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RESOLUTION A.373(X)
adopted on 14 November 1977

CODE OF SAFETY FOR DYNAMICALLY SUPPORTED CRAFT

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CODE OF SAFETY FOR DYNAMICALLY SUPPORTED CRAFT

THE ASSEMBLY,

NOTING Article 16(i) of the Convention on the Inter-Governmental Maritime Consultative Organization concerning the functions of the Assembly,

NOTING FURTHER that dynamically supported types of craft, such as hydrofoil boats and air-cushion vehicles, are increasingly being introduced in international transport,

RECOGNIZING that the design criteria for such dynamically supported craft are often quite different from those of conventional ships and by virtue of this the application of international conventions, such as the International Convention for the Safety of Life at Sea, 1960 and the International Convention on Load Lines, 1966, is inappropriate in respect of dynamically supported craft,

HAVING CONSIDERED the Recommendation by the Maritime Safety Committee at its thirty-sixth session,

ADOPTS the Code of Safety for Dynamically Supported Craft (Dynamically Supported Craft Code), the text of which is set out at Annex to this Resolution, and which supersedes the following Recommendations :

Recommendation on Life-Saving Appliances for Hydrofoil Boats (Resolution A.126(V)) ;

Recommendation on Life-Saving Appliances for Air-Cushion Vehicles
(Resolution A.170(ES.IV)) ;

Recommendation on Fire Safety Measures for Hydrofoil Boats (Resolution A.183(VI)) ;

Safety Radiocommunication Requirements for Novel Types of Craft
(Resolution A.218(VII)) ;

Provisional Interim Guidelines on Fire Safety Measures for Air-Cushion Vehicles
(adopted by the Maritime Safety Committee at its twenty-second session (MSC/Circ.87)) ;
and

INVITES all governments concerned :

to take appropriate steps to give effect to the Code not later than 31 December 1979 ;

to consider the Code including certification as an equivalent to the above-mentioned Conventions for those dynamically supported craft engaged in international voyages ; and

to inform the Organization on measures taken in this respect,

RECOGNIZING ALSO that dynamically supported craft design technology is rapidly evolving and new types of dynamically supported craft may be introduced,

AUTHORIZES the Maritime Safety Committee to amend the Code as may be necessary.

ANNEX

CODE OF SAFETY FOR DYNAMICALLY SUPPORTED CRAFT

Preamble

The International Conventions ratified in respect of conventional ships and the regulations applied as a consequence of such Conventions have largely been developed having in mind the manner in which ships are constructed and operated. Traditionally, ships have been built of steel and have been expected to operate on a world-wide basis with a minimum of operational controls. The requirements for passenger ships engaged on long international voyages are therefore framed in such a way that, providing the ship is presented for survey and a Passenger Ship Safety Certificate is issued, the ship may go anywhere in the world without any operational restrictions being imposed. Providing the ship is not involved in a casualty, all that is needed is that it is made available to the Administration for the purpose of a satisfactory re-survey before the Passenger Ship Safety Certificate expires and the certificate will be re-issued.

The traditional method of regulating passenger ships should not be accepted as being the only possible way of providing an appropriate level of safety. Nor should it be assumed that another approach, using different criteria, could not be applied. Over a period of some 30 years, new designs of marine vehicles, some of which are amphibious, have been developed, and while these cannot fully comply with the provisions of the international conventions relating to passenger ships, they have demonstrated an ability to operate at an acceptable level of safety when engaged on restricted voyages under restricted operational weather conditions and with approved maintenance and supervision schedules.

This Code has been prepared in order that the research and development of dynamically supported craft may be facilitated and in order that they may be accepted internationally. Such craft could take a number of forms, but are essentially within the spectrum which exists between ships and aircraft, for both of which regulations presently apply. The essential elements within the Code should permit any new type of such craft to be considered by an Administration and their application should produce an acceptable level of safety.

The Code takes into account dynamically supported craft essentially engaged in high-speed, high-passenger-density operations and sets out minimum requirements for craft carrying up to 300 passengers and operating within a distance of 100 nautical miles from a place of refuge. At the time the Code was being developed and reviewed this number represented the scope of substantial experience. Present technology indicates that the Code as formulated may be applied to designs carrying up to a maximum of 450 passengers without additional requirements. Should craft carrying more passengers or operating further from a place of refuge be envisaged, the Administration should consider what additional requirements or variations in the Code are required. Additional attention to life-saving appliances, evacuation arrangements, fire protection and extinguishing arrangements and the duplication of radiocommunication facilities might be required.

The Code could be extended to craft of similar technical concept but adapted to cargo operations, accommodation of passengers in sleeping berths, etc. ; this might require additional provisions applicable only to such cases.

The Code has been developed as a unified document on the principle that an equivalent level of safety to that normally expected on ships complying with the International Convention for the Safety of Life at Sea can be achieved in dynamically supported craft of differing design and constructional arrangements, providing all aspects of the construction, operation, maintenance and supervision are specified by the Administration and appropriate restrictions are placed on the length of the service, the sea state suitable for operation taking into account the communication facilities and the rapid availability of rescue craft.

It has therefore been based on the premise that :

- (a) the distance covered and the worst sea state for which operations will be permitted will be restricted ;
- (b) there will at all times be reasonable proximity to a place of refuge ;
- (c) adequate provision will be made for communication so that any accident to the craft will be quickly known to the base port ;
- (d) facilities are provided for rapid evacuation into suitable survival craft ;
- (e) rescue services will be rapidly available throughout the voyage ;
- (f) reliable weather forecast for the area concerned will be available ;
- (g) acceptable maintenance and inspection facilities together with adequate control arrangements are available ;
- (h) strict control over operations will be enforced ;
- (i) all passengers are provided with a seat and that no sleeping berths are provided.

Where any of the above do not apply, the Administration should consider whether equivalent safety can be achieved in another way.

It is important that an Administration, in considering the suitability of a dynamically supported craft under this Code, should apply all sections of the Code because non-compliance with any part could result in an imbalance which would adversely affect the safety of passengers and crew. For a similar reason, modifications to existing craft which may have an effect on safety, should be approved by the Administration.

In deriving the Code it has been considered desirable to ensure that such craft do not impose unreasonable demands on existing users of the environment or suffer unnecessarily through lack of reasonable accommodation by existing users. Whatever burden of compatibility there is should not necessarily be laid wholly on the dynamically supported craft, and in considering amphibious vehicles, Administrations should take appropriate cognisance of their amphibious capabilities.

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CHAPTER 1 – GENERAL

1.1 General Philosophy

- 1.1.1 This Code represents the recommended requirements for the design and construction of dynamically supported craft, together with the appropriate equipment which should be provided, and the appropriate condition for their operation and maintenance. It is intended that the application of the Code, as applied to craft in accordance with the definition in 1.4.1, should result in a level of safety for the craft and persons carried equivalent to that required for conventional displacement ships by the Safety and Load Line Conventions.
- 1.1.2 The provisions of this Code should be applied having regard to the general conditions set out in the Code, which are based on the following :
- (a) that distances covered and the worst intended environmental conditions in which operations are permitted will be restricted ;
 - (b) that the craft will at all times be in reasonable proximity to a place of refuge ;
 - (c) that the facilities specified in 1.4.11 will be available at the base port from which the craft operates ;
 - (d) the ability of the Administration to exercise strict control over the operation of the craft ;
 - (e) the rapid availability of rescue facilities at all points in the intended service ;
 - (f) that all passengers are provided with a seat and no sleeping berths are provided ;
 - (g) facilities are provided for rapid evacuation into suitable survival craft.
- 1.1.3 The safety of the passengers and crew of dynamically supported craft should be provided by appropriate standards of design and construction, by documentation complying with the requirements of Chapters 1 to 16 of this Code, by implementation of operational, maintenance and personnel competence requirements contained in Chapters 17 and 18, as well as by the system of surveys specified in this chapter. This Code should be treated as a unified document since non-compliance with any of its parts can be detrimental to the safety of passengers and crew.
- 1.1.4 Dynamically supported craft, by their very novelty and because of their small number, have problems peculiar to themselves and hence designers and operators should have maximum freedom to achieve the acceptable safety level in the appropriate manner.

1.2 Applicability

- 1.2.1 This Code applies to such dynamically supported craft which are engaged on voyages between a terminal in one country and a terminal in another country, part or all of which voyages are across areas of water (but not necessarily on routes navigable to ships) through which a ship operating on an international voyage, as defined by the Safety Convention, would proceed.
- 1.2.2 In applying this Code, the Administration should determine whether a craft is a dynamically supported craft, as defined in 1.4.1, or whether its characteristics are such that the Safety and Load Line Conventions, with appropriate additions, can be applied. For new types of dynamically supported craft, other than defined in 1.4.2 and 1.4.3, the Administration should determine the extent to which the provisions of the Code are applicable to those new types and inform the Organization thereof.

- 1.2.3 The Code should be applied by Administrations through more detailed national regulations based on a comprehensive coverage of this Code.

1.3 Scope of Application

- 1.3.1 This Code applies to craft which :

- (a) carry more than 12 passengers but not over 450 passengers with all passengers seated ;
- (b) do not proceed in the course of their voyage more than 100 nautical miles from the place of refuge ;
- (c) may be provided within the limits of sub-paragraphs (a) and (b) with special category spaces intended to carry motor vehicles with fuel in their tanks.

- 1.3.2 This Code may be extended to a craft as defined in 1.4.1 which is intended to carry passengers and cargo or solely cargo or to a craft which exceeds the limits stipulated in 1.3.1. In such cases, the Administration should determine the extent to which the provisions of the Code are applicable to these craft and, if necessary, develop additional requirements providing the appropriate safety level for such craft.

1.4 Definitions

For the purpose of this Code, unless expressly provided otherwise, the terms used therein have the meanings defined in the following paragraphs. Additional definitions are given in the general parts of the various chapters.

- 1.4.1 "Dynamically Supported Craft" is a craft which is operable on or above water and which has characteristics so different from those of conventional displacement ships, to which the existing International Conventions, particularly the Safety and Load Line Conventions, apply, that alternative measures should be used in order to achieve an equivalent level of safety. Within the aforementioned generality, a craft which complies with either of the following characteristics would be considered a dynamically supported craft :

- (a) the weight, or a significant part thereof, is balanced in one mode of operation by other than hydrostatic forces ;
- (b) the craft is able to operate at speeds such that the function $\sqrt{\frac{v}{gL}}$ is equal to, or greater than 0.9. Where "v" is maximum speed, "L" is the waterline length and "g" is the acceleration due to gravity, all in consistent units.

- 1.4.2 "Air-cushion vehicle" is a craft such that the whole or a significant part of its weight can be supported, whether at rest or in motion, by a continuously generated cushion of air dependent for its effectiveness on the proximity of the surface over which the craft operates.

- 1.4.3 "Hydrofoil boat" is a craft which is supported above the water surface in normal operating conditions by hydrodynamic forces generated on foils.

- 1.4.4 "Side wall craft" is an air-cushion vehicle whose walls extending along the sides are permanently immersed hard structures.

- 1.4.5 "Administration" means the Government of the State whose flag the craft is entitled to fly.

- 1.4.6 "Organization" means the Inter-Governmental Maritime Consultative Organization.
- 1.4.7 "Safety Convention" is the International Convention for the Safety of Life at Sea, in force.
- 1.4.8 "Load Line Convention" is the International Convention on Load Lines, in force.
- 1.4.9 "Passenger" is every person other than :
- (a) the master and members of the crew or other persons employed or engaged in any capacity on board a craft on the business of that craft ; and
 - (b) a child under one year of age.
- 1.4.10 "Place of refuge" is any naturally or artificially sheltered area which may be used as a shelter by a craft under conditions likely to endanger its safety. Suitable communication and transport facilities should be available.
- 1.4.11 "Base port" is a port with :
- (a) appropriate facilities providing continuous radiocommunication with the craft at all times while in ports and at sea, if required ;
 - (b) where Very High Frequency (VHF) is required for the craft :
 - (i) appropriate facilities providing VHF radiocommunication at all times with the craft while in the vicinity of the port ; and
 - (ii) access to facilities providing radiocommunication with the craft at all times when operating beyond the range of the VHF facilities provided in sub-paragraph (i) ;
 - (c) means for obtaining a reliable weather forecast for the corresponding region and its due transmission to all craft in operation ;
 - (d) access to facilities provided with appropriate rescue and survival equipment ; and
 - (e) access to craft maintenance services with appropriate equipment.
- 1.4.12 "Worst intended conditions" means the specified environmental conditions within which the intentional operation of the craft is provided for in the certification of the craft. This should take into account parameters such as the worst conditions of wind force, allowable wave height (including unfavourable combinations of length and direction of waves), minimum air temperature, visibility and depth of water for safe operation and such other parameters as the Administration may require in considering the type of craft in the area of operation.
- 1.4.13 "Critical design conditions" means the limiting specified conditions chosen for design purposes, which should be more severe than the "worst intended conditions" by a suitable margin acceptable to the Administration.
- 1.4.14 "Lightweight" is the displacement of the craft without cargo, fuel, lubricating oil, ballast water, fresh water and feedwater in tanks, consumable stores, passengers and crew and their effects.
- 1.4.15 "Maximum operational weight" means the overall weight up to which operation in the intended mode is permitted by the Administration.

1.5 Survey and Approvals

1.5.1 Every craft should be subject to the procedures specified below :

- (a) An initial assessment before the certificate required under 1.6 is issued for the first time. This assessment should include :
 - (i) an appraisal of the assumptions made and limitations proposed in relation to loadings, environment, speed and manoeuvrability ;
 - (ii) an appraisal of the data supporting the safety of the design obtained as appropriate from calculations, tests and trials ;
 - (iii) an investigation into the adequacy of the various manuals to be supplied with the craft ; and
 - (iv) a complete survey of the craft's structure, equipment, fittings, arrangements and materials in so far as the craft is covered by this Code ; and which should be such as to ensure that the structure, equipment, fittings, arrangements and materials fully comply with the applicable provisions of this Code and should be supported by such tests and trials as necessary.
- (b) Periodical surveys at intervals specified by the Administration, but not exceeding one year, in order that the Administration may satisfy itself as to the suitability of the structure, equipment, fittings, arrangements and materials for the intended service of the craft. The Administration should consider application to have the required surveys carried out over the duration of the certificate. An extension of the duration of the Dynamically Supported Craft Construction and Equipment Certificate may be granted by the Administration for a period not exceeding 30 days.
- (c) Intermediate inspections at intervals specified by the Administration which should be such as to ensure that the maintenance instructions and operating instructions listed in the technical manuals required by 1.8 are being complied with.

1.5.2 No change should be made that would affect the structural integrity, change the functional operation of a system, or change the arrangements or materials covered by the survey, without the sanction of the Administration, except the direct replacement of such equipment and fittings for the purpose of renewal, repair or maintenance.

1.5.3 Surveys of craft with respect to the enforcement of the provisions of this Code should be carried out by competent persons duly authorized for the purpose by the Administration.

1.5.4 The owner of the craft, or the organization responsible for the commercial operation and maintenance of the craft are to be authorized or approved by the Administration on the basis of information provided by documents and by direct inspection of the facilities that confirms the ability of the said owner or organization to comply with the requirements of Chapters 17 and 18.

1.5.5 The Administration may reconsider the approval if necessary but in any case the approval should be withdrawn if the conditions of approval are not observed.

1.6 Certification

1.6.1 The craft should not operate commercially unless the following certificates have been issued and are valid :

- (a) Dynamically Supported Craft Construction and Equipment Certificate after survey carried out in accordance with 1.5.1 (a) ;

- (b) Dynamically Supported Craft Permit to Operate if the Administration is satisfied that all other requirements of this Code have been met.

Issuing of these certificates should be effected by the Administration, or any person or organization duly authorized by it. In every case the Administration assumes full responsibility for the certificates.

- 1.6.2 Both certificates should remain in force for not more than one year provided the terms of issue are complied with. The certificates may be revalidated for further periods of not more than one year if the conditions given in 1.6.1 are met.
- 1.6.3 The Dynamically Supported Craft Construction and Equipment Certificate should be drawn up in the official language or languages of the issuing country. The Dynamically Supported Craft Permit to Operate should be drawn up in the official language or languages of the country operating the craft. If the language used is neither English nor French, the text should include a translation into one of these languages.
- 1.6.4 The Dynamically Supported Craft Construction and Equipment Certificate should contain at least the information given in the specimen draft certificate at Annex I.
- 1.6.5 The Dynamically Supported Craft Permit to Operate should contain at least the following information :
- (a) owner (or organization) responsible for operating the craft ;
 - (b) adequate identification of the craft concerned ;
 - (c) a statement that no craft may be operated commercially under the permit unless it has a valid Dynamically Supported Craft Construction and Equipment Certificate ;
 - (d) area of operation ;
 - (e) any operating conditions and limitations that are not given in the appropriate Dynamically Supported Craft Construction and Equipment Certificate ;
 - (f) a statement of validity.

1.7 Equivalent and Exemptions

- 1.7.1 Where this Code requires that a particular fitting, material, appliance or apparatus, or type thereof, should be fitted or carried in a craft, or that any particular provision should be made, the Administration may allow any other fitting, material, appliance or apparatus, or type thereof, to be fitted or carried, or any other provision to be made in that craft, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance or apparatus, or type thereof, or provision, is at least as effective as that required by this Code.
- 1.7.2 Where compliance with any of the requirements of this Code would be impractical for the particular designs of the craft, the Administration may substitute alternative requirements provided that equivalent safety is achieved. The Administration which allows any such substitution should communicate to the Organization particulars of these substitutions and the reasons therefor, which the Organization should circulate to its Member Governments for their information.

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1.7.3 The Administration may exempt any craft from any of the provisions of this Code if the application thereof would seriously impede research into the development of such craft engaged on international voyages provided that equivalent safety is achieved. Any such craft should, however, comply with safety requirements which, in the opinion of that Administration, are adequate for the service for which it is intended and are such as to ensure the overall safety of the craft and which are acceptable to the Governments of the States to be visited by the craft. The Administration which allows any such exemption should communicate to the Organization particulars of same and the reasons therefor, which the Organization should circulate to the participating Governments for their information.

