b}{W} \quad \textbf{(Fig. 2.4.1.7)}$$

M_b = bending moment in the considered section of the rudder (M_4 or M_r) determined according to the provisions of *2.2.4* to *2.2.6* for the appropriate type of the rudder, kN.m;

W = section modulus of the considered section of the web plates, including the effective flanges, about the axis of symmetry of the rudder profile, cm^3.

The dimensions of the effective flaggers of the web plates are to be as follows:

- the thickness equal to that of the rudder side plating;
- the width equal to 1/6 of the rudder height or 1/2 of the distance between the nearest web plates located on both sides of the considered web plate, whichever is the less.

2.4.1.8 Special care is to be given to the reliable securing to the rudder body of the flange for coupling the rudder body and the rudder stock and of the dudgeons for pintles.
The rear edge of the rudder is to be rigidly fixed in the proper way.

2.4.1.9 The thickness of the flat rudder, in mm is to be not less than determined from the Formula:

$$S = 6 \cdot (1 + 0{,}01 \cdot d)$$ **(Fig. 2.4.1.9)**

d = diameter of the flat rudder stock, in cm, with the same yield stress of the rudder;

2.4.1.10 In flat rudders they are to be provided with a rudder stock, in which shall extend in all its height the diameter of the rudderstock in the upper part of the rudder is to be determined in the way that the resulting stresses in its section are not to be higher than 0,5 of the limit upper yield stress of the web plates.

The normal stresses σ, in MPa, in this case, is to be determined from the formula:

$$\sigma = 10{,}2x10^3 \frac{M_i}{d^3}$$ **(Fig. 2.4.1.10-1)**

M_i = bending moment in the rudder (M_4 or M_f) according to *2.2.4 - 2.2.6* for the corresponding steering installation kNm;
d = diameter of the stock in the upper rudder, in cm.

The tangential stresses, τ in Mpa is to be determined from the Formula:

$$\tau = 10{,}2x10^3 \frac{M_t}{d^3}$$ **(Fig. 2.4.1.10-2)**

M_t = Torque moment according to *2.2.2.3* or *2.2.2.4*.

The section modulus of the rudder stock may be diminished gradually towards the inner part of the rudder in such way that the inner part does not constitute not less than 75% of its magnitude in the upper part.

2.4.1.11 The flat rudder is to be reinforced on both by means of stiffeners, which are to be placed in their upper and inner parts as well as in each spindles if existing the vertical distance among the stiffeners is not to be more than 1 m. If necessary intermediate stiffeners are to be provided.

The section modulus, in cm^3 of the transversal section of the stiffeners at the level of the rudder stock in not to be more than the determined from the formula:

$$w = 0{,}1 \cdot \frac{h_m}{h_p} \cdot d^3$$ **(Fig. 2.4.1.11)**

h_m = medium height of the reinforced rudder part, in m;
h_p = medium height of the rudder, in m.

2.4.2 Nozzle Rudders

2.4.2.1 The thickness s_0, in mm, of the nozzle rudder outside plating is to be not less than determined from the formula:

$$S_0 = k_{14} \cdot l_1 \cdot \sqrt{\frac{98 \cdot D_n : l_{nt} : d + 20 \cdot F_n}{D_n \cdot l_n \cdot R_{eH}}} + 2$$

(Fig. 2.4.2.1-1)

D_{NA} = inner minimum nozzle bore, m;

L_{en} = length of the nozzle rudder, m;
d = draught of the ship, m;
F_n = force acting on the nozzle rudder according to *2.2.3.1*, kN;

R_{eH} = upper yield stress of the material of the nozzle rudder outside plating, MPa;

k_{14} = factor determined from the formula:

$$k_{14} = 7{,}885 - 2{,}221 \cdot \left(\frac{l_1}{u_1}\right)^2$$ (2.4.2.1-2)

u_1 = distance between the longitudinal web plates measured along the length of the nozzle rudder outside plating, m. This distance is not to exceed 1000 mm;

l_1 = distance between transverse web plates or between the transverse web plate and the nearest edge of the nozzle rudder, m. This distance is not to exceed 600 mm.

2.4.2.2 The thickness s_m , in mm, of the nozzle rudder inside plating, except for its middle belt, is to be not less than:

$$S_i = 6{,}39 \cdot \frac{l_1}{D_n} \cdot \sqrt{T} \quad \textbf{(Fig. 2.4.2.2-1)}$$

T = propeller thrust at speed υ, kN.

The thickness S_m, in mm, of the middle belt of the nozzle rudder inside plating is to be not less than:

$$S_m = 7{,}34 \cdot \frac{l_2}{D_n} \cdot \sqrt{T} + 0{,}5 \cdot \frac{T}{D_n^2} \quad \textbf{(Fig. 2.4.2.2-2)}$$

l_2 = distance between transverse web plates situated in way of the middle belt of the inside plating, in m.

In case of application of stainless or clad steel the value of s_m, may be reduced on agreement with *ICS Class*.

2.4.2.3 In any case, the thickness of the outside and inside plating of the nozzle rudder is to be not less than that given in *2.4.1.2*.

2.4.2.4 The middle belt of the nozzle rudder inside plating is to extend not less than $0{,}05D_n$ forward and not less than 0,1 D_{NA}, aft of the propeller blade tips. Its breadth is to be at least equal to the maximum breadth of the side projection of the propeller blade.

2.4.2.5 The outside and inside plating of the nozzle rudder is to be stiffened from the inside by transverse and longitudinal web plates. The spacing of the web plates is to comply with the requirements of *2.4.2.1*.
At least four longitudinal web plates are to be provided which are equally spaced around the circumference of the nozzle rudder.

The thickness of web plates, except those situated in way of the middle belt of the nozzle rudder inside plating, is to be not less than the thickness of the outside plating according to *2.4.2.1* and *2.4.2.3*.
The transverse and longitudinal web plates are to be welded to the nozzle rudder inside plating by double side continuous welds with full penetration on the inside of the nozzle rudder.
When the thickness of the web plates is 10 mm and more, edge preparation is to be carried out.
The outside plating and web plates are to be connected by plug welding with slots of linear form or by backing welding.
The dimensions of elements of plug welds with slots of linear form are selected according to *Chapter 2, 1.7.5.13*.

The transverse and longitudinal web plates are to be provided with sufficient number of opening for free drainage of water which might penetrate inside the nozzle rudder, and in the lower and upper parts of the outside plating the drain plugs of stainless metal are to be fitted. The distance from the opening edge to the inside and outside plating of the nozzle rudder is to be not less than 0,25 times the web plate height.

It is not allowed to weld on doubling plates to the inside plating of the nozzle rudder.

2.4.2.6 In way of the middle belt of the nozzle rudder inside plating at least two continuous transverse web plates are to be fitted. The thickness of these web plates is to be not less than the thickness of the inside plating off its middle belt as per *Formula 2.4.2.2-1*.

2.4.2.7 Special care is to be given to the reliable securing of the nozzle flange, welded-in bush and other nozzle rudder welded-in parts for connecting the nozzle rudder welded-in parts for connecting the nozzle rudder with its stock and pintle.

2.4.2.8 The thickness s_{st}, of the stabilizer plating, in mm, is to be not less than determined from the formula:

$$S_{st} = k_{14} \cdot l_1 \cdot \sqrt{\frac{98 \cdot A_{st} \cdot d + 20 \cdot F_{st}}{A_{st} \cdot R_{eH}}} + 2 \quad \textbf{(Fig. 2.4.2.8)}$$

A_{st} = area of the nozzle rudder stabilizer, m²;

F_{st} = force acting on the stabilizer according to *formula* (*2.2.3.1-3*), kN;

k_{14} = factor according to *table 2.4.2.1* when the distance between horizontal web plates equals to u_1, , m;

l_l = distance between vertical web plates or between the web plate and fore or aft edge of the stabilizer, m;

R_{eH} = upper yield stress of material of the stabilizer plating, MPa.

2.4.2.9 The nozzle rudder stabilizer plating is to be stiffened from the inside by horizontal and vertical web plates having the thickness not less than that of the plating in accordance with *2.4.2.8*.

The stabilizer body is to terminate in top and bottom plates. The thickness of top and bottom plates is not to be less than 1,5 times the thickness of the plating according to *2.4.2.8*. Vertical web plates are to be securely connected to top and bottom plates.

The plating and horizontal and vertical web plates are to be welded together by fillet or plug welds.

The types of plug welds with slots of linear form are selected according to *Chapter 2, 1.7.5.13.*

The horizontal and vertical web plates are to be provided with sufficient number of openings, and top and bottom plates are to be fitted with drain plugs of corrosion-resistant material.

2.4.2.10 In way of attachment of the stabilizer to the nozzle rudder one or several vertical web plates are to be provided ensuring general strength of the stabilizer. The section modulus W_{st}, in cm^3, of these web plates, the effective flange included is to be not less than determined from the formula:

$$W_{st} = \frac{1390 \cdot F_{st} \cdot h_{st}}{R_{eH}} \quad \textbf{(Fig. 2.4.2.10)}$$

F_{st} = force acting on the stabilizer according to *Formula (2.2.3.1-3)*, kN;
h_{st} = stabilizer height, m;
R_{eH} = upper yield stress of the material used, MPa.

The effective flange dimensions are to be as follows: thickness equal to the stabilizer plating thickness; width equal to 1/5 of the stabilizer height.

2.4.2.11 The nozzle rudder-and stabilizer are to be so connected that rigid fixation of the latter is ensured.

The force F_{st}, determined from *Formula (2.2.3.1-3)* and uniformly distributed with the height of the stabilizer is to be taken in strength calculations as a force acting on the stabilizer. Depending on the type of connection a torque of force F_{st}, acting on this connection is to be considered with regard to the point of application of this force (see *Formula 2.2.3.2-3)*. In this case, stresses developed in the connection (see *1.5.1*) shall not exceed 0,4 times the upper yield stress of the material.

2.5 Couplings

2.5.1 Horizontal flange coupling

2.5.1.1 The diameter of the coupling bolts d_1, in cm, is to be not less than:

$$d_1 = 0{,}62 \cdot \sqrt{\frac{d_2^3 \cdot R_{eH_1}}{z_1 \cdot r_2 \cdot R_{eH_2}}} \quad \textbf{(Fig. 2.5.1-1)}$$

d_2 = diameter of the rudder stock at the coupling flange, cm;
z_1 = number of coupling bolts;
r_2 = mean distance from the centre of the bolts to the centre of the system of the flange bolt material, MPa;
R_{eH1} = upper yield stress of the rudder stock material, MPa;
R_{eH2} = upper yield stress of the bolt material, MPa.

The coupling bolt diameter at the bottom of threads d_3, in cm, is to be not less than determined from the formula:

$$d_3 = 76{,}84 \cdot \sqrt{\frac{M_b}{z_1 \cdot r_3 \cdot R_{eH_2}}} \quad \textbf{(Fig. 2.5.1-2)}$$

M_b = bending moment acting in the rudder stock section at the flange (M_2 or M_3) determined according to the provisions of *2.2.4* to *2.2.7* for the appropriate type of the rudder, kN.m;
r_3 = mean distance from the centre of the bolts to the longitudinal axis of symmetry of the flange, cm.

The number of bolts z_1, is to be not less than 6. The mean distance from the center of the bolts to the centre of the system of the flange bolt holes is to be not less than 0,9 times the rudder stock diameter according to *2.3.1*. When the coupling is under the action of the bending moment, the mean distance from the center of the bolts to the, longitudinal axis of symmetry of the flange is to be not less than 0,6 times the rudder stock diameter at the flange

2.5.1.2 Only fitted bolts are to be employed, except the cases of a key setting when it is sufficient to have only two fitted bolts. The nuts shall have standard sizes. The bolts and nuts shall be efficiently secured.

2.5.1.3 The thickness of the coupling flanges is not to be less than the diameter of the bolts. The centers of the holes for bolts are to be distant from the outside edges of the flange by not less than 1,15 times the diameter of the bolts.

2.5.1.4 When coupling flanges of nozzle rudders are not built into the nozzle rudder body but connected to it by the structure formed of sheets, the strength of this structure shall be equivalent to that of the rudder stock in accordance with *2.3.2*. In this case, the calculated combined stress shall not exceed 0,4 times the upper yield stress of the material used.

2.5.2 Keyed cone coupling

2.5.2.1 Where the rudder stock has a tapered lower end fitted to the rudder or nozzle rudder and secured by nut and key, the length of the taper is not to be less than 1,5 times the diameter of the rudder stock according to *2.3.2* and the taper is not to be greater than 1:10 on the diameter. The taper is to change into cylindrical portion without any step in the diameter.

2.5.2.2 A key is to be set on the cone generatrix. The ends of the key are to be fairly rounded. The working sectional area of the key A_k (product of the key length by its width), in cm², shall be not less than the greater value determined from the formula:

$$A_f = \frac{k_{15} \cdot M_t}{d_m \cdot R_{eH}} \qquad \textbf{(Fig. 2.5.2.2)}$$

k_{15} = factor equal to:
6920 for rudders for the ahead condition and for nozzle rudders;
4950 for rudders for the astern condition;

M_t = torque according to *2.2.2.3, 2.2-2.4* or *2.2.3.3*, kN.m;

d_m = diameter of the taper section at the middle of the key length, cm;

R_{eH} = upper yield stress of the key material, MPa.

The height of the key shall be not less than half its width.

The key way of the rudder stock shall be confined to the tapered coupling.

2.5.2.3 The external diameter of the rudder stock threaded portion is not to be less than 0,9 times the minimum diameter of the taper. The thread is to be fine,. The outer diameter and height of the nut are not to be less than 1,5 and 0,8 times the external diameter of the rudder stock threaded portion, respectively. To prevent self-unscrewing, the nut is to be securely fastened at least by two weld-on strips or one weld-on strip and a split pin.

2.5.3 Keyless cone coupling

2.5.3.1 The requirements of *2.5.3* are applicable to a keyless fitting of the stock to the rudder or nozzle rudder which is made by oil injection method.

2.5.3.2 The taper length of the stock fitted to the rudder or nozzle rudder is not to be less than 1.5 times the diameter of the stock according to *2.3.2*; the taper on the diameter is to he 1: 15.

2.5.3.3 The rudder or nozzle rudder is to be a good fit on the rudder stock cone. During the fit up, and before the push-up load is applied, an area of contact of at least 70 per cent of the theoretical area of contact is to be achieved, and this is to be distributed evenly.
The relationship of the rudder or nozzle rudder to stock at which this occurs is to be marked, and push-up length then measured from that point.
In well-founded cases another method of determining the original position of the stock and boss cones relationship can be used on agreement with *ICS Class.*

2.5.3.4 To ensure the required interference in the cone coupling the push-up length of the rudder stock (see *2.5.3.3*) during its fitting shall be not less than determined from the formula:

$$S_1 = \frac{1{,}1 \cdot q}{E \cdot k} \cdot \left[\frac{2 \cdot d_m}{1 - \left(\frac{d_m}{d_c} \right)^2} + 35{,}7 \right] \qquad \textbf{(Fig. 2.5.3.4-1)}$$

S_1 = push-up length of the rudder stock, mm;

d_m = mean diameter of the rudder stock taper, mm;

d_d = outer diameter (or minimum outer dimension) of rudder boss or nozzle rudder (in the mean section), mm;
E = modulus of elasticity of rudder stock material, MPa;
K = taper of conical coupling, on the diameter;
q = required contact pressure applied to mating surfaces during the push-up, in MPa, determined from the formula:

$$q = \frac{4{,}25\cdot 10^{6}\cdot n\cdot M_t}{d_m^2\cdot L_a}\cdot\sqrt{1+\left(\frac{5\cdot 10^{-6}\cdot Q\cdot d_m}{M_t}\right)^2}\cdot\left(1+0{,}257\cdot\frac{L_a}{d_m}\cdot\frac{M_b}{M_t}\right)$$

(Fig. 2.5.3.4-2)

M_t = maximum value of design torque according to *2.2.2.3, 2.2.2.4* or *2.2.3.3*, kN.m;
M_b = maximum bending moment in way of tone coupling determined according to *2.2.4.8, 2.2.6.3* or 2.2.7.3, kN.m;
Q = mass of rudder or nozzle rudder, kg;
L_a = actual length of the contact part of taper, excluding the oil distribution grooves and similar devices, mm;
n = safety factor against friction slip under the action of rated torque.

The spade rudders and nozzle rudders (types XIV and XV, *Fig. 2.2.4.1*) the value n is to be taken not less than 2,5; for other types of rudders and nozzle rudders this value shall be not less than 2,0.

If the contact pressure q determined from *formula (2.5.3.4-2)* is less than 40 MPa, then q = 40 MPa is to be taken in the calculations.

2.5.3.5 The strength of the maximum loaded part of the coupling shall be checked as follows.

The combined stress on the inside of the rudder boss or nozzle rudder shall not exceed 0,85 of the yield stress of the boss material. The combined stress on the inside of the boss is to be determined from the formula:

$$\sigma = \sqrt{0{,}5\cdot(\sigma_1-\sigma_2)^2+0{,}5\cdot(\sigma_2-\sigma_3)^2+0{,}5\cdot(\sigma_3-\sigma_1)^2}$$

(Fig. 2.5.3.5-1)

σ = combined stress, in MPa;

$$\sigma_1 = q_1\cdot\frac{d_c^2+d_3^2}{d_c^2-d_3^2} \qquad (2.5.3.5\text{-}2)$$

$$q_1 = q + 5{,}73\cdot\frac{M_b\cdot 10^6}{d_3\cdot L^2_{s.t}} \qquad (2.5.3.5\text{-}3)$$

$$\sigma_2 = -q_1 \qquad (2.5.3.5\text{-}3)$$

$$\sigma_3 = \frac{40\cdot Q}{\pi\cdot\left(d_c^2-d_3^2\right)}+\frac{M_b\cdot 10^{-7}}{d_3^3} \qquad (2.5.3.5\text{-}5)$$

q_1 = contact pressure between mating tapered surfaces in way of maximum diameter of the stock taper under combined action of torque and bending moments, MPa;
d_3 = maximum diameter of stock taper, mm;
$L_{s.t}$ = length of stock taper, mm.

2.5.3.6 The value of oil pressure applied to the mating tapered surfaces of the stock and boss of the rudder during mounting and dismounting of the coupling shall not exceed P_{max}, determined from the formula:

$$P_{max} = 0{,}55\cdot R_{eH}\cdot\left[1-\left(\frac{d_m}{d_c}\right)^2\right] \qquad \textbf{(Fig. 2.5.3.6)}$$

$P_{máx}$ = in MPa;
R_{eH} = yield stress of material for the rudder or nozzle rudder boss, MPa.

2.5.3.7 The design and dimensions of the stock tail and the nut, as well as the means for securing the nut shall be a subject of special consideration by *ICS Class*

2.5.4 Where the rudder stock is not made of a solid piece, its parts are to be joined by means of a muff coupling or by other method which will be specially considered by ICS Class in each case. The muff couplings are to be joined by not less than 8 bolts.

The total area of the transversal sections of the bolts A_B, in cm^2, is not to be less than determined from the formula:

$$A_B = 0{,}44\cdot d^2 \qquad \textbf{(Fig. 2.5.4-1)}$$

d = diameter of the rudder stock in the joint, in cm.

The thickness of each muff coupling is not to be less than 0,3 of the diameter of the rudderstock in the joint, moreover, keys are to be placed with a total area of its working section in cm^2 not less than determined from the formula:

$$A_F = \frac{k_{15} \cdot M_t}{d \cdot R_{eH}} \quad \textbf{(Fig. 2.5.4-2)}$$

k_{15} = see *2.5.2.2*;
M_t = see *2.5.2.2*;
R_{eH} = upper flow limit of key, in MPa.

Between the muffs coupling sufficient allowance is to exist to ensure the safe joint by means of friction.

2.6 Rudder pintles

2.6.1 The diameter d_4 , in cm, of pintles without liners, as well as of pintles with liners, but before their setting, is to be not less than determined from the formula:

$$d_4 = 18 \cdot \sqrt{\frac{R_i}{R_{eH}}} \quad \textbf{(Fig. 2.6.1)}$$

R_i = design value of the reaction of the considered pintle (R_2 or R_4) determined according to the provisions of *2.2.4* and *2.2.5* for the appropriate type of the rudder, kN;
R_{eH} = upper yield stress of the pintle material, MPa.

2.6.2 The length of the taper part of the pintle in rudder gudgeon, in welded-in bush of the nozzle rudder or in the sole piece is not to be less than the diameter of the pintle according to *2.6.1*; the taper on the diameter is not to exceed *1:10*. The taper is to change into cylindrical portion without any step in the diameter.
The external diameter of the pintle threaded portion is not to be less than 0,8 times the minimum diameter of the taper. The outer diameter and height of the nut are not to be less than 1,5 and 0,6 times the external diameter of the pintle threaded portion, respectively.

2.6.3 The length of the taper part of the pintle in rudder gudgeon, in welded-in bush of the nozzle rudder or in the sole piece is not to be less than the diameter of the pintle according to *2.6.1*; the taper on the diameter is not to exceed *1:10*. The taper is to change into cylindrical portion without any step in the diameter.
The external diameter of the pintle threaded portion is not to be less than 0,8 times the minimum diameter of the taper. The outer diameter and height of the nut are not to be less than 1,5 and 0,6 times the external diameter of the pintle threaded portion, respectively.

2.6.4 The width of material in the rudder gudgeons and welded-in bushes of the nozzle rudder measured outside the hole for the pintle bush is not to be less than 0,5 times the diameter of the pintle without liner.
The non-compliance of this requirement in each cases shall be considered by *ICS Class*.

2.6.5 To prevent self-unscrewing, the nut is to be securely fastened by means of at least two weld-on strips or one weld-on strip and a split pin, and the pintles are to be securely fastened in gudgeons of the rudder or stem frame.

2.6.6 The chosen dimensions of the pintles are to be checked by the surface loading p, in MPa, this being taken as

$$p = \frac{10 \cdot R_i}{d_4 \cdot l_7} \quad \textbf{(Fig. 2.6.6)}$$

R_i = see *2.6.1*;
d_4 = diameter of the pintle, in cm, including its liner, where fitted;
l_7 = height of the pintle bush, in cm.

This surface loading is not to exceed the values specified in *Table 2.1.6*. Use of the materials different from those specified in this Table for rubbing parts will be specially considered by *ICS Class* in each case

2.7 Rudder axle

2.7.1 The diameter of the rudder axle directly at the flange d_5 is to be such that the non stresses a developed in its sections do not exceed 0,5 times the upper yield stress of the rudder axle material. The normal stress σ, in MPa, is to be determined from the formula:

$$\sigma = \frac{M_{r.ac}}{d_5^3} \cdot 10^4 \quad \textbf{(Fig. 2.7.1)}$$

$M_{r.a}$ = design value of the bending moment determined according to the provisions of *2.2.4.15*, kN.m;
d_5 = diameter of the rudder axle at the flange, cm.

The diameter of the rudder axle in way of the rudder bearings is to be not less than the diameter d_5. The diameter of the rudder axle between the rudder bearings may be reduced by 10 per cent.

2.7.2 As regards the tapered and threaded portions of the rudder axle and also its nut, the requirements are as stipulated in *2.6.2* for the pintles.

2.7.3 The diameter of bolts of the rudder axle flange coupling d_6 , in cm, is to be not less than determined from the formula:

$$d_6 = 6{,}77 \cdot \sqrt{\frac{\left(R_2 + \frac{M_{r.a}}{r_4}\right) \cdot \sqrt{1 + \left(0{,}17 + 0{,}6 \cdot \frac{R_2 \cdot r_5}{M_{r.a}}\right)^2}}{z_2 \cdot R_{eH}}}$$

(Fig. 2.7.3)

R_2 = design value of the reaction of the rudder axle upper bearing determined according to *2.2.4.1 1*, kN;
$M_{r.a}$ = design value of the bending moment acting in the rudder axle section near its flange determined according to *2.2.4.15*, kN.m;
r_4 = mean distance from the centre of the bolts to the centre of the system of the flange bolt holes, m;
r_5 distance from the centre line of the rudder stock to the contact plane of the rudder axle flanges and the stem frame, m;
z_2 = number of the bolts of the flange coupling;
R_{eH} = upper yield stress of the bolt material, MPa.

The number of the bolts z_2 is to be not less than 6.
The distance from the center of any bolt to the centre of the system of the flange bolt holes is to be not less than 0,7, and to the vertical axis of symmetry of the flange plane, not less than 0,6 times the diameter d_5 of the rudder axle given in *2.7.1*.

2.7.4 Only fitted bolts are to be employed, except the cases of a key setting when it is sufficient to have only two fitted bolts.
The nuts shall have standard sizes, and they shall be securely fastened by split pins or weld-on strips.

2.7.5 The thickness of the coupling flange is not to be less than the diameter of the bolts. The centers of the holes for bolts are to be distant from the outside edges of the flange by not less than 1,15 times the diameter of the bolts.

2.7.6 Where the diameter of the rudder axle changes, sufficient fillets are to be provided. At

2.7.7 To prevent self-unscrewing, the nut of the rudder axle is to be securely fastened at least by two weld-on strips or one weld-on strip and a split pin.

2.7.8 The requirements of *2.6.6* for pintles are applicable to the rudder bearings on the rudder axle.

2.8 Rudder stock bearings

2.8.1 The requirements of *2.6.6* for pintles are applicable to the rudder stock bearings taking lateral load.

2.8.2 A rudder carrier is to be installed to take the mass of the rudder or nozzle rudder and rudder stock. The deck is to be efficiently strengthened in way of the rudder carrier.
Measures are to be taken against axial displacement of the rudder or nozzle rudder and rudder stock upwards by a value exceeding that permitted by the construction of the steering gear; furthermore, for nozzle rudder measures are to be taken to provide for guaranteed clearance between propeller blades and nozzle under service conditions.

2.8.3 A stuffing box is to be fitted in way of passage of the rudder stock through the top of a rudder trunk which is open to sea to prevent water from entering the ship's space. The stuffing box is to be fitted in a place accessible for inspection and maintenance at all times.

2.9 Steering gear

2.9.1 Ships shall be provided with a main steering gear and an auxiliary steering gear, unless expressly provided otherwise.

