UNITED NATIONS

E

Economic and Social Council

Distr.
GENERAL

TRANS/SC.3/2000/1
7 August 2000

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

INLAND TRANSPORT COMMITTEE

Working Party on Inland Water Transport
(Forty-fourth session, 17-19 October 2000,
agenda item 7 (a)

AMENDMENT OF THE RECOMMENDATIONS ON TECHNICAL REQUIREMENTS FOR INLAND NAVIGATION VESSELS (annex to resolution No. 17, revised)

Note by the secretariat

The Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation, at its nineteenth session, considered the draft amended text of chapters 2-6 of the annex, as transmitted to it by the ad hoc group of experts and reflected in TRANS/SC.3/WP.3/1998/28, (chapters 2 and 5), and TRANS/SC.3/WP.3/AC.2/1999/1 and Adds.1-2 (chapters 3, 4 and 6), modified the text as indicated in TRANS/SC.3/WP.3/39, paragraph 7 and requested the secretariat to prepare, in consultation with the Chairman and volunteer delegations of Hungary and Romania, a draft resolution of the Working Party on Inland Water Transport introducing the newly-amended chapters 2-6 (TRANS/SC.3/WP.3/39, para. 8).

The draft resolution, together with the text of chapters 2-6 annexed to it, is reproduced below for consideration and adoption by the Working Party on Inland Water Transport.

AMENDMENT OF THE RECOMMENDATIONS ON TECHNICAL REQUIREMENTS FOR INLAND NAVIGATION VESSELS (Annex to Resolution No. 17, revised)

Resolution No. …

(adopted by the Working Party on Inland Water Transport
on .. October 2000)

The Working Party on Inland Water Transport,

Considering resolution No. 17, revised (TRANS/SC.3/103, annex 1), containing in its annex the Recommendations on Technical Requirements for Inland Navigation Vessels (TRANS/SC.3/104 and Adds.1-4), and in particular chapters 2 to 6 thereof,

Recalling the recommendation of the Inland Transport Committee that the Working Party should continue its efforts towards a full reciprocal recognition of the ship's certificates and should, to this end, undertake updating the Recommendations on Technical Requirements for Inland Navigation Vessels (annex to resolution No. 17, revised) (ECE/TRANS/97, paragraph 104),

Recalling also the Declaration adopted by the Ministerial Conference on the most timely issues of European waterway transportation (Budapest, 11 September 1991) which inter alia urged Governments, with due regard to the work of UN/ECE, to endeavour to harmonize technical specifications and requirements with a view to ensuring free and safe movement of inland waterway vessels and protecting the water resources against pollution,

Bearing in mind the report of the Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation, on its nineteenth session in so far as the item on the amendment of the Recommendations on Technical Requirements for Inland Navigation Vessels (annex to resolution No. 17, revised) is concerned (TRANS/SC.3/WP.3/39, paragraphs 7-9),

Approves the first set of amended chapters of the Recommendations on Technical Requirements for Inland Navigation Vessels, as contained in the annex to this resolution with the understanding that the newly-amended chapters 2 to 6 may need to be modified further in order to be brought into uniformity with the rest of the future amended text of the annex to resolution No. 17, revised, and that the numbers of the chapters and cross-references may need to be reviewed once the work on the amendment of the annex has been completed,

Believes that Governments may already apply the new provisions of chapters 2 to 6, if they so wish, to newly designed vessels,

Affirms that the existing provisions of the annex to resolution No. 17, revised, as set out in TRANS/SC.3/104 and Adds.1-4 including the existing chapters 2 to 6, will continue to be applied until the work on amendment of the whole annex has been completed,

Requests Governments to inform the Executive Secretary of the Economic Commission for Europe whether they accept this resolution,

Requests the Executive Secretary of the Economic Commission for Europe to place the question of the application of this resolution periodically on the agenda of the Working Party on Inland Water Transport.

Annex

CHAPTER 2

HULL

2-1 STRENGTH

2-1.1 The general structural strength of the hull shall be sufficient to withstand all stresses under normal conditions of operations.

2-1.2 The structure of the hull, superstructures, deckhouses, machinery casings, companionways, hatchways and their closures, etc., and the equipment shall be designed to withstand the normal conditions of operation to the satisfaction of the Administration. The Administration may consider this requirement met by a vessel built and maintained in conformity with the rules of a recognized Classification Society.

However the minimum thickness for bottom and side plating shall never be less then 3 mm.

2-2 STRUCTURAL REQUIREMENTS

2-2.1 Layout of decks

The working areas on decks and on deckways shall be large enough to allow the crew to move about and work safely.

2-2.2 Openings in decks

All removable covers shall be protected against accidental shifting. Access openings shall be such as not to interfere with safe movement without prejudice to the requirements of other safety regulations and, in particular, those of chapter 3, the coamings shall be as low as possible. There shall be no possibility of covers and doors closing accidentally.

2-2.3 Hatchways

2-2.3.1 Construction of hatchways

Cargo hatchways shall be surrounded on all sides by coamings. It shall be made impossible for loading tackle to catch on the lower edges of hold coamings.

2-2.3.2 Hatch covers

Hatch covers must be capable of bearing the expected load. Non-load-supporting hatch covers shall be marked as such. If hatch covers admit walking, they must be able to withstand not less than 75 kg of concentrated load. Hatch covers intended to receive deck cargo shall be designed accordingly and have the permissible load in t/m2 marked on them.

Hatch covers and their supporting beams shall be so designed that they cannot be shifted accidentally by the wind, by tackle used for loading or moving the vessel, etc.

The hatch covers and all their components (e.g. fore-and-afters) shall be safe to handle.

CHAPTER 3

FREEBOARD AND SAFETY DISTANCE

3-1 GENERAL

3-1.1 This chapter specifies the minimum freeboard for inland waterway vessels. It also contains requirements concerning the indication of the freeboard mark.

3-1.2 This chapter assumes that the nature and stowage of the cargo, ballast, etc., are such as to ensure adequate stability and as to obviate any excessive structural fatigue.

3-1.3 Freeboards as prescribed in this chapter shall be assigned on the assumption, first, that navigation will cease when weather conditions are such that the maximum wave height defining the zone or zones in which a vessel is to navigate may be exceeded, and second that in such conditions vessels already under way will seek shelter as quickly as possible.

3-1. 4 The Administration may consider it sufficient if the vessel has been built and maintained in conformity with the rules of a recognised Classification Society.

3-2 TYPES OF VESSELS

For the purpose of this chapter, vessels shall be divided into three types:

Type A - Decked vessels

Type B - Tankers

Type C - Open vessels

Type A: Decked vessels. Decked vessels are vessels whose hatch covers are satisfactorily strong, rigid, sprayproof or weathertight.

Type B: Tankers and similar vessels. These vessels have only small openings giving access to the tanks, the openings being closed by steel or equivalent covers with watertight fittings. Such vessels have the following characteristics:

(i) Very high watertight integrity of the exposed deck;

(ii) Very high resistance to flooding, through low permeability of the loaded compartments and through the degree of subdivision applied in general.

Type C: Open vessels. Open vessels are either vessels whose hatch covers are not satisfactorily strong, rigid, sprayproof or weathertight or vessels whose cargo hatchways are open.

3-3 APPLICATION AND DEROGATIONS

3-3.1 The maximum draught level shall be so determined that both the freeboard requirements and the safety-distance requirements are observed. For safety reasons, however, the Administration may prescribe a higher figure for the freeboard.

3-3.2 Vessels so constructed that application of the provisions of this chapter is unwarranted or impracticable shall be assigned freeboards by the Administration in such a way that the safety conditions are equivalent to those of this chapter.

3-3.3 In the case of zone 1, derogations from the conditions of assignment of freeboard may be allowed to vessels to which a freeboard in excess of the minimum freeboard is assigned, provided that the safety conditions are deemed satisfactory by the Administration.

3-4 DETERMINATION OF FREEBOARDS

3-4.1 General

3-4.1.1 Definitions of terms used

Length

The length (L) shall be taken as 96% of the total length on a waterline at 85% of the minimum moulded depth measured from the top of the keel, or as the distance between the foreside of the stem and the axis of the rudder stock on that waterline, whichever is the greater. In vessels with a designed trim, the waterline on which this length is measured shall be parallel to the design load waterline.

Perpendiculars

The forward and after perpendiculars shall be taken at the ends of the length (L). The forward perpendicular shall pass through the point of intersection of the foreside of the stem with the waterline on which the length is measured.

Amidships

Amidships is at the middle of the length (L).

Breadth

The breadth (B) is the maximum breadth measured to the moulded line of the frames in vessels with a metal shell and to the outer surface of the hull in vessels with a shell of any other material.

Moulded depth

The moulded depth (D) is the vertical distance measured from the top of the horizontal keel to the top of the freeboard deck beam amidships at the vessel's side.

Safety distance

The safety distance is the vertical distance measured between the maximum draught level and the top of the deck at its lowest point above which, disregarding water intakes and outlets, the vessel can not be deemed watertight.

Freeboard

The assigned freeboard is the vertical distance measured amidships between the upper edge of the deck line as defined in paragraph 3-4.1.2 and the maximum draught level.

Freeboard deck

The deck from which the freeboard is measured shall normally be the uppermost complete deck exposed to the weather, up to which the watertight bulkheads of the hull extend and below which all openings in the ship's sides are fitted with permanent watertight closures.

In vessels having a discontinuous freeboard deck, the lowest part of the exposed deck and the continuation of that deck parallel to the upper part of the deck shall be taken as the freeboard deck.

Superstructure

A superstructure is a decked structure on the freeboard deck which extends from side to side of the vessel or whose side walls are not set inboard of the ship's sides by more than 4% of the breadth (B).

An enclosed superstructure is a superstructure:

Having closed bulkheads of sufficient strength, permanently so assembled with the deck as to be watertight;

In which the access openings, if any, in these bulkheads are fitted with watertight doors;

In which all other openings in the sides or ends are fitted with watertight closures.

The height of a superstructure is the mean vertical distance measured at the sides from the top of the freeboard deck beams to the top of the superstructure deck beams.

The length of a superstructure is the mean length of that part of the superstructure which lies within the length (L).

If the superstructure is set in from the ship's plating, the length shall be multiplied by the ratio of the breadth of the superstructure at the middle of its length to the breadth of the ship at the middle of the length of the superstructure.

A forecastle and a poop are superstructures which extend to the forward and the after perpendicular, respectively.

Watertight

Structural components or devices shall be deemed watertight if they are so fitted as to prevent any ingress of water into the vessel when they are subjected to a pressure corresponding to a head of water of one metre for one minute, or to a jet of water at a pressure of not less than 100 kPa (1 bar) for 10 minutes, in all directions over the entire surface of the structural component or device.

Weathertight

A device shall be deemed weathertight if, under all weather conditions encountered in the assigned zone, it prevents water from entering the vessel.

Sprayproof

A device shall be deemed sprayproof if, under all weather conditions encountered in the assigned zone, it allows only a small quantity of water to enter the vessel.

Flush-deck vessel

A flush-deck vessel is a vessel which has no superstructure on its freeboard deck.

3-4.1.2 Deck line

The deck line is the upper edge of a horizontal rectangle 300 mm long and 25 mm wide. This rectangle shall be marked amidships on each side of the hull, and its upper edge shall normally pass through the point where the continuation outwards of the upper surface of the freeboard deck intersects the outer surface of the shell amidships. However, the deck line may also be marked at a different height provided that the freeboard is corrected accordingly.

3-4.1.3 Freeboard mark

The freeboard mark for vessels for zone 3 consists of a horizontal band of 300 mm long and 40 mm width.

The freeboard mark for zone 1 and 2 shall consist of a ring intersected through its centre by a horizontal line which shall be supplemented if necessary by additional freeboard lines.