1.7.4 An Administration may allow the transit of a craft without passengers or cargo between areas of operation without a Dynamically Supported Craft Permit to Operate provided that it complies with safety requirements which are adequate in the opinion of the Administration for the voyage which is to be undertaken, keeping in mind the design parameters.

1.8 Information to be available

1.8.1 The Administration should ensure that the craft is provided with adequate information and guidance in the form of a technical manual to enable the craft to be operated and maintained safely. This technical manual should consist of an operating manual, maintenance manual and servicing schedule. Arrangements should be made for such information to be updated as necessary.

1.8.2 The operating manual should contain at least the following information :

- (a) worst intended conditions ;
- (b) permissible conditions of loading, including maximum weight, centre of gravity position and distribution of load ;
- (c) any loading procedures necessary to facilitate operational compliance with (b) ;
- (d) details arising from compliance with the requirements of Chapter 2 likely to be of direct practical use to the crew in an emergency ;
- (e) procedures for checking the integrity of buoyancy compartments ;
- (f) precautions to be followed to avoid a fire and the method of operation of equipment intended to prevent, detect, extinguish or control a fire ;
- (g) procedures for the evacuation of passengers and the use of life-saving appliances ;
- (h) any limitation regarding the operation of the craft ;
- (i) information regarding the handling of the craft determined in accordance with Chapter 16 ; and
- (j) maximum permissible towing speeds and towing loads where applicable.

1.8.3 Operating manuals should distinguish clearly those areas where :

- (a) advice is given of which the master needs to take proper account if he is to operate the craft to the level of safety intended, but non-compliance with it does not of itself render the Dynamically Supported Craft Construction and Equipment Certificate of the particular craft invalid ; and

- (b) limitation with which the master needs to comply, non-compliance rendering the Dynamically Supported Craft Construction and Equipment Certificate of the particular craft invalid.

1.9 Review of the Code

- 1.9.1 The Code will be reviewed by the Organization at intervals preferably not exceeding two years to consider revision of existing requirements to take account of new developments in design and technology.
- 1.9.2 Where a new development in design and technology has been found acceptable to an Administration, that Administration may submit particulars of such development to the Organization for consideration for incorporation into the Code during periodical review.

CHAPTER 2 – BUOYANCY, STABILITY AND SUBDIVISION

2.1 General

2.1.1 A craft should be provided with :

- (a) stability characteristics and stabilization systems adequate for safety when the craft is operated in the non-displacement mode and during the transient mode ; and
- (b) buoyancy and stability characteristics adequate for safety where the craft is operated in the displacement mode, both in the intact condition and the damage condition.

2.1.2 Account should be taken of the effect of icing in the stability calculations. An example for established practice for ice accretion allowances is given at Appendix I for the guidance of Administrations.

2.1.3 For the purpose of this and other chapters, unless expressly defined otherwise, the following definitions apply :

- (a) "Length (L)" means length of the rigid hull measured on the design waterline in the displacement mode.
- (b) "Breadth (B)" means breadth of the broadest part of the rigid hull measured on the design waterline in the displacement mode.
- (c) "Design waterline" means the waterline corresponding to the loaded displacement of the craft when stationary.
- (d) "Weathertight" means that water will not penetrate into the craft in any wind and wave conditions up to those specified as Critical Design Conditions.
- (e) "Skirt" means a downwardly-extending, flexible structure used to contain or divide an air cushion.
- (f) "Fully submerged foil" means a foil having no lift components piercing the surface of the water in the foilborne mode.

2.2 Intact Buoyancy

2.2.1 The craft should have a designed reserve of buoyancy when floating in seawater of not less than 100 per cent at the maximum operational weight. The Administration may require a larger reserve of buoyancy to permit the craft to operate in any of its intended modes. The reserve of buoyancy should be calculated by including only those compartments which are :

- (a) watertight ;
- (b) considered by the Administration to have scantlings and arrangements adequate to maintain their watertight integrity ; and
- (c) situated below a datum, which may be a watertight deck or equivalent structure watertight longitudinally and transversely and from at least part of which the passengers could be disembarked in an emergency.

2.2.2 (a) Means should be provided for checking the watertight integrity of buoyancy compartments. The inspection procedures adopted and the frequency at which they are carried out should be to the satisfaction of the Administration.

(b) Where entry of water into structures above the datum as defined in 2.2.1 (c) would significantly influence the stability and buoyancy of the craft, such structures should be of adequate strength to maintain the weathertight integrity or be provided with adequate drainage arrangements. A combination of both measures may be adopted to the satisfaction of the Administration. The means of closing of all openings in such structures should be such as to maintain the weathertight integrity.

2.3 Intact Stability

- 2.3.1 The stability of a craft in the displacement mode should be such that when in still water conditions, the inclination of the craft from the horizontal would not exceed 8° in any direction under all permitted cases of loading and uncontrolled passenger movements as may occur. A calculation of the dynamic stability should be made with respect to critical design conditions.
- 2.3.2 For guidance of the Administration, methods relating to the verification of the stability of hydrofoil boats fitted with surface piercing foils and fully submerged foils are outlined in Appendix II.

2.4 Buoyancy and Stability Following Damage

- 2.4.1 Following any of the postulated damages detailed in 2.4.4 and 2.4.5, the craft in still water should have sufficient buoyancy and positive stability to simultaneously ensure that in the displacement mode :
- (a) the final waterline is at least 76 millimetres below the level of any opening where progressive flooding could take place ;
 - (b) the angle of inclination of the craft from the horizontal does not exceed 8° in any direction for all permitted cases of loading and for such uncontrolled passenger movements as are likely in emergency conditions. The Administration may permit angles of inclination up to 16° immediately after damage but quickly reducing to 12° provided that :
 - (i) suitable handholds and efficient non-slip deck surfaces are provided ; and
 - (ii) it is impracticable to restrict the angle of heel to 8°.
- In exceptional cases the Administration may permit larger inclinations after damage provided the angle is quickly reduced to 12° and the provisions of sub-paragraphs (b) (i) and (ii) of this paragraph are satisfied ;
- (c) flooding of passenger compartments or escape routes will not significantly impede the evacuation of passengers ;
 - (d) the Administration should be satisfied that the range of residual stability after damage is adequate.
- 2.4.2 Following any of the postulated damage outlined in 2.4.4 and 2.4.5, the Administration should be satisfied that all reasonable and practicable steps have been taken to ensure that the craft, in the worst intended conditions, will have sufficient buoyancy and positive stability to remain afloat for at least 30 minutes or three times the demonstrated evacuation time plus 7 minutes whilst simultaneously ensuring that in the displacement mode :
- (a) any flooding of passenger compartments or escape routes will not significantly impede the evacuation of passengers ; and

- (b) essential emergency equipment, emergency radios, power supplies and public address systems needed for organizing the evacuation remain accessible and operational.

2.4.3 Any damage of a lesser extent than that postulated in 2.4.4 and 2.4.5 which would result in a more severe condition should also be investigated. The shape of the damage should be assumed to be parallelepiped.

2.4.4 The following side damages are to be assumed anywhere on the periphery of the craft :

- (a) the length of damage should be $0.1L$, or $3 \text{ metres} + 0.03L$, or 11 metres , whichever is the least ;
- (b) the depth of penetration into the craft should be : $0.2B$ or 5 metres , whichever is less.

However, where the craft is fitted with inflated skirts or with non-buoyant side structures, the depth of penetration should be at least 0.12 of the width of the main buoyancy hull or tank structure ;

- (c) the vertical extent of damage should be taken for the full depth of the craft.

2.4.5 Bottom damages are to be assumed anywhere on the bottom of the craft as follows :

- (a) the length of damage in the fore and aft directions should be : $0.1L$, or $3 \text{ metres} + 0.03L$, or 11 metres , whichever is the least ;
- (b) the width of damage should be : $0.2B$ or 5 metres , whichever is less, except that in the case of a catamaran or an air-cushion vehicle the damage to the bottom of the bridge deck cross-connecting the hulls or side walls need only be assumed if that structure is submerged with the craft in the undamaged displacement mode. The width of damage in such a case need not be greater than the separation of the hulls or side walls ;
- (c) the depth of penetration into the craft should be : $0.02B$ or 0.5 metres , whichever is less.

2.5 Stability of the Craft in the Non-Displacement Mode

2.5.1 The Administration should be satisfied that when operating in the non-displacement and transient modes within approved operational limitations, the craft will, after a disturbance causing roll, pitch, heave or any combination thereof, return to the original attitude.

2.5.2 The roll and pitch stability of each craft in the non-displacement mode, should be determined experimentally prior to entering commercial service and be recorded.

2.5.3 Where craft are fitted with surface piercing structure or appendages, precautions should be taken against dangerous attitudes or inclinations and loss of stability subsequent to a collision with a submerged or floating object.

2.5.4 The Administration should be satisfied that the structures and components provided to sustain operation in the non-displacement mode should, in the event of agreed damage or failure, provide adequate residual stability in order that the craft may continue safe operation to the nearest place where the passengers and crew could be placed in safety, provided caution is exercised in handling.

- 2.5.5 In designs where periodic use of cushion deformation is employed as a means of assisting craft control, or periodic use of cushion air exhausting to atmosphere for purposes of craft manoeuvring, the effects upon cushion-borne stability should be determined, and the limitations on the use by virtue of craft speed or attitude should be established.

2.6 Passenger Loading

Where compliance with this chapter requires consideration of the effects of passenger weight, Administrations should be guided by the recommendations contained in Appendix III.

CHAPTER 3 – STRUCTURES

- 3.1 This chapter covers those elements of hull and superstructure, which provide longitudinal and other primary and local strength of the craft as a whole and also other important components such as foils and skirts which are directly associated with the hull and superstructure.
- 3.2 Materials used for the hull and superstructure and the other features referred to in 3.1 should be adequate for the intended use of the craft. Due regard should be paid to 7.2.1.
- 3.3 The structure should be capable of withstanding the static and dynamic loads which can act on the craft under all operating conditions, without such loading resulting in inadmissible deformation and loss of watertightness or interfering with the safe operation of the craft.
- 3.4 Cyclic loads, including those from vibrations which can occur on the craft should not :
 - (a) impair the integrity of structure during the anticipated service life of the craft or the service life agreed with the Administration ;
 - (b) hinder normal functioning of machinery and equipment ; and
 - (c) impair the ability of the crew to carry out its duties.
- 3.5 The Administration should be satisfied that the choice of design conditions, design loads and accepted safety factors corresponds to the intended operating conditions for which certification is sought.
- 3.6 If the Administration considers it necessary it should require full scale trials to be undertaken in which loadings are determined. Cognizance should be taken of the results where these indicate that loading assumptions or structural calculations have been inadequate.

CHAPTER 4 – ACCOMMODATION AND ESCAPE MEASURES

4.1 Passenger and Crew Accommodation

- 4.1.1 Passenger and crew accommodation should be designed and arranged so as to protect the occupants from unfavourable environmental conditions and to minimize the risk of injury to occupants during normal and emergency conditions.
- 4.1.2 (a) Spaces accessible to passengers should not contain controls, electrical equipment, high temperature parts and pipelines, rotating assemblies or other items from which injury to passengers could result, unless such items are adequately shielded, isolated, or otherwise protected.

(b) Passenger accommodation should not contain operating controls unless the operating controls are so protected and located that their operation by a crew member is unlikely to be impeded by passengers during normal and emergency conditions of operation.

(c) Adequate means to notify passengers to be seated should be provided.
- 4.1.3 Crew accommodation should be to the satisfaction of the Administration having regard to the craft's intended service.
- 4.1.4 Windows in passenger and crew accommodation should be made of material which will not break into dangerous fragments if fractured.

4.2 Seats, Safety Belts

- 4.2.1 (a) A seat should be provided for each passenger that the dynamically supported craft is certified to carry. The Administration should specify which crew members are to be provided with a seat. No sleeping berth accommodation should be provided unless the Administration has made a comprehensive review of the Fire Safety Measures and Evacuation Procedures.

(b) Seats should be of a form and design such as to minimize the possibility of injury and to avoid trapping of the occupants particularly in emergency conditions. Dangerous projections and hard edges should be eliminated.

(c) Adjustable, folding or rotatable seats, if fitted, should be provided with locking mechanisms which should be designed so as to lock automatically in either the stowed or ready positions when the control is released.
- 4.2.2 Seats should not move or distort under normal service conditions. They may, however, distort under abnormal loads, in which case the risk of injury to occupants or persons thrown against them should be minimized.
- 4.2.3 The installation of seats should be such as to allow adequate access to any part of the accommodation space. In particular, they should not obstruct access to, or use of, any essential or emergency equipment or required means of escape.
- 4.2.4 (a) Safety belts should be provided for all seats from which the craft may be operated unless it is demonstrated to the satisfaction of the Administration that they are unnecessary. Administrations should consider the need to provide safety belts for other persons on board the craft having regard to other protection and the accelerations likely to be experienced.

(b) Safety belts, when correctly adjusted, should prevent the wearer's head and trunk from coming into contact with potentially dangerous objects under normal and emergency conditions.

(c) Safety belts and their attachments should be sufficiently strong to withstand the loads likely to arise due to a collision.

4.3 Exits and Means of Escape

4.3.1 The design of craft should be such that all occupants may safely evacuate the craft into survival craft with the minimum practicable delay in a single operation under all reasonable emergency conditions by day or by night. The positions of all exits which may be used in an emergency, and of all life-saving appliances, the practicability of evacuation procedure, and the evacuation time representative for crew and passengers, should be demonstrated to the satisfaction of the Administration.

4.3.2 Accommodation spaces, evacuation routes, exits, life-jacket stowage and survival craft stowage, and embarkation points, should be clearly and permanently marked and illuminated as required in Chapter 12.

4.3.3 (a) Each enclosed accommodation space should be provided with at least two exits arranged, if possible, in the opposite ends of the space. One of the exits may be an emergency exit. Normal exit(s) should be safely and easily accessible and should provide a satisfactory route to a normal point of boarding or disembarking from the craft, and should comply in any case with the requirements for an emergency exit.

(b) Normal exit doors should be capable of being readily operated from inside and outside the craft and in daylight and in darkness. The means of operation should be obvious, rapid and of adequate strength.

(c) The closing, latching and locking arrangement for normal exits should be such that it is readily apparent to the appropriate crew member when the doors are closed and in a safe operational condition, either in direct view or by an indicator.

4.3.4 (a) The craft should have a sufficient number of emergency exits which are suitable to facilitate the quick and unimpeded escape in emergency conditions, such as collision damage or fire, of persons wearing approved life-jackets.

(b) Sufficient space for a crew member should be provided adjacent to an emergency exit when the assistance of a crew member is likely to be necessary in ensuring the rapid evacuation of passengers.

(c) Emergency exit doors should be capable of being opened from either side, even though persons may be crowding against the door. Exits should not be unduly vulnerable to jamming in the event of minor structural deformation.

(d) Footholds, ladders, etc., provided to give access from the inside to emergency exits, should be of rigid construction and permanently fixed in position, except that they may fold if they can be brought into use immediately in emergency conditions and the risk of their jamming is small. Permanent handholds should be provided whenever necessary to assist persons using emergency exits, and should be suitable for conditions when the craft has developed any possible angle of heel or pitch.

(e) The means of opening of all emergency exits should be obvious, rapid, and of adequate strength. When the craft is in service the securing devices should be self-contained without removable handles or keys.

(f) All emergency exits, together with their means of opening, should be adequately marked for the guidance of passengers. Adequate marking should also be provided for the guidance of rescue personnel outside the craft.

4.3.5 (a) In general, at least two unobstructed evacuation paths should be available for the use of each person. Evacuation paths should be so disposed that adequate evacuation facilities will be available in the event of any likely damage or emergency conditions, and evacuation paths should be adequately lighted.

(b) The dimensions of passages, doorways and stairways which form part of evacuation paths should be such as to allow easy movement of persons when wearing life-jackets provided to comply with 8.3.1. There should be no protrusions in evacuation paths which could cause injury, ensnare clothing or damage life-jackets.

(c) Adequate notices should be provided to direct passengers to emergency exits.

4.3.6 Provision should be made on board for embarkation points properly equipped for evacuation of passengers into life-saving appliances.

4.4 Evacuation Time

4.4.1 The provisions for evacuation, together with the proposed evacuation procedures, should be submitted to the Administration for consideration at an early stage in the design of the craft.

4.4.2 If the Administration consider it necessary, a calculated abandon craft time may be ascertained at the design stage to ensure that the structural fire protection in accordance with 7.2.5 is adequate.

(a) Where there are no more reliable data, the calculated abandon craft time should include the time necessary to launch, inflate and secure a survival craft ready for embarkation plus the time taken to fill the survival craft to its required capacity allowing 5 seconds per person ; or the calculated abandon craft time should be the time taken to fill the survival craft to its required capacity allowing 10 seconds per person, whichever is greater.

(b) Where, for structural reasons, or where there are insufficient crew members for each survival craft to be simultaneously prepared, the calculated abandon craft time should be taken as the sum of the times taken for those survival craft not so simultaneously prepared.

(c) Where simultaneous preparation of survival craft is employed, the Administration should ensure that at least one crew member is available at each embarkation point for organizing the embarkation of passengers into survival craft. In addition to the master, the radio operator should not be regarded as a crew member for this purpose. In all cases, the Administration should ensure compatibility with 4.3 dealing with escape routes.

4.4.3 The Administration should require a practical demonstration that in a reasonably representative situation the survival craft can be deployed and the occupants of the dynamically supported craft evacuated into them in a time suitably related to the time for which fire hazard areas are designed to contain fire. The evacuation time should be demonstrated by an evacuation test which should be performed either with the full complement of crew and passengers, or by a series of partial evacuations using the number of persons at each exit for which that exit is designed, with due concern for the problems of mass movement or panic.

- 4.4.4 Any procedures on which certification is based should be scheduled in the Technical Manual.