2.9.2 The main steering gear shall be capable of putting the rudder or nozzle rudder over from 35° on one side to 35° on the other side, with the ship running ahead at maximum speed corresponding to the draught at which the rudder or nozzle rudder is fully immersed. Under the same conditions the rudder or nozzele rudder shall be capable of being put over from 35° on either side to 30° on the other side in not more than 28 s at the parameters not exceeding the rated values for the geqaqr (see Chapter 9, rule 6.2.1.5)

2.9.3 The auxiliary steering gear shall be capable of putting the rudder or nozzle rudder over from 15º, on one side to 15º on the other side in not more than 60 s, with the ship running ahead at half the maximum speed corresponding to the draught at which the rudder or nozzle rudder is fully immersed or 7 knots, whichever is the greater

2.9.4 In oil tankers, oil tankers (≥ 60ºC), combination carriers, gas carriers and chemical carriers of 10000 tons gross tonnage and upwards, in all nuclear ships and in other ships of 70000 gross tonnage and upwards the main steering gear shall comprise two or more identical power units satisfying the requirements of *2.9.5* (see also *Chapter 9, rule 6.2.1.8*).

2.9.5 In oil tankers, oil tankers (≥ 60 °C), gas chambers and chemical chambers of 1000 tons gross tonnage and upwards are to satisfy the following requirements (see also *2.9.6*).
The main steering gear is to be such that in the case of a loss of operation due to damages at any part of the power system, except the tiller, the quadrant and other elements useful for that purpose, on the obstruction the tiller device, recover its operational condition in a short period of time not greater than 45 seconds from the moment in which such system stay out of operation (see additionally *Ch 9*, *rule 6.2.1.8*).

2.9.6 In oil tankers, oil tanker (≥ 60 °C), gas carriers and chemical carriers of 1000 tons gross tonnage and upwards, but with dead tonnage lower than 100 000 tons, in consideration with *ICS Class* a different solution is to be allowed as regards *2.9.5*, not being required the only damage criterion of the tiller device if a level of safety is reached and the following conditions are satisfied:

.1 If after the loss of operation, as a result of being damaged any part of the piping system or one of the power units; it is regained after a period of 45 mins.

.2 If the steering gear had only one tiller device. In this case special care is to be given to the analysis of the stress I the constructions, including, where applicable, the analysis of breaking stresses. In each case a special care is to be given to the materials used in their tests, as well as to the assurance of a satisfactory technical work.

2.9.7 Where the main steering gear comprises two or more power units, an auxiliary steering gear need not be fitted in the following cases:

.1 In passenger and nuclear ships as well as in special purpose ships having more than 200 persons of special personnel on board the main steering gear is capable of operating as required in *2.9.2* while any one of the power units is out of operation;

.2 In cargo ships as well as in special purpose ships having 200 or less persons of special personnel on board the main steering gear is-capable of operating as required in *2.9.2* while all power units are in operation;

.3 The main steering gear is so arranged that after a single failure in its piping system or in any one of the power units the defect can be isolated so that steering capability can be maintained or speedily regained.

2.9.8 Where both the main and auxiliary steering gears are situated in a space that is entirely or partially below the uppermost load line, an emergency steering gear shall be provided which is to be arranged above the bulkhead deck.
The emergency steering gear shall be capable of putting the fully immersed rudder or nozzle rudder over from hard on one side to hard on the other side at an ahead speed of not less than 4 knots

2.9.9 Where according to *2.3.1* the diameter of the rudder head is required to be over 230 mm,

excluding strengthening for navigation in ice, provision is to be made for an additional source of electrical power as prescribed in *Chapter 11, rule 5.5.6* of sufficient to ensure operation of the steering gear power unit in compliance with the requirements of *2.9.3*.
When the diameter of the rudder head is 230 mm and less, the above-mentioned additional source of electrical power is to be also provided if the auxiliary steering gear, is not hand-operated or, according to *2.9.5*, it is not fitted.

2.9.10 The main steering gear may be hand-operated provided it meets the requirements of *Ch 9, rule 6.2.3.2* and the rudder stock diameter specified in *2.3.1* does not exceed 120 mm (excluding strengthening for navigation in ice).
In all other cases, the main steering gear shall be operated by power.

2.9.11 The auxiliary steering gear may be hand-operated provided it meets the requirements of Chapter 9, rule 6.2.3.3 and the rudder stock diameter specified in 2.3.1 does not exceed 230 mm (excluding strengthening for navigation in ice).

In other cases, the rudder tackle is not considered as a steering gear and is not necessarily to be fitted in ships.

2.9.12 The main and auxiliary steering gears shall act on the rudder stock independently of one another, but it is allowed that the main and auxiliary steering gears have some common parts (such as tiller, quadrant, gear box, cylinder block, etc.) provided the respective scantlings of these parts are increased in accordance with *Chapter 9, rule 6.2.8.2*.

2.9.13. The rudder tackle may be considered as an auxiliary or emergency steering gear only in the following cases:

.1 In self-propelled ships of less than 500 gross tonnage.

.2 In non-propelled ships.

In other cases, the rudder tackle is not considered as a steering gear and is not necessarily to be fitted in ships

2.9.14 The rudder arrangement shall be provided with a system of stops permitting to put the rudder or nozzle rudder over either side only to an angle β°:

$$\left(\alpha^o + 1^o\right) \le \beta^o \le \left(\alpha^o + 1{,}5^o\right) \quad \textbf{(Fig. 2.9.14-1)}$$

α^o = maximum hard-over angle to which the steering gear control system is adjusted but not over 35°; the greater hard-over angle is subject to special consideration by *ICS Class* in each case.

All the parts of the system of stops, including those which are at the same time the parts of the steering gear, are to be calculated to take forces corresponding to an ultimate reverse torque M_{ult}, in kN·m, from the rudder or nozzle rudder of not less than

$$M_{ult} = 1{,}135 \cdot R_{eH} \cdot d_0^{\,3} \cdot 10^{-4} \quad \textbf{(Fig. 2.9.14-2)}$$

d_0 = actual diameter of the rudder head, in cm;

R_{eH} = upper yield stress of the rudder stock material, MPa.

The stresses in these parts shall not exceed 0,95 times the upper yield stress of their material. The rudder stops of the system may be fitted on the stern frame, deck platform, bulkhead or other structural members of the ship's hull.

If in addition to the main system referred to above other systems of stops are available, they shall permit of putting the rudder or nozzle rudder over either side to an angle greater than that of the main system by 1,5°, but in any case not more than the maximum hard-over angle to which the steering gear is designed.
Where the active rudder is provided and there is a need to put the rudder over to an angle exceeding the maximum one, arrangement of stops is to be specially considered by *ICS Class* in each case.

2.9.15 Control of the main steering gear shall be provided both on the navigating bridge and in the steering gear compartment.

2.9.16 When the main steering gear is arranged according to *2.9.4* or *2.9.5*, two independent steering gear control systems are to be provided, each of which is to be operable separately from the navigating bridge. These systems may - have a common steering wheel or level. If the control system comprises a hydraulic telemeter, *ICS Class* may waive the requirement for a second independent control system of the steering gear for the ship (with the exception of oil tankers, oil tankers (≥ 60ºC), combination carriers, gas carriers and chemical carriers of 10000 gross tonnage and upwards, of other ships of 70000 gross tonnage and upwards and of nuclear ships)

2.9.17 . The auxiliary steering gear control shall be provided in the steering gear compartment. For the auxiliary steering gear which is power operated, control shall also be provided from the navigating bridge and shall be independent of the control system for the main steering gear.

2.9.18 A rudder angle indicator shall be fitted near each control station of the main and auxiliary steering gears and in the steering gear compartment. The difference between the indicated and actual positions of the rudder shall be not more than:

- 1º when the rudder or nozzle rudder is in the centre line or parallel to it;
- 1.5º for rudder angles from 0º to 5º;
- 2.5º for rudder angles from 5º to 35º

The rudder angle indication shall be independent of the steering gear control, system.

2.9.19 In all other respects the steering gear shall meet the requirements of *Chs 9* and *11*

SECTION 3

Anchor Arrangement

3.1 General provisions

3.1.1 Each ship is to be provided with anchor equipment and also with chain stoppers for securing the bower anchors in hawse pipes, devices for securing and releasing the inboard ends of the chain cables and machinery for dropping and hoisting the bower anchors as well as for holding the ship at the bower anchors dropped.

Besides, in cases specified in *3.6.1.1* each bower anchor chain cable shall be provided with a stopper for riding the ship at anchor.

3.1.2 If a ship in addition to the anchor arrangement or equipment specified in *3.1.1* is provided with some other anchor arrangement or equipment (for example, special anchors and winches on dredgers, mooring anchors on light ships, etc.), such anchor arrangement or equipment is regarded as special one and is not subject to supervision of *ICS Class*. The use of anchor arrangement specified in *3.1.1* as a working special arrangement for moving the dredgers and also for holding the dredgers in place in the course of dredging carried out by grabs is subject to special consideration by *ICS Class* in each case; it is necessary to submit to *ICS Class* the required data characterizing the conditions of work of anchor arrangement elements (the value and degree of dynamics of acting forces, the degree of intensity of work and wear rate of the anchor arrangement elements, etc.).

3.1.3 For all ships, except fishing vessels, the anchor equipment shall be selected from *table 3.1.3-1*, for fishing vessels - from *table 3.1.3-2* according to Equipment Number determined in compliance with *3.2* in the case of ships of unrestricted service and of restricted area of navigation I and according to Equipment Number reduced.

- by 15 per cent in the case of ships of restricted areas of navigation II.
- by 25 per cent in the case of ships of restricted area of navigation III, taking account of the provisions specified in *3.1.4, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.4.3, 3.4.7* and *3.4.10.*

3.1.4 For non-propelled ships the anchor equipment shall be selected according to equipment number increased by 25 per cent above that calculated in accordance with the provisions of *3.1.3*.

For self-propelled ships of unrestricted service, restricted areas of navigation I, II, having the maximum ahead speed not more than 6 knots at the draught to the summer load waterline and also for ships of restricted area of navigation III having the above speed not more than 5 knots, the anchor equipment shall be selected as in the case of non-propelled ships.

The anchor arrangement of shipborne barges and berth-connected ships should comply with the requirements of the *Rules for the Classification and Construction of Ships of Inland Navigation*, *Chapter 3*, *Section 3*. For the case of sea passage of berth-connected ships having no permanent anchor arrangement, provision should be made for anchors and anchor chains to be arranged on board.

3.1.5 For remote control systems of the anchor arrangements, if any, the type, extent of automated control and scope of remote control operations are determined by the Owner.

The additional requirements for the remote-controlled anchor arrangements are given in *3.6.5*, in *Chapter 9, rule 6.3.6* and also in *Chapter 11*, *Subsections 5.2* and *5.6*

Table 3.1.3-2 Anchoring outfits for all the fishing vessels

Equipment Number N_e		**Bower anchors**		**Chain cables for bower anchors**			**Mooring lines**		
Exceeding	**Not in excess of**	**Number**	**Mass per anchor,** (kg)	**Total length,** (m)	**Diameter** **Grade 1,** (mm)	**Diameter** **Grade 2,** (mm)	**Number**	**Length of each line** (m)	**Actual breaking strength** (kN)
1	2	3	4	5	6	7	8	9	10
10	15	1	30	55		-	2	30	29
15	20	1	40	55	(*)	-	2	30	29
20	25	1	50	82,5		-	2	40	29
25	30	1	60	82,5	(*)	-	2	50	29
30	40	1	80	82,5	11,0	-	2	50	29
40	50	2	100	192,5	11,0	-	2	60	29
50	60	2	120	192,5	12,5	-	2	60	29
60	70	2	140	192,5	12,5	-	2	80	29
70	80	2	160	220	14	12,5	2	100	34
80	90	2	180	220	14	12,5	2	100	37
90	100	2	210	220	16	14	2	110	37
100	110	2	240	220	16	14	2	110	39
110	120	2	270	247,5	17,5	16	2	110	39
120	130	2	300	247,5	17,5	16	2	110	44
130	140	2	340	275	19	17,5	2	120	44
140	150	2	390	275	19	17,5	2	120	49
150	175	2	480	275	22	19	2	120	54
175	205	2	570	302,5	24	20,5	2	120	59
205	240	2	660	302,5	26	22	2	120	64
240	280	2	780	330	28	24	3	120	71
280	320	2	900	357,5	30	26	3	140	78
320	360	2	1020	357,5	32	28	3	140	86
360	400	2	1140	385	34	30	3	140	93
400	450	2	1290	385	36	32	3	140	100
450	500	2	1440	412,5	38	34	3	140	108
500	550	2	1590	412,5	40	34	4	160	113
550	600	2	1740	440	42	36	4	160	118
600	660	2	1920	440	44	38	4	160	123
660	720	2	2100	440	46	40	4	160	128

* Chain cables or wire ropes may be used, chain cable breaking load or actual breaking strength of wire rope being not less than 44 kN.

Table 3.1.3-1 (Cont.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
910	980	3	2850	-	495	54	48	42	-	-	190	559	4	170	216
980	1060	3	3060	-	495	56	50	44	-	-	200	603	4	180	230
1060	1140	3	3300	-	495	58	50	46	-	-	200	647	4	180	250
1140	1220	3	3540	-	522,5	60	52	46	-	-	200	691	4	180	270
1220	1300	3	3780	-	522,5	62	54	48	-	-	200	738	4	180	284
1300	1390	3	4050	-	522,5	64	56	50	-	-	200	786	4	180	309
1390	1480	3	4320	-	550	66	58	50	-	-	200	836	4	180	324
1480	1570	3	4590	-	550	68	60	52	-	-	220	888	5	190	324
1570	1670	3	4890	-	550	70	62	54	-	-	220	941	5	190	333
1670	1790	3	5250	-	577,5	73	64	56	-	-	220	1024	5	190	353
1790	1930	3	5610	-	577,5	76	66	58	-	-	220	1109	5	190	378
1930	2080	3	6000	-	577,5	78	68	60	-	-	220	1168	5	190	402
2080	2230	3	6450	-	605	81	70	62	-	-	240	1259	5	200	422
2230	2380	3	6900	-	605	84	73	64	-	-	240	1356	5	200	451
2380	2530	3	7350	-	605	87	76	66	-	-	240	1453	5	200	480
2530	2700	3	7800	-	632,5	90	78	68	-	-	260	1471	6	200	480
2700	2870	3	8300	-	632,5	92	81	70	-	-	260	1471	6	200	490
2870	3040	3	8700	-	632,5	95	84	73	-	-	260	1471	6	200	500
3040	3210	3	9300	-	660	97	84	76	-	-	280	1471	6	200	520
3210	3400	3	9900	-	660	100	87	78	-	-	280	1471	6	200	554
3400	3600	3	10500	-	660	102	90	78	-	-	280	1471	6	200	588
3600	3800	3	11100	-	687,5	105	92	81	-	-	300	1471	6	200	618
3800	4000	3	11700	-	687,5	107	95	84	-	-	300	1471	6	200	647
4000	4200	3	12300	-	687,5	111	97	87	-	-	300	1471	7	200	647
4200	4400	3	12900	-	715	114	100	87	-	-	300	1471	7	200	657
4400	4600	3	13500	-	715	117	102	90	-	-	300	1471	7	200	667
4600	4800	3	14100	-	715	120	105	92	-	-	300	1471	7	200	677

Table 3.1.3-1 (Cont.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4800	5000	3	14700	-	742,5	122	107	95	-	-	300	1471	7	200	686
5000	5200	3	15400	-	742,5	124	111	97	-	-	300	1471	8	200	686
5200	5500	3	16000	-	742,5	127	111	97	-	-	300	1471	8	200	696
5500	5800	3	16900	-	742,5	130	114	100	-	-	300	1471	8	200	706
5800	6100	3	17800	-	742,5	132	117	102	-	-	300	1471	9	200	706
6100	6500	3	18800	-	742,5	-	120	107	-	-			9	200	716
6500	6900	3	20000	-	770	-	124	111	-	-	Tow lines are not required when ship's length exceeds 180 m		9	200	726
6900	7400	3	21500	-	770	-	127	114	-	-			10	200	726
7400	7900	3	23000	-	770	-	132	117	-	-			11	200	726
7900	8400	3	24500	-	770	-	137	122	-	-			11	200	736
8400	8900	3	26000	-	770	-	142	127	-	-			12	200	736
8900	9400	3	27500	-	770	-	147	132	-	-			13	200	736
9400	10000	3	29000	-	770	-	152	132	-	-			14	200	736
10000	10700	3	31000	-	770	-	-	137	-	-			15	200	736
10700	11500	3	33000	-	770	-	-	142	-	-			16	200	736
11500	12400	3	35500	-	770	-	-	147	-	-			17	200	736
12400	13400	3	38500	-	770	-	-	152	-	-			18	200	736
13400	14600	3	42000	-	770	-	-	157	-	-			19	200	736
14600	16000	3	46000	-	770	-	-	162	-	-			21	200	736

*. Chain cables or wire ropes may be used, chain cable breaking load or actual breaking strength of wire rope being not less than 44 kN.

3.2 Equipment number

3.2.1 The equipment number N_e for all ships, except floating cranes, is determined from the formula:

$$N_e = \Delta^{2/3} + 2B_h + 0{,}1A \quad \textbf{(Fig. 3.2.1)}$$

Δ = volume displacement, m^3, to the summer load waterline;
B = breadth of the ship, m;
h = height, m, from the summer load waterline to the top of the uppermost deckhouse, which is determined by the formula:
$h = a + \sum h_i$
a = distance, m, from the summer load waterline amidships to the top of the upper deck plating at side;
h_i = height, in, at the center line of each tier of superstructures or deckhouses having a breadth greater than 0,25B.

In case of ships with two or more superstructures or deckhouses along the length, only one superstructure or deckhouse of the considered tier with the greatest breadth is taken into account.

For the lowest tier h_1, is to be measured at the center line from the upper deck or, in case of a stepped upper deck, from a notional line which is a continuation of the upper deck.
When calculating *h*, sheer and trim are to be ignored. See also *3.2.2*;

A = area, in m^2, in profile view of the hull, super structures and deckhouses above tile summer load waterline which are within the ship's length *L* and also have a breadth greater than 0,25B (see also *3.2.2*).

3.2.2 Containers or other similar cargoes carried on decks and on hatchway covers, masts, derrick booms, rigging, guard rails and other similar structures may be ignored when determining *h* and *A*; bulwarks and hatch coamings less than 1,5 in height may also be ignored. Screens, bulwarks and hatch coamings more than 1,5 in height are to be regarded as deckhouses or superstructures.

Main gallows, ladders and pile drivers for lifting the ladders of dredgers may be ignored when determining *h*; when determining the value *A*, the area in profile, View of these structures shall be calculated as the area limited by the contour of the structure.

3.2.3 The equipment number N_e, for floating cranes is determined from the formula:

$$N_e = 1{,}5 \cdot \Delta^{2/3} + 2 \cdot B \cdot h + 2 \cdot S + 0{,}1 \cdot A \quad \textbf{(Fig. 3.2.3)}$$

Δ = is taken according to *3.2.1*; when determining the value of *A*, account shall be taken of the area in side profile view of the upper structure of floating crane (stowed for sea) which is calculated as the area limited by the outer contour of the structure;
B = is taken according to *3.2.1*; when determining the value of *A*, account shall be taken of the area in side profile view of the upper structure of floating crane (stowed for sea) which is calculated as the area limited by the outer contour of the structure;
h = is taken according to *3.2.1*; when determining the value of *A*, account shall be taken of the area in side profile view of the upper structure of floating crane (stowed for sea) which is calculated as the area limited by the outer contour of the structure;
A = is taken according to *3.2.1*; when determining the value of *A*, account shall be taken of the area in side profile view of the upper structure of floating crane (stowed for sea) which is calculated as the area limited by the outer contour of the structure;
S = projection on the mid-section of the front area, m^2, of the upper structure of the floating crane (stowed for sea) situated above the deck of the uppermost deckhouse taken into account in determination of *h*, the front area being determined, in this case, as the area limited by the outer contour of the structure

3.3 Bower and stream anchors

3.3.1 If the number of bower anchors determined in accordance with provisions of *3.1.3* and *3.1.4* is 3, one of them is supposed to be a spare anchor. The third, i.e. the spare anchor, is not required for ships of restricted areas of navigation I, II and III.

Ships with equipment number of 205 and less may have the second bower anchor as a spare one on condition that provision is made for its quick getting ready for use.

Ships of restricted area of navigation III with equipment number of 35 and less, if they are not passenger ships, may have only one bower anchor.

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For ships of restricted area of navigation III a stream anchor may be omitted

3.3.2 For Admiralty stocked anchors the anchor mass includes the mass of the stock.
The mass of each bower or stream anchor may differ by 7 per cent from the values determined according to *table 3.1.3-1* or *3.1.3-2* provided that the total mass of bower anchors is not less than the prescribed total mass thereof.

If high holding power anchors are used, the mass of each anchor may amount to 75 per cent of that determined according to *table 3.1.3-1* or *3.1.3-2*

3.3.3 Anchors of the following types are permitted to be used in ships:

.1 Hall's or Gruson's anchor (both are stockless);

.2 Admiralty anchor (stocked)

The mass of the head of Hall's or Gruson's anchors including pins and fittings shall be not less than 60 per cent of the total anchor mass

For admiralty stocked anchors the mass of the stock shall amount to 20 per cent of the total anchor mass including the anchor shackle.
The equipment of ships with anchors of other types is subject to special consideration by *ICS Class* in each case.

In order to recognize the anchor as a high holding power anchor, it is necessary to carry out comparative tests of this anchor and Hall's or Gruson's anchor in pair on various types of bottom; in this case, the holding power of the anchor shall be at least twice as much as that of Hall's or Gruson's anchor of the same mass.

The scope and procedure of such tests are subject to special consideration by *ICS Class* in each case.

As to the rest, the anchors shall satisfy the requirements of *Section 10*

3.4 Chain cables and ropes for bower anchors

3.4.1 Ship's with the equipment number 205 and less, in which the second bower anchor is permitted to be a spare one, and also ships with the equipment number 35 and less and provided according to *3.3.1* with only one bower anchor may be equipped with only one chain cable the length of which is two times less than that required in the relevant equipment table for two chain cables. For ships of restricted area of navigation III chain cables or wire ropes for a stream anchor may be omitted.

3.4.2 For ships having the notation *Supply vessel* added to the character of classification the total length of both chain cables for bower anchors shall be taken 165 in greater than the value specified in *Table 3.1.3-1*, and the diameter of these chain cables shall be taken not less than that given in *Table 3.1.3-1* two lines below the equipment number for the considered ship (having regard to the provisions of *3.1.3* and *3.1.4*).
For supply vessels having the equipment number over 720 at the specification depth of the anchorage over 250 in and for those having the equipment number 720 and less at the specification depth of the anchorage over 200 in, the length and diameter of chain cables for bower anchors shall be increased taking account of the specification depths and conditions of the anchorage on agreement with *ICS Class*.

3.4.3 For hopper barges and dredgers not having hoppers to transport spoil, the diameter of chain cables for bower
Anchors shall be taken not less than that specified in *Table 3.1.3-1* two lines below the equipment number of the considered ship, and for dredgers having hoppers to transport spoil, one line below (taking account of the provisions of *3.1.3* and *3.1.4*).

3.4.4 Chain cables of bower anchors are to be graded dependent on their strength as specified in *Chapter 13, Subs 7.1*.

3.4.5 *Tables 3.1.3-1* and *3.1.3-2* specify the diameters of chain cables on the assumption that the links of these chain cables are provided with studs, with the exception of the chain cables less than 15 mm in diameter which are assumed to have no studs. The use of short link chain cables of increased diameter instead of stud link chain cables 15 mm in diameter and over will be specially considered by *ICS Class* in each case.

3.4.6 The chain cables are to be composed of separate chain lengths, except for the chains less than 15 mm in diameter which need not be divided into chain lengths.
The lengths of chains are to be interconnected with joining links. The use of joining shackles instead of joining links is to be specially considered by *ICS Class* in each case.

Depending on their location in the chain cable the lengths are divided into:

- anchor length fastened to the anchor;
- intermediate lengths;
- inboard end chain length secured to the chain cable releasing device.

3.4.7 The anchor length of chain shall consist of a swivel, an end link and a minimum quantity of common and enlarged links required to form an independent length of chains. The anchor length of chains may consist only of a swivel, an end link and a joining link provided the relation between the dimensions of the chain cable parts allows to form such a length. In chain cables which are not divided into lengths of chains the swivel is to be included into each chain cable as near to the anchor as practicable. In all cases, the pins of swivels shall face the middle of the chain cable.

The anchor length is to be connected with the anchor shackle with the aid of an end shackle the pin of which shall be inserted into the anchor shackle.

3.4.8 The intermediate lengths of chains are to be not less than 25 in and not over 27,5 in, the chains consisting of the odd number of links. The total length of two chain cables given in the Equipment Tables is a sum of intermediate lengths of chains only without the anchor and inboard end lengths of chains.
If the number of intermediate lengths of chains is odd, the starboard chain cable shall have one intermediate length of chains more than the port chain cable.

3.4.9 The inboard end length of chains shall consist of a special link of enlarged size (provided, however, that this link is capable of passing freely through the wildcat of the anchor machinery) being secured to the chain cable releasing device, and of minimum number of common and enlarged links required for forming an independent chain length. The inboard end length of chains may consist of one end link only provided the relation between the dimensions of the chain cable parts and the chain cable releasing device allows to form such a length.

3.4.10 In all other respects, the chain cables for bower anchors are to comply with the requirements of *Chapter 13, Subs 7.1*.

3.4.11 For fishing vessels under 30 in length and for other ships having an equipment number 205 or less the-chain cables may be replaced with wire ropes; for fishing vessels between 30 and 40 in length one of chain cables may be replaced with a wire rope. The actual breaking strength of such ropes is not to be less than the breaking load of the corresponding chain cables, and the length is to be at least 1,5 times the length of the chain cables.
Wire ropes of trawl winches complying with this requirement may be used as anchor cables.
On agreement with *ICS Class*, ships having the equipment number 130 or less may be equipped with synthetic fiber ropes instead of chain cables or wire ropes.

3.4.12 The end of each wire rope is to be spliced into a thistle, clamp or socket and connected to the anchor by means of a chain cable section having a length equal to the distance between the anchor (in stowed for sea position) and the anchor machinery or 12,5 in, whichever is the less; a breaking load of the above chain section is to be not less than the actual breaking strength of the wire rope. The chain cable section is to be secured to the wire rope fitting and the anchor shackle by means of joining shackles being equal to the wire ropes in strength.
The length of the chain cable sections may be included into 1,5 times the length of wire ropes specified in *3.4.11*.

3.4.13 The wire ropes for anchors are to have at least 114 wires and one natural fiber core. The wires of the ropes are to have a zinc coating according to recognized standards.
In all other respects, the wire ropes for anchors are to meet the requirements of *Chapter 13, Subs 7.2*.