The width of the ring and of all the other lines of the freeboard mark shall be 30 mm; the outer diameter of the ring shall be 200 mm; the length of the horizontal line intersecting the ring shall be 300 mm; and the size of the numerals designating the zones shall be 60 x 40 mm (fig. 1).

The centre of the ring shall be placed amidships. The lower edge of the horizontal line which intersects the ring shall pass through the centre of the ring and shall constitute the freeboard line.

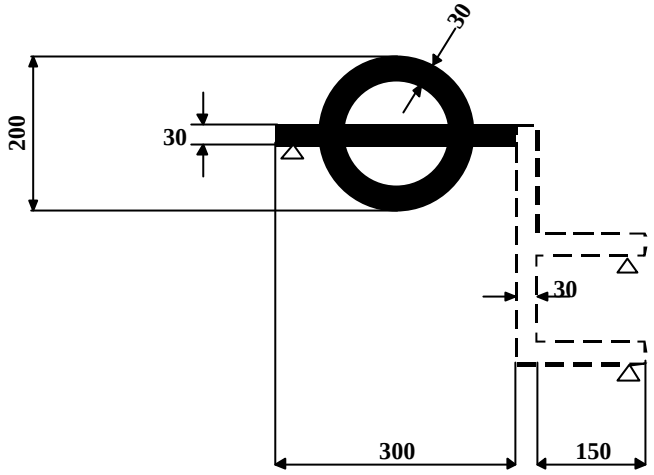
If the vessel is intended to navigate in several navigation zones, a vertical line and additional freeboard lines 150 mm in length shall be applied forward of the centre of the ring.

The lower edge of each freeboard line shall correspond to the freeboard prescribed for the navigation zone concerned.

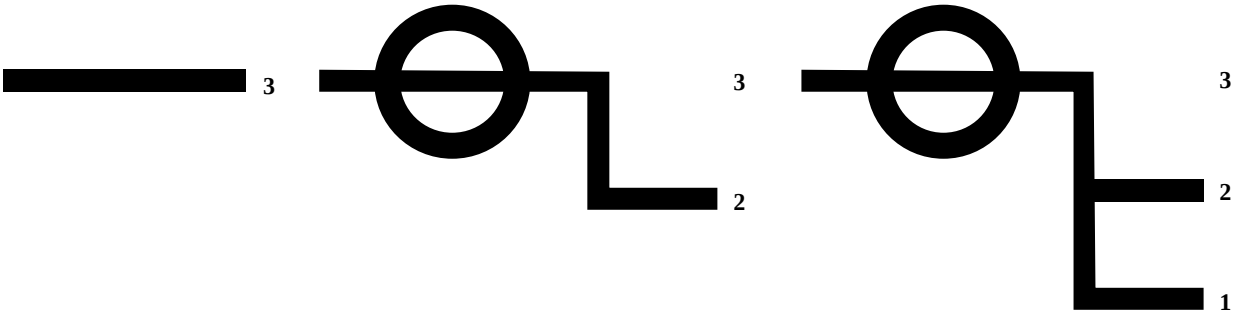
If the vessel is measured in accordance with the Convention on the Measurement of Inland Navigation Vessels, it shall bear, in addition to the freeboard mark, a measurement mark in accordance with the requirements of this Convention.

The freeboard mark and the measurement mark may be combined. In this case, the width of the freeboard mark rectangle (the width of the upper line if there are a number of freeboard marks) should be 40 mm.

Fig.1



Zones 1 and 2



Zone 3 **Zone 2** **Zone 1**

3-4.2 Minimum freeboard

3-4.2.1 Minimum freeboard (F) for vessels of type A

Length of the vessel, m	Minimum freeboard (F), mm	
	Zone 1	Zone 2
≤ 30	250	250
40	340	300
50	440	340
60	570	340
70	570	340
≥ 80	570	340
Note: In this and all subsequent tables, the values for the intermediate lengths of vessels shall be obtained by linear interpolation.		

3-4.2.2 Minimum freeboard (F) for vessels of type B

Length of the vessel, m	Minimum freeboard (F), mm	
	Zone 1	Zone 2
≤ 30	180	160
40	250	220
50	330	220
60	420	220
70	420	220
≥ 80	420	220

3-4.2.3 The minimum freeboard of flush-deck vessels should be obtained in the manner indicated for the vessel of type B.

3-4.2.4 The minimum freeboard for vessels of type C, regardless of length, should be not less than:

for zone 1 - 1000 mm

zone 2 - 600 mm

Furthermore, the sum of the freeboard and the height of coamings for these vessels must be not less than :

for zone 1 - 1200 mm

zone 2 - 1000 mm.

3-4.2.5 The Administration may authorize corrections for the freeboard for vessels with poop, sheer and forecastle, providing that such corrections are calculated in conformity with the rules of the Administration or of a recognized Classification Society.

3-4.3 Arrangement of openings and coamings

3-4.3.1 All outside doors of superstructure, deckhouses and companionways, situated on the freeboard deck shall be watertight on vessels in zone 1 and sprayproof on vessels in zones 2 and 3.

3-4.3.2 The coamings of hatchways, companionways and access openings to superstructures shall be not less than 300 mm high on vessels in zone 1 and 150 mm on vessels in zone 2.

3-4.3.3 If the height of the coamings is less than that required by this chapter, the minimum freeboard height shall be increased by the difference between the height required in 3-4 3.2 and the actual height of the coamings.

3-4.3.4 The freeboard height may not be reduced owing to an increase in the height of coamings below the figure indicated in 3-4 3.2.

3-4.3.5 Exposed cargo hatchways and other hatchways on the freeboard deck shall be fitted with weather tight closures on vessels in zone 1 and sprayproof closures on vessels in zones 2 and 3.

3-4.3.6 Ventilator heads on the exposed parts of the freeboard deck shall be fitted with a strong steel coaming of a height not less than that required for hatchway coamings. Ventilator heads for vessels in zone 1 must have efficient closures.

3-4.3.7 Pipe outlets in the ship's sides below the freeboard deck shall be fitted with efficient and accessible devices to prevent water from entering the vessel.

3-4.3.8 On vessels in zone 1, side scuttles in spaces below the freeboard deck shall be watertight and be provided with permanently attached deadlights. Windows in superstructures, deckhouses and companionways and windows in skylights on the freeboard deck, however, need only be watertight. The distance between side scuttles in the shell and the maximum draught level shall not be less than 300 mm.

3-4.3.9 Skylights and windows must be of sturdy construction.

3-4.3.10 On vessels in zones 2 skylights and windows must be fitted with spray proof covers which shall be permanently attached if the lowest part of the openings falls within the safety distance prescribed for the coamings of uncovered holds (para. 3-4 3.11). In this case, the height (h) of the superstructures in which the openings are provided is limited to the lowest point of these openings.

3-4.3.11 For vessels of type A and type B, the safety distance as defined in paragraph 3-4.1.1 must not be less than 600 mm in zone 2.

For vessels of type C, as well as other vessels navigating with open holds, this distance shall be increased to 400 mm in zone 2. However, this increase applies only to the coamings of open holds.

3-4.3.12 The covers of Kingston valves and ice boxes must be waterproof.

3-4.3.13 The scuppers and freeing ports in bulwarks shall be of sufficient size to drain the decks of shipped water.

3-4.4 Special requirements for freeboard in zone 3.

3-4.4.1 For vessels of types A and B the safety distance must not be less than 300 mm.

3-4.4.2 For vessels of the type C the safety distance must not be less than 500 mm.

3-4.4.3 The basic freeboard of vessels with a continuous deck without superstructures and sheer shall be 150 mm.

3-4.4.4 The Administration may authorise a correction for the freeboard for vessels with superstructures and sheer providing that such correction is calculated in conformity with the rules of the Administration or of a recognized Classification Society.

In view of the reduction referred to above the minimum freeboard shall not be less then 0 mm.

CHAPTER 4

STABILITY AND SUBDIVISION

4-1 STABILITY

4-1.1 General requirements

4-1.1.1 A vessel shall be designed and constructed to provide sufficient intact stability for all anticipated service conditions.

4-1.1.2 A sufficient margin of stability shall be allowed for every stage of the voyage, taking into account any increase in weight such as might result from the absorption of water by the cargo or from icing, if the vessel is to operate under conditions where increases of this kind may occur.

4-1.1.3 The Administration may exempt a vessel from all stability checks provided that basic stability data are available for a sister vessel and it is shown to the Administration's satisfaction that all the stability information for that vessel can be validly used.

4.1.1.4 The Administration may consider the stability of the vessel as sufficient, if a stability information has been approved by a recognized Classification Society.

4-1.2 Special requirements for vessels navigating in zone 1

4-1.2.1 Proof of sufficient stability shall be provided by calculation. In cases where the Administration does not apply requirements of its own, a vessel may be considered as having sufficient stability when it satisfies the criteria given in the appendix to this chapter. Every vessel referred to in paragraph 4-1.2.3 shall, on completion, undergo an inclining test in the presence of an expert of the Administration to determine the displacement of the light vessel and the coordinates of its centre of gravity.

4-1.2.2 In the calculations mentioned in paragraph 4-1.2.1, the adverse effects which the carriage of certain bulk cargoes may have on stability shall be taken into account.

4-1.2.3 All new vessels and all vessels which have undergone conversions that may affect their stability shall be furnished with approved information on their stability.

4-1.2.4 In the case of certain cargo vessels known to be stable, the stability information may be based on calculations only, and an inclining test may be dispensed with.

4-1.2.5 The stability information referred to in paragraph 4-1.2.3 shall comprise:

The stability characteristics for typical loading conditions;

Information in the form of tables or diagrams which will enable the boatmaster to assess the stability of his vessel and verify whether it is sufficient in other loading conditions.

4-1.3 Special requirements for vessels navigating in zones 2 and 3

4-1.3.1 Vessels shall have sufficient stability. In cases where the Administration does not apply stricter requirements of its own, a vessel may be considered as having sufficient stability when it satisfies the criteria given in the appendix to this chapter.

4-2 SUBDIVISION

4-2.1 Watertight bulkheads

4-2.1.1 Watertight bulkheads carried up to the uppermost continuous deck shall be fitted in the places mentioned below.

4-2.1.2 A collision bulkhead shall be fitted at an appropriate distance from the forward perpendicular. If the vessel has a long forecastle, the Administration may require the collision bulkhead to be carried up to the forecastle deck.

4-2.1.3 In vessels navigating in zones 2 and 3 the collision bulkhead shall be between 0,04 L and 0,04 L + 2 m. In vessels navigating in zone 1, the collision bulkhead shall be between 0.04 L and 0.08 L aft of the forward perpendicular, where L is the length defined in paragraph 3-4.1.1.

4-2.1.4 In vessels more than 25 m long, a bulkhead shall be fitted in the after part of the vessel at an appropriate distance from the after perpendicular having regard to the configuration of the vessel's after extremity.

4-2.1.5 The accommodation, engine rooms and boilers, and the working spaces forming part of these, shall be separated from the holds by watertight transverse bulkheads that extend up to the deck.

4-2.1.6 The Administration may require watertight bulkheads other than those mentioned above in regard to the vessel's design.

4-2.1.7 The Administration may permit derogations from these provisions, provided that equal safety is assured.

4-2.1.8 The bulkheads, the doors and closures in the bulkheads and the methods used for testing them shall comply with the requirements of the Administration or of a recognized Classification Society.

4-2.2 Openings in watertight bulkheads

4-2.2.1 General requirements applicable to all zones

4-2.2.1.1 No door or manhole shall be permitted in the collision bulkhead.

4-2.2.1.2 The number and dimensions of the openings in other watertight bulkheads shall be reduced to the minimum compatible with the design and operation of the vessel; satisfactory devices shall be provided for the watertight closing of these openings, with indicators showing whether the devices are open or closed. It shall be possible to open and close doors on the spot from either side of the bulkhead.