4.5 Baggage, Store and Cargo Compartments

- 4.5.1 Provision should be made to prevent shifting of baggage, store and cargo compartment contents, having due regard to occupied compartments and accelerations likely to arise. If safeguarding by positioning is not practicable, an adequate means of restraint for the baggage, stores and cargo should be provided.
- 4.5.2 Controls, electric equipment, high temperature parts, pipelines or other items, the damage or failure of which could affect the safe operation of the craft, should not be located in baggage, store and cargo compartments unless such items are adequately protected so that they cannot be damaged or, where applicable, operated inadvertently by loading, unloading or by movement of the contents of the compartment.
- 4.5.3 Loading limits, if necessary, should be durably marked in those compartments.
- 4.5.4 Having regard to the purpose of the craft, the closures of the exterior openings of the luggage and cargo compartments as well as special category spaces should be appropriately weathertight.

CHAPTER 5 – DIRECTIONAL CONTROL SYSTEMS

5.1 General

- 5.1.1 Craft should be provided with means for directional control of adequate strength and suitable design to enable the craft's heading and direction of travel to be effectively controlled without undue physical effort at all speeds and in all conditions for which the craft is to be certificated.
- 5.1.2 Directional control may be achieved by means of air or water rudders, foils, flaps, steerable propellers or jets, yaw control ports or side thrusters, differential propulsive thrust, variable geometry of the craft or its lift system components or by a combination of these devices.
- 5.1.3 For the purpose of this chapter, a directional control system includes any steering device or devices, any mechanical linkages and all power or manual devices, controls and actuating systems.
- 5.1.4 Attention is drawn to the possibility of interaction between directional control systems and stabilization systems. Where such interaction occurs or where dual purpose components are fitted, the requirements of Chapters 15 and 16 are also to be complied with as applicable.
- 5.1.5 For the purposes of this and other chapters, unless expressly provided otherwise the following definitions apply :
 - (a) "Foil" means a profiled plate at which lift is generated when the craft is under way.
 - (b) "Flap" means an element of the trailing edge of the foil with the help of which foil lift is controlled.
 - (c) "Side thrusting ports" are discrete controllable apertures in the cushion supply ducting or skirt system which enable jet reaction forces to be generated, to assist in controlling an air-cushion vehicle.

5.2 Reliability

- 5.2.1 The probability of total failure of all directional control systems should be extremely remote* when the craft is operating normally, i.e. excluding emergency situations such as grounding, collision or a major fire.
- 5.2.2 A design incorporating a power drive or an actuation system employing powered components for normal directional control should provide a secondary means of actuating the device unless an alternative system is provided.
- 5.2.3 The secondary means of actuating the device may be manually driven when the Administration is satisfied that this is adequate, bearing in mind the craft's size and design and any limitations of speed or other parameters that may be necessary.
- 5.2.4 As far as is practicable, the directional control systems should be constructed so that a single failure in one drive or system, as appropriate, will not render any other one inoperable.

*Attention is called to Annex II, "Use of Probability Concept".

The Administration may allow a short period of time to permit the disconnection of a failed power drive or directional control device when the design of the craft is such that such delay will not in their opinion hazard the craft.

- 5.2.5 Power drives for directional control devices should become operative automatically, and respond correctly, as soon as power is restored after a power failure.
- 5.2.6 Directional control devices involving variable geometry of the craft or its lift system components should, so far as is practicable, be so constructed that any failure of the drive linkage or actuating system will not significantly hazard the craft.

5.3 Demonstrations

- 5.3.1 The Administration should prescribe, if appropriate, limits of safe use of any of the directional control devices, if necessary, following a demonstration, and be satisfied by such demonstration that all systems as fitted and limited are effective within the permitted speed ranges in all conditions for which the craft is to be certificated.
- 5.3.2 The Administration should determine by demonstration any adverse effects upon safe operation of the craft in the event of an uncontrollable total deflection of any one steering device, and should prescribe any limitation on the operation of the craft as may be necessary to ensure that the redundancy or safeguards in the systems provide equivalent safety.

5.4 Control Position

- 5.4.1 All directional control systems should normally be operated from the craft's control position.
- 5.4.2 If directional control systems can also be operated from other positions, then two-way communication should be arranged between the operating point and the craft control position.
- 5.4.3 Where practicable, adequate indications should be provided at the operating point to provide the person controlling the craft with verification of the correct response of the directional control device to this demand, and also, where practicable, to indicate any abnormal responses or malfunction.

CHAPTER 6 – ANCHORING, TOWING AND BERTHING

6.1 Anchors

Craft should be provided with approved ground tackle to the satisfaction of the Administration having regard to the intended service of the craft and its ability to manoeuvre in an emergency condition.

6.2 Towing

- 6.2.1 Craft should be capable of being towed and suitable arrangements should be provided to effect this safely in the worst intended conditions.
- 6.2.2 A maximum towing speed should be established by the Administration.
- 6.2.3 The towing arrangements and all eyebolts, fair leads and bitts should be so constructed and attached to the hull that in the event of their damage, the watertight integrity of the craft is not impaired.

6.3 Berthing

Where necessary, suitable fair leads, bitts and mooring ropes should be provided.

CHAPTER 7 – FIRE SAFETY

7.1 General

7.1.1 The requirements in this chapter are based on the following conditions :

- (a) Where a fire is detected, the crew immediately puts into action the fire-fighting appliances, informs the port or base port of the accident and prepares, if necessary, for the evacuation of passengers.
- (b) The use of fuel with a flashpoint below 43°C is not recommended. However, fuel with a lower flashpoint, but not lower than 38°C, may be used provided suitable precautions, to the satisfaction of the Administration, are taken against the risk of fire and explosion.
- (c) Members of the crew are aware of the instructions approved by the Administration which specify the actions of the crew in the event of fire on the craft and that these instructions are permanently on board the craft and appropriate drills of the crew are arranged regularly.
- (d) The repair and maintenance of the craft are carried out in accordance with methods to the satisfaction of the Administration.

7.1.2 For the purpose of this chapter, unless expressly defined otherwise the following definitions apply :

- (a) "Fire hazard areas" are those compartments where the proximity to each other of combustible materials or flammable liquids and potential sources of ignition (electrical equipment, heat surfaces, etc.) may promote the initiation of fire (machinery spaces, etc.).
- (b) "Control stations" are those spaces in which the primary and emergency controls or instruments, the craft's radio or main navigating equipment or the emergency source of power is located or where the fire recording or fire control equipment is centralized.
- (c) A "Standard Fire Test" is one in which specimens of the relevant bulkheads or decks are exposed in a test furnace to temperatures corresponding approximately to the standard time-temperature curve. The specimen should have an exposed surface of not less than 4.65 square metres and height (or length of deck) of 2.44 metres resembling as closely as possible the intended construction and including where appropriate at least one joint. The standard time-temperature curve is defined by a smooth curve drawn through the following points :
 - at the end of the first 5 minutes – 538°C.
 - at the end of the first 10 minutes – 704°C.
 - at the end of the first 30 minutes – 843°C.
 - at the end of the first 60 minutes – 927°C.
- (d) "Special Category Spaces" are those enclosed spaces intended for the carriage of motor vehicles with fuel in their tanks for their own propulsion, into and from which such vehicles can be driven and to which passengers have access.
- (e) "Non-combustible material" means a material which neither burns nor gives off flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C, this being determined to the satisfaction of the Administration by an established test procedure*. Any other material is a combustible material.

* Reference is made to the Recommendation on Test Method for Qualifying Marine Construction Materials as Non-Combustible, adopted by the Organization by Resolution A.270(VIII).

- (f) "Steel or other equivalent material". Where the words "steel or other equivalent material" occur, "equivalent material" means any material which, by itself or due to insulation provided, has structural and integrity properties equivalent to steel at the end of the applicable fire exposure to the standard fire test (e.g. aluminium alloy with appropriate insulation).
- (g) "Flashpoint" means a flashpoint determined by an approved apparatus using the closed cup test.
- (h) "Low flame spread" means that the surface which may be exposed to a fire will adequately restrict the spread of flame, this being determined to the satisfaction of the Administration by an established test procedure.

7.2 Structural Fire Protection

- 7.2.1 The hull should be constructed of approved non-combustible materials having adequate structural properties. The Administration may permit the use of other materials provided that it is satisfied that the additional precautions taken are sufficient to ensure that an equivalent level of fire safety is achieved.
- 7.2.2 Fire hazard areas should be enclosed by fire-resisting divisions complying with the requirements of 7.2.5 except where, in the opinion of the Administration, the omission of any such division would not affect the safety of the craft. These requirements need not apply to those parts of the structure in contact with water at the lightweight condition, but due regard should be given to the effect of heat transfer from any uninsulated structure in contact with water to insulated structure above the water.
- 7.2.3 Control stations, life-saving appliances stowage positions, escape routes and places of embarkation into survival craft should not, as far as practicable, be located adjacent to any fire hazard areas.
- 7.2.4 Control stations should be provided with appropriate structural protection to the satisfaction of the Administration, having due regard to the craft's arrangements.
- 7.2.5 Fire-resisting divisions should preferably be of non-combustible material but other material insulated as required may be accepted by the Administration. They should prevent the passage of flame and smoke through them in the standard fire test for a period equal to the greater of : 30 minutes ; or three times the demonstrated time necessary for embarkation into survival craft referred to in 4.4.3 plus an allowance of seven minutes for initial detection and extinguishing action.
- 7.2.6 The main structures within the fire hazard areas should withstand the effect of flame during the standard fire test for the period of time specified in 7.2.5 without serious risk of collapse.
- 7.2.7 If the structures specified in 7.2.2, 7.2.5 and 7.2.6 are made of aluminium alloy, their insulation should be such that the temperature of the core does not rise more than 200°C above the ambient temperature during the first 30 minutes of the standard fire test.
- 7.2.8 Pipes, ducts, and controls penetrating a fire-resisting division should not reduce its fire-resisting integrity.
- 7.2.9 In general, thermal and acoustic insulation should be of non-combustible materials.

- 7.2.10 Where insulation is installed in areas in which it could come into contact with any flammable fluids or their vapour, its surface should be impermeable to such flammable fluids or vapours.
- 7.2.11 All ceilings and linings should be made of non-combustible materials. For facings it is permitted to use combustible materials having a total thickness of not greater than 1.5 millimetres and having low flame-spread characteristics.
- 7.2.12 Furniture installed in the craft should be of non-combustible materials. However, the materials used for upholstery and trim may be combustible but should possess low flame-spread characteristics.
- 7.2.13 The Administration may permit the use of materials other than those required in 7.2.9, 7.2.11, 7.2.12, provided that it is satisfied that additional precautions are taken sufficient to ensure that equivalent fire safety is achieved.
- 7.2.14 Materials used in the craft, when exposed to local fire, should not emit smoke or toxic gases in quantities that could be dangerous to the occupants of the craft.
- 7.2.15 When combustible materials are installed to provide buoyancy, these materials should be reliably protected against potential sources of ignition or contamination by flammable fluids.
- 7.2.16 In compartments where smoking is allowed, suitable ash containers should be provided. In compartments where smoking is not allowed, adequate notices should be displayed.
- 7.2.17 The exhaust gas pipes should be arranged so that the risk of fire is kept to a minimum. To this effect, all the compartments and structures which are contiguous with the exhaust system, or those which may be affected by increased temperatures caused by waste gases in normal operation or in an emergency, should be constructed of non-combustible material, or shielded with such material to the extent required by the Administration.
- 7.2.18 The design and arrangement of the exhaust manifolds or jet pipes should be such as to ensure the safe discharge of exhaust gases.

7.3 Fuel and other Flammable Fluid Tanks and Systems

- 7.3.1 Tanks containing fuel and other flammable fluids should be separated from passenger, crew and baggage compartments by vapour-proof enclosures or cofferdams which are suitably ventilated and drained.
- 7.3.2 Wherever possible, such tanks should not be located in, or contiguous to, fire hazard areas, but where they are so located they should be made of steel or other equivalent material.
- 7.3.3 Means should be provided to shut off the flow of flammable fluids into a fire hazard area. This means, and the control thereof, should be located outside the fire hazard area. The quantity of oil remaining in pipes, filter, etc., in such areas should be kept to a minimum.
- 7.3.4 Pipes, valves and couplings conveying flammable fluids should be of steel or such alternative material satisfactory to the Administration in respect of strength and fire integrity having regard to the service pressure and the spaces in which they are installed. Wherever practicable, the use of flexible pipes should be avoided but where such piping is used, it should be approved by the Administration.

- 7.3.5 Pipes, valves and couplings conveying flammable fluids should be arranged as far from hot surfaces or air intakes of engine installations, electrical appliances and other potential sources of ignition as is practicable and be located or shielded so that the likelihood of fluid leakage coming into contact with such sources of ignition is kept to a minimum.

7.4 Ventilation

- 7.4.1 Spaces in which flammable gases may accumulate should be provided with effective ventilation to the satisfaction of the Administration.
- 7.4.2 (a) In general, the control and closure of ventilation openings to fire hazard areas should be capable of being operated from outside the area and also from inside where necessary.
- (b) The Administration should, in addition, consider the need to have similar arrangements for other compartments.
- 7.4.3 All ventilation fans should be capable of being stopped from outside the spaces which they serve.
- 7.4.4 Where a compartment is likely to be occupied, ventilation controls for that compartment should also be operable from within.
- 7.4.5 Fire hazard areas should have separate ventilation systems and ventilation ducts. Ventilation ducts for fire hazard areas should not pass through other spaces, and ducts for ventilation of other spaces should not pass through fire hazard areas. The Administration may permit relaxations from these requirements, provided that the ducts have adequate fire integrity and insulation or automatic fire dampers are fitted close to the boundaries penetrated.
- 7.4.6 An effective ventilation system to give a minimum of 10 changes per hour should be provided in special category spaces with means provided at the control station to indicate the loss or reduction in operation of the system.

7.5 Fire Detection and Extinguishing Systems

- 7.5.1 The fire hazard areas should be provided with an approved automatic fire detection system to indicate at the control station the location of outbreak of a fire in all normal operating conditions of the installations.
- 7.5.2 Fire hazard areas should be protected by an approved remotely controlled, fixed, quick acting, extinguishing system which is adequate for the fire hazard that may exist. Administrations should also consider the need for providing local manual control, having regard to the reliability of the remote control system.
- 7.5.3 Control stations, accommodation spaces and fire hazard areas should be provided with approved portable fire extinguishers readily available, to the satisfaction of the Administration.
- 7.5.4 Water fire pumps, and appropriate associated equipment, or alternative effective fire extinguishing systems to the satisfaction of the Administration should be fitted.
- 7.5.5 A continuous fire patrol should be maintained in special category spaces, unless an automatic fire detection system is provided.

- 7.5.6 If the same automatic fire detection system is used both for the protection of the fire hazard areas and other spaces, the cables to which the sensors are connected should be independent.

7.6 Special Category Spaces

- 7.6.1 Each special category space should be fitted to the satisfaction of the Administration with one of the following fire extinguishing systems, taking into account the size of the space and the number of vehicles carried :

- (a) an approved fixed water-spraying system for manual or automatic operation, to protect all parts of the space ;
- (b) an approved fixed gas fire extinguishing system effective in dealing with petrol fuel ;
- (c) an approved system for providing high expansion foam in effective quantities to protect all parts of the space ;
- (d) semi-portable fire extinguishers readily available for use in the space, but with a minimum of two such extinguishers to each such space.

Systems required under sub-paragraphs (a), (b) and (c) of this paragraph should be controlled from outside the space.

- 7.6.2 Equipment which may constitute a source of ignition of flammable vapours, and in particular electrical equipment and wiring in such spaces, should be installed at least 0.45 metre above the deck.

- 7.6.3 Special category spaces should be structurally separated from the operating compartment, passenger accommodation and evacuation routes as effectively as practicable. If the Administration permits the adjacent arrangement of these spaces, provision should be made for easy evacuation from the passenger accommodation in the direction opposite to the special category space.

7.7 Miscellaneous

- 7.7.1 The controls referred to in 7.3.3, 7.4.3, 7.5.1 and 7.5.2 should be readily available and as far as possible, in close proximity to each other. In general, these controls should be located in the control station.
- 7.7.2 The Administration should consider which of the requirements of this chapter are appropriate to the protection of any cargo spaces.

CHAPTER 8 – LIFE-SAVING APPLIANCES

8.1 General

- 8.1.1 The survival system should include life-saving appliances to permit abandonment of a damaged craft in accordance with the requirements of 4.3.
- 8.1.2 The life-saving appliances should be of a type approved by the Administration.
- 8.1.3 Evacuation routes, exits and embarkation points should comply with the requirements of 4.3.

8.2 Survival Craft

- 8.2.1 Survival craft should be provided in sufficient quantity to accommodate at least 110 per cent of the total number of persons the dynamically supported craft is certified to carry, subject to a minimum total of two such survival craft being carried. In addition, at least one survival craft suitable for rescuing a person overboard should be provided if passengers have free access to exposed decks while the dynamically supported craft is under way and if the rescue operation cannot be performed with the dynamically supported craft.
- 8.2.2 Each survival craft and its life-saving equipment should be to the satisfaction of the Administration.
- 8.2.3 A portable radio transmitter receiver should be provided to the satisfaction of the Administration, capable of transmitting and receiving signals on a distress frequency for use in one of the survival craft. If battery powered, the battery capacity should be to the satisfaction of the Administration.
- 8.2.4 The portable radio transmitter receiver should be stowed in the craft in an identified readily accessible position from which a crew member can place it in a launched survival craft during evacuation.
- 8.2.5 Survival craft should be securely stowed externally to passenger accommodation. The stowage should be such that each survival craft may be safely launched in a simple manner, and remain secured to the craft during and subsequent to the launching procedure. The length of the securing line should be such as to maintain the survival craft suitably positioned for embarkation.
- 8.2.6 At the discretion of the Administration, inflatable survival craft may be stowed with a hydrostatic device, so arranged as to release and inflate the survival craft from its container in the event of the dynamically supported craft sinking.
- 8.2.7 Each survival craft and its equipment should be stowed in such a manner and position that all such craft may be launched rapidly without mutual interference.
- 8.2.8 In the case of inflatable survival craft, the launching procedure should initiate inflation.
- 8.2.9 All survival craft should be capable of being launched in adverse roll and trim attitudes, and for all emergency conditions.