3.5 Chain cable and wire rope for stream anchor

3.5.1 For stream anchors it is allowed to use chain cables with studs or without them which are to meet the applicable requirements of *3.4*.

3.5.2 The requirements of *3.4.12* and *3.4.13* will be applicable to the wire rope for the stream anchor.

3.6 Anchor appliances

3.6.1 Stoppers

3.6.1.1 Each bower anchor chain cable or rope is to be provided with a stopper holding the anchor in the hawse pipe when stowed for sea or, in addition, intended for riding the ship at anchor. In ships having no anchor machinery or having the anchor machinery, which is not in compliance with the requirements of *Chapter 9, rule 6.3.2.3.2* provision of stoppers for riding the ship at anchor is obligatory.

3.6.1.2 Where the stoppers is intended only for securing the anchor in the hawse pipe when stowed for sea, its parts are to be calculated to withstand the chain cable strain equal to twice the weight of the anchor, the stresses in the stopper parts not exceeding 0,4 times the upper yield stress of their material. Where the stopper comprises a chain cable or rope, this shall have safety factor 5 in relation to the breaking load of the chain cable or actual breaking strength of the rope under the action of a force equal to twice the weight of the anchor.

3.6.1.3 Where the stopper is intended for riding the ship at anchor, its parts are to be calculated on assumption that the stopper will be subjected to a force in the chain cable equal to 0,8 times its breaking load. The stresses in the stopper parts shall not exceed 0.95 times the upper yield stress of their material. Where the stopper comprises a chain cable or rope, they shall have strength equal to that of the chain cable for which they are intended.

3.6.1.4 In glass-reinforced plastic ships the stoppers shall be fastened by bolts with the use of steel gaskets or wooden pads on the deck and under deck flooring between the framing. Bolt connections shall comply with the requirements of the *Rules for GRP Vessels.*

3.6.2 Device for securing and releasing the inboard end of the chain cable

3.6.2.1 The parts of the device for securing and releasing the inboard end of the chain cable are to be calculated for strength under the force acting on the device which is equal to 0,6 times the chain breaking load, stresses in these parts not exceeding 0,95 times the upper yield stress of their material.

3.6.2.2 In ships with an equipment number of more than 205 the device for securing and releasing the inboard end of the chain cable is to be provided with a drive from the deck on which the anchor machinery is fitted or from other deck, in a place which gives quick and ready access at all times. The screw of the drive shall be self-braking.

3.6.2.3 The design of the device for securing and releasing the inboard end of the chain cable shall ensure the efficiency of its operation both under the action of and without the strain of the chain cable referred to in *3.6.2.1*.

3.6.2.4 In glass-reinforced plastic ships the device for securing and releasing the inboard end of the chain cable shall be fastened by bolts with the use of steel gaskets on both sides of the bulkhead. Bolt connections shall comply with the requirements of the *Rules for GRP Vessels.*

3.6.3 Laying of chain cables

3.6.3.1 Laying of chain cables shall provide for their free run when dropping or hoisting the anchors.

3.6.3.2 The anchor shank shall easily enter the hawse pipe under the mere action of the chain cable tension and shall readily take off the hawse pipe when the chain cable is released.

3.6.3.3 The thickness of the hawse pipe is not to be less than 0,4 times the diameter of the chain cable passing through the hawse pipe.

3.6.3.4 In glass-reinforced plastic ships galvanized or stainless steel plates shall be fitted on the outside plating under the hawse pipes; the plates shall be fastened by countersunk bolts. Bolt connections shall comply with the requirements of the *Rules for GRP Vessel.*

3.6.4 Chain Lockers

3.6.4.1 For stowage of each bower anchor chain lockers shall be provided. When one chain locker is designed for two chains, it shall be provided with an internal division so that separate stowage of each chain is ensured.

3.6.4.2 The chain locker shall be of shape, capacity and depth adequate to provide an easy direct lead of the cables through the chain pipes, an easy self-stowing of the cables and their free veering away when dropping the anchors.

3.6.4.3 The chain locker design and covers of the access openings shall be watertight as necessary to prevent accidental flooding of the chain locker which could damage essential auxiliaries or equipment (located outside the chain locker) or could affect the proper operation of the ship.

3.6.4.4 The chain locker design shall meet the requirements of *Chapter 2*; the drainage facilities with the requirements of *Chapter 8, rule 2.1 1.1*; the lighting with the requirements of *Chapter* 11, *Subsection 6.7.*

3.6.5 Additional requirements for remote controlled anchor appliances

3.6.5.1 Stoppers and other anchor appliances for which remote control is provided (see *3.1.5*) shall also be fitted with means of local manual control.

3.6.5.2 The anchor appliances and the associated means of local manual control shall be so designed that normal operation.
Is ensured in case of failure of separate elements or the whole of the remote control system (see also *Chapter 11, rule 5.1.3*.

3.7 Anchor machinery

3.7.1 Anchor machinery shall be fitted on the deck in the fore part of the ship for dropping and hoisting the anchors, as well as for holding the ship with the bower anchors dropped if the mass of the anchor exceeds 35 kg.

3.7.2 Ships having equipment number 205 and less may be fitted with hand operated anchor machinery and may, also use other deck machinery for dropping and hoisting the anchors.

3.7.3 The requirements for the design and power of anchor machinery are given in *Chapter 9, rule 6.3*.

3.7.4 In glass-reinforced plastic ships fastening of the anchor machinery shall comply with the requirements of *3.6.1.4.*

3.8 Space parts

3.8.1 Each ship equipped with a spare anchor and chain cable (cables) for bower anchor (anchors) in accordance with the provisions of *3.3.1* and *3.4* shall have:

- Spare anchor length of chain: 1 pc
- Spare joining link:. 2 pcs.
- Spare end shackle: 1 pc

3.8.2 Each ship equipped with a spare anchor and wire rope (ropes) for bower anchor (anchors) m accordance with the provisions of *3.3.1* and 3.4.11 shall have a spare set of parts for joining the wire rope and anchor shackle.

SECTION 4

Mooring arrangement

4.1 General provisions

4.1.1 Each ship is to be supplied with mooring arrangement for warping to coastal or floating berths and for reliable fastening of the ship to them.

4.1.2 For all ships, except fishing vessels, the number, length and actual breaking strength- of mooring ropes are to be selected from *Table 3.1.3-1*, and for fishing vessels - from *Table 3.1.3-2* according to equipment number determined in compliance with *3.2*.

4.1.3 In case the ratio A/N_e, for a ship is more than 0,9 the number of mooring ropes shall be increased as against that prescribed in *Table 3.1.3-1* by:

- 1 pc for ships having $0{,}9 < A/N_e \le 1{,}1$;
- 2 pcs for ships having $1{,}1 < A/N_e \le 1{,}2$;
- 3 pcs for ships having $A/N_e > 1{,}2$.

N_e = equipment number and area in profile view specified in *3.2*.
A = equipment number and area in profile view specified in *3.2*.

4.1.4 For individual mooring ropes with breaking strength above 490 kN according to *table 3.1.3-1* the latter may be reduced with corresponding increase of the number of mooring ropes and vice versa, provided that the total breaking strength of all mooring ropes aboard the ship is not less than the value selected from *table 3.1.3-1* with regard to rule 4*.1.3* and *4.1.6*. The number of ropes shall be not less than 6 and none of the ropes shall have the breaking strength less than 490 kN.

4.1.5 The length of individual mooring ropes may be reduced by up to 7 per cent as against the prescribed value provided that the total length of all mooring ropes is not less than that specified in *table 3.1.3-1* and *rule 4.1.3* or *table 3.1.3-2.*

4.1.6 In case mooring rope made of synthetic fiber material is used, its actual breaking strength F_s, in kN, shall not be less than determined from the formula:

$$F_s = 0{,}0742 \cdot \partial_p \cdot F_t^{8/9} \quad \textbf{(Fig. 4.1.6)}$$

∂_p = elongation at breaking of the synthetic fiber rope, in percent, but not less than 30 per cent;
F_t = actual breaking strength of the mooring rope specified in *Table 3.1.3-1* or *3.1.3-2*, in kN.

4.2 Mooring ropes

4.2.1 Mooring ropes may be of steel wire, natural fiber or synthetic fiber material, with the exception of the ropes intended for ships carrying in bulk flammable liquids having the flash point below 60°C. In these ships the operations with steel wire ropes are allowed only on the superstructure decks which are not the top of liquid cargo tanks and on condition that no pipelines for loading and unloading the cargo are carried through these decks.
Not whit standing the breaking strength specified *Table 3.1.3-1* or *3.1.3-2* or determined from *Formula (4.1.6)*, the diameter of the mooring rope made from natural or synthetic fiber material shall not be less than 20 nun.

4.2.2 Steel wire ropes are to have at least 144 wires and not less than 7 fiber cores. The exception is made for wire ropes for automatic mooring winches which may have only one fiber core but the number of wires in such ropes is to be not less than 216. The wires of the ropes are to have a zinc coating according to recognized standards.
I all other respects, the steel wire ropes are to meet the requirements of *Chapter 13, Subsection 7.2.*

4.2.3 Natural fiber ropes are to be either manila or sisal. The ships having equipment number 205 and less are permitted to use hemp ropes. The use of hemp ropes in ships with equipment number over 205 is subject to special consideration by *ICS Class* in each case.
In all other respects, the natural fiber ropes are to meet the requirements of *Chapter 13, Subsection 7.3.*

4.2.4 The synthetic fiber ropes are to be manufactured form approved homogeneous materials (polypropylene, capron, nylon, etc.) Combinations of synthetic fibers of approved different material are subject to special consideration by *ICS Class* in each case. In all other respects, the ropes of synthetic fiber material are to meet the requirements of *Ch 13, Subs 7.3.*

4.3 Mooring appliances

4.3.1 The number and position of mooring bollard, fairleaders and other mooring appliances depend on the constructional features, purpose and general arrangement of the ship.

4.3.2 Bollards may be of steel or cast iron. Small ships equipped only with natural fibers or synthetic fiber ropes are permitted to use the bollards made of light alloys. As to method of manufacture, the bollards may be welded or cast. It is not permitted to use bollards cut directly in the deck which is the top of cargo tanks intended for carriage or stowage of flammable liquids having the flash point below 60°C.

4.3.3 The outside diameter of the bollard column is to be not less than 10 diameters of the steel wire rope, not less than 5,5 diameters of the synthetic fiber rope, and not less than one circumference of the natural fiber rope for which the bollard is designed. The distance between the axes of bollard columns is not to be less than 25 diameters of the steel wire rope or 3 circumferences of the natural fiber rope.

4.3.4 Bollards, fairleaders and other parts of mooring appliances with the exception of wire stoppers, as well as their beds are to be so designed that the stresses in the parts do not exceed 0,95 times the upper yield stress of their material when the mooring rope for which they are intended is subjected to the strain equal to the breaking strength of the rope.
The breaking load of the wire stoppers shall be not less than 0,5 times the actual breaking strength of the whole mooring rope for which it is intended.
In glass-reinforced plastic ships the fastening of board bards, fairleaders and other parts of mooring appliances shall comply with the requirements of *3.6.1.4.*

4.4 Mooring machinery

4.4.1 Special mooring machinery (mooring capstans, coring winches, etc.) as well as other deck machinery (windlasses, cargo winches, etc.) fitted with mooring drums may be used for warping the hawsers.

4.4.2 The choice of the number and type of mooring machinery is within the owner's and designers discretion, however, the rated pull of the machinery is not to exceed 1/3 of the actual breaking strength-of the mooring ropes used in the ship and, besides, the requirements of *Chapter 9, Subsection 6.4* are to be satisfied.

SECTION 5

Towing arrangement

5.1 General provisions

5.1.1 Each ship is to be provided with towing arrangement which satisfied the requirements of *5.2* and 5.3. Besides, the ships having the notation *Tug* added to the character of classification are to comply with the requirements of *5.4* to *5.6.*

5.1.2 Oil tankers, oil tankers (≥ 60 ºC), combination carriers, gas carriers and chemical tankers of 20000 tons deadweight and over are to comply with the requirements of *5.4* to *5.7.*

5.2 Tow line

5.2.1 The length and the actual breaking strength of the tow line are to be selected from *Table 3.1.3-1* according to equipment number determined in compliance with *3.2.*
For ship borne barges the actual breaking strength of the tow line F_b, in kN, is to be calculated by the formula:

$$F_B = 16 \cdot n \cdot B \cdot d \qquad \textbf{(Fig. 5.2.1)}$$

n = number of barges intended to he towed in the wake of the tug in tandem;
B = breadth of the barge, m;
d = draught of the barge, m.

The breaking strength of the tow line is used in the strength calculation of the towing appliances of the ship borne barges. At the discretion of the ship owner the tow lines of the ship borne barges may be stores in the barge carrier or tug, and they do not form a part of the equipment of the ship borne barge.

5.2.2 The tow lines may be of steel wire, natural fiber or synthetic fiber material. The requirements of *4.1.6, 4.2.1* to *4.2.4* for mooring ropes are also applicable to the tow line.

5.3 Towing appliances

5.3.1 The number and location of towing bollards and chocks depend on the construction features, purpose and general arrangement of the ship.

5.3.2 The requirements for mooring bollards and chocks as provided in *4.3.2, 4.3.3* and *4.3.4* are also applicable to towing bollards and chocks.

5.4 Special arrangement for tugs

5.4.1 The number and type of equipment and outfit forming special arrangement for tugs which ensures towing operations under different service conditions are determined by the Ship owner considering that such equipment and outfit satisfy the requirements of the present Chapter.

5.4.2 The main determining factor in providing the tugs with special arrangements is the rated towing pull F acting on the tow hook. The rated towing pull is to be taken as:

- for tugs of unrestricted service and of restricted areas of navigation I and II, the pull on the tow hook required for towing the prescribed tow at a prescribed speed, but not exceeding 5 knots:

- for tugs of restricted area of navigation III, the bollard pull, but in no case the rated towing pull F, in kN, is to be taken less than:

$$F = 0{,}133 \cdot P_e \qquad \textbf{(Fig. 5.4.2)}$$

P_e = total power of the tug's main engines, in kW;
c = coefficient equal to:
1,25 Tugs with common propellers.
1,40 Tugs with paddle propellers.
1,65 Tugs with controllable pitch propellers.
1,80 Tugs with common propellers and nozzle.
2,10 Tugs with controllable pitch propellers and nozzle.

The numerical value of the rated towing pull under operating conditions specified in *5.4.2* is within the owner's and designers discretion and all calculations pertaining to the determinations of this value are not subject to approval by *ICS Class*. Nevertheless, during mooring and sea trials of the tug, *ICS Class* will check this value, and, if the parts of the special arrangement prove to be calculated from a smaller value, *ICS Class* may require the strengthening of these parts or may introduce restriction of power during towing operations.

5.4.3 All stressed parts of the towing arrangement (such as the tow hook, towing rails, etc.) as well as the fastenings for securing these parts to the ship's hull are to be designed to take the actual breaking load of the tow line. The stresses in these parts are not to exceed 0,95 times the upper yield stress of their material.

5.4.4 The cramp iron of the tow hook is to be calculated as a curvilinear bar. Where such calculations are not carried out, i.e. the Formula for rectilinear bars are used, permissible stresses are to reduced by 35 per cent.
The combinations in an equal wire of different approved synthetic fibers shall be specially considered by *ICS Class*.

5.4.5 All parts of the towing arrangement which are subjected to tension or bending under the hull of the tow line are not to be manufactured of cast iron.

5.4.6 The cramp iron of the tow hook is to be either solid forged or manufactured of a solid rolled blank. Percentage elongation of the cramp iron material is not to be less than 18 per cent on 5D.

5.4.7 Tow hook are to be of slip-type and have a tow fine releasing device operating efficiently in the range of loads on the tow hook from zero to three times the rated towing pull and at any practically possible deflection of the tow line from the centre line of the ship.
The device is to be controlled both at the tow hook and from the navigation bridge. Where the ship is fitted with a spare tow hook, in addition to the main one, this hook need not be of slip-type and have a device for releasing the tow line.

5.4.8 Each tow hook is to be provided with shock absorbers whose ultimate damping load is not to be less than 1,3 times the rated towing pull. The tow hooks for tugs of less than 220 kW of restricted are of navigation III may have no shock absorbers.

5.4.9 The device for the protection of the overloading hook is to have a breaking force not higher than 3 times the towing pull.

5.4.10 Prior to the installation on ship the tow hooks are to be tested by application of a test lead equal to twice the rated towing pull.

5.4.11 The configuration of the towing arc is to be close to a parable.

The towing arcs are to be made of tube or any other acceptable profile acceptable for this purpose. The high and wide arcs are to be reinforced with a shape tubular support with tubes placed in the amidships or symmetrically. In the bulwark the arcs are to be reinforced through brackets, placing bars or tubes in their free edges.

5.4.12 The stress modulus of the area of the transversal section of the towing arc, in cm^3, is not to be less than determined from the formula:

$$W = 0,343x10^{-2} \cdot \frac{d^2 \cdot L \cdot l}{R_{eH}} \quad \textbf{(Fig. 5.4.12)}$$

d = diameter of wire for the towing with winch, in mm;
L = length of the towing wire with the hook, in m, but not less than 300 m;
l = existing length between the supports or the supports and the bulwarks, in m;
R_{eH} = fluency limit of the arc material, in MPa.

5.4.13 The area in tha transversal section of each support function in *A shape,* in cm² is not to be less than:

$$f = 0,003 \cdot \frac{d^2 \cdot L}{R_{eH}} \quad \textbf{(Fig. 5.4.13)}$$

R_{eH} = flow limit of the support material, in MPa.

5.4.14 The wire stoppers and its fastenings are to be such that their breaking load is not less than 1,5 times the rated towing pull.

5.4.15 When determining the location of the towing hook and towing winch is to take into consideration the requirements in *Chapter 4, Subsection 3.7.*

5.5 Towing winches

5.5.1 The requirements for the design of towing winches are specified in *Chapter 9, Subsection 6.5.*

5.5.2 Provision is to be made for operating the towing winch from a site at the winch; it is recommended to allow for operating the towing winch from the navigation bridge.

5.6 Toe line for towing winch

5.6.1 The length of tow line for towing winch is not to be less than 700m if the power of the tug's main engine is 2200 kW and over, and at least 500m if that power is 1470 kW or less. In the tugs with the main engines having the power in the range from 1470 to 2200 kW the length of tow line for the towing winch is to be determinate by linear interpolation.

5.6.2 In all other respects, the tow line for towing winch is to comply with the requirements set forth in *5.4.2.2.*

5.7 Special arrangements for large ships

5.7.1 The ships fisted *5.1.2* are to be fitted at the bow and stem with special arrangements for their towing in emergency.
Each towing arrangement is to consist of a chafing chain (to which the tow line of the rescue ship is connected), a fairlead and a towing gear connection or strongpoint on the ship to be towed.

Provision is to be made for easy connection of both the tow fine of the rescue ship to the chafing chain and the latter to the ship. The connection and release of the tow line are to be possible on the towed ship in case of failure of the main source of electrical power.

5.7.2 The ships listed in *5.1.2* are to be provided in the bow and stern with suitable fittings which facilities passing the tow line from the rescue ship using the rescue ship's power.

5.7.3 The emergency towing arrangement components mentioned in *5.7.1* and supporting hull structures are to be designed to withstand maximum forces arising in them under the action of the force in th tow line of 2000 kN (at any angle of the tow line up to 90° from the ship's centre line).

Under the action of the specified maximum forces the stresses shall not exceed 0,5 times the tensile strength.

5.7.4 The bow and stern towing gear connections or strong points and fairleads specified in *5.7.1* are to be located so as to facilitate towing from either side of the bow or stern and minimize the stresses in the components of the towing arrangement.

The axis of the towing gear is to be, as far as practicable, parallel to and not more that 1,5 from either side of the center line. The distance between the towing gear connection or strongpoint and the fairlead is not to be less than 2,7m and not more than 5m.

The fairleads are to be located as close as possible to the deck and, in any case, in such in position that the chafing chain is approximately parallel to the deck when it is under strain between the strongpoint and the fairlead.

5.7.5 The towing connection is to be a stopper or bracket or other fitting of equivalent strength and easy of connection to the satisfaction of *ICS Class*.

5.7.6 The fairleads are to be of a closed type with the oval opening having inner sizes of at least 600 x 450 mm. The ratio of the fairlead chain bearing surface diameter to chain diameter is to be at least 7:1.
The outboard lips of the fairlead are to be, as far as practicable, flush with the bulwarks. The inboard end of the fairlead is to be fitted to avoid fouling of any part of the towing arrangement when under lead or being handled.

5.7.7 The chafing chain mentioned in *5.7.1.* is to be stowed in such a way as to be rapidly connected to the towing gear connection or strong point.

The chafing chain is to be long enough to ensure that the towing pennant (which is connected to the chafing chain) remains outside the fairlead during the towing operation, and therefore the chafing chain are to extend from the towing gear connection or strongpoint to a point at least 3m beyond the fairlead.

5.7.8 The chafing chain mentioned in *5.7.1* and *5.7.7* is to be made up of common stud links of Grade 3 chain cable 76mm in diameter satisfying the requirements of *Chapter 13, Subsection 7.1.* One end of the chafing chain is to be provided with necessary parts to ensure easy and reliable connection to the towing gear connection or strongpoint. The other end is to be provided with a standard stud less link having the dimensions indicated in *Fig. 5.7.8.*

The above-mentioned connecting parts and standard link are to be manufactured of chain steel of Grade 3 according to the requirements of *Chapter 13, Subsection 3.6.*

Figure 5.7.8 Standard studless link

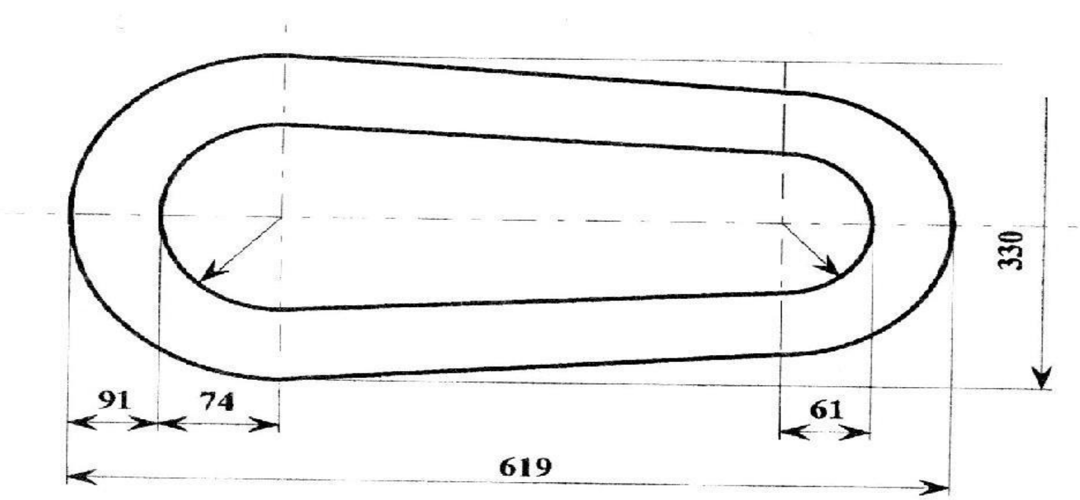

Figure 5.7.8 Standard studless link

SECTION 6

Signal masts

6.1 General Provisions

6.1.1 The requirements given in the present Section refer only to the signal masts, i.e. the masts which are intended for carrying the signal means: navigation lights, day signals, aerials, etc. Where the masts or their parts carry derrick booms or other cargo handling gear in addition to the signal means, such masts or their parts are to comply with the requirements of *Rules for the Cargo Handling Gear of Ships.*

6.1.2 Arrangement, height and provision of signal means on the signal masts are to comply with the requirements of the *Rules for the Equipment of Ships, Chapter 3.*

6.2 Stayed masts

6.2.1 The outside diameter *d* and the plate thickness *t*, in mm, at the heel of the masts made of steel having the upper yield stress from 215 up to 255 MPa and stayed by two shrouds on each side of the ship, are not to be less than:

$$d = 22 \cdot l \qquad \textbf{(Fig. 6.2.1-1)}$$

$$t = 0{,}2 \cdot l + 3 \qquad \textbf{(Fig. 6.2.1-2)}$$

l = mast length, m, from the heel to the shroud eye plates.

The diameter of the mast may be gradually decreased upwards to a value of 0,75*d* at the shroud eye plates, while the thickness of the masts plates is maintained constant throughout the length *1*.

The mast is to be stayed by the shrouds as follows:

.1 Horizontal distance *b*, in m, from the deck (or bulwark) stay eye plate to the longitudinal plane through the mast star eye plate is not to be less than:

$$a = 0{,}15 \cdot h \qquad \textbf{(Fig. 6.2.1.1)}$$

h = vertical distance, m, from the mast stay eye plate to the deck (or bulwark) stay eye plate;

.2 Horizontal distance *b*, in m, from the deck (or bulwark) stay eye plate to the longitudinal plane through the mast stay eye plate is not to be less than:

$$b = 0{,}30 \cdot h \qquad \textbf{(Fig. 6.2.1.2)}$$

.3 The value *a* is not to exceed the value *b*.

6.2.2 The actual breaking strength *F* of the ropes, in kN, used for the mast shrouds as specified in *6.2.1* is not to be less than:

$$F = 0{,}49 \cdot \left(l^2 + 10 \cdot l + 25 \right) \qquad \textbf{(Fig. 6.2.2)}$$

In other respects, the ropes for shrouds are to comply with the requirements of *Chapter 13, Subsection 7.2.*
The loose gear of shrouds (shackles, unbuckles, etc.) is to be such that their safe working load is not less than 0,25 times the actual breaking strength of the ropes referred to above.

6.2.3 The requirements of 6.4 shall apply:

.1 If the mast is made of high tensile steel, light alloys, glass-reinforces plastics or wood (the wood shall be of the 1st grade);

.2 If the mast is stayed in a way other than that specified in *6.2.1*:

.3 If in addition to a yard arm, lights and day signals, the masts is fitted with other equipment having considerable weight, such as radar reflectors with platforms for their servicing, “crow nests”, etc., proceed as specified in *6.4*.