4-2.2.1.3 Where shafts, pipes, scuppers, electric cables, etc., are carried through watertight subdivisions, arrangements shall be made to avoid impairing the watertight integrity of the bulkheads or decks.

4-2.2.1.4 In the collision bulkhead, no valves or cocks shall be fitted which open directly into the compartments lying abaft that bulkhead.

Such devices shall be avoided so far as possible in the other watertight bulkheads; if, however, such devices are fitted, they shall at all times be capable of being opened and closed from an accessible point situated above the uppermost continuous deck. Indicators shall be fitted to show whether the devices are open or closed.

4-2.2.1.5 If the drainage pipes of the forepeak tank pass through the collision bulkhead, each pipe shall be fitted with a valve which is controlled from a point situated above the freeboard deck and which is fitted to the collision bulkhead inside the forepeak.

4-2.2.2 Special requirements for vessels navigating in zone 1

4-2.2.2.1 Doors in watertight bulkheads shall be provided with a system for watertight closing, workable from either side of the bulkhead in proximity to the door and from a point above the maximum draught level. Each door shall be fitted with indicators which show, at all operating stations, whether it is open or closed.

In the accommodation and working spaces, however, and in the tweendeck immediately below the freeboard deck, remote control shall not be required. The doors shall be capable of being opened or closed on the spot from either side of the bulkhead. Hinged doors may be allowed.

Appendix

Criteria for checking the stability of vessels

1 General principles and definitions

1.1 The stability criteria do not take into account any shifting of cargo.

1.2 A vessel shall be deemed sufficiently stable if, for the loading conditions considered in 1.7, it satisfies:

1.2.1 The requirement that the initial metacentric height, corrected for the free-surface effects of liquid cargo, should have a positive value;

1.2.2 Weather criteria, as determined in accordance with the requirements of chapter 2 below;

1.2.3 The requirements for stability, as determined in accordance with the requirements of chapter 3 below with respect to the type and purpose of the vessel.

1.3 The values for the moments of the external forces exerted on the vessel shall be taken as constant for the whole range of inclination of the vessel.

1.4 The definitions used in this appendix, apart from those laid down in other paragraphs of these Recommendations are as follows:

1.4.1 Liquid cargo: all liquids carried on the vessel, including: cargo, stores, ballast, etc.;

1.4.2 Stores: cargo consumed in the operation of the vessel (fuel, lubricating oil, fresh water, provisions, etc.);

1.4.3 Empty vessel: a vessel that is fully prepared and equipped with machinery and systems, but with no cargo, passengers, liquid ballast or stores;

1.4.4 Vessel carrying fixed containers: vessels all of whose containers are fixed and having the equipment necessary to secure containers to the satisfaction of the Administration;

1.4.5 Critical angle θ_{f1}: angle of heel at which water begins to fill the vessel through unsecured openings, but not exceeding the angle at which the edge of the freeboard deck is submerged, or at which the middle of the bilge leaves the water;

1.4.6 Capsizing angle θ_c: angle of heel at which the vessel begins to capsize under the effect of the heeling moment.

1.4.7 Permissible angle θ_{perm}: angle of heel which should not be exceeded and which should be prescribed by the competent authority for the type of vessel under consideration. In general it corresponds to the critical angle θ_{f1} as defined in 1.4.5, but should not be greater than the capsizing angle as defined in 1.4.6.

1.5 The permissible heeling moment for all required loading conditions shall be determined by means of a static or a dynamic stability curve in accordance with the values of permissible angle of heel given for the various stability criteria in paragraphs 2 and 3 below.

For vertical-sided vessels, the maximum permissible heeling moments may be determined without constructing a curve, on the basis of the following formulae:

1.5.1 For the dynamic effect of the external forces:

$$M_{perm} = 0.0856 \cdot \Delta \cdot \overline{GM'} \cdot \theta_{perm} \text{ (kNm)}$$

1.5.2 For the static effect of the external forces

$$M_{perm} = 0.1712 \cdot \Delta \cdot \overline{GM'} \cdot \theta_{perm} \text{ (kNm)}$$

where:

Δ = displacement of the vessel for the given loading condition; in tonnes;

$\overline{GM'}$ = initial metacentric height corrected for the free-surface effects of liquid cargo, in metres;

M_{perm} = permissible heeling moment;

θ_{perm} = permissible angle of heel, in degrees.

1.6 The free-surface effects of liquid cargo shall be taken into account in the calculation of stability.

For liquid cargo in tanks where the quantity of liquid changes during the operation of the vessel, the calculation shall be made with the tanks filled to 50% of their capacity.

A tank filled with liquid cargo to more than 95% of its capacity shall be deemed completely full.

In calculating the stability of a vessel, the liquid cargo residues commonly found up to a depth of 5 cm in evacuated tanks shall not be taken into account.

If the vessel is intended for the transport of various types of liquid cargo, the calculation shall assume the most unfavourable loading condition.

1.7 The stability of vessels, according to their type or purpose, should be checked for the most unfavourable loading conditions, at least in the cases shown in the following table:

Type of vessel	Loading conditions
Passenger vessels	(i) - With no passengers or cargo, 10% stores (ii) - With 100% passengers and baggage, 10% stores, 100% cargo (iii) - With 100% passengers and baggage, 100% stores, 100% cargo
All other vessels	(i) - With 10% stores, with no cargo (ii) - With 100% stores and 100% cargo

If the vessel carries solid ballast, its mass shall be included as part of the light weight.

For all loading conditions, the inclusion of liquid ballast as part of the load should be agreed with the Administration.

2 Weather criteria

2.1 The vessel shall satisfy the weather criterion if, under the most unfavourable loading condition, the permissible moment produced by dynamic inclinations of the vessel is equal to or greater than the heeling moment resulting from the dynamic pressure of the wind, i.e. if the following condition is met:

$$M_{perm} \geq M_{wd}$$

where:

M_{perm} = permissible moment produced by the dynamic inclinations of the vessel corresponding to the critical angle or to the capsizing angle, if the latter is smaller;

M_{wd} = heeling moment resulting from the dynamic pressure of wind, as in 2.3.

2.2 Certain types or individual vessels need not be checked for stability with respect to the weather criterion if the competent authorities are satisfied beyond doubt that the stability requirements are met by the said vessels in any case.

2.3 The heeling moment resulting from the dynamic pressure of the wind shall be taken as:

$$M_{wd} = 0.001 \cdot P_{wd} \cdot A_w \cdot z \quad \text{(kNm)}$$

where:

P_{wd} = specific wind pressure, whose value shall be taken from the following table for the navigation zone of the vessel and for the lever arm;

Specific wind pressure P_{wd},(Pa):

z (m) Navigation zone	1	2	3	4	5	6
2	232	279	318	345	369	388
3	178	217	247	269	286	302

A_w = effective lateral area (m^2) - see below;

Z = level arm of free-floating vessel = distance between the centre of gravity of the lateral area and the plane of the load waterline considered, when the vessel is upright in calm water (m).

The effective lateral area should include all above-water projected surfaces (hull, superstructure, deck machinery, deck cargo, and other elements of the above-water port of the vessel) at the centre of the vessel when it is upright. The projected areas of structures of round section located separately on the deck should be assumed to have an effective coefficient of flow of 0.6.

The lateral area of lattice-type structures above the waterline shall be calculated on the basis of the areas bounded by these structures multiplied by the coefficients of fullness taken from the following table:

Type of lattice structure	Coefficient of fullness
Life rails:	
without guard mesh	0.2
with guard mesh	0.6
Other lattice structures	0.3-0.5

3 Stability requirements for different types of ships

3.1 Passenger vessels

3.1.1 The stability of passenger vessels should satisfy the following requirements:

3.1.1.1 The angle of heel under the most unfavourable distribution of passengers in terms of width and height should not exceed an angle at which 75% of the freeboard or of the distance between the waterline and unsecured openings, whichever is less, is submerged, and that angle should not exceed 10°;

3.1.1.2 The angle of heel should not exceed the critical angle; furthermore that angle should not exceed 12° under:

the combined effect of the heeling moments resulting from the most unfavourable crowding of passengers on one side M_{pass} and from the effect of the centrifugal force exerted by turning M_{cf};

the combined effect of the heeling moments resulting from the most unfavourable crowding of passengers on one side M_{pass} and from the static effect of wind M_{wst}.

3.1.2 The stability of passenger vessels should be checked against the supplementary requirements for the loading conditions shown in the table at paragraph 1.7 and for the loading condition which corresponds to the most dangerous number of passengers with baggage and 10% of stores.

3.1.3 The heeling moment of the vessel resulting from the static effect of wind shall be determined by the formula:

$$M_{wst} = 0.1 \cdot A_w \cdot (z + \frac{d}{2}) \text{ (kNm)}$$

or, alternatively

$$M_{wst} = 0.1 \cdot A_w \cdot (z + \frac{d}{2}) \text{ (kNm)}$$

where:

P_{wst} = specific pressure exerted by the static effect of wind, amounting to 50% of the pressure value shown in the first table at paragraph 2.3 (Pa);

A, z = as in paragraph 2.3.

3.1.4 The heeling moment resulting from the effect of the centrifugal force exerted by turning the vessel M_{cf} shall be determined by the formula:

$$M_{cf} = \frac{c \cdot \Delta \cdot v^2 \cdot (z_g - \frac{d}{2})}{L} \text{ (kNm)}$$

or alternatively,

$$M_{cf} = \frac{5 \cdot \Delta \cdot (z_g - \frac{d}{2})}{L} \text{ (kNm)}$$

where:

c = a coefficient which shall be determined in manoeuvrability trials and which shall not be less than 0.2;

v = speed of the vessel at full power in calm water (m/s);

z_g = height of the vessel's centre of gravity above the base line (m);

L = maximum length of the hull, measured at maximum draught (m).

3.1.5 The heeling moment of the vessel resulting from the crowding of passengers on one side M_{pass} should be determined having regard to the following conditions:

3.1.5.1 The distribution of passengers should correspond to the most dangerous crowding possible under normal operating conditions, taking into account decks accessible to passengers. In the case of vessels with more than one deck in use for passengers, the most unfavourable distribution of these passengers over the various decks shall be assumed;

3.1.5.2 The number of passengers shall be calculated at the rate of at least four persons per square metre of free deck area;

3.1.5.3 The width of seating space per person shall be taken to be 45 cm;

3.1.5.4 The mass per passenger shall be taken to be 75 kg;

3.1.5.5 The centre of gravity of standing passengers shall be taken to be 1.0 m above the deck level, and that of sitting passengers 0.3 m above the seat.

3.2 Cargo vessels

3.2.1 The stability of cargo vessels carrying deck cargo or cargo in holds, where the centre of gravity of the lateral area of the vessel and cargo is more than 2 m above the load waterline considered, should satisfy the supplementary requirement laid down in 3.2.2.

3.2.2 The heeling moment of a vessel resulting from the static effect of wind M_{wst} should not exceed the maximum permissible moment produced by the static inclinations of the vessel M_{perm}, i.e., the following condition should be met:

$$M_{perm} \geq M_{wst}$$

where:

M_{wst} = as in 3.1.3;

M_{perm} = maximum permissible moment produced by the static inclinations of the vessel = moment corresponding to an angle of heel representing 80% of the critical angle.

3.2.3 All vessels for which the ratio of the total power of the main machinery N_e to the maximum permissible displacement $\hat{I}$ is $N_e/\hat{I} > 0.75$ kW/t shall be checked with respect to the turning criterion as in 3.1.4. Their angle of heel should not in this case exceed 80% of the critical angle.