8.3 Life-Jackets

- 8.3.1 Life-jackets to the satisfaction of the Administration should be provided to a total number of not less than 105 per cent of the total number of persons on board. A number of life-jackets suitable for children should be provided in addition.

- 8.3.2 The stowage positions of all life-jackets should be clearly identified and indicated to all occupants.

8.4 Lifebuoys

- 8.4.1 One lifebuoy fitted with a buoyant lifeline of at least 27.5 metres should be provided adjacent to each normal exit from the craft, subject to a minimum of two being installed.
- 8.4.2 In addition to the requirements of 8.4.1 where passengers or crew have access to exposed decks under normal operating conditions, at least one lifebuoy on each side of the craft should be provided with a self-igniting light and a self-activating smoke signal. The release of such lifebuoys should be both locally and remotely controlled.
- 8.4.3 The Administration should be satisfied with the distribution of lifebuoys.

8.5 Distress Signals

- 8.5.1 At least twelve parachute flares capable of giving a high altitude red light should be provided in the control compartment.
- 8.5.2 If the parachute flares provided are not of the self-propelled type, a suitable means of firing them should be provided.
- 8.5.3 One portable signalling lamp capable of operating independently of the craft's main electrical supply should be provided and maintained ready for use in the control compartment at all times.

8.6 Line-Throwing Apparatus

If the Administration, taking into account the area of operation of the craft, considers it necessary, the craft should carry one line-throwing apparatus of an approved type.

CHAPTER 9 – MACHINERY

9.1 General

- 9.1.1 The ability of the propulsion system to alter the direction of thrust, if this is necessary to bring the craft to rest from maximum ahead speed in a reasonable time and distance, should be demonstrated to the satisfaction of the Administration.
- 9.1.2 The design, construction of, and materials used for the machinery of craft should be such that the probability of failure leading to hazard of the craft or occupants is remote (see Note).
- 9.1.3 In the design and installation of machinery containing high energy rotating parts, consideration should be given to the likelihood of ejection of high energy debris in the event of failure. Where practicable, the debris should be contained, either within the machinery or by the provision of external guards. Where this is not practicable, the probability of disruptive failure leading to the ejection of debris which would hazard the craft, its occupants or any other person should be extremely remote (see Note).
- 9.1.4 The Administration should be satisfied that the reliability of the machinery (i.e. its ability to continue to function), as installed in the craft, is adequate for its intended use. While the failure of the machinery will not always be a serious hazard to safety, machinery reliability is a necessary ingredient of safety in a great many craft applications. The Administration should take into account such factors as whether alternative power supplies are available and the worst intended conditions for the craft. They may take into account evidence arising from the use of the machinery in other applications (provided that any necessary marinization has been carried out and that no unsuitable modifications have been added), and evidence of testing other than in the craft.
- 9.1.5 The Administration may accept machinery which does not show detailed compliance with the Code where it has been used satisfactorily in a similar application, provided that they are satisfied :
- (a) that the design, construction, installation and prescribed maintenance are together adequate for its use in a marine environment ; and
 - (b) that an equivalent level of safety will be achieved.
- 9.1.6 Where only a small number of units of the particular type of machinery have been manufactured, the Administration should ensure that the detailed design, test, and quality control during manufacture provide at least comparable assurance to the operating experience obtainable from large numbers.
- 9.1.7 A failure mode and effects analysis should be carried out, to the satisfaction of the Administration, for each type of machinery and its associated controls in the system of installation. In cases where faults can occur without being detected during routine checks of the machinery, the analysis should take into account the possibility of faults occurring simultaneously or consecutively.
- 9.1.8 The Administration should be satisfied that the procedure used to control the quality of the machinery is adequate for the particular product.
- 9.1.9 Each part of all machinery should be protected against corrosion and deterioration, with due regard to the maintenance it will receive, the environment in which it will operate and the hazard arising if corrosion occurs.

- 9.1.10 The Administration should be satisfied that such information is made available by the manufacturers as is necessary to ensure that machinery can be installed correctly regarding such factors as operating conditions and limitations.
- 9.1.11 All boilers and pressure vessels should be of a design and construction adequate for the purpose intended and should be so installed and protected as to minimize danger to persons on board. In particular, attention should be paid to the materials used in the construction and the working pressures and temperatures at which the item will operate and the need to provide an adequate margin of safety over the stresses normally produced in service. Every boiler and pressure vessel should be fitted with adequate means to prevent over-pressures in service and be subjected to a hydraulic test before being put into service, and where appropriate at specified intervals subsequently to a pressure suitably in excess of the working pressure.

9.2 Engines (General)

- 9.2.1 The design of the engine should be such that :
- (a) the power output can be controlled within the approved limits ;
 - (b) the probability of an overspeed leading to hazard of the craft or occupants is extremely remote (see Note) ;
 - (c) safety devices do not cause complete engine shut-down without prior warning, except where it is essential.
- 9.2.2 The engine and its mountings should be of adequate strength and stiffness to enable it to withstand, when suitably supported, the most adverse combination of loads without exceeding acceptable stress levels for the material concerned, which should include :
- (a) loads arising from normal operation of the engine and reasonably probable (see Note) failure conditions ;
 - (b) vibration loads likely to occur under normal and anticipated fault conditions agreed to by the Administration ; and
 - (c) inertia and gyroscopic loads.
- 9.2.3 Each engine should be provided with :
- (a) an emergency overspeed shut-down device connected, where possible, directly to the engine shaft ; and
 - (b) at least two means for stopping the engine under any operating conditions.
- 9.2.4 The major components of the engine should have adequate strength to withstand both the thermal and dynamic conditions of normal operation and any excessive thermal and dynamic conditions that may result from malfunction of the engine. The engine should not be damaged by a limited operation at a speed or at temperatures exceeding the normal values but within the range of the protective devices. Such operation should be considered in determining the service life of the engine.

- 9.2.5 The design should be such as to avoid the risk of major rupture of casings in the event of a local failure of, or consequent to, local damage to the casing. Particular consideration should be given to those casings which are subjected to high stress due to internal pressure.
- 9.2.6 The design of the engine should be such as to minimize the risk of fire or explosion and to enable compliance with the fire precaution requirements of Chapter 7.
- 9.2.7 Provision should be made to drain all excess fuel and oil to a safe position so as to avoid a fire hazard.
- 9.2.8 Whenever practical, the integrity of the engine should not be unduly affected by the failure of components driven by it.
- 9.2.9 Reasonable provision should be made in engines for the connexion of adequate instrumentation to enable the crew to monitor engine operation and assess trends towards unsafe conditions. The overall limits of accuracy required of any instruments to be fitted should be stated.
- 9.2.10 The Administration should be satisfied in respect of any engine installed in a craft, that
- (a) the probability of a directly hazardous failure (having regard to the position and protection afforded by the installation) is extremely remote (see Note) ; and
 - (b) the probability of loss of power is acceptably low having regard to the duty of the craft and the duty of the engine in it.
- The Administration may take into account tests, investigations and operating experience on other engines of the type or related types in deciding on the evidence needed in the particular application.
- 9.2.11 Ventilation arrangements to engine spaces should ensure :
- (a) an adequate supply of air to the engine ; and
 - (b) safety of personnel when machinery is operating at full power in any operating conditions.
- 9.2.12 Measures should be taken to reduce engine noise and vibration in machinery spaces so that they are kept within acceptable levels as determined by the Administration having regard to the need for entry to the space during operation. If this noise cannot be sufficiently reduced, the source of excessive noise should be suitably insulated and isolated or a refuge from noise should be provided if the space requires manned supervision. Ear protectors should be provided for personnel required to enter such spaces.
- 9.2.13 Where two or more engines are employed, the systems servicing them should be so designed that, as far as practicable, failure of or explosion in one engine should not damage or impair the functioning of the others.

9.3 Gas Turbines

- 9.3.1 The gas turbine should be free from surge or dangerous instability throughout its operating range up to the maximum steady speed approved for use. The Administration should take measures to ensure that the turbine is not operated within any speed range where excessive vibration, stalling, or surging may be encountered.

- 9.3.2 The strength of turbine engines should be such that any reasonably probable shedding of compressor or turbine blades will not lead to damage that would be likely to hazard the craft, its occupants or any other persons (see Note).
- 9.3.3 Any turbine should be so installed as to avoid excessive vibration within the craft.
- 9.3.4 Sub-paragraph 9.2.7 should apply to gas turbines in respect of fuel which might reach the interior of the jet pipe or exhaust system after a false start or after stopping.
- 9.3.5 Turbines should be safeguarded as far as practicable against the possibility of damage by ingestion of contaminants from the operating environment. Information regarding the recommended maximum concentration of contamination should be made available to the Administration. Provision is to be made, if necessary, for preventing the air intake from icing.
- 9.3.6 In the event of a failure of a shaft or weak link, the broken end should not hazard the occupants of the craft, either directly or by damaging the craft or its systems. Where necessary, guards may be fitted to achieve compliance with this requirement.
- 9.4 Diesel Engines**
- 9.4.1 Any main propulsion diesel engine should have torsional vibration and other vibrational characteristics acceptable to the Administration. Precautions should be taken to ensure that the engine is not operated within any speed range where excessive vibration may be encountered.
- 9.4.2 Fuel injector pipes should be so positioned or screened as to avoid fuel impingement on hot surfaces in the event of leakage or fracture of the pipe. Where this is not practicable, the Administration should consider the need to install double-walled pipes and to ensure that any leakage is drained to a safe receptacle fitted with an alarm to indicate that leakage is taking place. In any case, unattended machinery spaces should have such an arrangement installed.
- 9.4.3 Engines of a cylinder diameter of 200 millimetres or a crankcase volume of 0.6 cubic metre and above should be provided with crankcase explosion relief valves of an approved type with sufficient relief area. The relief valves should be arranged with means to ensure that discharge from them is directed so as to minimize the possibility of injury to personnel.
- 9.4.4 The lubrication system and arrangements should be efficient at all running speeds, due consideration being given to the need to maintain suction and avoid the spillage of oil in all conditions of list and trim and degree of motion of the craft.
- 9.4.5 Arrangements should be provided to ensure that an alarm should be provided or that the engine should be stopped or slowed to a safe speed in the event of the lubricating oil pressure falling to a dangerously low level. Automatic shut-down of the engine should only be activated by conditions which could lead to complete breakdown, fire or explosion.
- 9.4.6 Where diesel engines are arranged to be started, reversed or controlled by compressed air, the arrangement of the air compressor, air receiver, and air starting system is to be such as to minimize the risk of fire and explosion.

- 9.4.7 Arrangements should be provided to ensure that, in the event of leakage in any liquid cooling system, ingress of coolant liquid into the craft may be minimized. Such arrangements should include measures to minimize the effect of such leakage upon machinery serviced by the system.

9.5 Transmissions

- 9.5.1 The transmission should be of adequate strength and stiffness to enable it to withstand the most adverse combination of the loads expected in service without exceeding acceptable stress levels for the material concerned.
- 9.5.2 The design of shafting should be such that hazardous whirling and excessive vibration do not occur at any speed up to 105 per cent of the maximum speed that it can attain, e.g. the speed attained at or after a governor trip.
- 9.5.3 The strength and fabrication of the transmission should be such that the probability of hazardous fatigue failure under the action of the repeated loads of variable magnitude expected in service is extremely remote (see Note) throughout its operational life. Compliance should be demonstrated either by suitably conducted tests, and/or by designing for sufficiently low stress levels, combined with the use of fatigue resistant materials and suitable detail design.
- 9.5.4 Where a clutch is fitted in the transmission, normal engagement of the clutch should not cause excessive stresses in the transmission or driven items. Inadvertent operation of any clutch should not produce dangerously high stresses in the transmission or driven item.
- 9.5.5 The transmission system should be such that a failure in any part of the transmission, or of a driven component, will not apply a torque to the system which could cause damage which might hazard the craft or its occupants. This could be accomplished by the provision of "weak links", as appropriate.
- 9.5.6 Where failure of lubricating fluid supply or loss of lubricating fluid pressure could lead to a hazardous condition, provision should be made to enable such failure to be indicated to the operating crew in adequate time to enable them as far as practicable to take the appropriate action before the hazardous condition arises.

9.6 Propulsion and Lift Devices

- 9.6.1 The requirements of this section are based on the premises that :
- (a) Propulsion arrangements and lift arrangements may be provided by separate devices, or be integrated into a single propulsion and lift device. Propulsion devices may be air, or water propellers or water jets and the requirements apply to all types of craft, whereas lift devices apply only to air-cushion vehicles.
 - (b) Propulsion devices are those which directly provide the propulsive thrust and include machinery items and any associated ducts, vanes, scoops and nozzles, the primary function of which is to contribute to the propulsive thrust.
 - (c) The lift devices, for the purpose of this section, are those items of machinery which directly raise the pressure of the air and move it for the primary purpose of providing lifting force for an air-cushion vehicle.

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- 9.6.2 The propulsion and lift devices should be of adequate strength and stiffness. The Administration should be satisfied with the design data and such calculations as are made and where necessary should establish by suitable tests the ability of the device to withstand the loads which can arise during the operations for which the craft is to be certificated, so that the possibility of catastrophic failure is extremely remote (see Note).
- 9.6.3 The design of propulsion and lift devices should pay due regard to the effects of allowable corrosion, electrolytic action between different metals, erosion or cavitation which may result from operation in environments in which it is subjected to spray, debris, salt, sand, icing, etc.
- 9.6.4 The design data and testing of propulsion and lift devices should pay due regard, as appropriate, to any pressures which could be developed as a result of a duct blockage, to steady and cyclic loadings, to loadings due to external forces and to the use of the devices in manoeuvring and reversing and to the axial location of rotating parts.
- 9.6.5 The Administration should be satisfied with the arrangements as appropriate to ensure that :
- (a) ingestion of debris or foreign matter is minimized ;
 - (b) the possibility of injury to personnel from shafting or rotating parts is minimized ;
and
 - (c) where necessary, inspection and removal of debris can be carried out safely in service.

Note : Reference is made to Annex II.

CHAPTER 10 – AUXILIARY SYSTEMS

10.1 General

- 10.1.1 Fluid systems should be constructed and arranged so as to assure a safe and adequate flow of fluid at a prescribed flow rate and pressure under all conditions of craft operation. The probability of a failure or a leakage in any one fluid system causing damage to the electrical system, a fire or an explosion hazard should be extremely remote (see Note). Attention should be directed to the avoidance of fuel impingement on hot surfaces in the event of leakage or fracture of the pipe.
- 10.1.2 The Administration should consider the need to provide redundancy in pumping and piping systems in single engine craft.
- 10.1.3 The maximum allowable working pressure in any part of the fluid system should not be greater than the design pressure acceptable to the Administration, having regard to the allowable stresses in the materials. Where the maximum allowable working pressure of a system component, such as a valve or a fitting, is less than that computed for the pipe or tubing, the system pressure should be limited to the lowest of the component maximum allowable working pressures. Every system which may be exposed to pressures higher than the system's maximum allowable working pressure should be safeguarded by appropriate relief devices.
- 10.1.4 Tanks and piping should be pressure tested, as required by the Administration, to a pressure that will assure a safety margin in excess of the working pressure of the item. The test on any storage tank or reservoir should take into account any possible static head in the overflow condition and the dynamic forces arising from craft motions.
- 10.1.5 Materials used in piping systems should be compatible with the fluid conveyed and due regard given to the risk of fire. Non-metallic piping material may be permitted in certain systems at the discretion of the Administration provided precautions are taken to maintain the integrity of the hull and watertight decks and bulkheads where necessary. Concerning materials and the use of flexible hoses in flammable fluid systems, reference is made to the fire safety requirements in 7.3.4 and 7.3.5.

10.2 Fuel Systems

- 10.2.1 Fuel piping should be accessible, protected from mechanical damage, be effectively secured against excessive movements and vibration, and so routed that it does not pass through passenger, cargo, or crew compartments. Flexible fuel pipes should have suitable connexions, be resistant to salt, water, oil and vibration, be visible, easily accessible and should not penetrate watertight bulkheads.
- 10.2.2 Fuel tank filling, vent and drain lines should be of adequate size and terminate in a manner that will not constitute a hazard.
- 10.2.3 Provision should be made for the management and control of the fuel system from a position readily accessible to the crew. Where gravity tanks are arranged, remote-controlled shut-off valves should be provided at the tank.

10.3 Hydraulic Systems

- 10.3.1 In addition to the requirements in 10.1.3, the additional pressure due to hydraulic shock and the rate of pressure rise caused by hydraulic shock should be considered in the design of hydraulic piping systems.

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- 10.3.2 The Administration should be satisfied with the hydraulic fluid used and the procedure for installation testing.

10.4 Pneumatic Systems

The Administration should be satisfied with the adequacy of any installed pneumatic system.

10.5 Lubrication Systems

Lubricating oil systems should be designed, installed and tested to the satisfaction of the Administration.

10.6 Bilge Pumping and Drainage Systems

- 10.6.1 Arrangements should be made for draining any watertight compartment other than the compartments intended for permanent storage of liquid. Where in relation to particular compartments drainage is not considered necessary, drainage arrangements may be omitted but it is to be demonstrated that the safety of the craft will not be impaired.
- 10.6.2 Bilge pumping arrangements should be provided to allow every watertight compartment other than those intended for permanent storage of liquid to be drained. The capacity or position of such compartments should be such that flooding thereof could not affect the safety of the craft.
- 10.6.3 The bilge pumping system should be capable of operation under all possible values of list and trim after sustaining the postulated damage in 2.4.4 and 2.4.5. The bilge pumping system should be so designed as to prevent water flowing from one compartment to another.
- 10.6.4 (a) At least two pumps should be available for bilge pumping of which at least one should be reserved solely for bilge pumping duties. Any other pump of suitable output available on board, except for an oil pump, may be used as the second bilge pump.
- (b) The pumps may be fixed or portable and they should be power driven unless the output of each pump is less than 1.5 tonnes per hour.
- (c) The output of each pump should in general meet the following formula :

$$Q = 3.75 \left(1 + \frac{L}{36} \right)^2$$

where Q = output in tonnes per hour and
L = length of the craft in metres

Provided that if, in the case of a particular type of craft, the Administration is satisfied that having regard to :

- (i) previous service experience with similar craft ;
- (ii) the conditions of service ; and
- (iii) the constructional features of the craft

a lesser bilge pump output can be permitted, the output of each bilge pump may be reduced, but in no case to less than :

$$Q = 0.05 LW$$

where Q = output in tonnes per hour with a minimum of 1 tonne per hour .