6.2.4 The wires of shroud are to have a zinc coating according to recognized standards.

6.3 Unstayed masts

6.3.1 The outside diameter *d* and the plate thickness *t*, in mm, at the heel of masts made of steel having the upper yield stress from 215 to 225 MPa are not to be less than:

$$d = 3 \cdot l^2 \cdot \left(0{,}674 \cdot l + a + 13\right) \cdot \left(1 + \sqrt{1 + \frac{51{,}5 \cdot 10^4}{l^2 \cdot \left(0{,}674 \cdot l + a + 13\right)^2}}\right) \cdot 10^{-2}$$

(Fig. 6.3.1-1)

$$t = \frac{1}{70} d$$ **(Fig. 6.3.1-2)**

l = length of the mast from heel to top, m;
a = elevation of the mast heel above centre of gravity of the ship, m.

The outside diameter of the mast may be gradually decreased upwards to a value 0,5*d* at the distance 0,751 from the heel. In no case is the thickness of the mast plate to be less than 4 mm.
The mast heel shall be rigidly fixed in all directions.

6.3.2 The requirements of *6.4* shall apply:

.1 If the mast is made of high tensile steel, light alloys, glass-reinforced plastics or wood (the wood shall be of the 1st grade):

.2 If, in addition to a yard arm, lights and day signals, the mast is fitted with other equipment having considerable weight, such as radar reflectors with platforms for their servicing, *crow's nests*, etc.

6.4 Masts of special construction

6.4.1 In the cases specified in *6.2.3* and *6.3.2* as well as where biped, tripod and other similar masts are installed, detailed strength calculations of these masts shall be carried out. These calculations are to be submitted to *ICS Class* for consideration.

6.4.2 The calculations are to be performed on the assumption that each part of the mast is affected by a horizontal force I_f, in kN.

$$F_i = \left[m_i \cdot \frac{4 \cdot \pi^2}{T^2} \cdot \left(\theta \cdot z_i + r \cdot sen\theta \right) + m_i \cdot g \cdot sen\theta + \rho \cdot A_i \cdot cos\theta \right] \cdot 10^{-3}$$

(Fig. 6.4.2)

m_i = mass of each part, kg;
z_i = elevation of the centre of gravity of each part above that of the ship, m;
A_i = projected lateral area of each part, m²;
T = rolling or pitching period, s;
θ = amplitude of roll or pitch, rad;
r = wave half-height, m;
g = g=9,81 m/s², acceleration due to gravity;
p = p=1960 Pa specific wind pressure.

The calculations are to be carried out for rolling and pitching of the ship, *r* being taken as equal to L/40 where *L* is the ships length, m, and θ, rad., as corresponding to an angle of 40° at roll and of 5° at pitch.

6.4.3 Under the loads specified in *6.4.2*, the stresses in the parts of the mast shall not exceed 0,8 time the upper yield stress of their material where they are made of metal, and 12 MPa where they are made of wood. The safety factor of the standing ropes under the same loads is not to be less than 3.
For glass-reinforced plastic masts under the loads specified in *6.4.2* the stresses in the parts of the mast shall not exceed the allowable stress value indicated in the *Rules for GRP Vessels* to for the case of short-time action of the load for the relevant type of deformation.

SECTION 7

Openings in hull, superstructure and deckhouse and their closing appliances

7.1 General provisions

7.1.1 The requirements of the present Section apply to ships of unrestricted service as well as to ships of restricted areas of navigation I and II engaged on international voyages. The requirements for ships of restricted areas of navigation I and II not engaged on international voyages, as well as for ships of restricted are of navigation III may be relaxed, the extent of relaxation will be specially considered by *ICS Class* in each case, unless expressly provided otherwise.

7.1.2 The requirements of the present Section apply to ships to which a minimum freeboard is assigned. Departures from these requirements may be permitted for the ships to which a greater than minimum freeboard is assigned on condition that *ICS Class* is satisfied with safety conditions provided.

7.1.3 The arrangement of openings and their closing appliances in the hull, superstructures and deckhouses is also to comply with the requirements of *Chapter 6* and *Chapter 11*.

7.1.4 As fair as deck openings are concerned, the following two positions are distinguished in the present Section:

7.1.4.1 Position 1:

.1 Upon exposed parts of:
Freeboard deck;
Raised quarter deck;
Superstructure deck and deckhouse top of the first tier situated forward of 0,25 of the ship's length *L* from the forward perpendicular.

.2 Upon the same parts within the superstructures and deckhouses which are not enclosed.

7.1.4.2 Position 2

.1 Upon exposed parts of superstructure decks and deckhouse tops of the first tier situated abaft 0,25 of the ship's length *L* from the forward perpendicular.

.2 Upon the same parts within the superstructures and deckhouse of the second tier which are not enclosed.

7.1.5 The height coamings specified in the present Section is measured from the upper surface of the steel deck plating or from the upper surface of the wood or other sheathing, if fitted.

7.1.6 In supply vessels the access to the spaces situated below the open cargo deck shall preferably be provided from the location inside the enclosed superstructure or deckhouse or form the location above the superstructure deck or deckhouse top. The arrangement of companion or other hatches on the cargo deck leading to the spaces below this deck is subject to special consideration by *ICS Class* in each case, taking account of the degree of protection of these hatches from possible damage during cargo handling operations as well as the volume of spaces flooded in case of damage to the hatch.

7.2 Side scuttles

7.2.1 Position of side scuttles

7.2.1.1 The number of side scuttle in the shell plating below the freeboard deck is to be reduced to a minimum compatible with the design and proper working of the ship.
Fishing vessels mooring alongside each other or other ships at sea shall not have side scuttles under freeboard deck in the mooring zone, wherever possible. If in this zone side scuttles are fitted in the shell plating, they shall be so positioned that the possibility of their damage during mooring operations is excluded.

No side scuttles are permitted within the boundaries of the ice belt of the shell plating specified in *Chapter 2* in icebreakers and ships with ice strengthening.

7.2.1.2 No side scuttle is to be fitted in a position so that its sill is below a lien drawn parallel to the freeboard deck at side and having its lowest point located 0,025 of the ship's breadth *B* or 500 mm, whichever is the greater, above the summer load waterline or above the summer timber load waterline where timber load lines are assigned to the ship.
If the length of the ship is less than 24 m, the specified distance may be reduced to 300 mm for ships of restricted areas of navigation II and to 150 mm for ships of restricted area of navigation III.

7.2.1.3 Side scuttles in the shell plating below the freeboard deck, in front bulkheads of enclosed superstructures and deckhouse of the first tier and also in front bulkheads of enclosed superstructures and deckhouses of the second tier within 0,25L from the forward perpendicular are to be of a heavy type and fitted with efficient deadlights hinged inside (see also *Chapter 6, rule 2.4.4).*

In ships of restricted are of navigation II having the length below 24 m and in ships of restricted are of navigation III it is allowed to fit side scuttles of normal type instead of those of heavy type.

7.2.1.4 In ships to which the requirements of *Chapter 5* apply the side scuttles outside a floodable compartment or a specified group of compartments, fitted in a position so that their sills are by less than 0,3 m or [0,1+(L-10)/150] m, whichever is less, above the corresponding damage waterline and the side scuttles in the floating cranes the sills of which are by less than 0,3m above the waterline corresponding to the actual maximum static heel in case the

hook is under load, shall be not only of heavy but also of non-opening type.
In ships of restricted areas of navigation II having the length below 24m and in ships of restricted area of navigation III it is allowed to fit side scuttles of normal non-opening type instead of those of heavy non-opening type.

7.2.1.5 Side scuttles in enclosed superstructures and deckhouse of the first tier, except those in their front bulkheads, and also side scuttles in enclosed superstructures and deckhouses of the second tier within 0,25 of the ship's length *L* from the forward perpendicular, except those in their front bulkheads, may be of normal type.
In ships of restricted are of navigation II having the length below 24m and in ships of restricted area of navigation III it is allowed to fit side scuttles of light type instead of those of normal type. Side scuttles are to be fitted with efficient deadlights hinged inside.

7.2.1.6 Side scuttles in enclosed superstructures and deckhouse of the second tier, except those fitted in a position within 0,25 of the ship's length from the forward perpendicular are to be as required in *7.2.1.5*, provided these side scuttles give direct access to an open stairway leading to spaces situated below.
In cabins and similar spaces of enclosed superstructures and deckhouses of the second tier it is allowed that instead of side scuttles specified in *7.2.1.5*, the side scuttles or windows could be fitted without deadlights.

7.2.2 Additional requirements for passenger ships, fishing ships and factory ships

7.2.2.1 When scuttles in outer plating of hull in a passenger ship or a factory ship are placed underneath the bulkhead, instead a frame closing butterfly nut, a nut in which a special wrench is needed is to be provided.

7.2.2.2 Scuttles placed beyond 0,125 length after in the perpendicular above parallel the line in the bulkhead deck in the ship's side and having a lower point to a distance of 3700mm + 0,25B on uppermost compartment the load line, may have detachable deadlight cover in the passenger compartment except the loading of passengers not placed in berths.

7.2.2.3 No scuttles shall be placed underneath the bulkhead deck with the purpose of the cargo transportation.

7.2.2.4 Scuttles could be placed however in the compartments with the purpose of carrying cargo and passengers. For such cases if scuttles were open type, then instead of the butterfly nuts they are to have a nut in which a special wrench is needed.

7.2.2.5 No ventilator shall be used in any of the scuttles.

7.2.2.6 The number and dimensions of the discharge of residues from fish processing compartments in fishing ships and factory ships placed underneath the freeboard deck are to be the minimum possible in correspondence with the normal working conditions of the ship.

7.2.2.7 The discharge opening covers for the extraction of the fish processing residues are to be placed as high as possible on the summer water line.

7.2.2.8 The discharge opening covers are to open and close by means of hand-operated or mechanical hydraulic pumps of each one or in group from a place situated above the freeboard deck, as well as each one in local and manual may (in the location where the cover is found). The closing time of the covers is to be the minimum possible one.

7.2.3 Construction and attachment of side scuttles and windows

7.2.3.1 The present Rules distinguish three types of side scuttle construction:

.1 **Heavy type** with a glass thickness of not less than 10 mm for inner diameter of 200 mm and below, not less than 15 mm for inner diameter from 30 mm to 350 mm and not less than 19 mm for inner diameter of 400 mm. The inner diameter shall not exceed 400 mm. For intermediate inner diameters (from 200 mm to 300 mm and from 350 mm to 400 mm) the glass thickness is to be determined by linear interpolation.
In addition, heavy side scuttles if they are of the opening type are to have a nut, (instead of one of the ear-nuts securing their frame) being screwed off with the aid of a special wrench;

.2 **Normal type** with a glass thickness of not less than 8 mm for inner diameter of 250 mm and below, and not less than 12 mm for inner diameter of 350 mm and over, however, the inner diameter is not to exceed 400 mm. For intermediate inner diameters the thickness of the glass is to be determined by linear interpolation;

.3 **Light type** with a glass thickness of not less than 6mm for inner diameter of 250 mm and below and not less than 10 mm for inner diameter of 400 min. and over, however, the inner diameter is not to exceed 450 mm. For intermediate inner diameters the thickness of the glass is to be determined by linear interpolation.

7.2.3.2 Normal and heavy side scuttles may be of non-opening type, i.e. with the glass fixed in the main frame, or of opening type, i.e. with the glass fixed in the glazing bead efficiently hinged on the main frame. Exception is to be made for the cases specified in *7.2.1.3, 7.2.1.4* and *7.2.1.8* where the side scuttles shall be of non-opening type only. The glasses of side scuttles are to be reliably and weather tight secured by means of a metal ring provided with screws or by other equivalent device and a gasket.

7.2.3.3 The main frame, glazing bead and deadlight of side scuttles are to have sufficient strength. The glazing bead and deadlight are to be fitted with gaskets and shall be capable of being effectively closed and secured weather tight by means of ear-nuts or nut being screwed off with the aid of a special wrench.

7.2.3.4 The main frame, glazing bead, deadlight and ring for securing the glass are to be manufactures from steel, brass or other material approved by *ICS Class*.
The ear-nuts and nuts being screwed off by a special wrench are to be made of corrosion-resistant material.
Glass used for the side scuttles is to be hardened.

7.2.3.5 In glass-reinforced plastic ships side scuttles shall be attached to the outside plating and to the bulkheads of superstructures and deckhouses in accordance with the requirements of the *Rules for GRP Vessels.*

7.2.3.6 The construction of the windows shall comply with the requirements of *7.2.3.2*, *7.2.3.3* and *7.2.3.4*, except for the requirements for the dead-lights.
The thickness of the window glass *t*, in mm, shall be not less than determined from the Formula:

$$t = 0{,}32kb\sqrt{p} \qquad \textbf{(Fig. 7.2.3.6-1)}$$

b = lesser clear size of the window, m;
p = pressure head, kPa, calculated according to *2.12.3* of *Chapter 2*; distance z_i being taken up to the middle of the window height;
k = factor determined from the formula:

$$k = 13{,}42 - 5{,}125\left(\frac{b}{a}\right)^2 \qquad (7.2.2.6\text{-}2)$$

a = greater clear size of the window, m.

7.3 Flush deck scuttles

7.3.1 Flush deck scuttles in positions 1 and 2 are to be provided with deadlights hinged or attached by either method (for example, by means of a chain) and capable of being easily and efficiently closed and secured.

7.3.2 The largest of clear dimensions of the flush deck scuttles is not to be over 200 mm, with the glass being at least 15 mm thick. The flush deck scuttles shall be attached to the metal deck plating by means of frames.

7.3.3 When secured, the deadlights of the flush deck scuttles are to be weather tight. The tightness is to be ensured by a rubber or other suitable gasket.

For the same purpose, along their contour the glasses of the flush deck scuttles are to be provided with a gasket made of rubber or other suitable material.

7.3.4 The strength and materials of the flush deck scuttles parts are governed by applicable requirements specified in *7.2.2.3* and *7.2.2.4*. As regards attachment of flush deck scuttles in glass-reinforced plastic ships, see requirements of *7.2.2.5*.

7.4 Cargo ports in the ship's hull plating

7.4.1 This subsection contains the requirements on the location, calculus and structures of fore, aft sides as well as sides, as well as that of the closing devices, backing and attachment elements as well as the tightness of the structural elements of the flat cargo ports.
The structure and tightness of structural elements of cargo ports which are not flat are to comply with requirements of *Chapter 2*, taking into account the attachment requirements of tight elements.

7.4.2 The number of cargo ports shall be the minimum compatible with the design and proper working of the ship.

7.4.3 The fore cargo ports shall be the minimum compatible with the design and proper working of the ship.

7.4.4 If fore cargo ports would take a closed superstructure extending all along the ship's length or to a closed extent castle, the collision bulkhead is to have a watertight door.

The bulkhead location is to comply with the requirements in *Chapter 2.*

7.4.5 Taking into account the servicing conditions the fore cargo ports are to be located in such a way that the inner door is protected effectively.

7.4.6 The inner edge of the cargo ports is to be below the parallel line in the freeboard deck in the side and have its lowest level over the maximum load line.
The exception of this requirement could be permitted in special cases for side cargo ports in ships which are not passenger ships, of it is proved that *ICS Class* safety does not diminish. In these cases it is to be provided:

- A second hatch (inner) that for its stress and water tightness is equivalent to the outer door.
- A device which allows determining the existence of water in the space between the hatches.
- A drainage of the mentioned water to the bilge and wells which are controlled by means of a closing value or other means approved by *ICS Class*

7.4.7 Cargo ports in the hull's framing are rather to be open outside, and doors in the bulkhead shall be open afore.

7.4.8 The doors when closed are to be weathertight when at sea, and its weathertightness is to be ensured by means of rubber joint as well as the watertight closing devices.

7.4.9 The stress acting on the doors in the outside plating, are to be gone through the hatch coamings, and the supporting and joining elements. In doors with a light area less than 12 m² shall be permitted that the stresses go through the hatch coamings through the closing devices.

7.4.10 Door joints when closed and lashed are not have any deformation by applying any force.

7.4.11 The pressure which acts upon the outside door p_e, in kPa is to be determined from the formula:

$$p_e = 5,28 \cdot \left(C_w \cdot a_v \cdot a_l - 1,5 \cdot Z_1\right) \quad \textbf{(Fig. 7.4.11-1)}$$

but is not to be less than:

$$p_e(min) = 3 \cdot \frac{L}{100} + 3,5 \quad \textbf{(Fig. 7.4.11-2)}$$

Table 7.4.11 Coefficient φ_r

Coefficient φ_r for ships with navigation region			
Unlimited	**Limited I**	**Limited II**	**Limited III**
1,0	0,9-12.L 10^{-4}	0,83-16.L 10^{-4}	0,72-3,0.L 10^{-4}

L = ship's length, in m;
= calculus height of wave, m, determined from the formula:
- for L < 300 m:

$$C_w = \varphi_r \cdot \left[10{,}75 - \left(\frac{300 - L}{100} \right) \right]^{3/2} \quad (7.4.11\text{-}3)$$

- for L ≥ 300m:

$$C_w = 10{,}75 \cdot \varphi_r \quad (7.4.11\text{-}4);$$

φ_r = coefficient determined by *table 7.4.11*;
a_v = coefficient equal to:

$$a_v = 0{,}8 \cdot \frac{v}{\sqrt{L}} \cdot \left(\frac{L}{10^3} + 0{,}4 \right) + 1{,}5 \quad (7.4.11\text{-}5)$$

v = ship's speed in accordance with *2.2.2.1*;
a_L = coefficient equal to:

$$a_L = K_L \cdot \left(1 - \frac{2 \cdot x}{L} \right) \quad (7.4.11\text{-}6)$$

k_L = - 1,25 for doors whose gravity centre is located fore from midship frame;
- 0.85 for doors whose gravity centre is located aft from midship frame;
x = distance in gravity centre of the door area to the closest perpendicular (aft or fore), m,
- for aft or fore doors x = 0;
Z_1 = vertical distance from the summer load line up to the gravity centre of the door area, m, for the fore door, the gravity centre projected on the midship frame is taken into account.

The product of $a_v \cdot a_L$ is less than 1,15, to determine p_e it shall be equal to 1,15.

7.4.12 The acting pressure from inside to the door frame, p_i, in kN/m² is determined:

$$p_i = 10 \cdot Z_2 \quad \textbf{(Fig. 7.4.12-1)}$$

Z_2 = vertical distance from the gravity center of the door area up to the door which is above it, m, the gravity center of the fore door area is equal to Z_1.

In all cases, the pressure p_i is not be less than 25 kN/m².

7.4.13 Compression pressure P_e y P_i, in kN which act upon the door in the hull's outer plating, which is found in the vertical plane and acting upon the gravity center of the door area and is determined from the formula:

- Outer pressure

$$P_e = p_e \cdot A \quad \textbf{(Fig. 7.4.13-1)}$$

- Inner pressure

$$P_i = p_i \cdot A \quad \textbf{(Fig. 7.4.13-2)}$$

P_e = calculated outer pressure in accordance with *7.4.11*;
P_i = inner pressure in accordance with *7.4.12*;
A = door area, in m².

7.4.14 Each securing device of the cargo port door opening inside shall be designed to withstand the force F_1, in kN, determined from the formula:

$$F_1 = \frac{1}{n}\left(pA + 0{,}1 p_1 l_p \right) \quad \textbf{(Fig. 7.4.14)}$$

n = total number of securing devices along the perimeter of the cargo port;
A = clear area of the cargo port, m^2;
p = taken as load p_e, determined from *Formula (7.4.10*-1), kPa;
p_1 = as defined under *7.4.16*;
l_p = as defined under *7.4.16*.

7.4.15 Pressure components P_e y P_i, in kN which act upon the door in the outer hulls plating, which are not in the vertical plane and act upon the gravity center in the projection area of the door is to be determined as follows:

- Outer pressure components

$$P_{ex} = p_e \cdot A_x \quad \textbf{(Fig. 7.4.14-1)}$$

$$P_{ey} = p_e \cdot A_y \quad \textbf{(Fig. 7.4.14-2)}$$

$$P_{ez} = p_e \cdot A_z \quad \textbf{(Fig. 7.4.14-3)}$$

- Inner pressure components

$$P_{ix} = p_i \cdot A_x \quad \textbf{(Fig. 7.4.14-4)}$$

$$P_{iy} = pi \cdot A_y \quad \textbf{(Fig. 7.4.14-5)}$$

$$P_{iz} = p_i \cdot A_z \quad \textbf{(Fig. 7.4.14-6)}$$

P_e = calculated outer pressure in accordance with *7.4.11*;
P_i = inner pressure in accordance with *7.4.12*;
A_x = area projection of door in midship frame, m² (*see fig 7.4.16*);
A = door area projection over acting floating line, m² (see *fig 7.4.16*);
A_y = area projection of door over the amidship line, m² (see *fig 7.4.16*).

7.4.16 The total forces F_e and F_i, in kN which act upon the gravity center of the door area which is in the vertical plane is to be determined:

- Total outer forces

$$F_e = P_e + F_p \qquad \textbf{(Fig. 7.4.15-1)}$$

- Inner total forces

$$F_i = P_i + F_p \qquad \textbf{(Fig. 7.4.15-2)}$$

P_e = calculated outer compensating force in accordance with *7.4.13*;
P_i = calculated inner force in accordance with *7.4.13*;
F_p = contact force, in kN determined:

$$F_p = p_p \cdot l_p \qquad (7.4.15\text{-}3)$$

p_p = contact length force, kN/m, is to be considered not less than 5 kN/m;
l_p = joint length, m.

7.4.17 The total acting forces on the fore doors, fan type is to be determined as follows:

.1 Acting force on length (X shaft direction) in the lower part of aft door, in kN (see Fig. 7.4.16):

$$F_{xl} = \frac{P_{ex} \cdot b - \left(M_T \cdot g \cdot c + P_{ex} \cdot a \right)}{d} \qquad \textbf{(Fig. 7.4.16-1)}$$

$$F_{x2} = \frac{P_{ix} \cdot a - M_T \cdot g \cdot c}{d} \qquad \textbf{(Fig. 7.4.16-2)}$$

M_T = door mass, t;
g = gravity acceleration, g = 9,81 m/s²;
a = vertical distance from the door rotating point up to the position of the gravity center of the area A_y in m; the position of the center of gravity by the height, it is determined in the A_x area;
b = horizontal distance from the door rotating point up to the position of the gravity center by the length shall be determined in the A_y area;
c = horizontal distance from the door rotating point to the gravity center in the aft center;
d = vertical distance from the rotating point up to inferior edge of door, m;
P_{ex} = force determined in accordance with *7.4.14*;
P_{ix} = force determined in accordance with *7.4.14*;
P_e = force determined in accordance with *7.4.14*.

.2 Acting forces transversally to the ship (towards the shaft Y).

$$F_y = P_{ey} \qquad \textbf{(Fig. 7.4.16.2)}$$

P_{ex} = calculated force in accordance with *7.4.14*.

.3 Vertical forces (towards the shaft 2).

$$F_{z1} = P_{ez} - M_T \cdot g \qquad \textbf{(Fig. 7.4.16.3-1)}$$

$$F_{z2} = 10 \cdot V_B - M_T \cdot g \qquad \textbf{(Fig. 7.4.16.3-2)}$$

P_{ez} = calculated force in accordance with *7.4.14*.
V_B = volume of the aft space which closes the door, m³.

7.4.18 In forces to doors in aft panels the pressure shall be determined in accordance with *7.4.14*, applied to the gravity center of projection of the area of the various blocks which comprise this door, taking into account that the sealing force F_p is considered in accordance with *7.4.15*.

7.4.19 The forces acting on the outer plating of ship in accordance with *7.4.16, 7.4.17* are to be distributed along the weather tight closing devices and the attachment elements considering rules *7.4.9* and *7.4.10* depending on the direction of the opening of the door as well as the securing and safety devices.

7.4.20 The directional arm and the fore door fastenings, fan type are to be calculated taking into account the dynamic and static forces provoked by the moments of rotating mechanisms of doors when opening and closing.

7.4.21 The dimensions in the transversal cuts of the closing devices and attachment elements of doors in the hull's plating, moreover it is to be verified by the acceleration of the ship in the wave with the following stresses, in kN:

$$F_x = M_T \cdot g \cdot a_x$$ **(Fig. 7.4.20-1)**

$$F_y = M_T \cdot g \cdot a_y$$ **(Fig. 7.4.20-2)**

$$F_z = M_T \cdot g \cdot a_z$$ **(Fig. 7.4.20-3)**

a_x = a dimensional coefficient of acceleration in accordance with *1.6*;
a_y = a dimensional coefficient of acceleration in accordance with *1.6*;
a_z = a dimensional coefficient of acceleration in accordance with *1.6*;

7.4.22 With the action of forces in accordance with *7.4.19, 7.4.20* and *7.4.21* stresses in closing devices and attachment elements are not to be higher than 0,5 the flow limit of materials.

7.4.23 In each side *k* of doors are to be mounted not less than two closing devices in which one of them is to be mounted as close as possible from the corner. The distance between each closing is not to be more than 2,5 m. the supporting points for rotation could be considered as weathertight closing devises, if they carry out that function. The amount of weathertight closing devices could be reduced increasing the distance among them, if it is verified that weathertightness ensures navigation.

7.4.24 The closing devices are to be easy handling and access.
Each closing device which has a power unit, in the control station is to indicate if it is open or closed. If it were manual control it to be found in the indicating door itself.

7.4.25 The weathertight closing devices for doors with a light more than 12m^2 are to have a distant control station from a secured place.

7.4.26 The distant control station of the closing devices is to be in the control budge and is not to be available to specialized personnel. In addition to what is indicated in *7.4.24*, in the steering bridges is to have a clear description that indicates that all closing devices are to be closed before sailing moreover, warning optical signaling is to be provided.

7.4.27 When using closing devices which start operating by means of electro hydraulic mechanisms, it is to ensure that closing devices have been kept closed through mechanism systems.
In case of breakage of the electro hydraulic system, it is to ensure the operation of the manual closing devices.

7.4.28 If due to the special purpose of ship it is intended to open and close the port doors not only in ports, but also sea, measures are to be taken approved by *ICS Class* (taking into account the working conditions), which ensure the total and safe closing of door which has been opened, even when the control station of doors or closing devices remain out of service, or other measures approved by *ICS Class*, which avoid the penetration of water in the ship's spaces, when doors in the outer plating are open.

7.4.29 Devices ensuring a safe fastening of doors when they are open.

7.4.30 The operation of these doors as well as the closing devices is to comply with the requirements in *Chapters 9* and *11*.

7.4.31 In doors in the hull's platings tape elements are to be installed, which ensure the non-movement of doors regarding the case, or ensure the division among doors without affecting the weathertightness gaskets.

7.4.32 Doors in the outer plating and the ones indicated in *7.4.4*. In the collision bulkhead are to be constructed of steel or any other material approved by *ICS Class*.