3.3 Tugs

3.3.1 Tug vessels shall have sufficient stability if the maximum permissible moment of the vessel M_{perm} (see 2.1) is greater than or equal to the sum of the heeling moments resulting from the dynamic effect of wind M_{wd} (see 2.3) and the dynamic effect of the lateral component of the bollard pull force M_t (see 3.3.2), i.e., if the following condition is met:

$$M_{perm} \geq M_{wd} + M_t$$

3.3.2 The heeling moment resulting from the dynamic pressure of the lateral component of the bollard pull force shall be determined by the formula:

$$M_t = 1.1 \cdot T \cdot (z_t - d) \qquad \text{(kNm)}$$

where:

z_t = height of the point of application of the bollard pull force above the base line (m);

T = maximum bollard pull force measured on checking at moorings (kN).

In cases where T is not known, the following values shall be assumed for calculation purposes:

for $\Delta \leq 30$ t:

$T = 0.13\ N_e$ - for tugs without propeller nozzles;
$T = 0.20\ N_e$ - for tugs with propeller nozzles;

for $\Delta \geq 30$ t:

$T = 0.16\ N_e$ - for tugs without propeller nozzles;
$T = 0.20\ N_e$ - for tugs with propeller nozzles:

where N_e = the total power of the main machinery (kW).

3.3.3 In addition to the conditions laid down in 3.3.1, the stability of each tug should satisfy the following supplementary requirement:

The angle of heel resulting from the combined effect of the heeling moments produced by the dynamic pressure of wind M_{wd} and the effect of the centrifugal force on turning M_{cf} (see 3.1.4) should not exceed the critical angle and should in no case exceed 15°.

3.4 Vessels carrying containers

The following two methods of calculation of stability of vessels carrying containers shall be considered as equally acceptable.

Method A

3.4.1 In the case of the vessels carrying non-fixed containers any calculation method used to determine the vessel's stability shall conform to the following requirements:

3.4.1.1 The metacentric height $\overline{MG}$ shall not be less than 1.00 m;

3.4.1.2 Under the combined action of the centrifugal force produced by the turning of the vessel, the thrust of the wind and the flooded free surfaces, the heel shall not be more than 5° and the deck side shall not be submerged;

3.4.1.3 The heeling arm resulting from the centrifugal force due to the turning of the vessel shall be determined by the following formula:

$$h_{cf} = C_{cf} = \frac{v^2}{L_F} \cdot (z_g - \frac{d'}{2}) \text{ (m)}$$

where,

C_{cf} = parameter: (C_{cf} = 0.04) (s^2/m),

v = maximum speed of vessel in relation to the water (m/s),

z_g = height of centre of gravity of loaded vessel above the baseline (m),

d' = average draught of loaded vessel (m),

L_F = length of the hull, measured at maximum draught (m).

3.4.1.4 The heeling arm resulting from the thrust of the wind shall be determined according to the following formula:

$$h_w = C_w \cdot \frac{A_w}{\Delta} \cdot (z + \frac{d'}{2}) \text{ (m)}$$

where,

C_w = parameter: (C_W = 0.025) [t/m^2],

A_w = lateral surface above the water when vessel is loaded (m^2),

Ä = displacement of loaded vessel (t),

z = height of centre of gravity of lateral surface A above the water in relation to the water-line (m),

d' = average draught of loaded vessel (m).

3.4.1.5 The heeling arm resulting from the free surfaces exposed to rainwater and residual water inside the hold or double bottom shall be determined according to the following formula:

$$h_{fs} = \frac{C_{fs}}{\Delta} \cdot \sum \left(b \cdot l \cdot (b - 0.55\sqrt{b}) \right) \text{ (m)}$$

where,

C_{fs} = parameter: (C_{fs} = 0.015) [t/m^2],

b = breadth of hold or section of hold concerned (m),[1]

l = length of hold or section of hold concerned (m),[1]

Ä = displacement of loaded vessel (t).

3.4.1.6 For each load, half the fuel and freshwater supply must be taken into account.

3.4.2 The stability of a vessel loaded with non-fixed containers shall be considered adequate when the actual z_g is not more than the $z_{g\,max}$ produced by the formula. The $z_{g\,max}$ must be calculated for various displacements covering the whole range of possible draughts.

3.4.2.1

$$z_{g\,max} = \frac{\overline{KM} + \frac{B_F}{2F} \cdot \left(C'_{cf} \cdot \frac{d_a}{2} - h_w - h_{fs} \right)}{\frac{B_f}{2F} \cdot C'_{cf} + 1} \text{ (m)}$$

For $\frac{B_F}{2F}$, no value below 11.5 shall be used (11.5 = 1/tan 5).

[1] Sections of hold of free surfaces open to water result from separation by watertight lengthwise or transverse partitions, forming separate sections.

3.4.2.2 $z_{g\,max} = \overline{KM} - 1.00$ (m).

The smaller value for $z_{g\,max}$ produced by 3.4.2.1 or 3.4.2.2 shall apply,

where,

$z_{g\,max}$ = maximum permissible height of the centre of gravity of the loaded vessel above the baseline (m),

$\overline{KM}$ = metacentric height above the baseline (m) according to the approximation formula in 3.4.3,

F = actual freeboard at 2 L (m),

C'_{cf} = parameter for centrifugal force produced by turning,

$$C'_{cf} = \frac{(0.7 \cdot v)^2}{9.81 \cdot 1.25 \cdot L_F} = 0.04 \cdot \frac{v^2}{L_F} \; [-]$$

v = maximum speed of vessel in relation to the water (m/s),

d_a = average draught (m),

h_W = heeling arm produced by lateral wind thrust (see 3.4.3.4) (m),

h_{fs} = sum of heeling arms produced by flooded free surfaces (see 3.4.3.5) (m),

B_F = breadth of the hull, measured from the outside of the side plating at the maximum draught line.

3.4.3 Approximation formula for $\overline{KM}$

Where there is no curve plan available, the value of $\overline{KM}$ for the calculation, according to 3.4.4, can be determined, for example, by the following approximation formulae:

3.4.3.1 pontoon vessels

$$\overline{KM} = \frac{B_F^2}{(12.5 - \frac{d_a}{H}) \cdot d_a} + \frac{d_a}{2} \; [m]$$

where,

H = side height of the hull which is the shortest vertical distance between the top of the keel and the lowest point of the deck at shipside.

3.4.3.2 other vessels

$$\overline{KM} = \frac{B_F^2}{(12.7 - 1.2 \cdot \frac{d_a}{H}) \cdot d_a} + \frac{d_a}{2} \text{ (m)}$$

3.4.4 In the case of vessels carrying fixed containers, any calculation method used to determine the stability of the vessel shall conform to the following requirements:

3.4.4.1 The metacentric height $\overline{MG}$ shall not be less than 0.50 m;

3.4.4.2 Under the combined action of the centrifugal force produced by the turning of the vessel, the thrust of the wind and the flooded free surfaces, no hull opening shall be submerged;

3.4.4.3 The heeling arm resulting from the centrifugal force produced by the turning of the vessel, the thrust of the wind and the flooded free surfaces shall be determined by the formulae referred to under paragraphs 3.4.1.3-3.4.1.5;

3.4.4.4 For each load, half the fuel and fresh water supply must be taken into account.

3.4.5 The stability of a vessel loaded with fixed containers shall be considered adequate when actual z_g is less than or equal to the $z_{g\,max}$ calculated for the various displacements resulting from the possible variation in height.

Method B

3.4.6 A cargo of containers is considered to be fixed when each individual container is firmly secured to the vessel hull by guides or tensioners and when its position cannot be altered during navigation.

3.4.7 The container cargo of vessels navigating in zone 1 must be fixed.

3.4.8 The equipment used to secure containers must satisfy the requirements laid down by the Administration.

3.4.9 The requirement regarding the stability of vessels carrying fixed containers is considered to be met if the criteria for the stability of cargo vessels set out in para. 3.2 have been satisfied.

3.4.10 The stability of vessels carrying non-fixed containers must satisfy the following additional requirements:

3.4.10.1 The metacentric height $\overline{GM}$ shall not be less than 1.00 m.

3.4.10.2 The permissible angle of heel $\grave{e}_{perm}$ is compared with the angle of heel $\grave{e}_{wst/cf}$ resulting from the combined effect of the heeling moments produced by the static pressure of wind M_{wst} (see para. 3.1.3 above)

and the effect of the centrifugal force on turning M_{cf} (see para. 3.1.4 above).[2] This angle must not be greater than 5° or the critical angle $è_n$ at which the upper edge of the freeboard deck is submerged, with a view to determining which of these angles is the smaller; in other words one of the following requirements must be satisfied:

$$è_{wst/cf} \leq è_{perm} = 5°$$

or

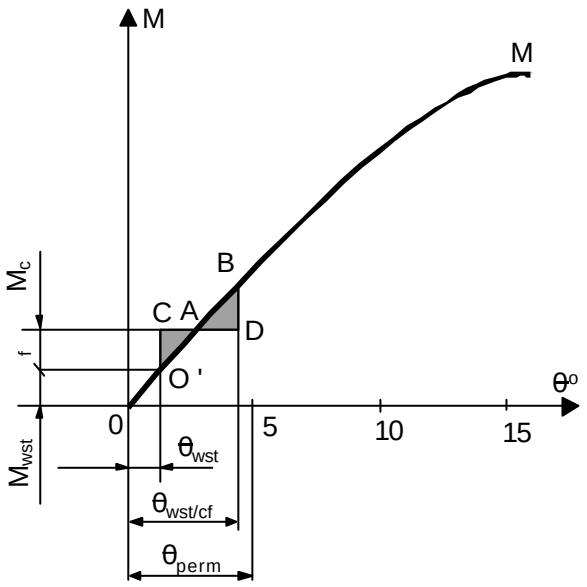
$$è_{wst/cf} \leq è_{perm} = è_n, \text{ if}$$

$$è\ n < 5°$$

3.4.10.3 The angle of heel $è_{wst/cf}$ should be determined from the static stability diagram in relation to the value of M_{wst} and M_{cf} as a result of constructions given in fig. 3.4.10.3 where the origin of the coordinates is transposed to point O' on curve M, corresponding to the static angle of heel $è_{wst}$, arising as a result of the application of the static moment M_{wst}, determined in accordance with 3.1.3.

The angle of heel $è_{wst/cf}$ is determined by selecting a straight line BD parallel to the ordinates axis, assuming that the hatched areas O'CA above the curve up to the moment M_{cf} and ABD below the curve are equal.

Figure 3.4.10.3



[2] In calculating M_{cf} in accordance with paragraph 3.1.4 the speed of the vessel before it begins its turn is taken as 0.8 of the full speed.

3.4.10.4 In determining the permissible moment produced by the dynamic inclinations M_{perm}, the permissible angle of heel $è_{perm}$ must be no greater than that given in para. 3.4.10.2.

3.4.10.5 If the requirements laid down in paras. 3.4.10.2 and 3.4.10.4 are not satisfied containers must be secured.

4 Supplementary requirements for vessels in navigation zone 1

4.1 General provisions

4.1.1 The stability of vessels intended for navigation in zone 1 should satisfy the requirements of chapters 1, 2 and 3 for vessels of zone 2, and also the supplementary requirements of this chapter. Furthermore the conditions for satisfactory stability laid down in paragraphs 1.2.1 and 1.2.2 should also be met for the simultaneous rolling of the vessel.

4.1.2 Compliance with the applicable requirements of the IMO Recommendations for sea-going vessels may be considered as equivalent to compliance with these regulations.

4.1.3 When checking stability with respect to the weather criterion, the heeling moment resulting from the dynamic pressure of wind M_{wd} shall be calculated taking the specific wind pressure P_{wd} for navigation zone 2, as in the table at paragraph 2.3.

4.1.4 The permissible heeling moment M_{perm} shall be determined by means of the stability curve, taking into account the value for the amplitude of roll calculated as in 4.2.

4.1.5 The critical angle shall be taken to be the angle of heel at which water begins to fill the vessel through unsecured openings in the side plating or on the deck. The maximum angle may not extend further than the upper edge of the side coaming of the cargo hatch or the upper edge of the expansion trunks of tankers.