LW = light weight of the craft in tonnes.

- 10.6.5 Internal diameters of suction branches should not be less than 25 millimetres. Suction branches should be fitted with effective strainers.
- 10.6.6 Spaces situated above the water level in the worst anticipated damage conditions may be drained directly overboard through scuppers fitted with non-return valves.
- 10.6.7 Any space for which bilge pumping arrangements are required should be provided with a method of establishing the presence of water in that space. In unattended machinery spaces this should be by means of a bilge alarm.

10.7 Ballast Systems

- 10.7.1 Ballast pumping and piping systems, when necessary, should be to the satisfaction of the Administration.
- 10.7.2 Where a fuel transfer system is used for ballast purposes, the system should be isolated from any water ballast system and meet the requirements for fuel systems.

10.8 Cooling Systems

The cooling arrangements provided should be adequate to maintain all lubricating and hydraulic fluid temperatures within manufacturers' recommended limits during all operations for which the craft is to be certificated.

10.9 Engine Air Intake Systems

Arrangements should provide sufficient air to the engine and should give adequate protection against damage as distinct from deterioration, due to ingress of foreign matter.

10.10 Ventilation Systems

The ventilation arrangements should be adequate to ensure that the safe operation of the craft is not put at hazard. Where appropriate, arrangements should ensure that enclosed engine compartments are forcibly ventilated to atmosphere before the engine can be started.

10.11 Exhaust Systems

All engine exhaust systems should be adequate to assure the correct functioning of the machinery and that safe operation of the craft is not hazarded. Exhaust systems should be so arranged as to minimize the intake of exhaust gases into manned spaces, air conditioning systems, and engine intakes. Exhaust systems should not in general discharge into lift system intakes. Exhaust discharging through the hull in the vicinity of the waterline should be fitted with shut-off valves on the shell unless alternative arrangements have been made to ensure that the risk of flooding of the space is minimized.

CHAPTER 11 – REMOTE CONTROL AND WARNING SYSTEMS

11.1 Remote Control

- 11.1.1 All control and manoeuvring functions of the craft should be exercised from the craft's control position.
- 11.1.2 An emergency device should be provided independent of the main remote control systems to ensure that, in the event of any one control system failure, it should be possible to remove the propulsive thrust and bring the craft safely into the displacement mode.
- 11.1.3 If provision is made for a machinery control station outside the craft's control position, means of communication should be provided between these positions ; transfer of control from one station to another should be effected only from the craft's control position.

11.2 Warning System

A warning system should be provided to indicate a malfunction which requires immediate attention and which should meet the following conditions :

- (a) It should actuate a visual warning signal which can be switched off at the craft's control position. Where the visual warning will not be immediately evident to the operating crew member, a sound warning should be provided in addition. There should be individual light signals at an appropriate control station to indicate which warning signal is in action.
- (b) It should be designed so as to be protected against breakdown : in general for this purpose, any fault in the alarm circuit should either activate the system or some appropriate signal. An appropriate test facility should be incorporated.
- (c) It should have a permanent power supply and should be fitted with a change-over switch so that it can be connected to an alternative source of power in case the normal source of power should fail. An alarm signal should be operated if the normal source of power for the warning system breaks down.
- (d) The fire detection system should be fitted with an automatic device and when the system comes into action should activate, at the craft's control position, a visual alarm signal which is different from all other devices. The fire detection system of the machinery installations should be automatically fed by an emergency source of power in case the main source of power should fail.

11.3 Safety System

- 11.3.1 The safety system should automatically stop that part of the monitored installation which is in danger in cases of serious malfunction of the machinery or its auxiliaries. Propulsion and lift should only be stopped in cases where there is a risk of complete breakdown or explosion. The Administration may permit provision to be made to override the safety system provided it is sealed so as to prevent inadvertent operation.
- 11.3.2 The safety system should be designed so as to be protected against breakdown. For this purpose, any fault in the safety circuit should not result in untimely stoppage of the installation it protects.

CHAPTER 12 – ELECTRICAL EQUIPMENT

12.1 General*

The electrical system should be designed and installed to the requirements of the Administration so that :

- (a) the probability of the craft being hazarded by failure of a service is extremely remote (see Note), taking into account :
 - (i) operation without fault ;
 - (ii) the occurrence of single failure ; and
 - (iii) the occurrence of conditions which could be imposed on it as a result of a single failure in another system in the craft ;
- (b) the safety of occupants (e.g. from electric shock) and of the craft (e.g. from fire) is assured.

12.2 Main Source of Electrical Power

12.2.1 Every craft, the electrical power of which constitutes the only means of ensuring operation of auxiliary services, machinery and arrangements necessary for maintaining the craft in normal operational and habitable conditions, should be provided with at least two main sources of electrical power.

12.2.2 The main sources of electrical power may be either :

- (a) generators driven by independent prime movers ;
- (b) generators driven by main engines ; or
- (c) accumulator batteries.

The above-mentioned main sources of electrical power may be used in any combination.

The power sources should be designed so that :

- (d) Power sources function properly when independent and when connected in combination, if such combination is possible.
- (e) No failure or malfunction of any power source can create a hazard or impair the ability of remaining sources to supply all essential loads.
- (f) The system voltage and frequency, as applicable, at the terminals of all essential services can be maintained within the limits for which the equipment is designed, during any probable operating condition.

12.2.3 The arrangement and design of main sources of electrical power as provided for in 12.2.2 should be such as to ensure a supply of power for the services required in any operational mode of the craft.

* In the implementation and application of the provisions in respect of electrical installations Administrations are recommended to take note of the recommendations published by the International Electrotechnical Commission.

Note : Reference is made to Annex II.

- 12.2.4 The power of these sources should be such as to ensure, when operating simultaneously, the maintenance of all operational modes of the craft and the maintenance of habitable conditions.
- 12.2.5 In the event of failure of any one of the sources, the remaining ones should be capable of feeding all those services that are, in the opinion of the Administration, necessary for propulsion, steering, draining and fire-fighting, essential internal communications and signalling and safe navigation of the craft, including starting the main propelling engines from a dead ship condition.
- 12.2.6 Where only accumulator batteries are used as main sources of power or in case of any combination thereof with generators, the capacity of each such accumulator battery should be sufficient to supply all services listed in 12.2.5 for a period to be specified by the Administration and having regard to the craft's area of navigation.
- 12.2.7 Where accumulator batteries are used as main sources of electrical power, suitable charging facilities should be on board for charging one accumulator battery in less than 8 hours. This should be by means of a charging generator driven by either the main engine or an independent prime mover. For a craft engaged on particularly short voyages, the Administration may not require the charging facilities to be provided if the rated power of the accumulators provides a reasonable margin above the requirements between charging periods.
- 12.2.8 Where accumulator batteries other than those specified in 12.2.6 including the accumulator batteries mentioned in 12.3.6 are installed on board the craft to supply essential services, provision should be made for a charging facility to alternately charge all the batteries from the main generators.
- 12.2.9 The charging facility should be so designed as to permit the supply of services from the accumulator battery irrespective of whether the latter is on charge or not.

12.3 Emergency Source of Electrical Power

- 12.3.1 In any craft there should be a self-contained emergency source of electrical power located above the waterline in the final condition of damage as referred to in Chapter 2. Automatic starting and switching devices should ensure an emergency power supply as quickly as is practicable and in any case within 20 seconds.
- 12.3.2 The location of the emergency source of power should be such as to ensure, to the satisfaction of the Administration, that a fire, or other serious failure in the space containing the main source of electrical power or in the propelling machinery space will not interfere with the supply or distribution of emergency power.
- 12.3.3 Provided that suitable measures are taken for safeguarding independent circuits under all circumstances, the emergency source of power may, in special cases, be used for short periods, to supply non-emergency circuits.
- 12.3.4 The emergency source of power should be capable of supplying simultaneously the following services :
 - (a) for a period of 2 hours, emergency lighting :
 - (i) at the stowage positions of life-saving appliances ;
 - (ii) at all escape routes, such as alleyways, stairways, exits from accommodation and service spaces, embarkation points, etc. ;
 - (iii) in the passenger compartments ;

- (iv) in the machinery spaces and main emergency generating spaces including their control positions ;
 - (v) in control stations ;
 - (vi) at the stowage positions for fireman's outfits ; and
 - (vii) at the steering gear ;
 - (b) for a period of 2 hours :
 - (i) main navigation lights, except for "not under command" lights ;
 - (ii) electrical internal communication equipment for announcements for passengers and crew required during evacuation ;
 - (iii) fire detection and general alarm system and manual fire alarms ; and
 - (iv) remote control devices of fire extinguishing systems, if electrical ;
 - (c) for a period of 4 hours of intermittent operation :
 - (i) the daylight signalling lamps, if they have no independent supply from their own accumulator battery ; and
 - (ii) the craft's whistle, if electrically driven ;
 - (d) for a period of 4 hours :
 - (i) craft radio facilities required by the Administration to be available in an emergency unless they are supplied by an independent battery (see 13.3.2) ; and
 - (ii) essential electrically powered instruments and controls for propulsion machinery, if alternate sources of power are not available for such devices ; and
 - (e) for a period of 12 hours : the "not under command" lights.
- 12.3.5 The emergency lighting system should be such that a fire or other occurrence in the spaces containing the emergency source of electrical power will not render the main lighting system inoperative.
- 12.3.6 The emergency source of electrical power should either be an accumulator battery or a generator driven by a suitable independent prime mover with supply of fuel from a separate tank (see 7.1.1 (b) for flashpoint limit).
- 12.3.7 The accumulator battery should be capable of carrying the emergency load without recharging whilst maintaining the voltage throughout the discharge period within ± 12 per cent of its nominal voltage.
- 12.3.8 The emergency switchboard should be installed as near as is practicable to the emergency source of power and should be located in accordance with the requirements of 12.3.1 and 12.3.2. Where the emergency source of power is a generator, the emergency switchboard should generally be located in the same space.

12.3.9 Where the main and emergency sources are of the same voltage and frequency, the emergency switchboard should be supplied :

- (a) in normal operation from the main switchboard by an interconnector feeder which is to be adequately protected at the main switchboard against overload and short circuits ; and
- (b) automatically from the emergency source of power in the event of failure of the normal supply from the main switchboard.

Where the system is arranged for feed-back operation, the interconnector feeder is also to be protected at the emergency switchboard at least against short circuit.

12.3.10 An indicator should be mounted in the craft's control position to indicate when the emergency accumulator battery is being discharged, or when any emergency engine-driven generator is in operation.

12.3.11 Arrangements should be made so that the emergency system including the emergency source of power will function satisfactorily, when the craft has a list or trim up to the maximum angle anticipated, including any postulated damage cases considered in Chapter 2.

12.3.12 Provision should be made for the periodic testing of the complete emergency system, including the testing of automatic arrangements.

12.4 Permissible Voltages and Distribution of Electrical Power

12.4.1 The electrical distribution voltages throughout the craft may be either direct current or alternating current and should not exceed :

- (a) 500 volt for power, cooking, heating, and other permanently connected equipment ; and
- (b) 250 volt for lighting, internal communications and receptacle outlets.

The Administration may accept higher voltages for propulsion purposes.

12.4.2 For electrical power distribution, two-wire or three-wire insulated systems should be used.

12.4.3 In general, hull return distribution systems should not be used ; however, for distribution systems with voltages under 55 volt, hull return systems may be adopted where appropriate precautions are taken for earthing ; these should include :

- (a) consideration of galvanic corrosion under normal operation ; and
- (b) consideration of the ability of the earthing points to accept fault currents without danger to the hull or from fire risk.

Such a system is permitted to be used only up to the section or distribution boards. The final sub-circuits should in all cases have an insulated return to the earthing points.

12.4.4 The hull return system may be used for starters of main or auxiliary engines.

12.4.5 When a distribution system for power, heating or lighting, with no connexion to earth (hull) is used, a device to monitor insulation resistance should be provided.

12.5 Cables and Protective Devices

- 12.5.1 All electric cables should be at least of a flame-retardant type and should be installed so as not to impair their original flame retarding properties.
- 12.5.2 Cables supplying the services listed in 12.3.4 should not pass through high fire risk areas such as machinery spaces and their casings, etc. except for those supplying any such services installed in these spaces. Such cables should not, so far as practicable, be run on bulkheads or deck where a fire in an adjacent space would render the cables unserviceable.
- 12.5.3 Except as permitted by the Administration in exceptional circumstances, all metal sheaths and armour of cables should be electrically continuous and should be earthed (grounded).
- 12.5.4 All cables should be efficiently supported in such a manner as to avoid chafing or other injury.
- 12.5.5 Terminations of and joints in cables should be made in junction boxes. The Administration may accept other arrangements provided that they retain the original mechanical, fire retarding and electrical properties of the cable.
- 12.5.6 Where cables are installed in fire- or explosion-hazardous areas, special precautions should be taken to the satisfaction of the Administration to preclude the possibility of fire or explosion due to faults of cables.
- 12.5.7 Distribution systems should be so arranged that the feeders from the main and emergency sources, passing through a fire hazard area, are separated both vertically and horizontally as widely as is practicable.
- 12.5.8 Cross-sectional areas of cables and wires should be chosen according to permissible electrical loads and rated operating temperatures taking into account the ambient temperatures which may be experienced in the proposed areas of operation. The choice of the cross-sectional areas of low-loaded wires should also take into account the necessary mechanical strength where materials other than copper are used for conductors. The Administration should be satisfied as to their suitability having regard to the marine environment.
- 12.5.9 All essential services should be supplied by separate and individually protected circuits.
- 12.5.10 All circuits should be protected against short circuit and overload except as referred to in 12.6.1. So far as is practicable, the circuit protective devices should be co-ordinated so that only the circuit affected by the overload or short circuit will be removed from service.

12.6 Steering and Stabilization

- 12.6.1 Where steering and/or stabilization of a craft is essentially dependent on one device as with a single rudder or pylon, which is itself dependent on the continuous availability of electric power, it should be served by at least two independent circuits fed from the main switchboard, one of which may be fed through the emergency switchboard. These circuits should be provided with short circuit protection and an overload alarm.

- 12.6.2 Protection against excess current may be provided, in which case it should be for not less than twice the full load current of the motor or circuit so protected, and should be arranged to accept the appropriate starting current with a reasonable margin. Where three-phase supply is used an alarm should be provided in a readily observed position in the control station that will indicate failure of any one of the phases.
- 12.6.3 Where such systems are not essentially dependent on the continuous availability of electric power but at least one alternative system, not dependent on the electric supply, is installed, then the electrically powered or controlled system may be fed by a single circuit protected as above.
- 12.6.4 The requirements of Chapters 5 and 15 for power supply of the directional control system and stabilizing system of the craft should be met.

12.7 Main and Emergency Lighting

- 12.7.1 A main electric lighting system which should provide illumination throughout those spaces and parts of the craft normally accessible to and used by passengers or crew should be supplied from the main source of power.
- 12.7.2 Arrangement of the main lighting system should be such that a fire or other occurrences in the space containing the main source of power will not render the emergency lighting system inoperative.
- 12.7.3 The intensity of the main lighting system should be adequate to provide :
- (a) the control of all essential machinery and arrangements ;
 - (b) legibility of all identification inscriptions ;
 - (c) reading of all indicating and recording instruments ; and
 - (d) clear visibility inside all spaces used by passengers and crew.
- 12.7.4 Emergency lighting should come into operation automatically in the event of failure of the main supply and should be adequate to facilitate the evacuation of the passengers and crew. The Administration should take account of the fact that escape routes may have reduced visibility due to smoke, steam, etc.

12.8 Installation of Electrical Equipment

- 12.8.1 All electrical equipment should be so designed, constructed and installed that it is suitable for any voltage which may be supplied to it and does not constitute any danger or cause injury to personnel under normal operation conditions.
- 12.8.2 Effective means should be provided so that power may be shut from each and every circuit and sub-circuit as may be necessary to prevent danger.
- 12.8.3 Electrical equipment should be so designed that the possibility of accidentally touching live parts, rotating or moving parts as well as heated surfaces which might cause burns or initiate fire is minimized.
- 12.8.4 Electrical equipment should be adequately secured. The probability of fire or dangerous consequences arising from damage to electrical equipment should be reduced to an acceptable minimum.

12.8.5 All exposed metal parts of electrical equipment which are not intended to be "live", but which are liable under fault conditions to become "live" should be earthed (grounded) unless :

- (a) the equipment is supplied at a voltage not exceeding 55 volt ; or
- (b) the equipment is constructed in accordance with the principle of double insulation.

The Administration may require the earthing of electrical equipment specified in sub-paragraphs (a) and (b) above as well as portable equipment, if it is installed or intended for use in exceptionally damp spaces.

12.8.6 Main and emergency switchboards should be so designed and installed as to give easy access to apparatus and equipment arranged inside the switchboards. The sides, backs and fronts of switchboards should be suitably guarded. Exposed live parts having voltages to earth (ground) exceeding 55 volt should not be installed on the front of such switchboards. There should be non-conducting mats or gratings at the switchboard fronts where necessary and practicable. Switchboards operating on voltages in excess of 55 volt should have a suitable notice warning persons working on the equipment of the hazard.

12.8.7 The rating or appropriate setting of the overload protective device for each circuit should be permanently indicated at the location of the protection device on the switchboard.

12.8.8 Lighting fittings should be so arranged as to prevent the wiring and other surrounding materials from becoming excessively hot.

12.8.9 In all spaces where flammable mixtures are liable to collect, no electrical equipment should be installed unless the Administration is satisfied that it is :

- (a) essential for operational purposes ;
- (b) appropriate to the space concerned ; and
- (c) appropriately certified for safe usage in the dusts, vapours or gases likely to be encountered in the process of operation.