7.4.33 Under the calculus load on the indicated door in *7.4.11* and *7.4.12*. The stress of side door elements are not to be greater that 0,7 of the upper flow limit of material and under the action of indicated loads in *7.4.12*, the design stress indicated in *7.4.4* are not to be greater than 0,6 limit of upper flow of material.

Figure 7.4.17 Door projection area

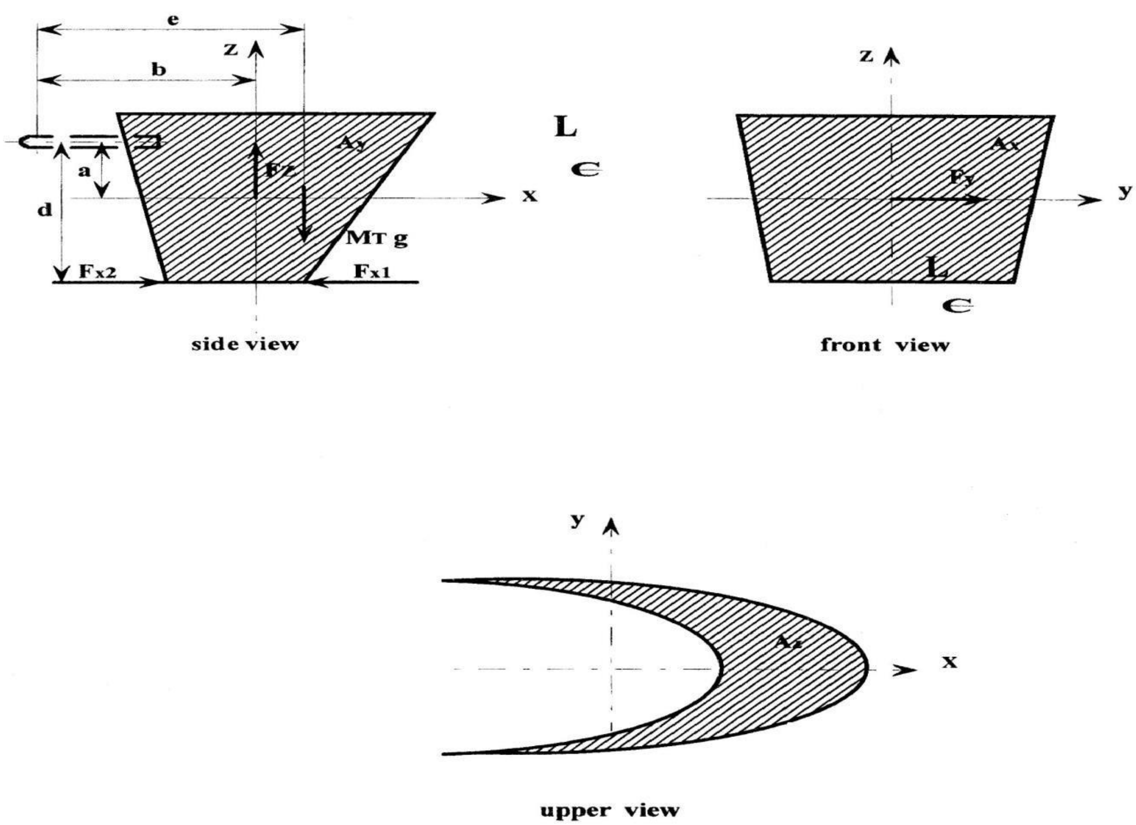

Figure 7.4.16 Door projection area

7.4.34 Irrespective of the compliance of rule *7.4.33,* the plating thickness of steel doors are not to be greater that the determined in the *Chapter 2, rules 2.2.4.8* and *2.12.4.4* for thickness in the corresponding areas of doors in bands, and the plating thickness less than indicated in the *Chapter 2, rule 2.7.4.1* for thickness in collision bulkhead.
The minimum thickness of door plating of other material is to be approved by *ICS Class*

7.4.35 What is indicated in *7.4.4* for doors in the collision bulkhead is also to comply with the requirements indicated in *rules 7.4.8, 7.4.10, 7.4.12, 7.4.13, 7.4.14, 7.4.15, 7.4.18,* and *7.4.21 – 7.4.30.*

7.4.36 The indicated doors in *7.4.35* can be used as ramps with the purpose of loads of transport means such ramps are to comply with requirements in *8.7.10.2.*

7.4.37 Passenger ships which have cargo holds with horizontal systems of cargo or special category compartment (determined in *Chapter 6, rules 1.5.4.3* and *1.5.9).*

It is to have means such as TV network or signally systems against flooding which transports to the control station bridge the sufficient information of water inlet which can flood the compartments.

Compartments which take doors or there is no a constant access, it is to control with proper means, like an observation in distance which permits movement of cargo and access of unauthorized personnel.

7.5 Superstructures and deckhouses

7.5.1 Construction, openings and closing appliances

7.5.1.1 Openings in the freeboard deck other than those defined in *7.3, 7.6* to *7.11* and *7.13* are to be protected by the enclosed superstructure or enclosed deckhouses.

7.5.1.2 Superstructures and deckhouses are considered enclosed if:

.1 Their construction complies with the requirements of *Chapter 2, Subsection 2.12;*

.2 All access openings comply with the requirements of *7.5.2* and *7.7;*

.3 All other openings in their outside contour comply with the requirements of *7.2* to *7.4* and *7.7* to *7.10.*

7.5.2 Doors in enclosed superstructures and enclosed deckhouses

7.5.2.1 All access openings in the end bulkheads of enclosed superstructures and outside of enclosed deckhouses are to be fitted with doors (see *Chapter 6, rule 2.4.5)*

7.5.2.2 The height of the sills to access openings specified in *7.5.2.1* is to be at least 380 mm. However, the bridge or poop shall not be regarded as enclosed unless access is provided for the crew to machinery and other working spaces inside these superstructures from any place in the uppermost continuous open deck or above it by alternative means which are available at all times when bulkhead openings are closed; the height of the sills of the openings in the bulkheads of such bridge or poop is to be at least 600 mm in position I and at least 380 mm in position 2.

7.5.2.3 The doors shall be so designed as to withstand the pressure head *p* calculated according to *Chapter 2, rule 2.12.3* the distance z_1, being taken up to the middle of the door height. Under the pressure head p the stresses is the door elements shall not exceed 0,8 times the upper yield stress of the material.
Whatever the stresses, the thickness of the steel door plate shall be not less than that specified in *Chapter 2, rule 2.12.4.4.* for steel doors manufactured by stamping the minimum thickness of the door plate may be reduced by 1 mm. the minimum thickness of the door plate made of other materials is subject to special consideration by *ICS Class*

7.5.2.4 The doors are to be permanently and strongly attached to the bulkhead and fitted with clamping devices or other equivalent means for expeditiously opening, closing and securing them weathertight; such devices shall be so arranged that they can be operated from both sides of the bulkhead. The doors are to be opening outside, opening of doors inside the superstructure or deckhouse space will be specially considered by *ICS Class* in each case.

7.5.2.5 The doors are to be weathertight when secured. The tightness is to be ensured by a rubber or other suitable gasket.

7.5.2.6 the doors are to be made of steel or other material approved by *ICS Class*.

7.5.2.7 In glass-reinforced platic ships the doors shall be attached to the bulkheads of superstructures and deckhouse in the same manner as the side scuttles, in accordance with the requirements of *7.2.3.5.*

7.6 Engine and boiler casings

7.6.1 Engine and boiler space openings in position 1 and 2 are to be efficiently enclosed by casings of ample strength raised above decks to the extent, which is reasonable and practicable, and being in their twin decked or termined in skylights. The construction of the casings is to meet the requirements of *Chapter 2, Subsection 2.13,* and in case of glass-reinforced plastic ships, with the requirements of *Rules for GRP Vessels.*

7.6.2 Casings are to be made weathertight.

7.6.3 Casings are to be made of steel or other materials approved by *ICS Class* (see also *Chapter 6, rule 2.1.1.2)*

7.6.4 The access openings in the casings are to be fitted with permanently attached doors complying with the requirements of *7.5.2.3* to *7.5.2.6.* The height of the sills to the access openings is to be at least 600 mm in position I and at least 380 mm in position 2.
If the length of the ship is less than 24 m, the specified height of the sills may be reduced sown to 300 mm for ships of restricted areas of navigation II.
In ships of restricted areas of navigation III having the length of 24 m and over (except passenger ships) the specified height of the sills may be reducted from 600 mm down to 450 mm and from 380 mm down to 230 mm, respectively.

7.6.5 In type "A" ships and also in type "B" ships which are permitted to have the tabular freeboard less than that prescribed by the *Rules for Load Line of Ships, table 4.1.3.2,* the engine and boiler casings are to be protected by enclosed poop or bridge of at least standard height, or by a deckhouse of equal height and equivalent strength. However, engine and bailer casings may be exposed if there are no open rungs giving direct access from the freeboard deck to the machinery space. A door complying with requirements of *7.5.2.3* to *7.5.2.6* may, however, be permitted in the machinery casing provided that it leads to a space or passageway which is a strongly constructed as the casings and is separated from the stairway to the engine and boiler room by a second similar door. The opening for the outside door is to be provided with a sill at least 600 mm in height, and that for the inside door with a sill of at least 230 mm in height.

7.6.6 Supply vessels the doors in the casings giving access to the engine or boiler rooms shall be located, where possible, inside the enclosed superstructure or deckhouse.

The door in the casing for access to the engine or boiler room may be fitted directly on the open cargo deck provided that, in addition to the first outside door, the second inside door is fitted; in this case, the outside and inside doors shall satisfy the requirements of *7.5.2.3* to *7.5.2.6*, the height of the outside door sill shall be at least 600 mm, and of the inside door sill, at least 230 mm.

7.7 Companion hatches, skylights and ventilating trunks

7.7.1 Deck openings in position 1 and 2 intended for stairways to the ship's spaces located below, as well as light and air openings to these spaces are to be protected by strong companion hatches, skylights or ventilating trunks.
Where the openings intended for stairway to the ship's spaces located below are protected by superstructures or deckhouses instead of companion hatches, these superstructures and deckhouses shall comply with the requirements of *7.5.*

7.7.2 Height of coamings of companion hatches, skylights and ventilating trunks is to be at least 600 mm in position 1 and at least 450 mm in position 2.
In ships of restricted area of navigation III having the length of 24 m and over (except passenger ships) the specified height of coamings may be reduced from 600 mm down

to 450 mm and from 450 mm down to 380 mm, respectively. If the length of the ship is less than 24 m the height of the coamings may be reduced down to 380 mm for ships of restricted areas of navigation II and down to 300 mm for ships of restricted are of navigation III.
Construction of coamings is to comply with the requirements of *Chapter 2, rule 2.6.5.2* and in case of glass reinforced plastic ships, with the requirements of the *Rules for GRP Vessels.*

7.7.3 All the companion hatches, skylights and ventilating trunks are to be provided with covers made of steel or other material approved by *ICS Class* and being permanently attached to the coamings.
Where the covers are made of steel, the thickness of their plate is to be equal to at least 0,01 times the spacing of stiffeners, but not less than 6 mm.
The minimum required thickness of 6 mm may be reduced if the cover is made by stamping in accordance with *fig. 7.7.3* and *table 7.7.3.*

Table 7.7.3 Covers constructed through stamping

Clear sizes of hatches $l \cdot b$, mm	Material of cover	Height of stamping, h mm	Minimum thickness s, mm
450 x 600	Steel		
	Light alloy	25	4
600 x 600	Steel		
	Light alloy	28	4
700 x 700	Steel		4
	Light alloy	40	6
800 x 800	Steel		4
	Light alloy	55	6
800 x 1200	Steel		5
	Light alloy	55	6
1000 x 1400	Steel	90	5

Figure 7.7.3 Covers constructed through stamping

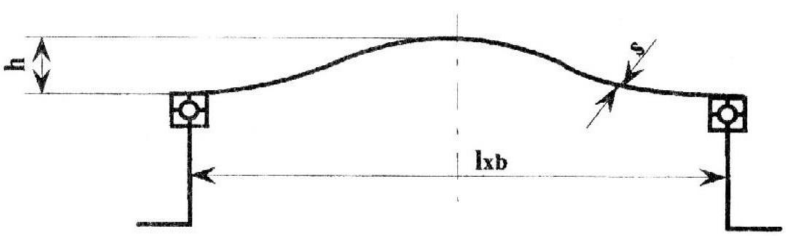

Figure 7.7.3 Covers constructed through stamping

In small ships having the deck thickness less than 6 mm the required minimum thickness 6 mm may be reduced down to the deck thickness regardless of whether the cover is made by stamping, but in no case is the plate thickness to be less than 4 mm.

7.7.4 Covers of companion, hatches, skylights and ventilating trunks are to have securing devices workable at least from outside of the hatch. However, where the hatches are used as emergency exits in addition to their primary application, the securing device is to be capable of being operated from each side of the cover. When secured, the covers are to be weathertight. The tightness is to be provided by a rubber or other suitable gaskets.

7.7.5 The glass for windows, in the covers of skylights is to be hardened and at least 6 mm thick if the inner diameter is 150 mm and below, and at least 12 mm with the inner diameter of 450 mm. For intermediate inner diameters, the thickness of glass is to be determined by linear interpolation. However, where wire-reinforced glass is used, its thickness may be 5 mm, and the requirement relating to its hardening will not be applicable. Glass is to be efficiently attached to the covers by means of a frame and have on its contour a weathertight gasket of rubber or other equivalent material.

Windows in the covers if skylights fitted in machinery spaces shall comply with the requirements of *Chapter 6, rule 2.1.4.2.*

7.7.6 Each window or group of adjacent windows is to be provided with portable shield of the same material as the cover being at least 3 mm in thickness and capable of being efficiently fastened outside the cover by means of ear-nuts; such portable shields are to be stowed adjacent to the skylights.

7.7.7 In floating docks the height of coamings of companion hatched, skylight and ventilating trunks situated on the top deck shall be at least 200 mm.

The portable shields mentioned in *7.7.6* need not to be provided for covers of skylights situated on the top deck of the floating docks.

7.8 Ventilators

7.8.1 Ventilators to spaces below freeboard deck or deck of enclosed supers and deckhouses are to be fitted with coamings efficiently connected to the deck. The coamings of ventilators are to be at least 900 mm height position 1 and at least 760 mm position 2.
In ships of restricted area of navigation III having the length of 24 m and over (except passenger ships) the specified height of the coamings may be reduced from 900 mm down to 760 mm and from 760 mm down to 600 mm, respectively.

In ships of restricted areas of navigation II and III having the length below 24 m the height of the coamings may be reduced down to 300 mm for all open decks.

Construction of comings is to comply with the requirements of *Chapter 2, rule 2.6.5.2* and in case of glass-reinforced plastic ships, with the requirements of the *Rules for GRP Vessels.*
The strength of ventilators, connections of ventilators to coamings and connections of ventilator parts, if any, shall be equivalent to that of the coaming.

7.8.2 Ventilator in position 1 the coamings of which extend to more than 4500 mm above the deck and in position 2 the coamings of which exztend to more than 2300 mm above the deck need not be fitted with closing appliances. In all other cases, each ventilator is to be fitted with a strong cover made of steel or other material approved by *ICS Class.*
In ships of less than 200 m in length, the covers are to be permanently attached; in ships of 100 m in length and over they may be conveniently stowed near the ventilators to which they are to be fitted.

7.8.3 When secured, the covers of ventilators are to be weathertight, the tightness is to be provided by a rubber or other suitable gasket.

7.8.4 In supply vessels, in order to minimize the possibility of flooding the spaces situated below, the ventilators shall be positioned in the protected locations where the probability of their damage by cargo is excluded during cargo handling operations.

Particular attention shall be given to the arrangement of ventilators to the engine and boiler rooms for which the location is preferable above the deck level of the first tier of superstructures or deckhouses.

7.9 Manholes

7.9.1 The height of coamings of manholes for deep and other tank, except for those indicated in *Chapter 2, rule 2.4.5.3*, air spaces, cofferdams, etc. will not be regulated by *ICS Class.*.

7.9.2 Covers of manholes are to be made of steel or other material approved by *ICS Class.*.

The thickness of the covers is not to be less than that of the plating on which they are fitted. In sound cases, *ICS Class* may permit to decrease the thickness of the covers where the thickness of plating is greater than 12 mm.

7.9.3 The covers of manholes are to be efficiently attached to the coaming or doubling ring by means of bolts or pins with nuts.

7.9.4 When secured, the covers are to be tight both for water and liquid cargoes or stores for which the tanks ate intended under the inner pressure corresponding to the test pressure of the tank under consideration.

The tightness is to be provided by a rubber or other suitable gasket. The gasket is to be resistant to the liquids referred to above.

7.10 Hatchways of dry cargo holds

7.10.1 General

7.10.1.1 The deck openings through which cargoes or ship's stores are loaded and unloaded are to be protected by strong hatchways. If these hatchways are situated in positions 1 and 2, the hatchway covers are to be weathertight. The tightness is to be provided by one of the following two methods:

.1 By portable covers and tarpaulins as well as battening devices.

.2 By weathertight covers made of steel or other equivalent material fitted with rubber or other suitable gaskets and clamping devices.

7.10.2 Coamings

7.10.2.1 The height of hatchway coamings in positions 1 and 2 is to be at least 600 mm and 450 mm, respectively.

If the length of the ship is less than 24 m, the height of the coamings may be reduced down to 380 nin for ships of restricted areas of navigation II and down to 300 mm for ships of restricted area of navigation III. In fishing vessels the height of cargo hatchway coamings in position 2 may be reduced down to 300 mm.

In ships of restricted are of navigation III having the length of 24 m and over (except passenger ship) the specified height of cargo hatchway coamings may be reduced from 600 mm down to 450 mm and from 450 mm down to 380 mm, respectively.
Construction of coamings in position 1 and 2 is to comply with the requirements of *Chapter 2, Subsection 2.6* and in case of glass-reinforced plastic ships, with the requirements of the *Rules for GRP Vessels.*

7.10.2.2 The height of coamings of the hatchways specified in *7.10.1.2* may be decreased in relation to that prescribed by *7.10.2.1* or the coamings may be omitted entirely where the efficiency of the cover tightness and securing means will satisfy *ICS Class.* In type "B" ships which are permitted to have the tabular Freeboard less than that prescriber by of *Rules for Load Lines of Ships, table 4.1.3.2*, such hatchways with coamings of a decreased height (or the hatchways without coamings) in case they are situated in the exposed parts of the free-board deck in way of 0,25 of the ship's length *L* from the forward perpendicular, are to be strengthened in accordance with *7.10.4.2.*

7.10.3 Materials

7.10.3.1 Regarding steel and light alloys for the closing of hatchway covers it is to follow what is indicated in *1.3.5.*

7.10.3.2 The wood of hatchway covers shall be of good quality and of the type and grade which proved to be satisfactory for this purpose. Wedges are to be of hard wood.

7.10.3.3 Canvas used for making tarpaulins is to be impregnated to make them moisture-resistant and shall not contain jute thread. Mass of 1m^2 of canvas before impregnation is to be not less than 0,55 kg. Breaking stress of impregnated canvas band 200 x 50 mm in size is to be at least 3 kN and 2 kN in longitudinal and transverse directions, respectively. When tested for watertightness, the impregnated canvas shall not get wet under water head of 0,15 m acting for 24 hours.
Use of tarpaulins made of synthetic fiber will be specially considered by *ICS Class* in each case.

7.10.3.4 The rubber for packing gaskets of hatchway covers is to be elastic, strong, and resistant to atmospheric changes. The rubber is to be of sufficient hardness.

7.10.3.5 Adhesives for fastening the rubber in the grooved of hatchway covers are to meet to requirements of *Chapter 13, Subsection 6.5.*

7.10.4 Design loads

7.10.4.1 Hatchway covers are to be designed to sustain deck cargoes which are intended to be carried on these covers. Where operation of the cargo handling cards on hatchways covers is anticipated in the course of the ship's service, during cargo handling operations, the loads induced by such cars are to be taken into consideration. For hatchway covers in position 1 and 2 it is additionally required that the value of the design deck load is not to be less than the product of the cover area by the load intensity given in *table 7.10.4.1*

Table 7.10.4.1 Design load intensity

Location of cargo hatchways	**Design load intensity, kPa, at ship's length *L***	
	24 m and less	**100 m and over**
Zone 1	9,81	17,16
Zone 2	7,35	12,75

For ships of more than 24 m, but less than 100 m in length the design load intensity is to be found by linear interpolation.

For ships of less than 24 m in length of restricted are of navigation engaged on international voyages and for all ships of restricted are of navigation not engaged on international voyages the load intensity reduced by:

- 15 per cent for ships of restricted areas of navigation II.

- 30 per cent for ships of restricted area of navigation III may be taken in calculations instead of the values given in *Table 7.10.4.1.*

In any case, the design load for open-deck hatch covers is not to be adopted less than P_w, determined in accordance with *Chapter 2, rule 1.3.2.2.*

7.10.4.2 In type "B" ships which are permitted to have the freeboard less than prescribed by *Rules for Load Line of Ships, table 4.1.3.2* if they are provided with hatchways without coamings in the exposed parts of the freeboard deck in way of 0,258 of the ship's length *L* from the forward perpendicular, the design load for covers of these hatchways is to be increased by 15 per cent over that given in *Table 7.10.4.1.* Where these hatchways are provided with coamings, but their height is less than given in *7.10.2.1,* the percentage of the load increase is to be found by linear interpolation.

7.10.4.3 When deck cargo other than containers is carried, the design load on cargo hatch covers should not be less than stipulated by *Chapter 2, rule 1.3.4.1.*

7.10.4.4 When containers of international standard types are carried on hatch covers, the design load P_z, in kN, concentrated at the points where the corner fitting of the containers are installed is determined, for the purpose of calculating the deck cargo effect as stipulated by *7.10.4.1* and *7.10.4.3*, by the following formula:

$$P_z = m \cdot g \cdot (1 + a_z)$$ **(Fig. 7.10.4.4)**

m = maximum mass of container stack, in t;

g = gravity acceleration equal to 9,81 m/s²;

a_z = dimension less acceleration factor in accordance with *1.7.2*.

Besides, the vertical components of the initial pull of the lashings (if fitted securing containers should be included in the calculation as an additional load.

7.10.4.5 Where cargo-handling cars and wheeled vehicles are to be used on hatch cover during cargo handling operations, the loads upon hatch covers are determined in accordance with Chapter 2, rule 3.2.3.

7.10.4.6 The hatch covers of lower decks not intended for the carriage of cargo should be designed to bear:

- evenly distribute load of 2 kPa intensity;
- force of 3 kN applied to any pint upon the hatch cover.

7.10.4.7 In strength and rigidity calculations of hatch covers, their own weight is ignored.

7.10.5 Strength and rigidity criteria

7.10.5.1 Where hatch covers in position 1 and 2 come under design loads, the stresses in the structural components are not to exceed the values of *Table 7.10.5.1.*

7.10.5.2 Where the hatch covers of lower decks come under design loads, the stresses in the structural component are not to exceed the values of *table 7.10.5.2*

Table 7.10.5.1 Stresses in the structural components hatch covers

Type of hatch covers	Design load according to	σ	τ	σ_{com}
1	2	3	4	5
Portable beams and pontoon hatch covers	7.10.4.1 7.10.4.2	0,35 R^1_{eH} or 0,2 R_{eH}	0,25 R_{eH}	-
	7.10.4.3 7.10.4.4 7.10.4.5	0,5 R_{eH}	0,35 R_{eH}	-
Hatch covers of other designs [2]	7.10.4.1 7.10.4.2	0,4 R_{eH} or 0,235 R_{eH}	0,3 R_{eH}	-
	7.10.4.3 7.10.4.4	0,65 R_{eH}	0,4 R_{eH}	0,71 R_{eH}
	7.10.4.5	0,65 R_{eH}	0,45 R_{eH}	0,77 R_{eH}

NOTES:
[1] Whichever is less
[2] Whichever is less
σ Normal stresses;
τ Tangential stresses;
σ_{com} Combined stresses, see *1.5.1*;
R_{eH} Upper yield strength of hatch cover material;
R_m Ultimate strength of hatch cover material.

Table 7.10.5.2 Stresses in the structural components of hatch covers in lower decks

Type of hatch covers	Design load according to	σ	τ	σ_{com}
1	2	3	4	5
Portable beams	7.10.4.3	0,5 R_{eH}	0,35 R_{eH}	-
Pontoon hatch covers and other hatch cover designs	7.10.4.4 7.10.4.5 7.10.4.6	0,65 R_{eH}	0,45 R_{eH}	0,75 R_{eH}
NOTES: For σ, τ, σ_{com} and R_{eH}, see *7.10.5.1*.				

7.10.5.3 For hatch covers in position 1 and 2, the deflection under the design load mentioned in *7.10.4.1* and *7.10.4.2* is not to exceed the following values:

- 0,0022 of the span for portable beams and pontoon covers,
- 0,0028 of the span for hatch covers of other design.

7.10.6 Stress standards

7.10.6.1 The stability of structural components of hatch covers is considered to guarantee provided the following conditions are met:

$\sigma \leq 0,87\sigma_{cr}$ **(Fig. 7.10.6.1-1)**

$\tau \leq 0,87\tau_{cr}$ **(Fig. 7.10.6.1-2)**

σ = normal and tangential stresses in action, in MPa;
τ = normal and tangential stresses in action, in MPa;
σ_{cr} = critical normal and tangential stresses, in MPa, determined in accordance with *Chapter 2, rule 1.6.5.3*;
τ_{cr} = critical normal and tangential stresses, in MPa, determined in accordance with *Chapter 2, rule 1.6.5.3.*

7.10.7 Construction of hatchway covers specified in:

7.10.7.1 These covers are to be so constructed as to prevent their accidental opening under the effect of sea and weather.

7.10.7.2 Portable beams are to be placed in sockets of the coamings and locked therein. Where portable beams are of sliding type, efficient devices are to be provided for locking them whem the hatchway is either closed or open.

7.10.7.3 If the hatchway covers are jointed on the portable beam, a vertical flat bar of at least 60 mm in height is to be attached by welding to the upper flange of the beam.

7.10.7.4 The width of each bearing surface for hatchway covers is to be at least 65 mm.

7.10.7.5 Where the covers are made of wood, their finished thickness is to be at least 60 mm for a load intensity sustained by the cover equal to 17,16 kPa and less. If the load intensity exceeds this value, the above thickness is to be increased by 15 mm per 0,981 kPa of overload. In all cases, the portable beams of the hatchway provided with wooden covers are to be spaced not more than 1,5 m apart. Independently of the provisions of 7.10.5, all covers made of steel are to have the thickness of their plating at least 0,01 times the spacing of stiffeners or 6 mm, whichever is the greater.