4.2 Calculation of the value for the amplitude of roll of a vessel

4.2.1 The value for the amplitude of roll $è_m$ of a flat-bottomed vessel with a bilge radius of 0.05 B or more not fitted with bilge keels shall be determined from the following table in terms of a value m calculated by the formula:

$$m = 0.66 \cdot m_1 \cdot m_2 \ (s^{-1})$$

where m_1 and m_2 = factors determined in accordance with paragraphs 4.2.2 and 4.2.3.

$m_1(s^{-1})$	0.40	0.60	0.80	1.00	1.20	1.40	1.60 or more
$è_m$ (o)	9	10	13	17	20	23	24

4.2.2 The factor m_1 shall be calculated by the formula:

where:

$$m_1 = \frac{m_o}{\sqrt{\overline{GM}}} \ (s^{-1})$$

$\overline{GM}$ = initial metacentric height for the loading condition considered, without correction for the free-surface effects of liquid cargo;

m_o = a value from the following table in relation to the parameter n_1 determined by the formula:

$$n_1 = \frac{B \cdot \overline{GM}}{3\sqrt{\Delta} \cdot z_g}$$

where:

Ä = see paragraph 1.5;

z_g = see paragraph 3.1.4.

n_1	0.1 or less	0.15	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.0 or more
m_o	0.42	0.52	0.78	1.38	1.94	2.40	3.00	3.00	3.50	3.60

4.2.3 The non-dimensional factor m_2 shall be taken from the following table as a function of the ration B/d.

B/d	2.5 or less	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10 or more
m_2	1.0	0.9	0.81	0.78	0.81	0.87	0.92	0.96	0.99	1.0

4.2.4 In cases where the bilge radius is less than 0.05 B, the value for the amplitude of roll determined in accordance with paragraph 4.2.1 may be reduced to a value of è determined by the formula:

$$\theta = \theta_m \cdot (0.75 + \frac{5r}{B}) \text{ (degrees)}$$

where: r = bilge radius (m).

4.2.5 The amplitude of roll $è_m$ determined in accordance with paragraph 4.2.1 shall be taken into account in the stability curve (see sketches 4.2.5-1 (a) and (b) and 4.2.5-2 (a) and (b)).

Explanation of sketches 4.2.5-1 (a) and (b) and 4.2.5-2 (a) and (b)

Sketches 4.2.5-1 (a) and 4.2.5-1 (b) show static stability curves constructed taking into account the amplitude of roll $è_m$ in the following manner:

The curves are amplified by a static stability curve in the area of negative angles of heel to the abcissa $è_m$ (segment O-D);

In order to determine the maximum heeling moment, the area on the static stability diagram below the curve up to angle $è_{perm}$ (ABE) should be equal to the area above the curve (ACD);

The diagram in sketch 4.2.5-1 (a) shows a case in which the angle $è_{perm}$ equals the capsizing angle, and the diagram in sketch 4.2.5-1 (b) a case in which the angle $è_{perm}$ equals the angle of maximum heel which is permissible on other grounds.

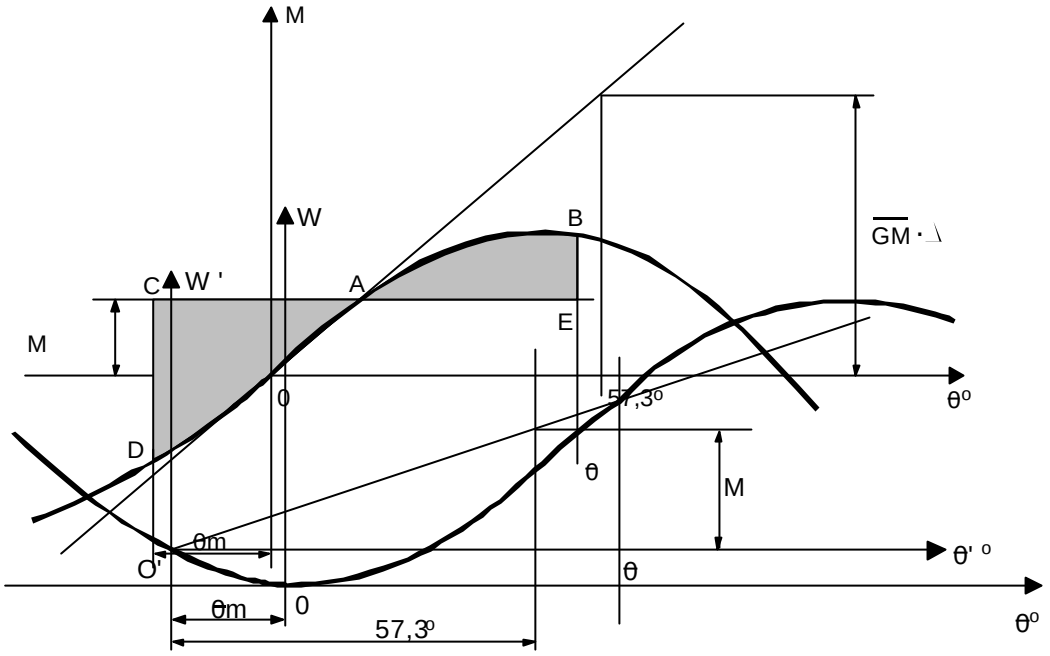
Sketches 4.2.5-2 (a) and 4.2.5-2 (b) show static stability curves constructed taking into account the amplitude of roll $è_m$ in the following manner:

The curves are amplified by a dynamic stability curve in the area of negative angles of heel to the abcissa $è_m$;

A tangent to the dynamic stability curve is produced through new origin O' in order to determine the maximum capsizing moment $è_{perm}$ (cf. sketch 4.2.5-2 (a)), or a straight line is produced through the point of intersection of the dynamic stability curve with a vertical straight line drawn from the point of the angle of heel $è_{perm}$ which is permissible on other grounds;

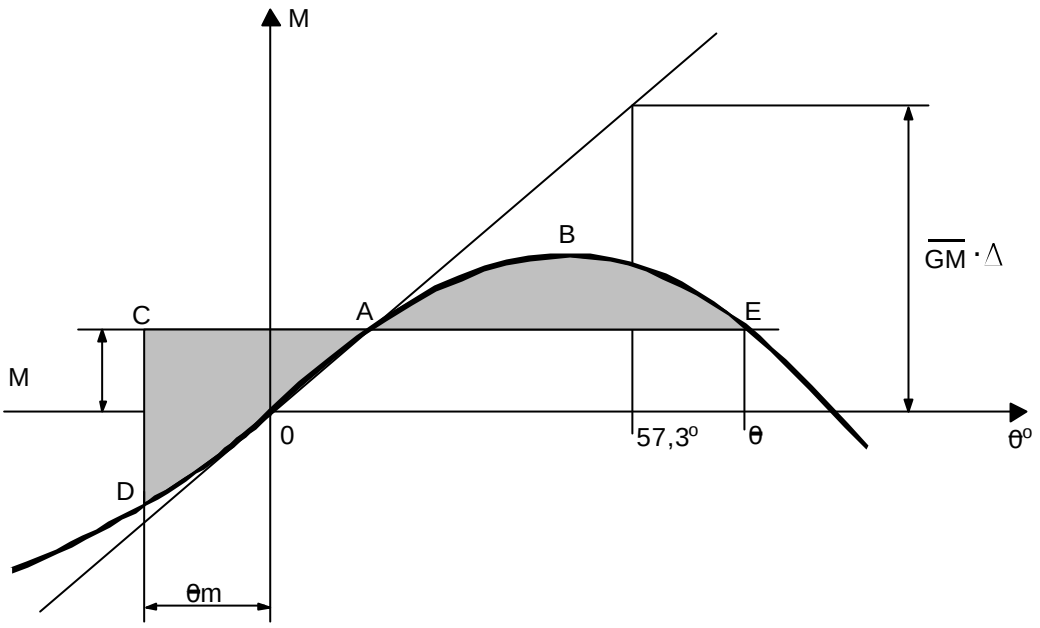
The segment at an angle of 1 radian gives the value of the maximum permissible heeling moment.

4.2.5-1(a)

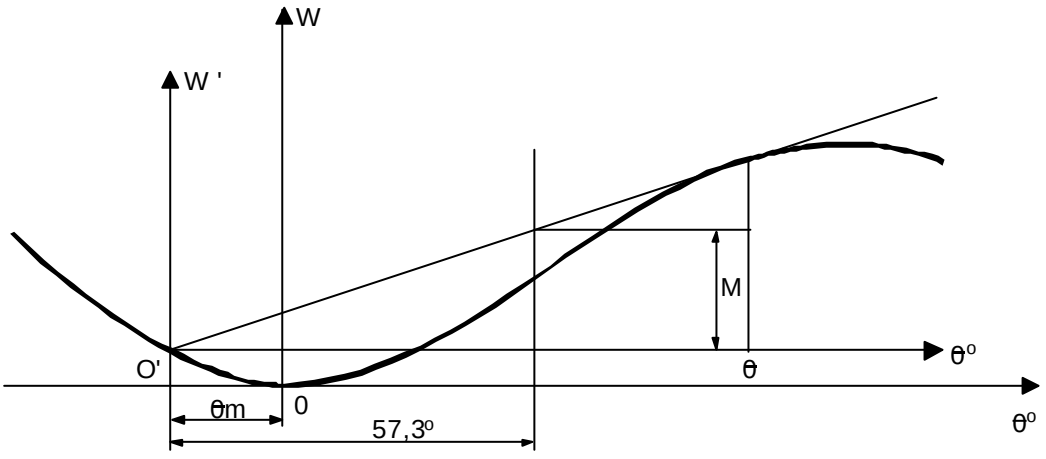


4.2.5-2(a)

4.2.5-1(b)



4.2.5-2(b)



CHAPTER 5

MACHINERY

5-1 General

5-1.1 The machinery space is the part of the vessel housing the main and auxiliary machinery. The machinery space is divided up as follows:

(a) The main engine room - the space where the main machinery is installed;

(b) The engine room - the space where only auxiliary machinery, namely internal combustion engines, is installed;

(c) The boiler room - the space housing a fuel-operated installation designed to produce steam or to heat a thermal fluid.

5-1.2 The main machinery is that designed to drive the propelling mechanisms and/or serving the main purpose of the vessel.

5-1.3 The auxiliary machinery is that which contributes to the operation of the main machinery and that which supplies the vessel with all forms of power necessary for the operation of the vessel's various systems and installations.

5-1.4 Machinery and their attachments shall be designed built and installed in accordance with the state of the art, the rules of the Administration and/or of a recognized Classification Society. It shall be possible to start and stop the machinery, and if necessary to reverse the main machinery, reliably, quickly and safely.

The main machinery and auxiliary machinery, boilers and pressure vessels, together with their accessories shall be fitted with safety devices.

5-1.5 The liquid fuel for the main or auxiliary machinery shall have a flashpoint above 55°C. In certain cases, such as for lifeboat engines, the Administration may allow a fuel with a flashpoint below 55°C.

5-1.6 Installations requiring special inspections, such as boilers and pressure vessels, shall comply with the rules of the Administration or with the rules of a recognized Classification Society.

5-1.7 The fuel system, the lubricating and cooling-water systems and the starting devices shall conform to the requirements of the Administration or to the rules of a recognized Classification Society.

5-1.8 The following parameters of the main machinery shall be monitored by means of suitable devices which trigger an alarm once a critical level has been reached:

(a) The temperature of the cooling water;

(b) The lubricating oil pressure for the engines and transmissions;

(c) The oil and air pressure of the reversing units, reversible transmissions or propellers.

5.1.9 Where vessels have only one main propulsion engine that engine shall not be shut down automatically except in order to protect against over-speed of the engine.

5-2 Main machinery/Shafting

5-2.1 The main machinery power shall make the vessel sufficiently manoeuvrable under normal operating conditions.