12.8.10 Accumulator batteries should be suitably housed, and compartments used for their accommodation should be properly constructed and efficiently ventilated. Starting accumulator batteries of main and auxiliary engines may be arranged in machinery spaces in gas-tight boxes ventilated separately to the open air. Where the starting batteries are arranged according to 12.3.1 and 12.3.2 and have additional capacity satisfying the requirements of 12.3.4 and 12.3.5, the Administration may in special cases permit that these starting batteries be used as emergency power source required by 12.3.1. In these special cases arrangements shall be such that under normal operations the batteries cannot be discharged to a point where the load and time period requirements specified in 12.3 cannot be assured.

12.8.11 Electrical and other equipment which may constitute a source of ignition of flammable vapours should not be permitted in the accumulator battery spaces.

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CHAPTER 13 – RADIOCOMMUNICATIONS AND NAVIGATIONAL EQUIPMENT

13.1 Radiocommunication – General

13.1.1 The scope and technical characteristics of the radio installation should be such as to maintain reliable radiocommunication with coast radio stations or base port radio stations and other craft, bearing in mind the need to integrate into the existing radio facilities.

13.1.2 For the purposes of this chapter “radio regulations” means the Radio Regulations annexed to, or regarded as being annexed to, the most recent International Telecommunication Convention in force.

13.2 Radio Installation

13.2.1 All equipment forming part of the radio installation should be reliable and should be so installed that it is readily accessible for maintenance purposes.

13.2.2 Due regard should be given to the possibility of radio interference from electrical and other apparatus on board.

13.2.3 Controls, switches and indicators should be so positioned that they can be operated and viewed without causing undue strain or fatigue, without the operator moving from his normal control position and without interference with other crew members.

13.2.4 Under normal operational conditions, the power supply of the radio installation should be from the main sources of electrical power.

13.2.5 Craft operating in areas adequately covered by Medium Frequency (MF) radiotelephone coast radio stations or base port radio stations should be fitted with a radiotelephone installation. Such an installation should include a transmitter, a receiver, a suitable aerial and all necessary devices for transmitting and receiving on frequencies in the bands between 1605 and 2850 kHz and on the distress frequency of 2182 kHz, using the classes of emission prescribed by the Radio Regulations. The transmitter should have a minimum normal range of 75 nautical miles.

13.2.6 Craft operating in areas not adequately covered by radiotelephone coast stations or in areas where propagational or static interference are known to be severe, should be fitted with a radiotelegraph installation. The radiotelegraph installation should include a transmitter, a receiver, a suitable aerial and all necessary devices for transmitting and receiving messages on the frequencies of 405–535 kHz and of the distress frequency of 500 kHz and using the emissions prescribed by the Radio Regulations. The transmitter should have a minimum normal range of 75 nautical miles.

13.2.7 Where the area of operation and intended service of the craft are considered suitable, the Administration may allow the carriage of VHF equipment in lieu of radiotelephony or radiotelegraphy equipment specified in 13.2.5 and 13.2.6. In such cases, the craft's base port should also be so equipped and the capability for two-way communication between the craft and base port should be maintained at all points on the craft's route. This equipment should be fitted with the distress, safety and calling frequency 156.8 MHz and appropriate working frequencies. The transmitter should have an RF carrier output power of at least 10 Watts and sufficient aerial height.

13.2.8 The technical characteristics of the radio installation should correspond with the relevant requirements of this chapter whilst in other respects the installation should generally comply with Part “C”, Chapter IV of the Safety Convention and the Radio Regulations. The Administration may indicate whether any items therein are inappropriate to dynamically supported craft.

13.3 Emergency Equipment

- 13.3.1 The radio equipment required by this chapter should have an emergency source of power capable of operating the equipment for a minimum of 4 hours.
- 13.3.2 Such source of power should be capable of being made independent of the craft's main electrical system and should be capable of being put into operation rapidly. Attention is drawn to 2.4.2(b).
- 13.3.3 If such a system consists of accumulator batteries they should be capable of being charged from the craft's electrical system and normally should be kept fully charged. A means should be provided for indicating the charge condition.
- 13.3.4 A light capable of giving sufficient illumination to enable the radio equipment to be operated should also operate from the emergency source of power.
- 13.3.5 Adequate information should be provided to enable the reserve power supply to be conserved so that the time required by the Administration for operation under 13.3.1 is met.

13.4 Navigation – General

Only those instruments are considered here which relate to the navigation of the craft as opposed to the safe functioning of the craft and the following represents the minimum required for normal safe navigation unless it is demonstrated to the Administration that an equivalent level of safety is achieved by other means.

13.5 Compasses

- 13.5.1 One compass suitable for the craft and the intended area of service should be provided together with such repeaters as may be necessary.
- 13.5.2 Where such a compass is operated by mechanical and electrical means, a suitable stand-by direct reading magnetic compass should be provided.
- 13.5.3 The compass card or repeater should be capable of being easily read from the position at which the craft is normally controlled.
- 13.5.4 A table of deviations should be provided for each magnetic compass and this should be checked annually, or whenever structural alterations or events have occurred which may cause large deviations.
- 13.5.5 Care should be taken in siting the compass or sensing element so that magnetic interference is eliminated or minimized as much as is practicable.
- 13.5.6 Where intermittent operation of other instruments affects the compass, notice of the crew should be drawn to the magnitude and sense of the deviations so caused.

13.6 A Means for Measuring Speed

A means for establishing speed over the water with sufficient accuracy should be provided. Such a means should preferably be capable of giving speed along track.

13.7 Depth Sounder

On non-amphibious craft a sounding device should be provided giving an indication of depth of water to a sufficient degree of accuracy for use when the craft is in the displacement mode.

13.8 Radar

- 13.8.1 At least one radar set should be provided in each craft unless the Administration determines otherwise.
- 13.8.2 The set should be mounted so as to be as free from vibration as practicable.
- 13.8.3 Any radar set provided in compliance with this section should be acceptable to the Administration.
- 13.8.4 Adequate communication facilities should be provided between the radar operator and the person in immediate charge of the craft.
- 13.8.5 The radar set provided should be suitable for the intended craft speed.
- 13.8.6 The range scales provided should be suitable for the intended operational service of the craft.
- 13.8.7 Any crew member required to operate a radar set should be suitably qualified to appropriate national requirements.

13.9 Other Navigational Aids

Whenever navigational systems are employed, the information should be so displayed that the probability of mis-reading is reduced to a minimum and should be capable of giving readings to an accuracy deemed suitable by the Administration.

13.10 Display and Illumination

- 13.10.1 Navigational instruments should be so placed in a craft, and of such a design, that information from them is easily and readily available to the navigator or, where no navigator is carried, to the person in immediate charge of the craft without movement from the control station.
- 13.10.2 Suitable illumination should be provided to permit reading of navigational instruments.

13.11 Masts

- 13.11.1 Masts provided for the display of navigation lights and the deployment of antennae should be constructed so as to withstand loads associated with the critical design conditions.
- 13.11.2 At least one mast should be equipped with a hoist capable of displaying distress signals, shapes and signal flags, and such hoist should be safely and readily accessible to crew members.

CHAPTER 14 – OPERATING COMPARTMENT LAYOUT

14.1 General

The design and layout of the compartments from which the crew operate the craft should be such as to permit operating crew members to perform the duties for which they are responsible in a correct manner without unreasonable difficulty, fatigue or concentration, and minimize the likelihood of injury to operating crew members in both normal and emergency conditions.

14.2 View from Control Position

- 14.2.1 The Administration should be satisfied that the view from the control position is adequate for the safe operation of the craft in all operating conditions.
- 14.2.2 On craft with an enclosed operating compartment, it should be demonstrated to the satisfaction of the Administration that an adequate portion of the windscreen and windows serving the operating station can be maintained in a clear condition during operation in conditions of spray or precipitation. The cleared portion of the windscreen and windows should be adequate for the field of vision necessary for normal operations, approach to and coming to rest at all operating speeds. On craft intended for operation in icing conditions, this requirement should be met in icing conditions up to the severity in which the craft as a whole has been shown to be satisfactory.
- 14.2.3 The means provided for maintaining the windscreen and windows in a clear condition should be so arranged that no reasonably probable single failure can result in a reduction of the cleared field of vision such as to interfere seriously with the ability of the operating crew to continue the operation and bring the craft to rest.

14.3 Operating Compartment

- 14.3.1 The design and arrangement of the compartment from which the crew operate the craft, and the relative positions of the primary and emergency controls and the seats should be such that each operating crew member, with his seat and any adjustable controls suitably adjusted, and without prejudicing compliance with 14.2.1 can :
 - (a) without interference, produce full and unrestricted movement of each control which he is responsible for operating, both separately and with all practical combinations of movement of other controls ; and
 - (b) at all control positions exert adequate control forces for the operation to be performed.
- 14.3.2 When a seat at a station from which the craft may be driven has been adjusted so as to suit the occupant, subsequent change of seat position to operate any controls needed for driving should not be acceptable.
- 14.3.3 In craft where the Administration considers the provision of a safety belt is necessary for use by the operating crew, it should be possible for those operating crew members, with their safety belts correctly worn, to comply with 14.3.1, except in respect of controls which it can be shown will only be required on very rare occasions dissociated from the need for safety restraint.

14.4 Instruments

- 14.4.1 Instruments required for use by any member of the operating crew should be plainly visible and easily read :
- (a) with the minimum practicable deviation from his normal seating position and line of vision ; and
 - (b) with the minimum risk of confusion under all likely operating conditions.
- 14.4.2 Instruments essential for the safe operation of the craft should be clearly marked with any limitation if this information is not otherwise clearly presented to the operating crew.

14.5 Lighting

- 14.5.1 Operating crew compartment lighting should be arranged to ensure :
- (a) a general intensity of illumination under normal conditions which allows the efficient performance of duties ;
 - (b) that only a limited reduction in the illumination of essential instruments and controls will occur under likely system fault conditions ; and
 - (c) the absence of glittering and reflections on window glass of the operating compartment which could result in navigational errors.
- 14.5.2 The intensity and uniformity of illumination for all instruments, controls, indicators, switches and placards should allow for easy readability and should be such that there are no reflections or direct rays which could be objectionable to any member of the operating crew.
- 14.5.3 Reference is made to additional requirements on lighting in 12.7.

14.6 Windows

Windows in operating crew compartments, the breakage of which might injure the operating crew, should be made of material which will not break into dangerous fragments if fractured.

14.7 Communication Facilities

- 14.7.1 Such means as are necessary should be provided to enable the operating crew to communicate between and have access to each other and with other occupants of the craft in both normal and emergency conditions. Attention is drawn to 2.4.2(b).
- 14.7.2 Provision should be made for means of communication between the position from which the craft is navigated and spaces where essential machinery and arrangements are accommodated, irrespective of whether they are remotely or only locally controlled.

CHAPTER 15 – STABILIZATION SYSTEMS

15.1 Definitions

- 15.1.1 Stabilization system is a system intended to stabilize the main parameters of the craft's attitude : heel, trim, course and height and minimize the craft's motion : roll, pitch, yaw and heave.
- 15.1.2 Self-stabilization of the craft is stabilization ensured solely by the craft's inherent characteristics.
- 15.1.3 Forced stabilization of the craft is stabilization achieved by :
 - (a) an automatic system ; or
 - (b) a manually assisted system ; or
 - (c) a combined system incorporating elements of both automatic and manually assisted stabilization systems.
- 15.1.4 Augmented stabilization is a combination of self-stabilization and forced stabilization.
- 15.1.5 The main elements of a stabilization system are as follows :
 - (a) stabilization devices such as rudders, foils, flaps, skirts and jets ;
 - (b) power drives actuating stabilization devices ; and
 - (c) stabilization equipment for accumulating and processing data for making decisions and giving commands such as sensors, logic processors and automatic safety control.
- 15.1.6 An automatic safety control is a logic unit for processing data and making decisions to put the craft into the displacement or other safe mode if a condition impairing safety arises.
- 15.1.7 For the purposes of this chapter "stabilization device" means devices with the aid of which forces for controlling the craft's position are generated (rudders, foils, flaps, fans, skirts, water jets, pumps, etc.).

15.2 General Requirements

- 15.2.1 Stabilization systems should be so designed that in case of failure or malfunctioning of any one of the stabilization devices, or equipment, it would be possible either to ensure maintaining the main parameters of craft's motion within safe limits with the aid of working stabilization devices or to put the craft into the displacement or other safe mode.
- 15.2.2 The Administration should be satisfied that in case of failure of any automatic equipment or stabilization device, or its power drive the parameters of craft motion will remain within safe limits.
- 15.2.3 Craft fitted with an automatic stabilization system should be provided with an automatic safety control unless the Administration is satisfied that the redundancy in the system provides equivalent safety. Where an automatic safety control is fitted, provision should be made to override it and to cancel the override from the main control position.

- 15.2.4 The Administration should be satisfied with the parameters and the levels at which any automatic safety control should give the command to decrease speed and put the craft safely into the displacement or other safe mode. In considering these parameters, the Administration should have regard to the safe values of heel, trim, yaw and combination of trim and draught appropriate to the particular craft and service ; also to the possible consequences of power failure for propulsion, lift or stabilization devices.
- 15.2.5 The parameters and the degree of stabilization of the craft provided by the automatic stabilization system should be agreed by the Administration having regard to the purpose and service conditions of the craft.
- 15.2.6 The requirements for control systems and warning devices are set out in Chapter 11 and Chapter 14, Section 3.

CHAPTER 16 – HANDLING, CONTROLLABILITY AND PERFORMANCE

16.1 Scheduling

The information on controllability and manoeuvrability which should be contained in the Operating Manual specified in 1.8 should include the characteristics under 16.5 and the list of parameters of the worst intended conditions affecting the controllability and manoeuvrability according to 16.6.

16.2 Proof of Compliance

Compliance with the handling, controllability and performance requirements should normally be established by an adequate series of tests which should include full-scale testing as appropriate to the craft concerned and acceptable to the Administration.

16.3 Weight and Centre of Gravity

Compliance with each of the handling, controllability and performance requirements should be established for all relevant combinations of weight and centre of gravity position in the range of weights up to the maximum permissible weight.

16.4 Effect of Failures

The effect of any likely failure in handling and control devices, services or components (e.g. power operation, power assistance, trimming and stability augmentation) should be assessed in order that a safe level of craft operation can be maintained to the satisfaction of the Administration.

16.5 Controllability and Manoeuvrability

- 16.5.1 It is necessary to ensure that the effort required to operate the controls in the worst intended conditions is not such that the person at the control will be unduly fatigued or distracted by the effort necessary to maintain the safe operation of the craft.
- 16.5.2 The craft should be controllable and be capable of performing those manoeuvres essential to its safe operation up to the critical design conditions.
- 16.5.3 When determining the safety of a craft in respect of handling, controllability and performance, the Administration should pay particular attention to the following aspects during normal operation and during and subsequent to failures :
 - (a) Yawing.
 - (b) Turning.
 - (c) Stopping in normal and emergency conditions.
 - (d) Stability in the non-displacement mode about three axes.
 - (e) Trim.
 - (f) Plough in.
 - (g) Lift power limitations.

The terms in (b), (f) and (g) above are defined as follows :

- (b) "Turning" is the rate of change of direction of a craft at its normal maximum operating speed in specified wind and sea conditions.
- (f) "Plough in" is an involuntary motion involving sustained increase in drag of an air-cushion vehicle at speed, usually associated with partial collapse of the cushion system.
- (g) "Lift power limitations" are those limitations imposed upon the machinery and components which provide the lift.

16.6 Change of Operating Surface and Mode

There should be no unsafe change in the stability, controllability or attitude of the craft during transition from one type of operating surface or mode to another. Information on change in the behaviour characteristics of the craft during transition should be available to the master.

16.7 Surface Irregularities

Factors which limit the ability of the craft to operate over sloping ground and steps or discontinuities should be determined, as applicable, and made available to the master.

16.8 Acceleration and Deceleration

The Administration should be satisfied that the worst likely acceleration or deceleration of the craft, due to any likely failure, emergency stopping procedures, or other likely causes, would not hazard the persons on the craft.

16.9 Speeds

Safe maximum speeds should be determined, taking account of modes of operation, wind force and direction and the effects of possible failures of any one lift or propulsion system over calm water, rough water and over other surfaces as appropriate to the craft.

16.10 Minimum Depth of Water

The minimum depth of water and other appropriate information required for operations in all modes should be determined.

16.11 Hard Structure Clearance

For amphibious craft, when cushion borne, clearance of the lowest point of the hard structure above a hard flat surface should be determined.

CHAPTER 17 – OPERATIONAL REQUIREMENTS

17.1 General

- 17.1.1 The Dynamically Supported Craft Construction and Equipment Certificate, the Dynamically Supported Craft Permit to Operate, or certified copies thereof, a copy of the operating section of the Technical Manual, and a copy of such elements of the Maintenance Manual as the Administration may require, should be carried on board.
- 17.1.2 The craft should not be intentionally operated outside the worst intended conditions and limitations specified in the Dynamically Supported Craft Permit to Operate, in the Dynamically Supported Craft Construction and Equipment Certificate, or in documents referred to therein.
- 17.1.3 A commercial service should not be commenced unless there is in force a Dynamically Supported Craft Permit to Operate issued by the Administration.
- 17.1.4 The Administration should issue a Dynamically Supported Craft Permit to Operate when it is satisfied that the operator has made adequate provision from the point of view of safety generally, including the following matters specifically, and should revoke the Permit if such provisions are not maintained to their satisfaction :
- (a) the suitability of the craft for the service intended having regard to the safety limitations and information contained in the Dynamically Supported Craft Construction and Equipment Certificate and documents provided with that Certificate ;
 - (b) the arrangements for obtaining weather information on the basis of which the commencement of a voyage may be authorized ;
 - (c) provision in the area of operation of a base port fitted with facilities in accordance with 1.4.1.1 ;
 - (d) the designation of responsibility for delaying or cancelling the commencement of a particular voyage, e.g. in the light of the weather information available ;
 - (e) crew complement required for operating the craft, the supervision of passengers and cargo ;
 - (f) crew qualifications and training, including competence in relation to the particular type of craft and service intended ;
 - (g) restrictions with regard to working hours and rest periods of the crew ;
 - (h) the maintenance of crew competence in regard to operation and emergency procedures ;
 - (i) safety arrangements at terminals and compliance with any existing safety arrangements as appropriate ;
 - (j) traffic control arrangements and compliance with any existing traffic control, as appropriate ;
 - (k) restrictions and/or provisions relating to position fixing, to operation by night or in bad visibility, including the use of radar and/or other electronic aids to navigation, as appropriate ;

- (l) additional equipment which may be required, due to the specific characteristics of the service intended specifically for night operation ; an approved searchlight controllable from the craft's control position should be installed to the satisfaction of the Administration ;
- (m) communications between craft, coast radio stations or base port radio stations, emergency services and other vessels, including radio sets to be carried, frequencies to be used and watch to be kept ;
- (n) the keeping of records which the Administration may at any time verify, should be required for :
 - (i) ensuring the craft is operated within the specified parameters ;
 - (ii) noting those items required for the safety of the craft and safety of life at sea ;
 - (iii) purposes of any law to which the craft is subject ;
- (o) arrangements to ensure that equipment is maintained in compliance with the Administration's requirements, and to ensure co-ordination of information as to the serviceability of the craft and equipment between the operating and maintenance elements of the operator's organization ;
- (p) the existence and use of adequate instructions regarding :
 - (i) loading of the craft so that weight and centre-of-gravity limitations can be effectively observed and cargo is, when necessary, adequately secured ;
 - (ii) the provision of adequate fuel reserves ;
 - (iii) action in the event of reasonably foreseeable emergencies.