If the covers are made of light alloys, the minimum thickness of their top plating will be special considered by *ICS Class* in each case.

7.10.7.6 The hatchways in position 1 and 2 are to be protected by at least two layers of tarpaulins.

Tarpaulins are to be tightly pressed against the hatchways coamings with the aid of battens and wedges, for which purpose the coamings, as well as horizontal stiffeners, if fitted, are to be provided with cleats of at least 65 mm wide and 10 mm thick; edges of the cleats shall be rounded so that the possibility of cutting the wedges is brought to the minimum. Cleats are to be spaced not more than 600 mm centre; the cleats along each side or end are to be not more than 150 mm from hatch corners. The cleats are to be so mounted as to provide setting of wedges in them in the fore to aft direction on the side coamings, and from the sides to centre fine direction on the end coamings.

Wedges are to be not less than 200 mm in length and 50 mm in width a taper of not more than 1:6, and a thickness not less than 13 mm at the thinnest point.

7.10.7.7 Steel bars or other equivalent means are to be provided in order to efficiently and independently secure each section of hatchway covers after the tarpaulins are battened down. Section of hatchway covers of more than 1,5 m in length shall be secured by at least two such securing appliances.

7.10.8 Construction of hatchway covers specified in *7.10.1.2*

7.10.8.1 These covers are to be so constructed as to prevent their accidental opening under the effect of sea and weather.

When secured, the covers shall be pressed against the bearing surface of the coamings without further deformation of the packing gasket.

7.10.8.2 The scantlings of components of hatch covers made of steel are determined in conformity with the requirements of *7.10.4 – 7.10.6.*

For primary members and webs, the effective flange width is determined in accordance with *Chapter 2, rules 1.6.3.3* and *1.6.3.4*, the effective flange thickness is determined in accordance with *1.6.3.2* of the same Part. The application of fight alloys is in each case subject to special consideration by *ICS Class.*

7.10.8.3 Irrespective of the provisions of *7.10.8.2* being complied with, the top plating thickness *t*, in mm, of steel hatch covers should not be less than determined from the formula:

$$t = 10 \cdot a \quad \textbf{(Fig. 7.10.8.3)}$$

a = distance between the stiffeners, in m.

In any case, the top plating thickness not to be less than 6 mm.

7.10.8.4 Where cargo-handling cars are to be used on hatch covers, the top plating thickness should not be less than Stipulated by *Chapter 2, rule 3.2.4.1.*

7.10.8.5 The hatchway covers on which containers are carried shall be provided, in way of corner fittings of containers, with structural elements ensuring immediate load transfer from the containers to the cover framing.

If the above-mentioned structural elements are not coincident with the cover stiffeners in way of fitting the former, the additional stiffeners shall be provided having section modulus equal to 0,8 times that of main stiffeners of the cover. In this case, structural bonding of main and additional stiffeners shall be ensured.

7.10.8.6 Where dry cargo holds are adapted for transportation of dangerous goods (see *Chapter 6, Subsection 1.2*), cargo hatch covers of the upper deck are to be made of steel; the cargo hatch covers of upper and lower decks are to be provided with drives ensuring smooth movement (without striking) of cover and all parts of hatch covers. The design of the drives should be such that in the case of their failure no dropping of the covers could occur during closing or opening operations; reliable securing of covers kept open should be provided. Measures are to be taken to prevent the ingress of working fluid of the drives for these hatch covers into cargo holds (see also *Chapter 6, rules 2.8.2* and *2.8.17*).

7.10.8.7 Each hatch cover or section of hatch covers should be fitted with proper securing devices along its transverse and longitudinal sides, which would ensure the weather tightness of the cover.
The number of securing devices is not to be less than two on each side of the section, and the securing devices should be spaced not more than 6m apart.

The securing device fitted in close proximity to the corner of the section is considered to be the device both for the transverse and longitudinal sides of the sections, and the securing device fitted in way of two jointed sections and pressing the corners of the two sections against the coaming is considered to be the device both for the transverse and longitudinal sides of the two sections adjacent to the device.

7.10.8.8 Each securing device of the hatchway cover shall be calculated for the action of force *F*, in N, determined from the formula:

$$F = \frac{1}{n}\left[m \cdot g \cdot \left(8 \cdot a_y - k\right) + p \cdot l_p\right] \quad (7.10.8.8)$$

m = total mass of covers of the hatchway under consideration, kg;
n = total number of securing devices along the perimeter of the hatchway under consideration;
l_p = clear perimeter of the hatchway under consideration, m;
p = pressure of the packing gasket when compressed to the maximum depth possible for the accepted design, N/m. Where the value p is less than 4900 N/m in calculations performed according to *Formula (7.10.8.6)*, p is taken equal to 4900 N/m;
g = acceleration due to gravity equal to 9,81 m/s^2;
a_y = dimensionless acceleration to be determined in accordance with *1.7* as applied to the centre of gravity of the considered hatchway covers;
k = coefficient to be determined from the formula:

L = ship's length, in m.

In any case, *F* should not be taken less than 40 kN.

7.10.8.9 When the securing device is under the effect of the design force specified in *7.10.8.8*, the stresses in its parts shall not exceed 0,8 times the upper yield stress of material.

7.10.8.10 Hatching closing, in which cargoes are transported and have not special construction which ensure the immobility of the cover sections, determined in *7.10.8.14*, are to be calculated in the force provoked by a shore angle of 60°. In those cases tensions on closing are not to be higher than 0,8 of the maximum stress limit of the material.

7.10.8.11 Irrespective of the results calculated in accordance with *7.10.8.8*, the free section area *A*, in cm^{2,} of the securing device should not be less than determined from the formula:

$$A = \frac{1{,}4 \cdot a}{f} \qquad \textbf{(Fig. 7.10.8.10)}$$

a = distance between securing devices, in m, which in any case should not be adopted less than 2 m;
f = factor determined from the formula:
R_{eH} = the upper yield strength of the securing device material, in MPa, and should not be adopted greater than 0,7 of the tensile strength of the material;
e = index equal to:
- 0,75 for $R_{eH} > 235$ *MPa;*
- 1,00 for $R_{eH} \le 235$ *MPa*

For hatch covers and hatch cover sections having an area in excess of 5m, the active diameter of bars and bolts of the securing devices should not be less than 9 mm.

7.10.8.12 Where the packing gaskets is compressed to the maximum depth possible and its pressure exceed 5000 N/m, the area of securing devices as determined in accordance with *7.10.8.10* should be increased in a relevant proportion.

7.10.8.13 To ensure a sufficient pressure of the packing gasket between securing devices, the cross-sectional inertia moment of the securing device covers fitted in corners, *l*, in cm^4, is not to be less than determined from the formula:

$$I = 6 \cdot p \cdot a^4 \cdot 10^{-3} \qquad \textbf{(Fig. 7.10.8.12)}$$

p = pressure of the packing gasket when compressed to the maximum depth possible for the accepted design, in N/m, but not less than 5 000 N/m;

a = distance between securing devices, in m.

7.10.8.14 Covers on which cargoes are to be carried are to be provided with securing devices preventing the cover sections from shifting relative to the hatchway coaming during rolling or prolonged statically heel. These securing devices are to be calculated to take up the load induced therein when the common centre of gravity of the cover with the cargo thereon is affected by the loads directed perpendicular to the centre plane of the ship P_y and parallel to the centre plane P_x, obtained in N, using the following formula:

$$P_y = m \cdot g \cdot a_y$$ **(Fig. 7.10.8.13-1)**

$$P_x = m \cdot g \cdot a_x$$ **(Fig. 7.10.8.13-2)**

m = total mass of the cover and cargo secured thereon, kg,
g = acceleration due to gravity equal to 9,81 m/s²;
a_x and a_y = dimension less accelerations obtained in accordance with *1.7* as applied to the common centre of gravity of the considered cover with cargo thereon. For hatchway covers of shipborne barges, when determining ay and a., to be taken as *L* and *B* are the length and the breadth of the barge carrier (on which the considered shipborne barge is transported), and as *x* and *z* the maximum possible distances between the centre of gravity of the cover, and the midship frame and the summer load waterline of the barge carrier, respectively, are to be taken.

Stresses arising in the parts of securing devices are not to exceed 0,8 times the upper yield stress of the material of which these devices are made.

7.10.8.15 In ships underway having large hatchways for which considerable deformation of the hatchway coamings is possible the following should be met:

.1 The design of the securing device shall allow for possible horizontal shifting of the cover section from the coaming.

.2 In the hinged joints of the cover sections to each other and to the hatchway coaming provision shall be made for clearances adequate for possible horizontal relative shifting of the sections without obstruction.

.3 Over the lower bearing edges of cover sections, an appropriate metal contact surface should be provided allowing for free gliding of sections over hatch coamings.

.4 The horizontal stiffener of hatch coaming on which the covers rest should be properly stiffened to ensure a permanent contact of the cover section and coaming.

7.10.8.16 Hydraulic drives of hatch covers should comply with *Chapter 11*.
The hatchway covers and the drives are to be so designed as to make it possible to close the hatch kept open shall be provided. The direction of the cover opening shall ensure, wherever possible, maximum protection of open hatches from exposure to sea.

7.10.9 Hatch covers design for lower decks

7.10.9.1 The hatch cover designs for lower decks should comply with the requirements of *7.10.7* and *7.10.8.*

7.11 Hatchways of cargo tanks in type “A” ships and oil recovery ships.

7.11.1 Openings of the hatchways of the cargo tanks on tankers are to be of round or oval form. Height of the coamings of cargo tank hatchways will not be regulated by *ICS Class*. Construction of the coamings of cargo tank hatchways is to comply with the requirements of *Chapter 2, rule 3.5.5.1.*

7.11.2 Covers of hatches and tank cleaning openings are to be made of steel, bronze or brass. Use of other materials is subject to special consideration by *ICS Class* in each case.
In ships carrying flammable liquids in bulk use of fight alloys for covers of hatches and tank cleaning openings is not permitted.

7.11.3 Covers of the cargo tank hatchways are to be permanently attached and tight when secured, under the inner pressure of liquid carried in tanks to a head of at least 2,5 m. tightness is to be provided by a rubber or other suitable gasket being resistant to the liquids which are carried in the cargo tanks.

7.11.4 The plate of the cargo tank hatchway covers id to be at least 12 mm in thickness if it is of steel. The cover plate is to be reinforced by stiffeners made of flat bars not less than 80 x 12 mm in size and spaced at every 600 mm of the cover length, or the cover is to be of spherical shape.

7.11.5 The hatchway cover is to be provided with a sighting port having an inner diameter of 150 mm and closed by a cover of similar construction.

7.11.6 Materials and design of cargo tank hatch-way covers in ships intended to carry flammable liquids are to be so selected as to preclude spark formation during opening and closing the covers.

7.12 Openings in watertight subdivision bulkheads and their closing appliances

7.12.1 General provisions

7.12.1.1 Unless expressly provided otherwise, the present Chapter covers ships to which the requirements of *Chapter 5* apply.
For other ships, the requirements of this Chapter apply to bulkheads only, provided in accordance with *Chapter 2, rule 2.7.1.4*; for these ships, the requirements may be relaxed, and the degree of relaxation will be specially considered by *ICS Class* in each case.
In ships indicated in *7.12.6.1*, the requirements of *7.12.2 – 7.12.5* may be relaxed for doors fitted in watertight subdivision bulkheads dividing a cargo space from an adjoining cargo space provided the requirements of *7.12.6* are met.

7.12.1.2 The number of openings in watertight bulkheads should be reduced to minimum compatible with the design and normal service conditions of the ship.

7.12.1.3 Where piping and electric cables are carried through watertight subdivision bulkheads, the requirements of *Chapter 8, rule 1.6.1* and *Chapter 11, rule 16-8.6*, should be taken into consideration.

7.12.2 Doors in watertight subdivision bulkheads. General provisions

7.12.2.1 Doors in subdivision bulkheads shall be of the type required in *table 7.12.2.1*.

Table 7.12.2.1
CharacteristICS Class of doors in bulkhead

Type	**CharacteristICS Class**
1	Descending door
2	Hand-operated sliding door
3	Hand-operated and power-operated sliding doors

7.12.2.2 The doors are to be made of steel. The use of other materials will be specially considered by *ICS Class* in each case.

7.12.2.3 Doors are to withstand the pressure of a water head of the height measured from the lower edge of doorway to the underside of bulkhead deck plating at the center line, but not less than 5 m.

7.12.2.4 Under the effect of water head specified in *7.12.2.3*, the stresses in the door frame and door plate are no to exceed 0,6 times the upper yield stress of their material.

7.12.2.5 When closed, the doors are to be tight under the pressure of a water heads of the height specified in *7.12.2.3.*

7.12.2.6 Each means of operation of the doors should alone ensure closure of the door with the ship listed 15° either way and with a trim up to 5°. Doors closed by dropping or by the effect of a dropping weight are not permitted. Portable plates secured by bolts only are not permitted.

7.12.2.7 Frames in doors type II and III with vertical motion are not to have plates in the lower part where rubbish is stores which constitute a failure in closing the door.

7.12.3 Doors type I

7.12.3.1 Doors type Y are to be provided with fast closing devices, which should be operated from both sides of the bulkhead doors are to have a rubber joint or any other appropriate.

7.12.4 Doors type II

7.12.4.1 Doors type II could be of horizontal or vertical motion.

7.12.4.2 The closing device of the doors shall allow its operation (door opening and closing) from both sides of the bulkhead deck with a steering wheel, a crank or any other similar accessory, the stress applied to the wheel, crank or any other accessory in the moving period of the door is not to be higher than 157 N.

7.12.4.3 If in the place above the bulkhead deck where the door closing and opening devices are found and cannot be seen then any lead in the wheel or any other similar accessory should be placed indicating when the doors is either open or closed. The necessary time needed for the total closing of the door by higher 90 seconds when the ship is right.

7.12.5 Doors type III

7.12.5.1 If hand-operated, it should be possible to open and close the door from both sides of the bulkhead and, in addition, from an accessible position above the bulkhead deck by means of a hand wheel, knob or another similar gear.
The force applied to the hand wheel, knob or similar gear while the door is in motion is not to exceed 157 N.

7.12.5.2 The closing device having a power unit is to ensure the possibility of pushing the closing and opening doors from both sides of the bulkhead local controls are to be placed so that any person going through the door can keep them in open position without being taken to the close position.

7.12.5.3 Besides having control close the door, the closing device having a power unit, is to be pushed from a main control station. For such case an installation which closes the door being closed from a main control station, was opened from the command close to it.
Furthermore, it is to avoid that from any closed door from the local control could be opened from the main station.

7.12.5.4 The closing device having a power unit is to ensure the closing of the door in a period of time not more than 60 s and not less than 10 seconds having the ship righted.
The closing of the door from the moment it starts moving to its total closing, is to be accompanied by a non-stop audible signal.
The signaling device is to be closed on both sides of the bulkhead. When the door is closed from the main control station, the indicated signaling device, in addition to the signal which accompanies the closing operation is to emit a preventive non-stop audible signal within 30 seconds, after the closing of the door shall be automatic. The length of the audible preventive signal shall not be included in the required time to close the door as indicated in the above paragraph.

7.12.5.5 The main control station in doors type III is to be located in the control station it is to placed so that it ensures either the individual closing or of each door or of all of them simultaneously. For each door, in the main control station it must have leads indicating if the door is closed or not.

7.12.5.6 The energy of the closing devices type III are to have at least two independent source. Each of them is ensure the simultaneous operation of all the doors. Both power units are to be controlled from the main control station as indicated in *7.12.5.5*, in which all the leads shall be provided marking sure that each of the two power units are operating properly.

7.12.5.7 When the closing device is hydraulic, each of the two power units indicated in *7.12.5.6* is to operate a pump.
Furthermore a third unit of hydraulic accumulator is to be provided with a sufficient capacity to ensure at least three times the pushing of all the doors (that is, closing, opening-closing). The liquid applied in the system is not being freeze at any temperature during the operation of the ship.

7.12.5.8 The electric equipment is doors type III is to comply with the requirements in *Chapter 11, rule 5.10.2*.

7.12.6 Requirements to the installation of doors

7.12.6.1 No doors are permitted in:
Collision bulkhead below the bulkhead deck of ships having a subdivision distinguishing

mark in the class notation and below the freeboard deck of all other ships;

Watertight subdivision bulkheads dividing a cargo space from an adjoining cargo space except where *ICS Class* is satisfied that such doors are essential. In this case, the doors may be hinged, sliding or of another equivalent type, but they should not be remotely controlled.
In passenger ships with subdivision distinguishing in the class notation, the outboard vertical edges of the doors are not to be located at less than 0,2 of the ship breadth. This distance is to be measured at right angles to the center line of the ship at the level of the deepest subdivision load line.

7.12.6.2 In doors whose inner edge are located watertight floating line with the exception of passenger ships and special purpose ships:

.1 If the amount of such doors in ships, with the exception of the doors which conduct the propeller shaft tunnels were more than 5, all of them are to be doors type III.
If the amount of this door type is less than 5 then all doors could be type II.

.2 In special purpose ships of length less than 50m, which have compartment for specialized personnel under the bulkhead deck, all doors, as well as the access doors of the propeller shaft tunnels are to be type III.

7.12.6.3 In all ships, excepting special ships with length above 50 m and passenger ships, doors type I located in passenger and crewmen compartment between bridges, as well as the servicing spaces doors can only be installed in the case that the upper edge of its hatch coamings are located at a distance not less than 300 mm over the damage floating, corresponding to the most critical case of flooding of the compartments (or its combination, when it is required by *Chapter 5*), located at each side of bulkhead the ship after the indicated flooding.

7.12.6.4 If conditions of the previous subsection referring the upper edge of the coamings are not complied, doors are to be at least, type III.
An exception could be made with ships with short voyage in which for *Chapter 5,* a factor of 0,50 or less; in this case doors are to be type III.

7.12.7 Doors in passenger ships and special purpose ships with length above 50 m

7.12.7.1 The requirements of *7.12.7* apply to doors fitted in the subdivision bulkheads of passenger ships and special purpose with length above 50 m ships except those mentioned in *7.12.6.*

7.12.7.2 The doors situated in the compartment bulkhead for special purpose ships with length above 50 m and passenger ships are to comply with rules *7.12.5.1 – 7.12.5.3* and *7.12.5.5*.

7.12.7.3 Door controls, including hydraulic piping and electric cables should be kept as close as practicable to the bulkhead in which the doors are fitted in order to minimize the likelihood of them, being involved in any damage which the ship may sustain.

7.12.7.4 The maximum width of the door aperture is not to exceed 1,2 m. Fitting the doors with the opening width in excess of 1,2 m is subject to special consideration by *ICS Class* in each case.

7.12.7.5 Each door should be provided with an audible alarm, distinct from any other alarm in the area, which will sound whenever the door is closed remotely b power and which should sound for at least five seconds, but not more than the seconds, before the door begin to move, and should continue sounding until the door is completely closed. In the case of remote hand operation it is sufficient for the audible alarm to sound only when the door is moving.

7.12.7.6 The power gear of the doors should have either:

.1 A centralized hydraulic system with two independent powers source each consisting of a motor and pump capable of simultaneously closing all doors. In addition, there should be for the whole installation hydraulic accumulators of sufficient capacity to operate all doors at least three times, i.e. closed – open – closed; or

.2 An independent hydraulic system for each door with each power source consisting of a motor and pump capable of opening and closing the door. In addition, there should be hydraulic accumulator of sufficient capacity to operate the door at least three times, i.e. closed – open – closed; or

.3 An independent electrical system and motor for each door with each power source consisting of a motor capable of opening and closing the door. The power source should be capable of being automatically supplied b a transitional source of emergency electrical power, as required by *Chapter 11, rule 19.1.2.7* in the event of failure of either the main or emergency source of electrical power and with sufficient capacity to operate the door at least three times, i.e. closed – open – closed.

7.12.7.6 The power system indicated in *7.12.7.6* is to be independent from any other power system. No damage in the hydraulic electric power system is to affect the manual operation of any of the mechanisms in the door.

7.12.7.7 Direction knobs of doors are to install on each side of bulkhead to a minimum height, 1,6 from the deck plating and designed in such a way that any person coming through the door may keep the knobs in *open* position and may not actuate the *closed* mechanism unconsciously. The moving direction of knobs to open or close the doors is to coincide with the moving direction of doors and re to be clearly indicated.

7.12.7.8 The central operating console at the navigation bridge should have a switch with two modes of control:

- A *local control* mode which should allow any door to be locally opened and closed with automatic closure and

- A *door closed* mode which should allow doors to be opened locally and should automatically close the doors upon release of the local control mechanism.

The switch should normally be in the *local control* position. The *doors closed* position should only be used in an emergency or for testing purposes.

7.12.7.9 The central operating console at the navigation should be provided with a diagram showing the location of each door, with visual indicators to show whether each door is open or closed. A red light should indicate a door fully open and a green light should indicate a door fully closed. When a door is closed remotely, the red light should indicate the intermediate position by flashing. The indicating circuit should be independent of the control each door.

7.12.8 Doors in ships designed for the carriage of vehicles

7.12.8.1 The requirements of *7.12.8* apply to doors fitted in watertight subdivision bulkheads separating a cargo space from an adjacent cargo space in ships designed for the carriage of vehicles and covered by the requirements of *Chapter 5*, if the total number of persons on board (excluding the master and the members of the crew or other persons employed or engaged in any capacity on board a ship on the business of that ship, and also a child under one year of age) is not greater than the value N determined from the formula:

$$N = 12 + 0{,}04A \qquad \textbf{(Fig. 7.12.8.1)}$$

A = total deck area, in m^2, of spaces available for the stowage of vehicles where the clear height at the stowage position and at the entrances to such spaces is not less than 4 m.

7.12.8.2 The doors specified in *7.12.8.1* may be fitted at any level if *ICS Class* is satisfied that such doors are essential for the movement of the vehicles in the ship.
The number and arrangement of these doors are subject to special consideration by *ICS Class.*

7.12.8.3 The doors specified in *7.12.8.1* shall be fitted as far from the shell plating as practicable, but in no case shall the outboard vertical edge of the door be situated at a distance from the shell plating that is less than 0,2 of the breadth of the ship, such distance being measured at right angles to the center line of the ship at the level of the subdivision load line.

7.12.8.4 The doors specified in *7.12.8.1* may be of the following types: hinged, sliding or rolling but they should not be controlled remotely.
The doors shall be fitted with devices ensuring watertightness, securing and locking.
When the sealing material of the door is not classed as non-combustible (see *Chapter 6, rule 1.6.1*), the gasket shall be suitably protected from the effects of fire by a method approved by *ICS Class*.

The doors shall be fitted with a device which prevents unauthorized opening.

7.12.8.5 The doors specified in *7.12.8.1* shall be so designed that they could be opened and closed both in case of unload and loaded decks, the deck deflections under, the effect of the stowed cargo being taken into account.
The securing devices of the door shall be so designed that account is taken of the deck deflections under the effect of the stowed cargo resulting in relative displacement of the structural elements of the bulkhead and the door.

7.12.8.6 Where watertightness is ensuring by rubber or other suitable gaskets and securing devices, at each corner of the door or door section (if any) the securing devices shall be fitted.

The securing devices of such doors shall be designed to withstand the following forces, in kN:

- F_1, for securing devices fitted at the lower edge of the door.
- F_2 for securing devices fitted at the upper edge of the door;
- F_3 for securing devices fitted at the vertical edge of the door.

These forces are to be obtained from the formula:

$$F_1 = \frac{9{,}81A}{n_1}\left(\frac{H_1}{2} - \frac{h}{6}\right) + 29{,}42 \quad \textbf{(Fig. 7.12.8.6-1)}$$

$$F_2 = \frac{9{,}81A}{n_2}\left(\frac{H_1}{2} - \frac{h}{3}\right) + 29{,}42 \quad \textbf{(Fig. 7.12.8.6-2)}$$

$$F_3 = \frac{\alpha}{A}\left[F_1\left(n_1 - 1\right)h_i + F_2\left(n_2 - 1\right)\left(h - h_i\right)\right]$$

(Fig. 7.12.8.6-3)

A = clear area of the door, m²;
H_1 = vertical distance from the lower edge of the door opening to the lower edge of the plating of the bulkhead deck at the center fine of the ship, in m, but not less than 5 m;
h = clear height of the door, m;
h_1 = vertical distance from the securing device considered to the upper edge of the door, m;
α = half the sum of the vertical distance from the securing device considered to the nearest upper and lower securing devices, m;
n_1 = number of the securing devices fitted in the lower edge of the door;
n_2 = number of the securing devices fitted on the upper edge of the door.

When the securing device is under the effect of the design force F_l, F_2 or F_3, the stresses is its parts shall not exceed 0,5 times the upper yield stress of material.

7.12.8.7 The operation of the doors specified in *7.12.8.1* shall be by means of local control only. On the bridge indicators shall be provided to show automatically that each door is closed and all door fastenings are secured.

7.12.8.8 The requirements of *7.12.2.2* to *7.12.2.5* are also applicable to doors specified under *7.12.8.1*.

7.12.9 Manholes in watertight subdivision bulkheads

7.12.9.1 The requirements of *7.9* relating to the manholes located on the freeboard deck, raised quarter deck or the first tier of superstructures are generally applicable to the manholes fitted in the watertight subdivision bulkheads.

.1 In the collision bulkhead below the bulkhead deck for ships having subdivision distinguishing mark in the class notation, and below the freeboard deck for other ships;

.2 In watertight subdivision bulkheads separating a cargo space from an adjacent cargo space or a fuel oil tank.

7.13 Cargo hatchways of holds designed for alternate carriage of dry and liquid cargoes in bulk

7.13.1 The requirements of this Chapter cover the cargo hatchways of holds designed for alternate carriage of liquid cargoes in bulk with the density of not over 1,025t/m^3 and of dry cargoes; the requirements are applicable in case of carriage of liquid. Cargoes in bulk in the hold, filled to not less than 90 per cent of its volume.

When liquids cargoes are carried in bulk in the hold filled to less than 90 per cent, the cargo hatchways are subject to special consideration by *ICS Class*.