5-2.2 The control devices shall be so constructed that they cannot be accidentally moved from their appointed position.

5-2.3 A system of two-way communication shall be provided between the main machinery space and the wheelhouse.

5-2.4 Where the main machinery is remote-controlled, a local control station shall be provided.

5-2.5 It shall be possible to turn the main machinery over in complete safety.

5-2.6 If the propeller shafts cannot be disconnected, they shall be equipped with suitable blocking devices.

5-2.7 Shafting shall be designed in such a way as to prevent the spread of water-polluting lubricants.

5-3 Machinery space

5-3.1 In the machinery space the machinery, accessories and equipment shall be so placed as to be readily accessible and safe for operation, dismantling and maintenance.

5-3.2 All moving parts of the machinery and transmissions dangerous to members of the crew shall be fitted with appropriate protective devices.

5-3.3 The machinery and equipment shall be installed on sturdy and rigid seatings firmly fixed to the vessel's hull.

5-3.4 The machinery space shall be provided with efficient ventilation

5-3.5 The floor plates of the machinery space shall be fixed and made of sufficiently firm non-slip sheet metal. They have to be removable.

5-3.6 All doors and hatch covers usable as exits from the machinery space shall open and close from both inside and outside. The covers of skylights not intended for use as exits shall be closable from outside.

5-4 Gas exhaust system

5-4.1 All exhaust gases shall be evacuated outside the vessel. All necessary steps shall be taken to prevent dangerous gases from penetrating the various compartments.

5-4.2 Exhaust pipes shall be suitably shielded, insulated or cooled. Protection against physical contact may suffice outside the engine rooms.

5-4.3 Gas exhaust pipes which pass through accommodation or the wheelhouse shall, in those compartments, be enclosed within a gastight protective sleeve. The space between the exhaust pipe and the sleeve shall communicate with the open air.

5-4.4 The exhaust pipes shall be arranged and protected in such a way that they cannot cause a fire. If the exhaust pipes run alongside or pass through inflammable materials, those materials shall be effectively protected.

5-5 Fuel system

5-5.1 Liquid fuels shall be stored in steel tanks or, if so required by the design of the vessel, in an equivalent material in terms of fireproofing, this forming part of the hull or being firmly attached to this. That requirement shall not apply to tanks having a capacity of no more than 12 litres that have been incorporated in ancillaries at the factory. No tank for any liquid fuel shall be installed forward of the collision bulkhead.

5-5.2 Fuel tanks shall not be situated near sources of heat. Daily-service tanks, their fittings and connections shall not be located above engines or gas exhaust pipes. Drip-trays shall be placed under daily-service tanks in order to collect any leaking fuel.

5-5.3 Fuel transfer pumps, fuel separators and oil burners, shall be fitted not only with a local control device but also with a stopping device accessible at all times and situated outside the spaces where they are installed.

5-5.4 Fuel pipes shall be independent of other piping systems.

5-5.5 Fuel may be heated only by devices allowed by the Administration.

5-5.6 Fuel tanks, their piping and other accessories shall be so designed and installed that no fuel or gas can escape into the vessel. Tank valves intended for fuel sampling or water drainage shall be of a self-closing type. Drip-trays to collect any leaking fuel or oil shall be placed under fittings and fuel and oil tank connections.[3]

5-5.7 Fuel shall be supplied by means of a leak-proof connection.

5-5.8 If machinery can run on either light or heavy fuel, measures shall be taken to avoid mixing different kinds of fuel by accident.

5-5.9 At tank outlets the pipeline for the distribution of liquid fuels shall be fitted with a shutoff device that can be operated from the deck. That requirement shall not apply to tanks mounted directly on the engine. Fuel pipes, their connections, seals and fittings shall be made of materials that are able to withstand the mechanical, chemical and thermal stresses to which they are likely to be subjected. The fuel pipes shall not be subjected to any damaging effects of heat and it must be possible to monitor them throughout their length.

5-5.10 Pipes for filling liquid-fuel tanks other than daily supply tanks shall have their opening above the deck and shall be fitted with a cap. Every such tank shall be fitted with a vent pipe leading to the open air above the deck and so placed that no water can enter it. Its cross-section shall be at least 1.25 times the cross section of the filler neck. The filler openings for fuel tanks shall be marked distinctly.

---

[3] Note by the secretariat: The Working Party SC.3/WP.3, at its nineteenth session, agreed to drop this additional third sentence if a similar provision would find its place in the text of the newly-proposed chapter 18 of the annex to resolution No. 17, revised, "Prevention of water pollution" (TRANS/SC.3/WP.3/39, para. 9, chapter 5 (x)). The attention of the Working Party is drawn to paragraph 18-2.1 of the draft chapter 18 (document TRANS/SC.3/2000/2 reading: "All necessary steps should be taken to reduce the filtration of oil on board vessels. **When justified, oil-collecting pans should be installed**." The Working Party may wish to decide whether the third sentence of paragraph 5-5.6 (and possibly, 5-5.2) should be deleted and fully reproduced in paragraph 18-2.1 of the draft chapter 18.

5-5.11 Fuel- and lubricating oil tanks shall be provided with a capacity-gauging device that is legible right up to the maximum filling level. External gauge columns shall be effectively protected against impacts, shall be fitted with self closing valves at their base and shall be attached at their upper part to the tanks above their maximum filling level. The material used for the gauge columns shall not deform under normal ambient temperatures.

5-5.12 Tanks which directly supply essential machinery shall be equipped with a device that gives a visual and acoustic signal in the wheelhouse when their degree of filling is no longer sufficient for reliable operation.

5-5.13 Tanks for liquid fuel or lubricating oil shall not have vertical common walls with accommodation spaces. Fuel tanks shall not have common surfaces with drinking water tanks.

5-5.14 Liquid fuel tanks shall be provided with openings having leak-proof closures that are intended to permit cleaning and inspection.

5-5.15 Fire hazards which might result from the splashing of liquid fuel or other inflammable liquids on to hot surfaces shall sufficiently be prevented by:

(i) Suitable construction, arrangement or shielding of the high pressure pipes carrying such liquids;

(ii) Heat-resistant insulation of hot surfaces by oilproof or sheet-metal shielding.

5-6 Bilge pumping and drainage systems

5-6.1 It shall be possible to pump each watertight compartment dry separately. However, that requirement shall not apply to compartments that are normally sealed hermetically during operation.

5-6.2 Vessels requiring a crew shall be equipped with two separate bilge pumps which shall not be installed within the same space. At least one of these shall be motor driven. However, if the power units for such vessels develop less than 225 kW or weigh less than 350 t gross respectively, or where vessels not intended for the carriage of goods have a displacement of less than 250 m³, either a manually-operated or motor-driven pump will suffice. Each of the required pumps shall be capable of use on each sealed compartment.

5-6.3 The pumping capacity of the first bilge pump shall be calculated via the formula:

$Q_1 = 0.1 \cdot d_1^2$ [l/min]

d_1 is calculated via the formula

$$d_2 = 1.5 \sqrt{L(B + H)} + 25 \text{ [mm]}$$

The pumping capacity of the second bilge pump shall be calculated, in l/min via the following formula:

$Q_2 = 0.1 \cdot d_2^2$ [1/min]

d_2 is calculated by the formula:

$$d_2 = 2 \sqrt{1 (B + H)} + 25 \text{ [mm]}.$$

However, the value d_2 may be taken not to exceed value d_1. The length of the longest sealed compartment shall be taken to be l in order to determine Q_2.

In these formulae:

l = the length of the corresponding sealed compartment, in m;
d_1 = the calculated internal diameter of the drainage pipe, in mm;
d_2 = the calculated internal diameter of the drainage spur, in mm.

5-6.4 Where the drainage pumps are connected to a drainage system the drainage pipes shall have an internal diameter of at least d_1, in mm, and the drainage spurs an internal diameter of at least d_2, in mm. Where vessels are less than 25 m in length these values may be reduced to 35 mm.

5-6.5 Only self-priming drainage pumps are acceptable.

5-6.6 There must be at least one strainer on both the starboard and port sides of all flat-bottomed, drainable compartments that are wider than 5 m.

5-6.7 It may be possible to drain the rear beak via the main engine room by means of an easily accessible, automatically closable set of pipes.

5-6.8 The drainage spurs for the various compartments shall be linked to the main drain by means of a lockable non-return valve.

The compartments or other spaces fitted out for ballast may only be linked to the drainage system by means of a single closing device. That requirement shall not apply to holds fitted out for ballast. Such holds shall be filled with ballast water by means of ballast piping that is permanently installed and independent of the drainage pipes, or by means of spurs consisting of flexible pipes or intermediate pipes that can be connected to the main drain. Water intake valves located in the base of the hold shall not be permitted for this purpose.

5-6.9 The hold bottoms shall be fitted with depth gauges.

5-6.10 Where a drainage system incorporates permanently fixed pipework the bilge-bottom drainage pipes intended to extract oily water shall be equipped with closures that have been sealed in position by an inspection body. The number and position of those closures shall be entered on the certificate.

CHAPTER 6

ELECTRICAL INSTALLATIONS

6-1 GENERAL PROVISIONS

6-1.1 Definitions

Earthing. "Earthing" means electrical connection to the mass of the hull.

Hull return. The distribution of direct or alternating current is said to be of the "hull return" type when the insulated conductors are connected to one of the feed poles and the hull or superstructure is connected to the other pole.

Safe voltage. "Safe voltage" means a voltage presenting no danger to persons. This condition shall be deemed to be satisfied if the windings of transformers, converters and other voltage-reducing devices are electrically separate and the reduced voltage of such devices or the voltage of sources of electric power does not exceed 50 V between the poles in the case of direct current, or between phases in the case of alternating current.

6-1.2 General requirements

6-1.2.1 Where there are no specific requirements concerning certain parts of an installation the safety level shall be considered satisfactory where those parts have been produced in accordance with an approved European standard or in accordance with the requirements of an approved classification society. The relevant documents shall be submitted to the authorized inspection body.

6-1.2.2 The electrical and electronic equipment shall be designed for permanent lists of up to 15E and ambient inside temperatures of between 0 and +40EC, and on the deck between -20EC and +40EC. It shall function perfectly at those limits. The Administration may extend the outside temperature range in accordance with local climatic conditions.

6-1.2.3 The electrical and electronic equipment and appliances shall be fully accessible and easy to maintain.

6-1.3 Electrical supply systems

6-1.3.1 Where craft are fitted with an electric system that system shall have at least two power sources in such a way that where one power source fails the remaining source is able to supply the equipment needed for navigational safety for an appropriate period of time to be determined by the Administration of the river basin .

6-1.3.2 Adequate sizing of the power supply shall be demonstrated by means of a power balance. An appropriate simultaneity factor may be taken into account.

6-1.4 Documents required to be available on board

Documents containing the following, and duly stamped by the authorised inspection body, shall be kept on board:

(a) a set of instructions for use and a description of the electrical installations;

(b) wiring diagrams concerning all of the electrical equipment;

(c) switching diagrams for the main control panel, the emergency-installation panel and the distribution panels, together with the most important technical data such as the amperage and rated current of the protection and control devices;

(d) power data concerning the electrical service equipment;

(e) types of cable and statement of conductor cross sections;

(f) All other particulars essential for an assessment of safety.

It is not necessary to keep such documents on board uncrewed craft, but they must be available at all times from the owner.