17.1.5 The Administration should determine the maximum allowable distance from a base port or place of refuge after assessing the provisions made under 17.1.4.

17.2 Training and Qualifications

- 17.2.1 The level of competence and the training considered necessary in respect of the master and each crew member should be laid down and demonstrated in the light of the following guidelines to the satisfaction of the Administration in respect of the particular type of craft concerned.
- 17.2.2 The Administration should specify an appropriate period of operational training for the master and each member of the crew and if necessary the periods at which appropriate re-training should be carried out.
- 17.2.3 The Administration should, as necessary, issue a certificate after the appropriate period of training, an examination if considered necessary, and on conclusion of a practical test commensurate with the operating task on board the particular type of craft concerned and the route followed.
- 17.2.4 The Administration should consider the need to specify standards of physical fitness and frequency of medical examinations having regard to the route and craft concerned.

- 17.2.5 The Administration of the country in which the craft is to operate – if other than the Flag State – should be satisfied with the training, experience and qualifications of the master and each crew member. A current, valid licence or certificate issued to a master or crew member by a Flag State which is signatory to the Safety Convention should be acceptable as evidence of satisfactory training, experience and qualification to the Administration of the country in which the craft is to operate.

17.3 Listening Watch

- 17.3.1 Each craft which is fitted with a radiotelephone station should carry at least one radiotelephone operator and should, while at sea, maintain continuous listening watch on a radiotelephone distress frequency prescribed by the Administration in the place onboard from which the craft is usually operated using a loudspeaker or other appropriate means.
- 17.3.2 To the extent the Administration may require, each craft which is fitted with a radiotelegraph station should, while at sea, carry at least one radio officer, and if not fitted with a radiotelegraph auto alarm, should listen continuously on the radiotelegraph distress frequency.
- 17.3.3 Each craft which is only fitted with Very High Frequency (VHF) radiotelephone should, while at sea, carry at least one radiotelephone operator and should, while at sea, maintain continuous listening watch on a frequency prescribed by the Administration in the place onboard from which the craft is usually operated using a loudspeaker or other appropriate means.
- 17.3.4 Each craft should, while at sea, maintain listening watch during the silent periods prescribed by the Radio Regulations on the appropriate distress frequency.

17.4 Radio Log

A radio log maintained in accordance with Part D of Chapter IV of the Safety Convention in force and the Radio Regulations in force should be kept in those craft fitted with radiotelegraphy. Arrangements for log-keeping for craft fitted with radiotelephone should be to the satisfaction of the Administration.

17.5 Emergency Instruction and Drills

- 17.5.1 Emergency instructions including a general diagram of the craft showing the location of all exits, routes of evacuation, emergency equipment, life-saving equipment and appliances and illustration of life-jacket donning should be available to each passenger and placed near each passenger's seat.
- 17.5.2 Attention of passengers should be drawn to the provisions of the emergency instructions on boarding.
- 17.5.3 Emergency fire and evacuation drills for the crew should be held on board the craft at intervals not exceeding one week.

CHAPTER 18 – MAINTENANCE REQUIREMENTS

18.1 Organization Responsible for Operating the Craft

The Administration should be satisfied with the operator's organization or any organization on which he may call in the maintenance of his craft and should specify the scope of the duties which any part of the organization may carry out having regard to the number and competence of its staff, facilities available, arrangements for calling on specialist assistance should it be necessary, record-keeping, communications, and allocation of responsibilities.

18.2 Inspection and Maintenance

18.2.1 The craft and equipment should be maintained to the satisfaction of the Administration, in particular :

- (a) routine preventive maintenance should be performed to a schedule approved by the Administration, which should have regard at least in the first instance to the manufacturer's schedule ;
- (b) in the performance of maintenance tasks, due regard should be paid to maintenance manuals, service bulletins acceptable to the Administration and to any additional instructions of the Administration in this respect ;
- (c) all modifications should be recorded and their safety aspects investigated. Where it could have any effect on safety, the modification, together with its installation, should be to the satisfaction of the Administration ;
- (d) appropriate arrangements should be provided for informing the master of the serviceability state of his craft and equipment ;
- (e) the duties of the operating crew in respect of maintenance and repairs and the procedure for obtaining assistance with repairs when the craft is away from the base port should be clearly defined ;
- (f) the master should report to the maintenance organization any defects and repairs which are known to have occurred during operations ;
- (g) records of defects and their correction should be maintained and those defects of a recurrent nature, or those which adversely affect craft or personal safety, should be reported to the Administration.

18.2.2 The Administration should be satisfied that arrangements are provided for ensuring adequate inspection, maintenance and recording of all life-saving appliances and distress signals carried.

ANNEX I

Sample of the Dynamically Supported Craft Construction and Equipment Certificate.

DYNAMICALLY SUPPORTED CRAFT CONSTRUCTION AND EQUIPMENT CERTIFICATE

[Official Seal]

[Country]

Issued in compliance with the provisions of the
Code of Safety for Dynamically Supported Craft

Type of Dynamically
Supported Craft

Distinctive Identification
(Name or Number)

Date at which the craft's
keel was laid or the craft was at
a similar stage of construction

The
I, the undersigned

(Name) Government certifies
(Name) certify

- I. That the above-mentioned craft has been duly surveyed in accordance with the applicable provisions of the Code of Safety for Dynamically Supported Craft.
- II. That the survey showed that the craft complied with the relevant provisions of the Code as regards :
 1. the structure, main and auxiliary machinery and systems ;
 2. the buoyancy, stability and subdivision ;
 3. the handling, controllability and performance.
- III. That the life-saving appliances provide for a total number ofpersons and no more, as follows :
- IV. That the craft complied with the requirements of the Code as regards radio installation, as follows :
- V. That the craft complied with the requirements of the Code as regards fire prevention, fire-detecting and fire-extinguishing appliances and was provided with navigational instruments, navigation lights and shapes, means of making sound signals, and distress signals, in accordance with the provisions of the Code and also the Convention on the International Regulations for Preventing Collisions at Sea, in force.
- VI. That the maintenance schedule and the technical information for design, construction and equipment related to the safe operation of the craft is in accordance with the requirements of the Code.
- VII. That in all other respects the craft complied with the requirements of the Code so far as these requirements apply thereto.

This certificate is issued under the authority of theGovernment.

It will remain in force untilunless suspended or revoked.

Issued at the day of 19.....

Signed

The undersigned declares that he is duly authorized by the said Government to issue this certificate.

ANNEX II

USE OF PROBABILITY CONCEPT

1. General

- 1.1 Absolute safety cannot be achieved in any human activity. Naturally, this fact has to be taken into account in developing safety requirements, which means that requirements should not imply that safety is absolute. In the case of traditional craft, it has frequently been possible to specify certain aspects of design or construction in some detail, in a way which was consistent with some level of risk which had over the years been intuitively accepted without having to be defined.
- 1.2 For dynamically supported craft, however, it would often be too restrictive to include engineering specifications into the Code. Requirements therefore need to be written (where this question arises) in the sense of "... the Administration should be satisfied on the basis of tests, investigations and past experience that the probability of ... is (acceptably low)". Since different undesirable events may be regarded as having different general orders of acceptable probability (e.g. temporary impairment of propulsion as compared with an uncontrollable fire), it is convenient to agree on a series of standardized expressions which can be used to convey the relative acceptable probabilities of various incidents, i.e. to perform a qualitative ranking process. A vocabulary is given below which is intended to ensure consistency between various requirements, where it is necessary to describe the level of risk which must not be exceeded.

2. Terms Associated with Probabilities

Different undesirable events may have different orders of acceptable probability. In connexion with this, it is convenient to agree on standardized expressions to be used to convey the relatively acceptable probabilities of various occurrences, i.e. to perform a qualitative ranking process.

2.1 Occurrences

An occurrence is a condition involving a potential lowering of the level of safety.

- 2.1.1 **Failure** An occurrence in which a part, or parts, of the craft fail or malfunction, e.g. runaway. A failure includes:

- (a) a single failure;
- (b) independent failures in combination within a system; and
- (c) independent failures in combinations involving more than one system, taking into account:
 - (i) any undetected failure that is already present;
 - (ii) such further failures* as would be reasonably expected to follow the failure under consideration.

- 2.1.2 **Event** An occurrence which has its origin outside the craft (e.g. waves).

* In assessing the further failures which follow, account should be taken of any resulting more severe operating conditions for items that have not up to that time failed.

2.1.3 **Error** An occurrence arising as a result of incorrect action by the operating crew or maintenance personnel.

2.2 Probability of Occurrences

2.2.1 **Frequent** Likely to occur often during the operational life of a particular craft.

2.2.2 **Reasonably Probable** Unlikely to occur often but which may occur several times during the total operational life of a particular craft.

2.2.3 **Recurrent** A term embracing the total range of Frequent and Reasonably Probable.

2.2.4 **Remote** Unlikely to occur to every craft but may occur to a few craft of a type over the total operational life of a number of craft of the same type.

2.2.5 **Extremely Remote** Unlikely to occur when considering the total operational life of a number of craft of the type, but nevertheless has to be considered as being possible.

2.2.6 **Extremely Improbable** So Extremely Remote that it does not have to be considered as possible to occur.

2.3 Effects

An effect is a situation arising as a result of an occurrence.

2.3.1 **Minor Effect** An effect which may arise from a failure, an event, or an error (as defined in 2.1.1, 2.1.2, 2.1.3 of this Annex) which can be readily compensated for by the operating crew ; it may involve :

- (a) a small increase in the operational duties of the crew or in their difficulty in performing their duties ; or
- (b) a moderate degradation in handling characteristics ; or
- (c) slight modification of the permissible operating conditions.

2.3.2 **Major Effect** An effect which produces :

- (a) a significant increase in the operational duties of the crew or in their difficulty in performing their duties which by itself should not be outside the capability of a competent crew provided that another major effect does not occur at the same time ; or
- (b) significant degradation in handling characteristics ; or
- (c) significant modification of the permissible operating conditions, but will not remove the capability to complete a safe journey without demanding more than normal skill on the part of the operating crew.

2.3.3 **Hazardous Effect** An effect which produces :

- (a) a dangerous increase in the operational duties of the crew or in their difficulty in performing their duties of such magnitude that they cannot reasonably be expected to cope with them and will probably require outside assistance ; or

- (b) dangerous degradation of handling characteristics ; or
- (c) dangerous degradation of the strength of the craft ; or
- (d) marginal conditions for, or injury to, occupants ; or
- (e) an essential need for outside rescue operations.

2.3.4 **Catastrophic Effect** An effect which results in the loss of the craft and/or in fatalities.

2.4 Safety Level

A safety level is a numerical value characterizing the probability of avoiding a specified class of occurrence.

3. Numerical Values

Where numerical probabilities are used in assessing compliance with requirements using the terms similar to those given above, the following approximate values may be used as guidelines to assist in providing a common point of reference. The probabilities quoted should be on an hourly or per journey basis depending on which is more appropriate to the assessment in question :

Frequent	Greater than 10^{-3} to 10^{-4}
Reasonably Probable :	Less than frequent but more than 10^{-5}
Remote :	10^{-5} to 10^{-7}
Extremely Remote :	10^{-7} or less
Extremely Improbable :	Whilst no approximate numerical probability is given for this, the figures used should be substantially less than 10^{-7} .

Note : Different occurrences may have different acceptable probabilities according to the severity of their consequences.

ANNEX III

INTERPRETATION OF THE CONVENTION ON THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA, 1972, CONCERNING DYNAMICALLY SUPPORTED CRAFT

The following notes and observations regarding the carriage and positioning of lights and shapes and giving of sound signals as required by the Convention on the International Regulations for Preventing Collisions at Sea, 1972, as they would affect dynamically supported craft, may be of interest to Administrations.

1. The definition of "vessel" used in Rule 3 would appear to encompass these dynamically supported craft either in existence or envisaged in the foreseeable future.
2. Where difficulty would be experienced in complying completely with Rule 1 (e) Administrations have the right to decide upon the degree of exemption permitted.
3. The term "hearing" in Rule 5 may be impracticable for dynamically supported craft due to their own high self-generated noise level and/or enclosed operating positions. This also applies to Rule 19 (e). Because of this, Administrations should ensure that adequate compensatory features are present on the craft (e.g. clear view from operating position, carriage of radar, etc.).
4. Rule 23(b) requires an air-cushion vehicle to carry an all-round flashing light. As it is accepted that the carriage of this light should be reserved for craft capable of operating at high speed and whose aspect may not necessarily indicate its true direction of travel, it may be necessary at a future date to apply this section to other forms of dynamically supported craft (e.g. ram-wing craft). Due care should be exercised in the positioning of this light due to its possible cause of "stroboscopic" sickness to operating crews.
5. The permanent fixture of a bell, and possibly gong, required by Rule 33 is generally impracticable when applied to dynamically supported craft. Such devices should be portable and only fixed in position when required to be used.
6. When there is a high self-generated noise level of those dynamically supported craft propelled by airscrews, it should be possible to conduct practical tests to ascertain the audibility range. Where this is less than the figures given in Annex III, paragraph 1 (c) then the craft's whistle must be used under those circumstances stated in the Regulations.
7. The term "height above the hull" used in the definition of Annex I may be difficult to interpret for dynamically supported craft. In deciding what constitutes such height, the datum so chosen should be clearly indicated on any document issued by an Administration in respect of the navigation lights.
8. The height of the white masthead light related to beam as quoted in the Regulations is most probably based on normal ship length/beam ratios of the order of 5 to 8. Whereas with dynamically supported craft, especially air-cushion vehicles, the length/beam ratio may be in the range of 1.5 to 2.5. As a result of this, for ships, if the height of the white fore mast light is related to the beam of the vessel as required by paragraph 2 (a) (i) of Annex I and the side lights are placed at the maximum height allowed by paragraph 2 (g) of that same Annex, the base angle of the isosceles triangle formed by these lights when seen in end elevation will be approximately 27 degrees. Whilst not explicit in the Rules, it is assumed that this is the minimum angle desirable. For air-cushion vehicles, however, it would be possible for this base angle to be 14 degrees or less. Consequently, it is considered desirable that Administrations, by exercising the privilege granted by Rule 1 (e), allow relaxation for dynamically supported craft from the height/breadth relationship of the white masthead light given in paragraph 2 (a) (i) of Annex I, providing :

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- the height of the white masthead light gives the specified range ;
 - the base angle of the isosceles triangle formed by the white masthead light and side lights, when seen in end elevation, is not less than 27 degrees ;
 - other Rules concerning lights are complied with as appropriate.
9. On dynamically supported craft of 50 metres or more in length, the vertical separation between fore mast and main mast light of 4.5 metres required by paragraph 2(a) (ii) of Annex I may be unduly onerous. It is suggested that this figure may be modified by use of the following formula which takes into account paragraph 2(b) of Annex I :

$$y = \frac{(a + 17\psi)C}{1000} + 2$$

where y is the height of the main mast light above the fore mast light in metres ;

a is the height of the fore mast light above the water surface in service condition in metres ;

ψ is the trim in service condition in degrees ;

C is the horizontal separation of masthead lights in metres.

APPENDIX I

ICE ACCRETION APPLICABLE TO ALL TYPES OF CRAFT

1. Icing allowances

- 1.1 For craft operating in areas where ice accretion is likely to occur, the following icing allowance shall be made in the stability calculations :
- (a) 30 kilogrammes per square metre on exposed weather decks and gangways ;
 - (b) 7.5 kilogrammes per square metre for projected lateral area of each side of the craft above the water plane ;
 - (c) the projected lateral area of discontinuous surfaces of rail, sundry booms, spars (except masts) and rigging and the projected lateral area of other small objects shall be computed by increasing the total projected area of continuous surfaces by 5 per cent and the static moments of this area by 10 per cent.
- 1.2 For craft operating in areas where ice accretion may be expected :
- (a) Within the areas defined in paragraph 2(a), (c), (d) and (e) known to have icing conditions significantly different from those in paragraph 1.1, ice accretion requirements of one-half to twice the required allowance may be applied.
 - (b) Within the area defined in paragraph 2(b), where ice accretion in excess of twice the allowance required by paragraph 1.1 may be expected, more severe requirements than those given in that paragraph may be applied.
- 1.3 Information should be provided in respect of the assumptions made in calculating the condition of the craft in each of the circumstances set out in this Appendix for the following :
- (a) duration of the voyage in terms of the period spent in reaching the destination, and returning to port ;
 - (b) consumption rates during the voyage for fuel, water, stores and other consumables.