7.13.2 Cargo hatchways of holds designed for alternate carriage of dry and liquid cargoes in bulk shall comply with the requirements of *7.10.1, 7.10.2, 7.10.3.4, 7.10.3.5, 7.10.4, to 7.10.6, 7.10.8, 7.11.5* and *7.11.6.*

7.13.3 Hatchway cover shall be made of steel; the use of other materials for this purpose is subject to special consideration by *ICS Class* in each case.

7.13.4 Hatchway covers, except for the cases specified in *7.13.5*, shall be designed to withstand the inner pressure of liquid carried in the hold, the design load being taken depending on the framing system of the cover.

.1 For transverse framing system of the cover (stiffeners are perpendicular to the center line of the ship) the uniformly distributed load with the intensity *P* in kPa, determined from the following formula, shall be taken as the design load acting upon the whole are to the cover.

$$p = 0,7 \cdot p_o + 1,275 \cdot (b + 2 \cdot r) + 0,245 \cdot l + 2,55 \cdot K$$

(Fig. 7.13.4-1)

.2 For longitudinal framing system of the cover (stiffeners are parallel to the center line of the ship) and also for combined framing system of the cover the variable load shall be taken as the design load acting upon the whole are of the cover.

The law of changing the intensity *p*, in kPa, is determined from the formula:

$$p = 0,7 \cdot p_o + 1,275 \cdot (b + 2 \cdot r + 2 \cdot y) + 2,55 \cdot K$$

(Fig. 7.13.4-2)

b = clear width of the hatchway, m;
l = clear length of the hatchway, m;
r = value taken equal to:
- distance between longitudinal (parallel to the center line of the ship) axes of symmetry of hatchways, m, for twin hatchways arranged symmetrically about the center line of the ship where no longitudinal tight wash bulkhead is provided in the hold;

zero for central hatchways and for twin hatchways where the center line tight wash bulkhead is provided in the hold;

y = distance from longitudinal (parallel to the center line of the ship) axis of symmetry of the hatchway to the point of the cover under consideration, m.
- At $r > 0$ the value *y* is taken to be positive in the direction of the nearest side of the ship from the axis of symmetry of the hatchway and is taken to be negative in the opposite direction.
- At the design value of $r = 0$ two variants of the design load shall be considered;
- for positive values of *y* in one direction and negative values in the other direction from the axis of symmetry of the hatchway;

with the rule of signs for the value *y* opposite to that of the first variant;

P_O = maximum pressure of the pressure/vacuum valve opening, in kPa, (see *Chapter 8, rules 5.2.1* and *5.2.5*);

K = value determined from the formula:
$K = C - 2,4 \cdot h$ (7.13.4-3)

C = value taken equal to:
- distance measured at the deck level from the side coaming of the hatchway positioned at the ship's side to the shell plating or to the inner longitudinal bulkhead of the side tank, if any, in m, for central hatchways and for twin hatchways if no longitudinal tight wash bulkhead is provided in the hold;
- distance measured at the deck level from the side coamings of the hatchway positioned at the ship's side to the shell plating or to the inner longitudinal bulkhead of the side tank, if any, in m, or distance measured at the deck level from the side coamings of the hatchway positioned at the center line to the tight wash bulkhead or to the central tank longitudinal bulkhead nearest to this coamings, if any, in m,
- whichever of the two distances is greater, for twin hatchways where the tight wash bulkhead is provided in the hold in the center line;

h = distance between inner edges of the deck plating and cover plating, m.

If the value of K determined from *Formula (7.13.4-3)* is negative, the value of K = 0 shall be taken in the calculations.

7.13.5 When two or more hatchways are arranged one after another throughout the hold length, the design loads for cargo hatchway covers are subject to special consideration by *ICS Class.*

7.13.6 When the hatchway cover is under the design load, stresses in its parts shall not exceed 0,7 times the upper yield stress of material.

7.13.7 The sealing parts of the hatchway covers being secured shall be tight under the inner pressure of the liquid carrier on the hold not less than 24.5 kPa or double value of the load determined from *formula (7.13.4-2)*, whichever is the greater.

The tightness shall be provided by rubber or other suitable gaskets being resistant to the liquid carried in the hold.

The securing devices-shall be equally spaced, where possible.

7.13.8 Each securing device of the hatchway cover shall be calculated for the action of the greater force F_1, or F_2, in kN, determined from the formula:

$$F_1 = \frac{1}{n} \cdot \left[4,4 \cdot G + 294 \cdot b \cdot l \cdot \left(b + 2 \cdot r + 2 \cdot K_1\right)\right] \cdot 10^{-2}$$

(Fig. 7.13.8-1)

$$F_2 = \frac{34,3 \cdot b \cdot l}{n} + 44$$

(Fig. 7.13.8-2)

Q = total mass of covers of the hatchway under consideration, kg;

n = total number of securing devices along the perimeter of the hatchway under consideration;

K_1 = value determined from the formula:
$K_1 = C - 0,75 \cdot h$ (7.13.8-3)

If the value of K_1, from *formula (7.13.8-3)* is negative, the value of $K_1 = 0$ shall be taken in the calculations.

For *b, 1, r, C* and *h,* see *7.13.4*.

7.13.9 Each securing device of the side coamings of the hatchway shall be calculated for (in addition to the force specified in *7.13.8*) the action of force F_3, in kN, determined from the formula:

$$F_3 = a \cdot b \cdot \left(1,13 \cdot b + 1,72 \cdot r + 1,72 \cdot K_2\right) + 35,3$$

(Fig. 7.13.9-1)

a = distance between securing devices, m;

K_2 = value determined from the formula:
$K_2 = C - 2,14 \cdot h$ (7.13.9-2)

If the value of K_2 determined from *formula (7.13.9-2)* is negative, the value of $K_2 = 0$ shall be taken in the calculations.

For *b, r, C* and *h,* see *7.13.4*.

7.13.10 When the securing device is subjected to the design force specified in *7.13.8* and *7.13.9*, stresses in its parts shall not exceed 0,7 times the upper yield stress of material.

7.13.11 Notwithstanding the provisions of *7.10.8.2* and *7.13.6*, for all covers made of steel the thickness of their plating shall be not less than 8 mm or the value s, in mm, determined from *formula (7.13.11),* whichever is the greater.

$$s = 25 \cdot a_1 \cdot \sqrt{\frac{p}{R_{eH}}}$$ **(Fig. 7.3.11)**

p = load, kPa, determined from *Formula (7.13.4-2)*, with the value y measured from the longitudinal (parallel to the center line of the ship) axis of symmetry of the hatchway to the edge of the plate under consideration most distant from this axis, in m;
a_1 = distance between the cover stiffeners of the main direction, m;
R_{eH} = upper yield stress of the cover plating material, MPa.

7.13.12 Where the hatchway cover is provided with opening with access to the hold, for hold cleaning or cargo sampling or with other similar openings, the closing appliances of these openings shall comply with the requirements of *Chapter 7 Sec 11.*

7.13.13 When closed and secured, the hatchway covers of holds intended for carriage of flammable liquids shall be earthed (see *Chapter 11, rule 1.2 and 2.5*).
Special, earthing need to be used in case reliable electrical contact is ensured between covers and ship's hull when the hatchway is closed and secured.

SECTION 8

Arrangement and equipment of ship's spaces, various equipment, arrangements and outfit.

8.1 General provisions

8.1.1 The requirements for the arrangement and equipment of machinery spaces are specified in *Chapter 7* and those relating to refrigerating machinery spaces, refrigerant store rooms, as well as refrigerated cargo spaces are set forth in *Chapter 12.*

8.2 Location of spaces

8.2.1 The ship's control station is to be located in a enclosed space of the wheelhouse on the navigation bridge.
The navigation bridge is to be located so as to ensure:

.1 Proper visual control of the ship's running.

.2 Good visibilities with maximum view of water surface.

.3 Good audibility of sound signals of the approaching ships.

It is recommended to arrange the steering control station at the ship's center line.

8.2.2 The chart room is to be located in a space adjacent wheelhouse. The chart room and the wheelhouse may be situated in a common space.

8.2.3 No accommodation spaces are to be arranged of the collision bulkhead and abaft of the after peak bulkhead bellow the bulkhead deck (see also *Chapter 6, rule 2.1.5.1, 2.1.15, 2.4.7, 2.8.3*).

8.3 Equipment of dry cargo holds

8.3.1 When in ships no having double bottom wooden ceiling is placed on top of the floors, it shall be solid and shall extend up to the bilge. The ceiling is recommended to be made by portable section of such dimensions and so constructed as to allow of their ready removal at any place.
The thickness of a ceiling is to be:

- At least **40 mm** for ships of 30 m in length and less;
- At least **60 mm** for ships over 30 m, in length:
- At least **70 mm** under cargo hatchways.

8.3.2 When in ships having double bottom wooden ceiling is fitted, it shall have a thickness as follow:

- At least **60 mm** for ships of 60 m in length and less,
- At least **70 mm** for ships over 60 m in length.

The application of the ceiling made from synthetic material is subject to special consideration by *ICS Class* in each case.

8.3.3 Where cargo is discharged by grabs or other mechanisms, the thickness of the wooden ceiling fitted under cargo hatchways is to be doubled.

8.3.4 In holds intended for carriage of grain and other bulk cargoes the wooden ceiling on the inner bottom or, in case the latter is omitted, on the top of floors, is to be fitted so as to prevent wells, bilges and suction pipes of the bilge system from clogging.

8.3.5 The wooden ceiling is not to be laid directly on the inner bottom metal plating, but is to be embedded in a bituminous or epoxy composition approved by *ICS Class*, or placed on battens of 25 – 30 mm in thickness along the floors.
The wooden ceiling over the bilges is to be placed so as to be readily removable (see also *Chapter 8, rule 2.6.9*).

8.3.6 The bulkheads of deep tanks are to be protected with a wooden coat by the half side in ships where may be damaged by the action of the cargo.

8.3.7 It is recommended that the cargo battens made of wood or metal should be fitted on sides in holds and spaces intended for carriage of general cargoes. The thickness of wooden battens is to be as follows:

- At least 40 mm for ships of 70 m in length and less;
- At least 50 mm for ships of length exceeding 70 m.

The distance between adjacent battens is not to exceed 305 mm. the battens are to be attached to side framing so as to be readily removable and replaceable.

8.3.8 All protruding parts of various equipments in the holds (manholes, air pipes, sounding pipes, etc.) are to be protected with wooden screens, grids, chutes, etc. in places subject to impacts of cargos, grabs or the hoisting devices. Requirements for laying pipe lines in cargo holds are given in *Chapter 8, rule 1.6.3.*

8.3.9 Design of cellular guide members in holds of container

8.3.9.1 The requirements of *8.3.9* apply to the cellular guide members used for the carriage of containers, manufactured in accordance with Rules for the Construction of Containers in the holds of cargo ships.

8.3.9.2 Cellular guide members comprise upright and horizontal shores arranged breadth wise and lengthwise. In the holds, the cellular guide members may be removable or permanent.

8.3.9.3 Cellular guide members shall not be integrated in the hull structure. They are to be so designed that no stresses are exerted on them when the hull comes under bending or torsion.

9.3.9.4 Cellular guide member shall be designed to withstand stresses due to the forces F_x, and F_y, affecting the gravity center of each container, which are to be determined from the Formula:

$$F_x = m \cdot g \cdot a_x, \text{ N}$$ **(Fig. 8.3.9.4-1)**

Breadth wise

$$F_y = m \cdot g \cdot a_y, \text{ N}$$ **(Fig. 8.3.9.4-2)**

m = maximum gross mass of container, in kg;
g = gravity acceleration, g = 9,81 m/seg²;
a_x y a_y = dimension less accelerations to be determined in accordance with *1.6*, the coordinates of *x* and *z* being determined up to the gravity center of each container volume.

The forces F_x, and F_y are to be determined for each container, and through the four relevant comer fitting of the end or side wall they are uniformly distributed among the uprights. By way of simplification, maximum F_x and F_y values may be adopted for each container. Where a number of adjoining containers are supported by a pair of uprights, the F_x and F_y values for the particular container tier shall be summed up and distributed among the respective uprights.

Friction forces arising where the corner fittings of containers touch each other or the inner bottom are to be ignored.

8.3.9.5 The forces resultant from loads to be determined in accordance with 8.3.9.4, where the container corner fittings rest upon the upright, shall not exceed 150 kN per fitting breadth wise or 75 kN per fitting lengthwise.

8.3.9.6 Where the attachment pf uprights to the hull structure is not considered as firm fixing (free resting, flexible fixing, etc.), the cellular guide members shall be calculated as three-dimensional frames.

Where the attachment of uprights to the hull structures can be considered as firm fixing, particular vertical surface of cellular guide members may be calculated as plane frames.

The stresses in the cellular guide member components are not to exceed 0,8 times the upper yield stress of heir material.
The terms of calculating the stability of cellular guide member components are to be found under *8.3.9.14*.

8.3.9.7 In view of the requirements under *8.3.9.6*, the displacement of the resting points of corner fittings upon the uprights is not to exceed 25 mm breadth wise or 10 mm lengthwise.

8.3.9.8 When determining the thickness of the upright components, the thickness of those especially subject to wear shall be increased by 5 mm to equal 12 mm at least.

8.3.9.9 Where the uprights comprise separate angular sections, they are to be firmly secured to each other with horizontal plates at the resting points of container corner fittings and least halfway between those points.

8.3.9.10 At the upper ends of the uprights, devices shall be fitted to facilitate the insertion of containers into the stowage frames.

8.3.9.11 Uprights shall, so far as possible without notches, be attached to transverse and longitudinal bulkheads by means of shear – and bend stiff members.

8.3.9.12 The total margin between the external scantlings of container and the internal uprights surfaces shall not exceed 25 mm breadth wise or 40 mm lengthwise.
When fitting the uprights, the deviation from the straight line shall not exceed 5 mm.

8.3.9.13 Transverse horizontal and longitudinal horizontal shores serve to connect the stand-alone uprights to each other and to secure then to vertical hull structures. The horizontal shores shall, as far as possible, be fitted on the level of the corner fitting rest points and be torsion and bend-stiff connected to the uprights.

8.3.9.14 The stability of transverse horizontal and longitudinal horizontal shores and, where necessary, that of uprights shall be checked by a procedure approved by *ICS Class*.

When determining the permissible bucking stresses, the relevant safety factor may be adopted equal to 2,0.

The free length of buckling shall be adopted span-equal in the case of a bolted joint or 0.7 times the shore or uprights span in the case of a welded joint. The flexibility is not to exceed 250.
For other types of bar-end fixing, the free length is to be established on agreement with *ICS Class*.

8.3.9.5 The container rest points on the inner bottom and areas containing the connections and attachments of container stowage frames in way of hull structures shall be strengthened in conformity with the requirements of *Chapter 2*.

8.3.10 Movable decks, platforms, ramps and other similar structures

8.3.10.1 The requirements of *8.3.10* apply to the movable decks, platforms, ramps and other similar structures designed to be installed in two positions:

- In working position when they are used for carriage, loading or unloading of vehicles or other cargoes;
- In non-working position when they are not used for carriage, loading or un-loading of vehicles or other cargoes.

8.3.10.2 The movable decks, platforms, ramps and other similar structures and also their supporting elements at ship's sides, deck and bulkheads. The pillar or suspensions for decks and platforms ensuring their proper installation in the working position shall be designed in accordance with the requirements of *Chapter 2*.

8.3.10.3 Arrangements shall be provided for reliable securing of the movables decks, platforms ramps and other similar structures in the nonworking position.

8.3.10.4 When the movable decks, platforms, ramps and other similar structures are secured in the nonworking position, the hoisting gear and elements thereof shall not generally be kept under the load.
It is not permitted to secure the movable decks, platforms, ramps and other similar structures by suspending them on ropes.

8.3.10.5 The structural elements of the arrangements mentioned in *8.3.10.3* and also the associated supporting structures shall be designed to withstand the forces resulting from the application of the loads P_x, P_y, P_z, as obtained from the Formula given below, to the centers of gravity of the considered section of the deck, platform, ramp or other similar structures:

$$P_x = m \cdot g \cdot a_x$$ **(Fig. 8.3.10.5-1)**

$$P_y = m \cdot g \cdot a_y$$ **(Fig. 8.3.10.5-2)**

$$P_z = m \cdot g \cdot (1 + a_z)$$ **(Fig. 8.3.10.5-3)**

P_x = horizontal load parallel to the center plane of the ship, N. Consideration shall be given to the cases .when the load P_x. is directed both forward and aft;
P_y = horizontal load parallel to the mid station plane, N. Consideration shall be given to the cases when the load *P*, is directed both to the nearest ship's side and to the opposite side;
P_z = vertical load directed downward, N;
m = mass of the considered section of the deck, platform, ramp or other similar structure, kg;
g = acceleration due to gravity equal to 9,81 m/s²;
a_x, a_y and a_z = dimension less accelerations to be determined in accordance with 1.7.

8.3.10.6 When the determining the forces affecting the structural elements of the arrangements specified in *8.3.10.3* and the associated supporting structures with regard to the provisions of *8.3.10.5*, the loads P_x, P_y and P_z, are regarded as separately applied, i.e. no account is taken of their combined action and of the frictional forces originating on the surfaces of the considered sections of decks, platforms, ramps or other similar structures which are in contact with the associated supporting structures.

8.3.10.7 When the structural elements of the arrangements specified in *8.3.10.3* and associated supporting structures are under the effect of the loads determined according to the provisions of *8.3.10.5* and *8.3.10.6*, the stresses in their parts hall not exceed 0,8 times upper yield stress of material.

Under the effect of these loads the safety factor of the wire ropes in relation to their actual breaking strength shall be not less than 4; the safety factor of the chain cables in relation to the proof load of the chain shall be not less than 2; the margin of safety against buckling of the elements subjected to the compression stress shall be not less than 2.

8.3.10.8 Wire ropes used in the arrangements specified in *8.3.9.3* shall satisfy the requirements of *Chapter 13, Subsection 7.2* and chain cables, those of *Chapter 13, Subsection 7.1*.

8.4 Exits, doors, corridors, stairways and vertical ladders

8.4.1 General

8.4.1.1 Location and arrangements of exits, doors, corridors, stairways and vertical ladders are to ensure ready access of persons from spaces to the places of embarkation into lifeboats and liferafts.

8.4.2 Exits and doors

8.4.2.1 In passenger ships and in special purpose ships each watertight compartment or similarly restricted space or groups of spaces situated below the bulkhead deck shall have at least two means of escape, in any case one of which shall be independent of the door in the subdivision bulkhead.

8.4.2.2 In passenger ships and in special purpose ships above the bulkhead deck each main vertical fire zone (see *Chapter 6, Subsection 1.2*) or similarly restricted space or groups of spaces shall have at least two means of escape one of which shall give access to a stairway forming a vertical escape.

8.4.2.3 In passenger ships the number and location of means of escape from special category spaces (see *Chapter 6, rule 1.5.9*) are subject to special consideration by *ICS Class*, and the degree of safety for escape from these spaces to the places of embarkation into lifeboats and liferafts shall at least correspond to that specified in *8.4.2.1* and *8.4.2.2*.

For cargo ships in all ro-ro cargo spaces where the crew is normally employed the number and locations of escape routes to the open deck are subject to special consideration by *ICS Class*, but shall in no case be less than two and shall be widely separated.

8.4.2.4 In cargo ships of 500 gross tonnages and upwards at each level of accommodation spaces there shall be at least two means of escape, as widely separated as possible, from each restricted space or group of spaces; from the spaces situated below the open deck the main means of escape shall be formed by a stairway, the other means of escape may be formed by a casing with a vertical ladder or by a stairway; from the spaces situated above the open deck the means of escape shall be formed by doors of stairways leading to the open deck or combination thereof.

8.4.2.5 Exceptionally, *ICS Class* may dispense with one of the means of escape specified in *8.4.2.1* or *8.4.2.4*, due regard being paid. To the purpose and location of spaces and to the number of persons who normally might be quartered or employed there.

8.4.2.6 In hydrofoil boats each passenger space shall have at least two independent means of escape arranged at the opposite ends of the space and ensuring ready access to the life-saving appliances.

8.4.2.7 Stairways serving only a space a balcony in that space, as well as lifts shall not be considered as means of escape specified in *8.4.2.1, 8.4.2.2* to *8.4.2.4* and *8.4.2.6*.

8.4.2.8 Each cinema hall is to be provided with at least two means of escape. Both exits are to be spaced from each other as wide as practicable. A readily seen inscription *Exit* or *Emergency exit* is to be provided above every such exit.

8.4.2.9 The wheelhouse is to have two exits, one to each side of the navigation bridge, with the passageway through the house from side to side.

8.4.2.10 In the ships with gross tonnage equal or more than 500, with the exception of the cargo compartments of the ships designed for the transportation of liquids in bulk, shall have not less than two exits as separate as possible. The cargo refrigerated space may only have one exit.

8.4.2.11 The total width the exits from cinema halls shall be determined on the basis of 0,8 m per 50 persons, however, the width of each exit shall be not less than 1,l m, when the number of seats is more than 50, and not less than 0,8 m when the number of seats is not more than 50.

The width of each exit from accommodation and service spaces shall be not less than 0,6 m. the sizes of the ladder ways from cargo holds shall be not less than 0,6 x 0,6 m.

8.4.2.12 The exit doors and ladder way covers are to be so arranged that they can be operated from both sides.

Doors are to open as follows:

.1 Doors of accommodation and service spaces giving access to a corridor inside the spaces;

.2 Doors of public rooms, outside or each side;

.3 Doors in the end bulkheads of superstructures and in external transverse bulkheads of deckhouses, outside in the direction of the nearest side;

.4 Doors in the external longitudinal bulkheads of deckhouses, outside in the forward direction.

In ships of 31 m in length and less the doors indicated in *.1* May open outside (to the corridor) if they are situated at the end of blind corridors do not hinder the exits from other spaces.
In cargo ships the inner doors duplicating the doors specified in *.3* and *.4* may open inside the space.

No sliding doors are to be fitted at exits and means of escape, except for doors of the wheelhouse.

The doors referred to in I shall not be provided with hooks for holding the door open. It is permitted that such doors be fitted with buffers and spring catchers to fix the door in the open position and to allow for its closure without entering the space.

8.4.2.13 Doors of accommodation spaces specified in *Chapter 6, rules 1.5.2.1* and *1.5.2.2* are to have in their lower portions detachable panels 0,4 x 0,5 m in size, these panels of the passenger cabin doors shall be provided with the following inscription: *"Means of escape – break out in case of emergency".*
The detachable panels need not be fitted where the spaced are provided with opening type side scuttles of at least 400 mm in diameter of windows the smaller side of which being at least 40 mm and on condition that persons may get to the corridor or open deck through these side scuttles or windows. The appropriate means shall be provided, if necessary, to facilitate exit through side scuttles or windows.

8.4.3 Corridors and passageways

8.4.3.1 All corridors and passageways are to ensure free movement of persons along them.
The length of the corridor or part of the corridor with only one means of escape shall not exceed:

- **13 m** for passenger ships carrying more than 36 passengers and for special purpose ships having more than 200 persons of special personnel on board:

- **7 m** for passenger ships carrying not more than 36 passengers, for special purpose ships having not more than 200 persons of special personnel on board and for cargo ships.

8.4.3.2 The width of main corridors in way of passengers and crew accommodation spaces is not to be less than 0,9 m and that of side corridors is to be at least 0,8 m. where the number of passengers and crew using the corridor surpasses 50 persons the widths referred to above are to be increased by 0,1m.

In ships (including the tugs) below 500 gross tonnage and in tugs of less than 370 kW the width of the main corridors and side corridors may be reduced down to 0,8 and 0,6 m. respectively.

8.4.3.3 The widths of passageways in the cinema hall and n the entrance hall are not to be less than 1,l m and 1,4 m, respectively.
The width of the main passageways in the restaurant or dining room and also the mess room is not to be less than 0,9 m and that of the side passageways is to be at least 0,65 m. In ships of less than 500 gross tonnage the width of main passageways in the messroom may be reduced down to 0,65 m.

8.4.3.4 The width of the main passageway in the seating passenger space is to be at least 1m with number of passengers up to 50 and at least 1,1 m with number of passengers in excess of 50.

8.4.3.5 In passenger ships the main corridors adjacent to engine and boiler casings are to be at least 1,2 m in width, however, in ships of less than 500 gross tonnage this width may be reduced down to 0,9 m.

8.4.3.6 The width of passageway on the bridge is not to be less than 0,8 m in ships of 500 tons gross tonnage and over and at least 0,6 m in ships of less than 500 gross tonnage.

8.4.3.7 In passenger ships and special purpose ships the width of the deck passageways providing access to the lifeboat and liferaft embarkation deck is not to be less than:

- **0,9 m** if the number of seats in lifeboats is not more than 50 on each side of ship;
- **1,0 m** if the number of seats in lifeboat is 50 and over, but less than 100 on each side of ship;
- **1,2 m** if the number of seats in lifeboats is 100 and over, but less than 200 on each side of ship.

If number of seats in lifeboats is 200 and over on each side of ship, the width of the passageways will be specially considered by *ICS Class* in each case.
In other ships the width of the passageways referred to above is not to be less than 0,8 m.

8.4.4 Stairways and vertical ladders

8.4.4.1 All between deck stairways shall be of steel frame construction or of equivalent material on agreement with *ICS Class* (see *Chapter 6, Subsection 1.2*). Special requirements for arrangement of stairway enclosure and protection of means of escape are specified in *2.1.4.3, 2.1.4.5, 2.2.2.4* and *Chapter 5, rule 6, table 3.1.2.1.*

8.4.4.2 A sufficient area is to be provided near each stairway to prevent dangerous congestion of people in case of emergency.

8.4.4.3 In ships having to decks and more the total width of the stairways providing access from between deck spaces to the embarkation deck is to be ascertained on the basis of the following calculations:

.1 For means of escape from one tier compartment, not less than 1cm per seat located in this tier.

.2 For means of escape from two tiers arranged one above another in one compartment, not less than 1 cm per seat located in both tiers.

.3 For means of escape from three tiers arranged one above another in one compartment, not less than 1 cm per seat located in two mostly inhabited tiers of the compartment and in addition 0,5 per seat of the remaining number of seats located in this compartment.

.4 The total width of stairways for means of escape from four and more tiers arranged one above another in one compartment is to be obtained as provided in *8.4.4.3.3* taking into consideration the number of tiers and of seats located in these tiers.
When calculating the width of stairways, the number of seats located in a compartment is to be taken according to the number of regular berths increased by the number of personnel servicing this compartment. In any case, the width of stairways is not to be less than that of the corridor specified in *8.4.3.2.*

8.4.4.4 For the compartments and decks in which the public spaces are arranged the width of stairways may be calculated at the rate of 0,8cm per seat located in this space. In other respects, the width of stairways is to be determined as specified in *8.4.4.3.*

8.5 Guard rails, bulwarks and gangways

8.5.1 All exposed parts of the freeboard decks, superstructure decks and deckhouse tops are to be provided with efficient guard rails or bulwarks; in case of ships intended for carriage of timber deck cargo collapsible railing or storm rails are to be fitted on this cargo.