6-2 TECHNICAL REQUIREMENTS

6-2.1 Maximum permissible voltages

6-2.1.1 The following voltages shall not be exceeded:

Type of installation	Maximum permissible voltage		
	Direct current	Single-phase alternating current	Three-phase alternating current
a. Power and heating installations including the relevant sockets	250 V	250 V	500 V
b. Lighting, communications, command and information installations,including the relevant sockets	250V	250V	-
c. Sockets intended to supply portable devices used on open decks or within narrow or damp metal lockers, apart from boilers and tanks:			
1. In general	50V	50V[1)]	-
2. Where a circuit-separation transformer only supplies one appliance	-	250V[2)]	-
3. Where protective-insulation (double insulation) appliances are used	250V	250V	-
4. Where ≤30 mA default current circuit breakers are used.	-	250V	500V
d. Mobile components such as electrical equipment for containers, motors, blowers and mobile pumps which are not normally handled during service and use conducting parts which are open to physical contact are earthed by means of a protective conductor that is incorporated into the connecting cable and which, in addition to that effective conductor, are connected to the hull by their location or another conductor	250V	250V	500V
e.Sockets intended to supply portable appliances used inside and tan and tanks	50V[1)]	50V[1)]	

Comments:
1) Where that voltage comes from higher-voltage networks galvanic separation must be used (safety transformer).
2) All of the poles of the secondary circuit shall be insulated from the earth.

6-2.1.2 If the required protective measures are applied higher voltages are acceptable:

(i) for power installations where their power so requires;

(ii) for special on-board installations such as radio and ignition systems.

6-2.2 Protection against physical contact, the insertion of solid objects and the infiltration of water

6-2.2.1 The type of minimum protection for parts of permanent fixtures shall be as set out in the table below or may be stricter in accordance with the requirements of the Administration.

Location	Type of minimum protection (in accordance with IEC publ. 529)					
	Generators	Motors	Transformers	Panels Distributors Switches	Installation equipment	Lighting devices
Service premises, engine rooms, steering-gear compartments	IP 22	IP 22	IP 22 [2)]	IP 22 [1)2)]	IP 44	IP 22
Holds					IP 55	IP 55
Battery and paint lockers						IP 44 u. (EX)[3)]
Unroofed decks and steering positions		IP 55		IP 55	IP 55	IP 55
Enclosed wheelhouse		IP 22	IP 22	IP 22	IP 22	IP 22
Accommodation apart from health facilities and washrooms				IP 22	IP 20	IP 20
Health facilities and washrooms		IP 44	IP 44	IP 44	IP 55	IP 44

Remarks

1. Where appliances release large amounts of heat: IP 12
2. Where appliances or panels do not have this type of protection their location shall meet the conditions applying to that type of protection.
3. Electrical equipment of the certified safety type as in accordance with or in accordance with IEC Publication 79.

6-2.3 Explosion proofing

Only electrical equipment that has been explosion proofed, (safety-certified) may be installed in premises where potentially explosive gases or mixtures of gases are likely to accumulate, such as compartments set aside for accumulators or the storage of highly inflammable products. No light switches or other electrical appliances shall be installed on those premises. The explosion proofing shall take account of the characteristics of the potentially explosive gases or mixtures of gases that are likely to arise (explosion-potential group, temperature class).

6-2.4 Distribution systems

6-2.4.1. The following distribution systems are allowed for direct and single-phase alternating current:

(i) two-conductor systems of which one is earthed;

(ii) single-conductor systems using the hull-return principle, only for local installations (for example, starting gear for combustion engines, cathodic protection);

(iii) two-conductor systems that are insulated from the hull.

6-2.4.2 The following distribution systems are allowed for three-phase alternating current:

(i) four-conductor systems with earthing of the neutral point, not using the hull return principle;

(ii) three-conductor systems insulated from the hull;

(iii) three-conductor systems with earthing of the neutral point using the hull return principle except for terminal circuits.

6-2.4.3 All such systems shall comply with the rules of the Administration or of a recognised Classification Society.

6-2-4-4 The use of other distrubution systems shall be subject to the prior consent of the Administration.

6-2.4.5 Connection to the shore or other external networks

6-2.4.5.1 Incoming supply lines from landbased networks or other external networks to the installations of the onboard network shall have a permanent connection on board in the form of fixed terminals or fixed plug sockets. The cable connections shall not be subjected to any pulling load.

6-2.4.5.2 The hull shall be capable of being earthed effectively when the connection voltage exceeds 50 V. The earthing connection shall be specially marked.

6-2.4.5.3 The switching devices for the connection shall be capable of being locked so as to prevent the concurrent operation of the onboard network generators and the shore network or another external network. A brief period of concurrent operation shall be permitted when changing from one system to another without a break in voltage.

6-2.4.5.4 The connection shall be protected against short circuits and overloads.

6-2.4.5.5 The main switchboard shall indicate whether the connection is live.

6-2.4.5.6 Indicator devices shall be installed to enable polarity to be compared, in the case of direct current, and phase sequence in the case of alternating current, between the connection and the onboard network.

6-2.4.5.7 A panel on the connection shall indicate:

(i) the measures required to make the connection;

(ii) the types of current and the nominal voltage and, for alternating current, the frequency.

6-2.4.6 Special provisions for pushed convoys and other craft

6-2.4.6.1 The supply to the barges of the convoy shall be controlled by means of multiple switches installed on the pusher.

6-2.4.6.2 Instruction plates shall be affixed to current take-off devices and to craft-coupling devices, stipulating that feeders must be disconnected before barges are coupled or uncoupled.

6-2.4.6.3 When power is supplied to other craft, a separate connection shall be used. If power sockets rated at more than 16 A are used to supply current to other craft, steps shall be taken to ensure (for example, by the use of switches or interlocks) that connection and disconnection can take place only when the line is dead.

6-2.4.6.4 Cables and their connections shall not be subjected to any pulling load

6-2.4.6.5 Paragraphs 6-2.4.5.3 - 6-2.4.5.7 shall apply by analogy.

6-2.5 Generators and motors

6-2.5.1 Generators and motors shall be so installed as to be readily accessible for inspection, measurements and repairs and as to prevent water and oil from reaching the windings. Terminal boxes shall be readily accessible, amply dimensioned and sufficiently waterproof. The type of protection should be in accordance with the table in 6-2.2 above.

6-2.6 Accumulators

6-2.6.1 The accumulators shall be of a construction suitable for use on board a vessel. They shall be grouped in boxes or trays fitted with grips to facilitate handling. Cell boxes shall be made of a shock-resistant material that does not easily catch fire and shall be so made as to prevent any spillage of electrolyte at an inclination of 40E from the vertical.

6-2.6.2 Accumulators shall be so arranged as not to shift with the movements of the vessel. They shall not be exposed to excessive heat, extreme cold, spray, steam or vapour. Accumulator batteries shall be installed so as to permit easy access for replacement, topping up and cleaning of the elements, with a space of not less then 15 mm all around them to allow air to circulate, and with no more than 1.5 m. separating the deck from the plugs in the uppermost bank. If accumulators are installed on two or more shelves one above the other, at least 50 mm space shall be left at the front and back of each shelf to allow air to circulate.

Accumulator batteries shall not be installed in the wheelhouse, accommodation or holds.

This requirement shall not apply to accumulators for portable appliances, or to accumulators requiring a charging power of less than 0.2 kW.

6-2.6.3 Accumulator batteries requiring a charging power of more than 2 kW (calculated from the maximum charging current and the nominal voltage of the battery) shall be installed in a special battery room. If placed on deck, they shall be enclosed in a cupboard or chest.

Accumulator batteries requiring a charging power not exceeding 2 kW may be installed below decks in a cupboard or chest. They may be installed in the machinery space or any other well-ventilated place provided that they are protected against falling objects and dripping water.

Special battery rooms shall be capable of being heated when the temperature inside them falls below 5° C.

6-2.6.4 The interior surfaces of all battery rooms, including cupboards, lockers, shelving and other built-in fixtures, shall be protected against action of the electrolyte by a coat of paint or a lining made of a material resistant to the electrolyte.

6-2.6.5 Provision shall be made for effective ventilation when batteries are installed in a closed compartment, cupboard or chest. Forced-draught ventilation shall be provided for nickel-cadmium accumulators requiring a charging power of more than 2 kW and for lead-acid accumulators requiring more than 3 kW.

The air shall enter at the bottom and be discharged at the top so that the whole of the battery is swept by the air stream. Ventilation ducts shall not include devices which obstruct the air flow.

The minimum air throughput for ventilation, in m^3/hour, shall be calculated by the following formula:

$Q = 0.11 \times I \times n$

where:

I represents, in amperes, the maximum charging current (it shall be not less than one quarter of the maximum current admissible by the charging device);

n represents the number of cells.

6-2.6.6 Where natural ventilation is used, the cross-section of the ducts shall be sufficient for the required air throughput at an air-flow velocity of 0.5 m/sec. It shall be not less than 80 cm^2 for lead batteries and not less than 120 cm^2 for alkaline batteries.

6-2.6.7 Where the required ventilation cannot be obtained by natural air flow, an exhauster fan shall be provided; its motor shall be clear of the gas stream.

Special devices shall be provided to prevent gases from entering the motor.

Fans shall be of a construction and material precluding the production of sparks through contact between a blade and the fan casing. In addition, the material shall be such as to dissipate any electrostatic charges. Warning signs prohibiting smoking and entry by persons carrying a naked flame shall be placed on the doors of rooms or cupboards, or the covers of chests, containing batteries.

6-2.7 Electrical switchboards

6-2.7.1 Switchboards shall be situated in accessible and well-ventilated places protected against gaseous or acid emissions. They shall be so arranged as to be protected against jolting and against the effects of weather, water, oil, liquid fuel, steam and vapour.

Switchboards shall not be placed near sounding pipes or near the vent pipes of liquid-fuel tanks.

No pressure pipes shall be situated above the main or emergency switchboard or the control panels of propulsion equipment. In vessels where this requirement cannot be met, no pipe joint shall be installed above an electrical switchboard.

6-2.7.2 In general, materials used in the construction of switchboards shall have suitable mechanical strength and be durable and non-inflammable. They shall not be hygroscopic.

6-2.7.3 Where the voltage exceeds the safe voltage:

(i) The current-carrying components shall be so arranged or protected as to prevent accidental personal contact;

(ii) An insulating mat or an impregnated wooden grating shall be provided; this shall not apply, however, to subdistribution panels;

(iii) Metal parts of the frames or substructures of control devices and the metal casings of appliances shall be carefully earthed.

6-2.7.4 All parts of switchboards, including the connections, shall be readily accessible for inspection, maintenance or replacement.

6-2.7.5 Marker plates for all circuits shall be affixed to switchboards.

6-2.8 Switches, protective devices

6-2.8.1 Generator circuits and consumer circuits shall be protected against short circuits and overcurrent on all non-earthed conductors. Overload circuit-breakers or-fuses may be used for this purpose. Circuits supplying the steering-gear motors (steering installations) and fire pumps and their control circuits shall only be protected against short circuits. Where circuits include thermal circuit-breakers these shall be neutralized or set at not less than twice the nominal amperage and fitted with an emergency warning light indicating overloading.

6-2.8.2 Outputs from the main switchboard to appliances operating at more than 16 A shall include a load or power switch.

6-2.8.3 Prime movers for the craft, the steering system, the rudder position indicator, navigation or safety systems, and appliances with a nominal amperage greater than 16 A shall be supplied by separate circuits.

6-2.8.4 The circuits of appliances required for propelling and manoeuvring the vessel shall be supplied directly by the main switchboard.

6-2.8.5 Circuit-breaking equipment shall be selected on the basis of nominal amperage, thermal or dynamic strength, and their breaking capacity. Switches shall simultaneously cut off all live conductors. The switching position shall be identifiable.

6-2.8.6 Fuses shall be of the enclosed-melt type and be made of porcelain or an equivalent material. It shall be possible to change them without any danger of operator contact.

6-2.9 Measuring and monitoring devices

6-2.9.1 Generator, battery and distribution circuits shall be equipped with measuring and monitoring devices where the safe operation of the installation so requires.

6-2.9.2 Non-earthed networks where the voltage is higher than 50 V, must include an earth-insulation checking device equipped with a visual and audible alarm. In secondary installations such as control circuits, this device may be dispensed with.