2. Areas of icing conditions

In the application of paragraph 1 the following icing areas should apply :

- (a) The area North of latitude 65°30'N, between longitude 28°W and the West coast of Iceland ; North of the North coast of Iceland ; North of the rhumb line running from latitude 66°N, longitude 15°W to latitude 73°30'N, longitude 15°E, North of latitude 73°30'N between longitude 15°E and 35°E, and East of longitude 35°E, as well as North of latitude 56°N in the Baltic Sea.
- (b) The area North of latitude 43°N bounded in the West by the North American coast and the East by the rhumb line running from latitude 43°N, longitude 48°W to latitude 63°N, longitude 28°W and thence along longitude 28°W.
- (c) All sea areas North of the North American Continent, West of the areas defined in sub-paragraphs (a) and (b) of this paragraph.
- (d) The Bering and Okhotsk Seas and the Tartary Strait during the icing season.
- (e) South of latitude 60°S.

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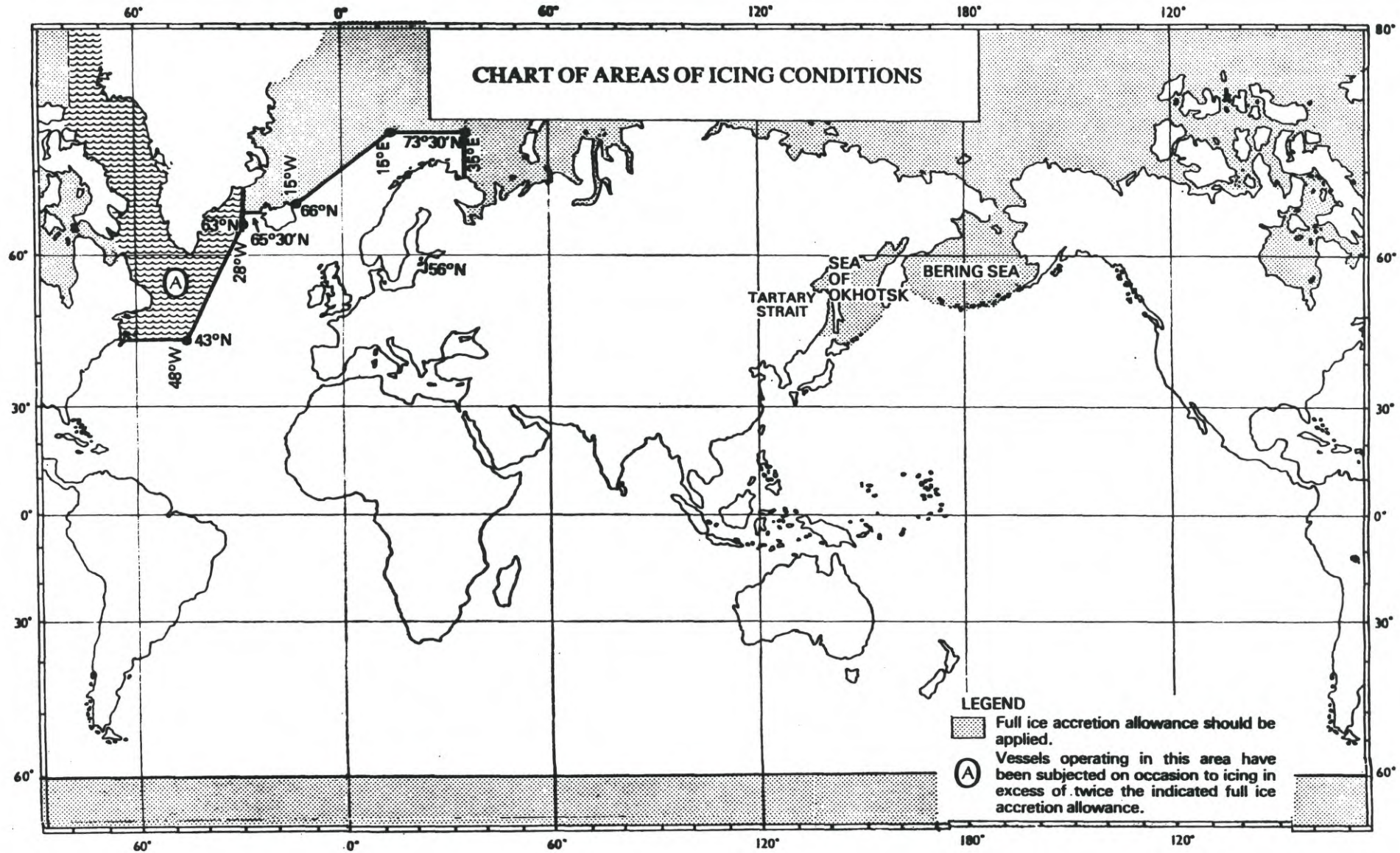
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A chart to illustrate the areas is attached.

3. Special requirements

Craft intended for operation in areas where ice accretion is known to occur shall be :

- (a) designed to minimize the accretion of ice ; and
- (b) equipped with such means for removing ice as the Administration may require.



APPENDIX II

METHODS RELATING TO THE INTACT STABILITY INVESTIGATION OF HYDROFOIL BOATS

The stability of these craft should be considered in the hull-borne, transient and foil-borne modes. The stability investigation should also take into account the effects of external forces. The following procedures are outlined for guidance in dealing with stability.

1. Surface piercing hydrofoils

1.1 *Hull-borne mode*

1.1.1 The stability should be sufficient to satisfy 2.3 and 2.4 of this Code.

1.1.2 *Heeling moment due to turning*

The heeling moment developed during manoeuvring of the craft in the displacement mode may be derived from the following formula :

$$M_R = 0.196 \frac{V_o^2}{L} \cdot \Delta \cdot \overline{KG} \text{ (Kilonewton-metres)}$$

where M_R = moment of heeling ;

V_o = speed of the craft in the turn (metres per second) ;

Δ = displacement (tonnes) ;

L = length of the craft on the waterline (metres) ;

\overline{KG} = height of the centre of gravity above keel (metres).

This formula is applicable when the ratio of the radius of the turning circle to the length of the craft is 2 to 4.

1.1.3 *Relationship between the Capsizing Moment and Heeling Moment to satisfy the weather criterion*

The stability of a hydrofoil boat in the displacement mode can be checked for compliance with the weather criterion K as follows :

$$K = \frac{M_c}{M_v} \geq 1,$$

where M_c – minimum capsizing moment as determined when account is taken of rolling ;

M_v – dynamically applied heeling moment due to the wind pressure.

1.1.4 *Heeling Moment due to Wind Pressure*

The heeling moment M_v is a product of wind pressure P_v the windage area A_v and the lever of windage area Z .

$$M_v = 0.001 P_v A_v Z \text{ (Kilonewton-metres)}$$

The value of the heeling moment is taken as constant during the whole period of heeling.

The windage area A_v is considered to include the projections of the lateral surfaces of the hull, superstructure and various structures above the waterline. The windage area lever Z is the vertical distance to the centre of windage from the waterline and the position of the centre of windage may be taken as the centre of the area.

The values of the wind pressure in Pascal associated with Force 7 Beaufort Scale depending on the position of the centre of windage area are given in Table 1.

TABLE 1

Typical Wind Pressures for Beaufort Scale 7 100 Nautical Miles from Land

Z above waterline (metres)	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
P_v (Pascal)	46	46	50	53	56	58	60	62	64

Note : These values may not be applicable in all areas.

1.1.5 *Evaluation of the Minimum Capsizing Moment M_c in the displacement mode*

The minimum capsizing moment is determined from the static and dynamic stability curves taking rolling into account.

- (a) When the static stability curve is used, M_c is determined by equating the areas under the curves of the capsizing and righting moments (or levers) taking rolling into account – as indicated by Figure 1, where θ_z is the amplitude of roll and MK is a line drawn parallel to the abscissa axis such that the shaded areas S_1 and S_2 are equal.

$M_c = OM$ if the scale of ordinates represents moments

$M_c = OM \times \text{Displacement}$ if the scale of ordinates represents levers

STATIC STABILITY CURVE

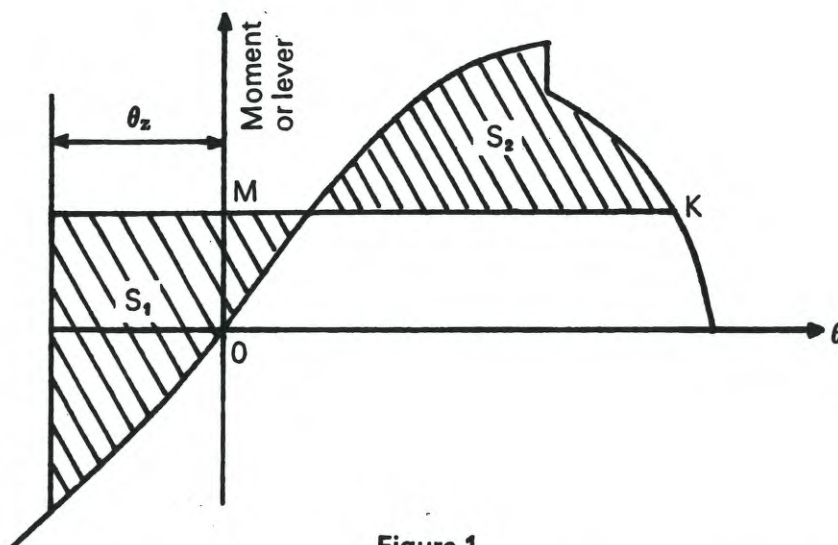


Figure 1

- (b) When the dynamic stability curve is used, first an auxiliary point A must be determined. For this purpose the amplitude of heeling is plotted to the right along the abscissa axis and a point A' is found (see Figure 2). A line AA' is drawn parallel to the abscissa axis equal to the double amplitude of heeling ($AA' = 2\theta_z$) and the required auxiliary point A is found. A tangent AC to the dynamic stability curve is drawn. From the point A the line AB is drawn parallel to the abscissa axis and equal to 1 radian (57.3°). From the point B a perpendicular is drawn to intersect with the tangent in point E. The distance \overline{BE} is equal to the capsizing moment if measured along the ordinate axis of the dynamic stability curve. If, however, the dynamic stability levers are plotted along this axis \overline{BE} is then the capsizing lever, and in this case the capsizing moment M_c is determined by multiplication of ordinate \overline{BE} in metres by the corresponding displacement in tonnes

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$$M_c = 9.81 \triangle \overline{BE} \text{ (Kilonewton-metres)}$$

- (c) The amplitude of rolling θ_z is determined by means of model and full-scale tests in irregular seas as a maximum amplitude of rolling of 50 oscillations of a craft travelling at 90° to the wave direction in sea state for the worst design condition. If such data are lacking the amplitude is assumed to be equal to 15° .
- (d) The effectiveness of the stability curves should be limited to the angle of flooding.

DYNAMIC STABILITY CURVE

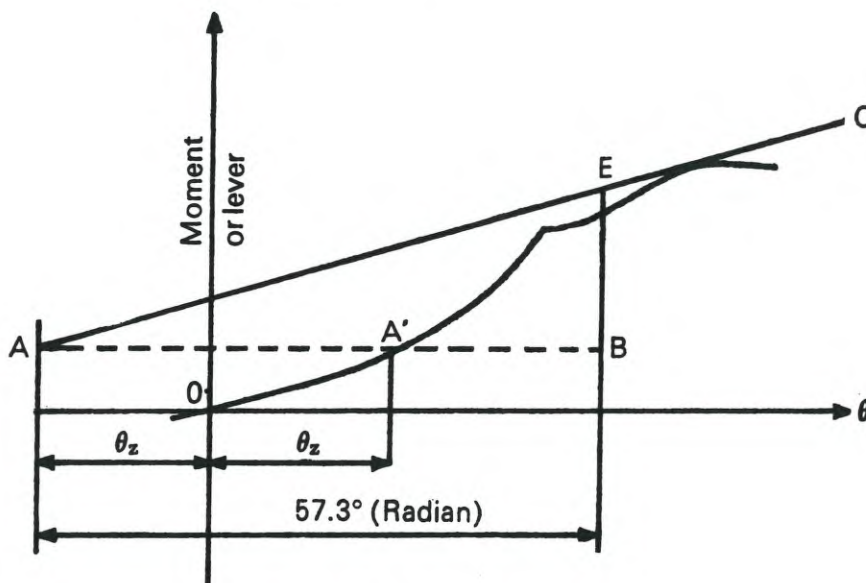


Figure 2

1.2 Stability in the transient and foil-borne modes

1.2.1 The stability should satisfy 2.5 of this Code.

- 1.2.2 (a) The stability in the transient and foil-borne modes should be checked for all cases of loading for the intended service of the craft.
- (b) The stability in the transient and foil-borne modes may be determined either by calculation or on the basis of data obtained from model experiments and should be verified by full-scale tests by the imposition of a series of known heeling moments by off-centre ballast weights, and recording the heeling angles produced by these moments. When taken in the hull-borne, take-off, steady foil-borne, and settling to hull-borne modes, these results will provide an indication of the values of the stability in the various situations of the craft during the transient condition.
- (c) The time to pass from the hull-borne mode to foil-borne mode and vice versa should be established. This period of time should not exceed two minutes.
- (d) The angle of heel in the foil-borne mode caused by the concentration of passengers at one side should not exceed 8° . During the transient mode the angle of heel due to the concentration of passengers on one side should not exceed 12° . The concentration of passengers should be determined by the Administration, having regard to the guidance given at Appendix III to this Code.

- 1.2.3 One of the possible methods of assessing foil-borne metacentric height (GM) in the design stage for a particular foil configuration is given in Figure 3.

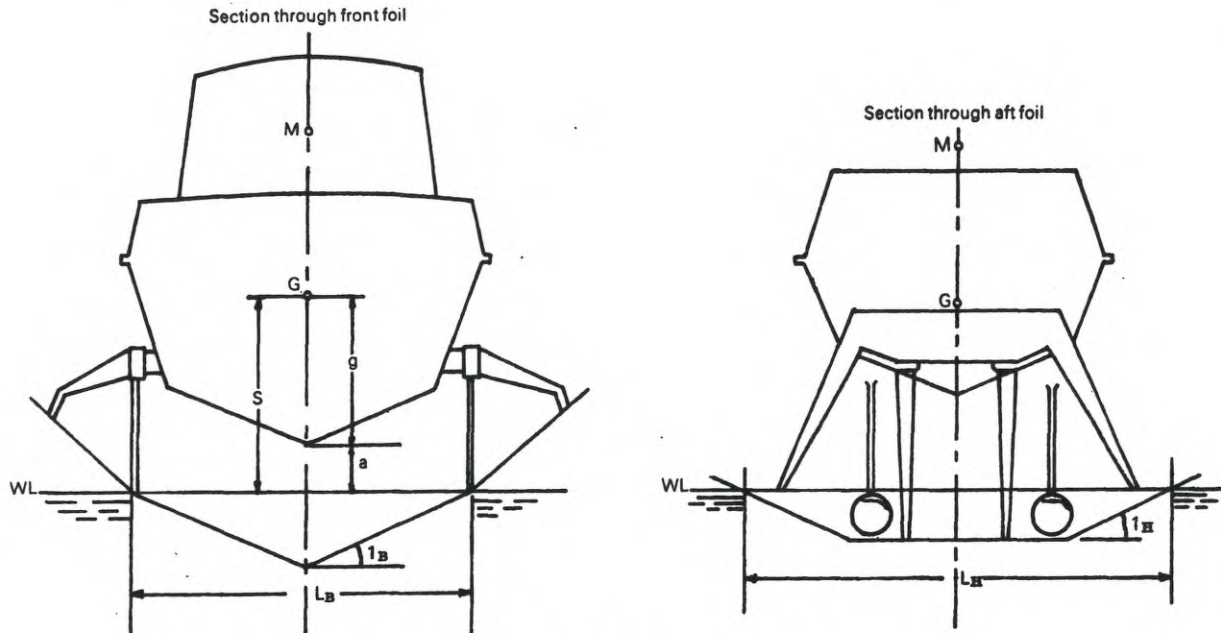


Figure 3

$$GM = n_B \left(\frac{L_B}{2 \tan 1_B} - S \right) + n_H \left(\frac{L_H}{2 \tan 1_H} - S \right)$$

- where n_B = percentage of hydrofoil load borne by front foil
 n_H = percentage of hydrofoil load borne by aft foil
 L_B = clearance width of front foil
 L_H = clearance width of aft foil
 a = clearance between bottom of keel and water
 g = height of centre of gravity above bottom of keel
 1_B = angle at which front foil is inclined to horizontal
 1_H = angle at which aft foil is inclined to horizontal

2. Fully Submerged Hydrofoils

2.1 Hull-borne mode

- The stability in the hull-borne mode should be sufficient to satisfy paragraphs 2.3 and 2.4 of the Code.
- Paragraphs 1.1.2 to 1.1.5 of this Appendix are appropriate to this type of craft in the hull-borne mode.

2.2 Transient mode

- The stability should be examined by the use of verified computer simulations to evaluate the craft's motions, behaviour and responses under the normal conditions and limits of operation, and under the influence of any malfunction.
- The stability conditions resulting from any potential failures in the systems or operational procedures during the transient stage which could prove hazardous to the craft's watertight integrity and stability should be examined.

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2.3 ***Foil-borne mode***

The stability of the craft in the foil-borne mode should be in compliance with 2.5 of the Code. The provision of paragraph 2.2 of this Appendix should also apply.

- 2.4 Paragraph 1.2.2 of this Appendix should be applied to this type of craft as appropriate and any computer simulations or design calculations should be verified by full-scale tests.

APPENDIX III

PASSENGER LOADING

1. A mass of 75 kilogrammes should be assumed per passenger except that this value may be reduced to not less than 60 kilogrammes where this can be justified. In addition, the mass and distribution of the luggage should be to the satisfaction of the Administration.
 2. The height of the centre of gravity for passengers should be assumed equal to :
 - (a) 1 metre above deck level for passengers standing upright. Account may be taken, if necessary, of camber and sheer of deck.
 - (b) 300 millimetres above the seat in respect of seated passengers.
 3. Passengers and luggage should be considered to be in the space normally at their disposal.
 4. Passengers should be considered as distributed to produce the most unfavourable combination of passenger heeling moment and/or initial metacentric height which may be obtained in practice. In this connexion, it is anticipated that a value higher than four persons per square metre will not be necessary.
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