8.5.2 The height of the bulwark or guard rails above the deck is not to be less than 1 m. however, where this height would interfere with the normal operation of the ship, a lesser height may be approved provided the adequate protection of passengers and crew is ensured to the satisfaction of *ICS Class*.

8.5.3 The distance between the stanchions of the guard rails shall be not more than 1,5 m. at least every third stanchion shall be supported by a stay.
Removable and hinged stanchions shall be capable of being locked in the upright position.

8.5.4 The gunwale, hand rails and guard rails shall be generally of rigid construction; wire ropes shall be made taut by means of turnbuckles.

Lengths of chains may only be accepted in lieu of rigid guard rails if they are fitted between two fixed stanchions or between the fixed stanchion and bulwark.

8.5.5 The opening below the lowest course of the guard rails is not to exceed 230 mm. the other courses of rails are not to be more than 380 mm apart. An exception is made for the guard rails above the timber deck cargo where the height from the

8.5.6 Type “A” ships with bulwarks as well as type “B” ships with a freeboard reduced to that required for type “A” ships are to have open rails fitted for at least half the length of the exposed parts of the weather deck, or other effective water freeing arrangements the upper edge of the sheer strake is to be kept as low as practicable.
Where superstructures are connected by trunks, open rails are to be fitted for the whole length of the exposed parts of the freeboard deck.

8.5.7 The bulwark, if arranged, is to comply with the requirements of *Chapter 2, Subsection 2.14.*

8.5.8 Satisfactory means (in the form of life lines, gangways, under deck passages, etc.) are to be provided for the protection of the crew in getting to and from their quarters, the machinery space and all other parts used in the necessary work of the ship.

8.5.9 A fore and aft permanent gangway is to be provided on type "A" ships at the level of the superstructure deck between the poop and the midship superstructure or deckhouse, where fitted or equivalent means of access are to be provided to carry out the purpose of the gangway, such as under deck passages.
The gangway shall be designed in compliance with the requirements of *Chapter 2, rule 3.5.5.2.*

Elsewhere and on type "A" ships without a midship superstructure, arrangements to the satisfaction of *ICS Class* are to be provided to safeguard the crew in reaching all parts used in the necessary work of the ship.

8.5.10 Safe and satisfactory access from the gangway level is to be available between separate crew accommodation spaces and also between crew accommodation spaces and the machinery space.

8.6 Hoisting gear of shipborne barges

8.6.1 The elements of the hoisting gear of the shipborne barges to be lifted by the crane on board the barge carrier (lugs, eye plate, rings, shackles, grips, etc.) are to be designed to withstand the forces resulting from lifting the shipborne barge uniformly loaded with the specification cargo and gripped in two points diagonally positioned. Under these forces the stresses in the elements of the hoisting gear are not to exceed 0.7 times the upper yield stress of material.

SECTION 9
Emergency outfit
9.1 General provisions

9.1.1 The items in *tables 9.2.1*, *9.2.2-1*, *9.2.2-2* and *9.2.3* available in the ship, but intended for other purpose may be included into the emergency outfit provided these it have corresponding markings and their permanent storage places are situated above the bulkhead deck.

9.2 Items required

9.2.1 All ships, except those specified in *9.2.4* and *9.2.6* are to have emergency outfit not less than that indicated in *Table 9.2.1*.
For shipborne barges the emergency outfit is not required.

9.2.2 Additional set of emergency outfit, above that listed in *Table 9.2.1* shall be provided.

.1 In accordance with *table 9.2.2-1* for passenger and special purpose ships, of 70 m in length and over, except those of glass reinforced plastics.

.2 In accordance with *table 9.2.2-2* for glass reinforced plastics ships.

9.2.3 The sets of rigging and fitter's tools specified in *Table 9.2.1* are to be completed according to *table 9.2.3.*

9.2.4. For ships of restricted areas of navigation I and II, except those specified in *9.2.5*, equipment with emergency outfit and materials may be laid down as for the nearest lower group of ship's division depending on their length according to *Table 9.2.1*.

The minimum amount of emergency outfit for ships of restricted are of navigation III will be specially considered by *ICS Class* in each case.

9.2.5 For ships with ice strengthening of RHI and RH categories, equipment with emergency outfit and materials are to be established as for the nearest higher group of ship's division according to their length as per *table 9.2.1.*

9.2.6 For glass reinforced plastic ships provision of emergency outfit listed under *items 6, 9, 17, 21* to *24*, *26* to *29*, *31*, *35*, *36*, *39*, and *40* of *Table 9.2.1* is not required.

9.2.7 In ships intended to carry flammable and explosive cargoes tools of emergency outfit are to be made of sparkles materials wherever practicable.

Table 9.2.1 Emergency outfit

Nos.	Item, unit	Size	Quantity for ships of length (*L*), m				Quantity for tankers
			150 and over	From 150 to 70 incl.	From 70 to 24 incl.	Below 24	
1	2	3	4	5	6	7	8
1	Armored collision mat, pc	4,5 x 4,5 m	1	-	-	-	-
2	Lightened collision mat, pc	3,0 x 3,0 m	-	1	-	-	1
3	Thrummed collision mat, pc	2,0 x 2,0 m	-	-	1	-	-
4	Thrummed pad, pc	0,4 x 0,5 m	4	3	2	1	2
5	Set of rigging tools	as per *table 9.2.3*	1	1	1	1	1
6	Set of fitter's tools	as per *table 9.2.3*	1	1	1	1	1
7	Pine bar, pc	150 x 150 x 4000 mm	8	6	-	-	-
8	Pine bar, pc	80 x 100 x 2000 mm	2	2	4	-	4
9	Pine plank, pc	50 x 200 x 4000 mm	8	6	2	-	-
10	Pine plank, pc	50 x 200 x 2000 mm	4	2	2	-	2
11	Pine wedge, pc	30 x 200 x 200 mm	10	6	4	-	4
12	Birch wedge, pc	60 x 200 x 400 mm	8	6	4	-	4
13	Pine plugs for ships with side scuttles, pc	side scuttle diameter	6	4	2	2	4
14	Pine plugs, pc	10 x 30 x 150 mm	10	6	4	2	4
15	Unbleached canvas, m^2	-	10	6	4	2	-
16	Coarse felt, m^2	s = 10 mm in thickness	3	2	1	-	-
17	Rubber plate, m^2	s = 5 mm in thickness	2	1	0,5	-	0,5
18	Tarred tow, kg	-	50	30	20	10	5
19	Wire (low-carbon steel), pc	Ø 3 mm, in dia, coils 50 m each	2	2	1	-	1
20	Construction shackles, pc	d = 12 mm in dia	12	8	4	-	4
21	Hexagon-head bolt, pc	M16 x 400 mm	10	6	2	-	-
22	Hexagon-head bolt, pc	M16 x 260 mm	4	2	2	2	-
23	Hexagonal nut, pc	M16	16	10	6	4	-
24	Washer for bolt, pc	M16	32	20	12	8	-
25	Construction nails, kg	l = 70 mm long	4	3	2	1	1
26	Construction nails, kg	l = 150 mm long	6	4	2	1	1
27	Cement (quit setting), kg	-	400	300	100	100	100
28	Sand, natural, kg	-	400	300	100	100	100
29	Accelerator for concrete setting, kg	-	20	15	5	5	5
30	Minimum, kg	-	15	10	5	5	5
31	Technical fat, kg	-	15	10	5	-	5
32	Carpenter's axe, pc	-	2	2	1	1	1
33	Saw, cross-cut, pc	l = 1200 mm in length	1	1	1	-	-
34	Hack-saw, pc	l = 600 mm in length	1	1	1	1	1
35	Shovel, pc	-	3	2	1	1	1
36	Bucket, pc	-	3	2	1	1	1
37	Sledge hammer, pc	5 kg	1	1	1	-	-
38	Lantern of explosion-proof type, pc	-	1	1	1	1	1
39	Stop of telescopic type, pc	-	3	2	1	1	1
40	Emergency screw clamp, pc	-	2	1	1	-	-

Table 9.2.2-1 Additional set of outfit for passenger ships and special purpose ship except for glass reinforced plastic fibber

Nos.	Item	Quantity
1	Portable autogenously cutting torch complete with set of fully charged gas cylinders	1
2	Hand jack, hydraulic	1
3	Sledge hammer	1
4	Forge chisel with haft	1
5	Crowbar	2
6	Jack 9,8 kN	1
7	Jack 19,6 kN	1

Table 9.2.2-2 Additional outfit for glass reinforced plastic fibers

Nos.	Item	Quantity
1	Glass fabric	25 m²
2	Glass roving	3 kg
3	Resin binder with hardener	5 kg

Table 9.2.3 Sets of rigging and fitter's tools

Nos.	Item	Size	Quantity per set	
			rigging	fitter's
1	2	3	4	5
1	Tape measure	l = 2000 mm long	1	-
2	Bench hammer	0,5 kg	1	1
3	Sledge hammer	3 kg	-	1
4	Rigger's mallet	-	1	-
5	Puncher (dumb iron)	-	1	-
6	Chisel	b = 20 mm wide l = 200 mm long	1	1
7	Marlin spike	l = 300 mm long	1	-
8	Carpenter's chisel	b = 20 mm wide	1	-
9	Screw auger	Ø 18 mm	1	-
10	Tongs	l = 200 mm long	1	-
11	Hollow punch	Ø 18 mm	-	1
12	Hollow punch	Ø 25 mm	-	1
13	Triangular file	l = 300 mm long	-	1
14	Half-round file	l = 300 mm long	-	1
15	Multi-purpose tongs	l = 200 mm long	-	1
16	Screw driver	b = 10 mm wide	-	1
17	Adjustable wrench	Jaw width up to 36 mm	-	1
18	Wrench	Jaw width of 24 mm	-	1
19	Rigger's knife	-	1	-
20	Hacksaw frame	-	-	1
21	Hacksaw blade	-	-	6
22	Kit bag	-	1	1

9.3 Storage of emergency outfit

9.3.1 The emergency outfit indicated in *9.2* shall be stored at least in two emergency stations, one of which shall be situated in the machinery space. Emergency stations may be special spaces, boxes or places allocated on the deck or in spaces. In the emergency station of the machinery space the outfit necessary for carrying out the emergency operations inside the space shall be stored; the rest of the emergency outfit shall generally be stored in the emergency stations located above the bulkhead deck; in ships of less than 45 m in length it is allowed to locate the emergency station below the bulkhead deck on condition that free access to this station is provided at all times.
In ships of 31 m in length and below it is allowed to store the emergency outfit only in one emergency station.

9.3.2 A free passage shall be provided in front of the emergency station; the passage width shall be selected depending on the overall dimensions of the outfit stored in the station but not less than 1.2 m. In ships of less than 70 m in length the passage width is allowed to be reduced to 0.8 m and in ships of 31 m in length and below to 0.6 m.

The passage to the emergency stations shall be as straight and short as practicable.

9.4 Marking

9.4.1 Items of the emergency outfit and cases for their storage (apart from collision mats) are to be painted blue either entirely or in stripe. The cases for emergency equipment storage shall have the distinct inscription to indicate the name of the material, weight and warranted storage period.

9.4.2 The emergency stations are to be provided with distinct inscription *"Emergency Station"*. Moreover, in the passages and on the decks notices shall be posted showing location of the emergency stations.

9.5 Collision mats

9.5.1 Collision mats are to be made of water resistant canvas or other equivalent fabric and be provided with either a soft or wire interlayer depending on the type of the collision mat. The collision mats are to be edged by a leech rope with four thimbles fitted into its corners. Moreover, ringlets are to be provided according to the number of ropes specified in *table 9.5.1*.

Basic data on the collision mats are given in table 9.5.1 and *fig. 9.5.1*.

9.5.2 The pads are to be made of natural fiber rope strands and be thrummed with natural fiber spun yam. A canvas shall be sewn on the bottom side of the pad.

9.5.3 Sheets and guys of armored collision mats shall be made of flexible steel wire ropes, control lanyards of natural fibber ropes and hogging lines for all collisions mats of flexible steel wire ropes or chains having suitable diameter. Wires of steel ropes shall have heavy zinc coating in accordance with the national standards.
The length of the sheets is to be chosen so that a hole may be shut up in any place of the shell plating and the ends of the ropes may be efficiently secured on the deck.
The actual breaking load of the whole sheets is to exceed that of the leech ropes by not less than 25 per cent.

9.5.4 The blocks of emergency outfit may have hooks as hangers. The permissible load of the shackles joining the ropes is not to be less than 0,25 times the actual breaking load of the whole ropes referred to above.

Table 9.5.1 Technical data about the equipment and arrangement of collision matting

	Item nomination	Quantity		
		Collision matting		
		Armoured collision mat 4,5 x 4,5 m	Lightened collision mat 3,0 x 3,0 m	Thrummed collision mat 2,0 x 2,0 m
1	Canvas layers	4	2	2
2	Interlayer	1 wire net with leech rope	1 felt padding	1 pad
3	Fastening of stiffeners	-	In pockets (pieces of wire rope or pipes)	-
4	Sheets	2	2	2
5	Hogging lines	3	2	2
6	Guys	2	2	-
7	Control lanyard with marking	1	1	1
8	Shackles	12	9	6
9	Tackles (safe working load)	4 14,7 kN	2 9,8 kN	2 9,8 kN
10	Snatch blocks (safe working load)	4 14,7 kN	2 9,8 kN	2 9,8 kN

Figure 9.5.1 Technical data outfit meats

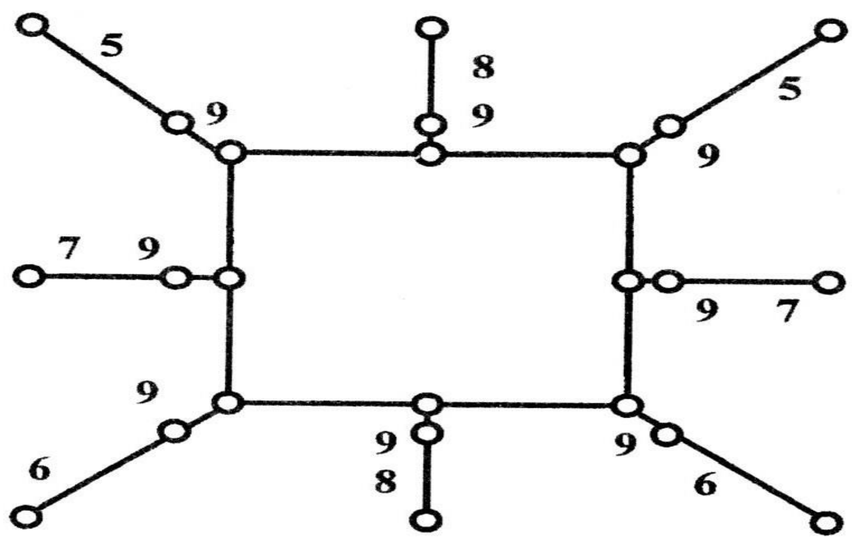

Figure 9.5.1 Technical data of outfit mats

SECTION 10

Anchors

10.1 Manufacture

10.1.1 Anchors may be of forged, cast or welded construction.

10.1.2 Anchor parts are to be free from cracks, cavities and other defects affecting the strength of the parts. The external defects may be repaired by electric welding. Welding procedure is to be agreed with *ICS Class*.

10.1.3 The pins of the heads shaft and the pin of the anchor shackle are to be efficiently locked against axial displacement. The locking may be effected by electric welding.

10.1.4 The necessity of heat treatment of the anchors after their manufacture as well as heat treatment conditions is defined by the manufacturer. Heat treatment, if the anchors are subject to it, is to be performed before testing.

10.2 Testing

10.2.1 All cast or welded anchors or their parts are to be tested by dropping in a steel plate not less than 100 mm in thickness. The height of dropping is given in *table 10.2.1*.

Table 10.2.1 Height of dropping

Anchor mass *m* (kg)	**Height of dropping (measured from plate to lower edge of anchor)** (m)
m < 750	4,5
750 ≤ m < 1500	4,0
1500 ≤ m < 5000	3,5
m ≥ 5000	3,0

The heads of Hall's, Gruson's and high holding power anchors are dropped on the plate the crown downwards; the shank's of Hall's, Gruson's and high holding power anchors and also the shanks with the flukes of admiralty stocked anchor are dropped in horizontal position.

10.2.2 Moreover, each cast or welded shank with flukes of the admiralty stocked anchor is to be suspended in a vertical position, the flukes downwards, and dropped on two steel blocks put on the plate such a manner that the distance between them is half the span of the flukes (*Fig. 10.2.2*).
The thickness of the blocks is to be such as to prevent the anchor crown from striking against the plate.

10.2.3 After the drop test the anchors or their parts are to be suspended and subjected to a hammer test with a hammer having mass of not less than 3 kg. They must give out a clear ringing sound.
If the sound is not clear, the crack detention is the part shall be carried out by the non-destructive method, the defects shall be eliminated, if necessary, and the test shall be repeated.

10.2.4 Anchor shackles should be tested together with the anchors. When tested by proof load, no fractures or permanent deformation should be detected.

10.2.5 Each anchor, irrespective of the method of its manufacture, shall be subjected to tensile test by application of a proof load either on a chain testing machine or by a load suspended to the flukes.

10.2.6 Hall's, Gruson's and high holding power anchors are to be tested by simultaneous gripping of both flukes (*Fig. 10.2.6*), first turned to one side and then to the other.

10.2.7 The admiralty stocked anchors are to be tested by applying the load to each fluke in succession (*Fig. 10.2.7*). The test may be carried out both with or without the stock.

10.2.8 In all cases, the proof load is applied on one side to the statutory shackles and on the other side to flukes (Hall's Gruson's and high holding power anchors)or fluke (admiralty stocked anchors) at a distance of one-third of the fluke length 1, apart from the bill (see *Figs. 10.2.6* and *10.2.7*).

10.2.9 The value of the proof load F_1, which the anchor shall withstand, is not to be less than that specified in table 10.2.9

Figure 10.2.2 Admiralty stocked anchors with forged, cast or welded shank to the flukes

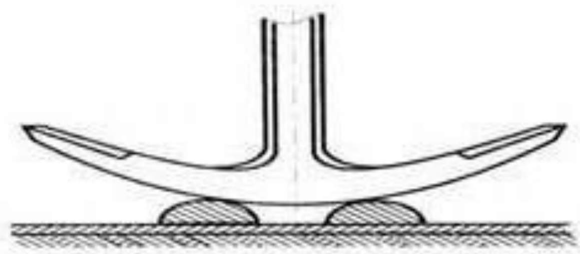

Figure 10.2.2 Admiralty stocked anchors with forged, cast or welded shank to the flukes

10.2.10 Prior to the proof testing, a punch mark is to be made on the anchor shank and also on each bill of flukes. Then Hall's, Gruson's and high holding power anchors are subjected to a preliminary 5 minute tension by a load equal to 0,5 F_1. The load is then reduced down to 0,1 F_1, and the distances between the punch marks are measured. After this the load is increased to the proof test value and maintained during 5 min. Then the load is reduced to 0,1 F_1, and the distances between the punch marks are measured again.

If the increase of the distance between the punch marks exceeds 0,5 per cent of the initial distance, the anchor will be rejected.

The Admiralty stocked anchors are not subjected to the preliminary tension. The distance between the punch marks is measured before and after the application of the proof load which is to be applied during 5 min. No residual deformation is allowed.

10.2.11 After Hall's, Gruson's and high holding power anchors have been subjected to the proof load, the free rotation of their flukes though the complete angle is to be controlled. In am the rotation of the flukes is impeded or they rotate through an incomplete angle, the defects shall be found and eliminated and the test repeated. The results of the repeated test are considered final.

10.2.12 On completion of the proof load test all anchors are to be visually inspected to ascertain that they have no defects and are to be weighed. On agreement with *ICS Class* is it permitted to weigh only 5 per cent of the total number of the anchors of one series, but not less than two anchors manufactured according to the same model.

Figure 10.2.6 Hall's, Gruson's and high holding power anchors

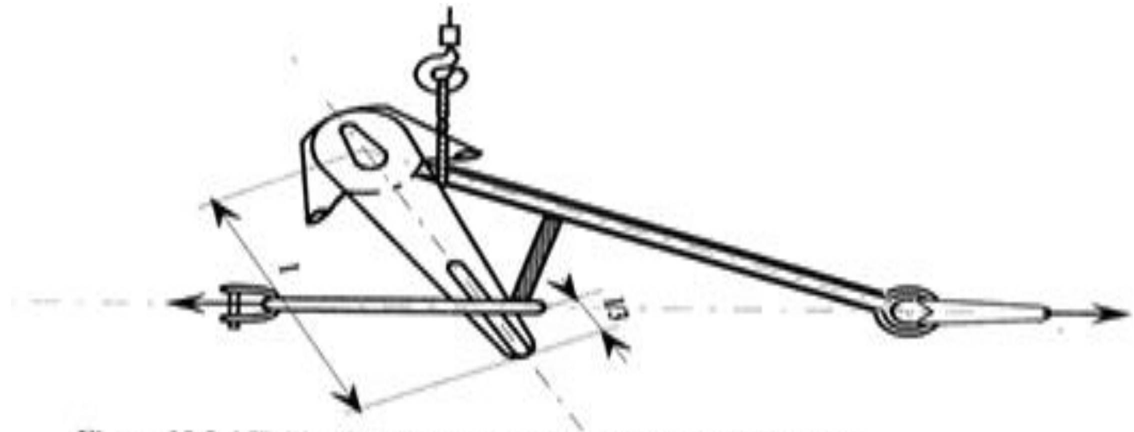

Figure 10.2.6 Hall's, Gruson's and high holding power anchors

Figure 10.2.7 Admiralty stocked anchor testing

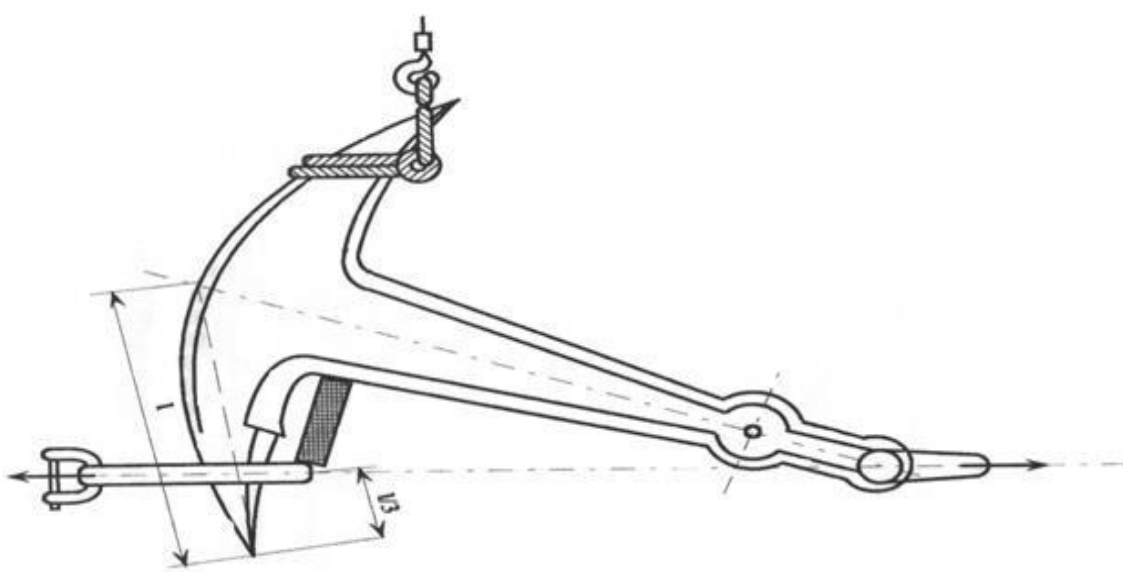

Figure 10.2.7 Admiralty stocked anchor testing

Table 10.2.9 Values of the proof load F_1

Anchor mass kg	**Proof load,** kN	**Anchor mass** kg	**Proof load,** kN	**Anchor mass** kg	**Proof load,** kN	**Anchor mass** kg	**Proof load,** kN
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
50	23	1250	239	5000	661	12500	1130
55	25	1300	247	5100	669	13000	1160
60	27	1350	255	5200	677	13500	1180
65	29	1400	262	5300	685	14000	1210
70	31	1450	270	5400	691	14500	1230
75	32	1500	278	5500	699	15000	1260
80	34	1600	292	5600	706	15500	1270
90	36	1700	307	5700	713	16000	1300
100	39	1800	321	5800	721	16500	1330
120	44	1900	335	5900	728	17000	1360
140	49	2000	349	6000	735	17500	1390
160	53	2100	362	6100	740	18000	1410
180	57	2200	376	6200	747	18500	1440
200	61	2300	388	6300	754	19000	1470
225	66	2400	401	6400	760	19500	1490
250	70	2500	414	6500	767	20000	1520
275	75	2600	427	6600	773	21000	1570
300	80	2700	438	6700	779	22000	1620
325	84	2800	450	6800	786	23000	1670
350	89	2900	462	6900	794	24000	1720
375	93	3000	474	7000	804	25000	1770
400	98	3100	484	7200	818	26000	1800
425	103	3200	495	7400	832	27000	1850
450	107	3300	506	7600	845	28000	1900
475	112	3400	517	7800	861	29000	1940
500	116	3500	528	8000	877	30000	1990
550	125	3600	537	8200	892	31000	2030
600	132	3700	547	8400	908	32000	2070
650	140	3800	557	8600	922	34000	2160
700	149	3900	567	8800	936	36000	2250
750	158	4000	577	9000	949	38000	2330
800	166	4100	586	9200	961	40000	2410
850	175	4200	595	9400	975	42000	2490
900	182	4300	604	9600	987	44000	2570
950	191	4400	613	9800	998	46000	2650
1000	199	4500	622	10000	1010		
1050	208	4600	631	10500	1040		
1100	216	4700	638	11000	1070		
1150	224	4800	645	11500	1090		
1200	231	4900	653	12000	1110		

REMARKS:

1- Proof load for intermediate values of the anchor mass is determined by linear interpolation.
2- For high holding power anchors the proof load is taken depending on the anchor mass increased by 35 per cent.