6-2.10 Emergency circuit breakers

Emergency circuit breakers for oil burners, fuel pumps, fuel separators and engine-room ventilators shall be installed outside the premises containing the equipment.

6-2.11 Fixed installations

6-2.11.1 Equipment seals shall be sized as a function of the cables to be connected and be appropriate to the types of cable used.

6-2.11.2 Sockets for distribution circuits at different voltages or frequencies shall be impossible to confuse.

6-2.11.3 Switches shall simultaneously switch off all unearthed conductors within a circuit. However, single-pole switches within unearthed circuitry shall be permitted in accommodation-lighting circuits apart from in laundries, bathrooms and washrooms.

6-2.11.4 Where amperage exceeds 16 A it shall be possible to lock the sockets by means of a switch in such a way that the plug can only be inserted and withdrawn with the power switched off.

6-2.12 Cables

6-2.12.1 Cables shall be flame-retardant, self-extinguishing and resistant to water and oil. In accommodation, other types of cable may be used, provided that they are effectively protected, have flame-retardant characteristics and are self-extinguishing.

6-2.12.2 Cables with conducting wires with a minimum cross-section of 1.5 mm^2 shall be used for power circuits and of 1.0 mm^2 for lighting circuits.

6-2.12.3 The armouring and metal sheathing of power and lighting circuits shall not, under normal operating conditions, be used as conductor wires or earth wires.

6-2.12.4 The armouring and metal sheathing of power and lighting circuits shall be earthed at least at one end.

6-2.12.5 The cross-section of conductor wires shall take account of the final permissible maximum temperature of conductor wires (maximum permissible amperage) and permissible voltage drop. Such a drop between the main switchboard and the furthermost consumer on the circuit shall not be more than 5% of nominal voltage for lighting or more then 7% for power or heating circuits.

6-2.12.6 Cables shall be protected against mechanical damage.

6-2.12.7 The means of fixing the cables shall ensure that any pulling load remains within the permissible limits.

6-2.12.8 When cables pass through partitions or decks, the mechanical strength, watertightness and fire resistance of these partitions and decks shall not be affected by the seals.

6-2.12.9 Cables linking mobile wheelhouses shall be sufficiently flexible and be fitted with insulation with sufficient flexibility down to -20°C and resistance to steam and vapour, ultraviolet rays, ozone, etc.

6-2.13 Lighting

6-2.13.1 In spaces in which accumulators are installed or paint and other highly inflammable substances are stored, limited-explosion-risk lighting appliances shall be used.

6-2.13.2 Lighting appliances shall be so installed that the heat they emit cannot set fire to nearby inflammable objects or components.

6-2.13.3 Lighting appliances on open decks shall be so installed as not to impede the recognition of signal lights.

6-2.13.4 When two or more lighting appliances are installed in an engine-, or boiler-rooms, they shall be supplied by at least two different circuits. This requirement shall also apply to spaces where cooling or hydraulic machinery, or electric motors, are installed.

6-2.14 Signal lights

6-2.14.1 The switchboards for the signal lights shall be installed in the wheelhouse. They shall be supplied by a separate feeder from the main switchboard or by two separate secondary networks.

6-2.14.2 Lights shall be individually supplied from the lighting panel and be individually protected and controlled.

6-2.14.3 Tell-tale lamps or other equivalent devices monitoring the signal lights shall be placed on the switchboard in the wheelhouse unless direct monitoring from the wheelhouse is possible. No fault in the monitoring installation shall affect the operation of the light which it monitors.

6-2.14.4 Several lights forming a functional unit and installed together at the same point may be jointly supplied, controlled and monitored. The monitoring installation shall be capable of identifying the failure of any of these lights. However, it shall not be possible to use both light sources in a double light (two lights mounted one above the other or in the same housing) simultaneously.

6-2.15 Earthing

6-2.15.1 Systems under a voltage of more than 50 V need to be earthed.

6-2.15.2 Metal parts that are open to physical contact and which, during normal operation, are not electrically live, such as engine frames and casings, appliances and lighting equipment, shall be earthed separately where these are not in electrical contact with the hull as a result of their installation.

6-2.15.3 The housings of electrical receivers of the mobile and portable type shall, during normal use, be earthed by means of an additional neutral conductor that is incorporated into the power cable.

6-2.15.4 That prescription does not apply where a circuit-separation transformer is used, nor to appliances fitted with protective insulation (double insulation).

6-2.15.6 The cross section of the earthing conductors shall be not less than as set out in the table below:

Cross section of outside conductors (mm^2)	Minimum cross section of earthing conductors	
	in insulated cables (mm^2)	fitted separately (mm^2)
from 0.5 to 4	same cross section as that of the outside conductor	4
more than 4 to 16	same cross section as that of the outside conductor	same cross section as that of the outside conductor
more than 16 to 35	16	16
more than 35 to 120	half of the cross section of the outside conductor	half of the cross section of the outside conductor
more than 120	70	70

6.2.16 Emergency source of electric power

6-2.16.1

(i) Every vessel navigating in zone 1 shall be equipped with an emergency source of electric power.

(ii) Every passenger vessel navigating in zones 2 and 3 shall be equipped with an emergency source of electric power.

The Administration may prescribe more detailed requirements concerning emergency source of electric power, depending on the type and purpose of the vessel.

6-2.16.2 If a vessel navigating in zones 2 and 3, other than a passenger vessel not less than 25 m in length, is equipped with two or more independent sources of power, one of them may be accepted as an emergency source of power.

6-2.16.3 The emergency source of power may be:

(i) Either an auxiliary set whose fuel supply system and cooling system are independent of the main machinery, and which is automatically started and connected to the network as soon as the voltage falls on the bus-bars of the main switchboard. The electric power shall be supplied within 30 seconds after the failure of the main electricity supply. The Administration or a recognized Classification Society may permit manual starting if the auxiliary set is installed in the immediate vicinity of a station which is permanently manned and which is outside the machinery space;

(ii) Or an accumulator battery automatically taking up current-supply duty in a network failure and capable of meeting the requirements of paragraph 6-2.16.4 for the prescribed time without having to be recharged and without a voltage drop exceeding that authorized. The Administration or a recognized Classification Society may permit manual switching on from a station which is permanently manned and which is outside the machinery space.

On passenger vessels, power for emergency lighting shall be supplied within seven seconds.

6-2.16.4 The emergency source and its switchboard shall be installed:

(i) On vessels navigating in zone 1, above the freeboard deck and outside the machinery space;

(ii) On passenger vessels navigating in zones 2 and 3, outside the machinery space. If the vessel is less than 25 m in length, the emergency source may be installed in the machinery space, as high up as possible.

(iii) On all other vessels navigating in zones 2 and 3, as high up as possible.

If the space housing the emergency source is situated below the freeboard deck, that space shall be accessible from the deck. On passenger vessels not less than 25 m in length, the space housing the emergency source shall be enclosed by watertight and fire-resistant decks and watertight and fire-resistant bulkheads.

The emergency source of power shall not be installed forward of the collision bulkhead.

6-2.16.5 The capacity of the emergency source shall be sufficient to supply all consumers necessary to the safety of all persons on board, due account being taken of consumers which may be required to operate simultaneously. At least the following, if their use is prescribed, and if they each have no independent emergency source of power, shall be supplied simultaneously

(i) Navigation and signal lights;

(ii) Emergency lighting;

(iii) Alarm and safety systems;

(iv) Intercommunication systems;

(v) Radio and telephone equipment;

(vi) Emergency floodlight;

(vii) Controls of fixed fire-fighting installations;

(viii) Fire pump and emergency pump (on passenger vessels);

(ix) Emergency steering gear.

The length of time for which the emergency source of power shall be required to supply the prescribed consumers shall be fixed according to the vessel's purpose, but shall not be less than 30 minutes.

6-2.16.6 At least the following places and stations shall be provided with sufficient emergency lighting:

(i) Places where collective life-saving appliances are stored, handled and launched;

(ii) Accommodation exists and passages;

(iii) Machinery spaces and their exits;

(iv) The emergency switchboard;

(v) The wheelhouse (with provision for disconnection);

(vi) The space housing the emergency source of power;

(vii) Fire-fighting stations;

(viii) Emergency assembly stations for passengers and crew.

The intensity of the emergency lighting shall be prescribed by the Administration.

6-2.17 Alarm and safety systems

The alarm and safety systems for monitoring and protecting mechanical equipment shall meet the following requirements:

6-2.17.1 Alarm systems

The alarm systems shall be so designed that no failure in the alarm system can result in failure of the apparatus or equipment being monitored. Binary transmitters shall be designed on the quiescent-current principle or on the monitored load-current principle. Visual alarms shall remain visible until the fault has been remedied; an alarm with acknowledgement shall be distinguishable from an alarm without acknowledgement. Each alarm shall also comprise an audible warning. It shall be possible to switch off acoustic alarms. Switching off one acoustic alarm shall not prevent another signal from being set off by another cause. Exceptions shall be permitted in the case of alarm systems comprising less than 5 measurement points.

6-2.17.2 Safety systems

Safety systems shall be designed to halt or slow down the operation of the affected equipment, or to warn a permanently-manned station to do so before a critical state is reached. Binary transmitters shall be designed according to the load-current principle. If safety systems are not designed to be self-monitoring their operation must be checkable. Safety systems must be independent of other systems.

6-2.18 Electronic equipment

6-2.18.1 General

The test conditions in 2 below shall apply only to electronic devices and their ancillaries on the steering system and the craft's power plants.

6-2.18.2 Test conditions

(i) The stresses arising from the test shall not cause electronic devices to be damaged or to malfunction. The tests in accordance with the international standards, such as publication IEC 92-504 concerning these, shall be carried out with the device in operation, apart from the cold-proofing test;

(ii) Variations in voltage and frequency

	Value for service	Variations	
		continuous	short-duration
General	Frequency voltage	± 5% ± 10%	± 10% 5 s ± 20% 1.5 s
Battery operation	voltage	+ 30% / - 25%	-

(iii) Heating test

The sample is brought up to a temperature of 55EC within a half-hour period. After that temperature has been achieved it is maintained for 16 hours. An operating test is then conducted.

(iv) Cold-condition test

The sample is shut down and cooled to -25°C and held at that temperature for two hours. The temperature is then raised to 0°C and an operating test is conducted.

(v) Vibration test

The vibration test shall be carried out along the three axes at the resonance frequency of the appliances or parts for the period of 90 minutes in each case. If no clear resonance emerges the vibration test takes place at 30 Hz. The vibration test takes place via sinusoidal oscillation within the following limits:

General:

f = 2.0 - 13.2 Hz; a = ± 1mm
(amplitude a = 1/2 the vibration width)

f = 13.2 Hz - 100 Hz; acceleration ± 0.7g.

Equipment intended to be fitted to diesel engines or steering system shall be tested as follows:

f = 2.0 - 25 Hz; a = ± 1.6mm
(amplitude a = 1/2 the vibration width)

f = 25 Hz - 100 Hz; acceleration ± 4g.

The sensors intended to be installed in diesel-engine exhaust pipes may be exposed to considerably higher stresses. Account shall be taken of this during the tests.

(vi) The electromagnetic compatibility test shall be carried out on the basis of IEC publications 801-2, 801-3, 801-4, 801-5 at test degree number 3.

(vii) Proof that the electronic equipment is adequate for these test conditions shall be provided by their manufacturer. A certificate by a Classification Society is likewise considered to be proof.

6-2.19 Electromagnetic compatibility

The operation of the electric and electromagnetic systems shall not be impaired by electromagnetic interference. General accompanying measures shall concentrate on:

(i) disconnection of the transmission paths between the source of interference and the user appliances;

(ii) reducing the causes of disturbance at their source;

(iii) reducing the sensitivity of the consumer appliances.
