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GUIDELINES FOR WING-IN-GROUND CRAFT

1 The Maritime Safety Committee, at its seventy-sixth session (2 to 13 December 2002), approved the *Interim Guidelines for wing-in-ground (WIG) craft* (MSC/Circ.1054 and Corr.1) with the intention to be used with proper engineering analysis, design and developmental testing to achieve an inherently safe craft, and agreed their relevancy and adequacy should be assessed as experience is gained in their application.

2 The Maritime Safety Committee, at its seventy-ninth session (1 to 10 December 2004), approved the *Amendments to the Interim Guidelines for Wing-in-ground (WIG) Craft* (MSC/Circ.1126) regarding the date of completion of the survey on which the Wing-in-ground Craft Safety Certificate is based.

3 The Maritime Safety Committee, at its eighty-ninth session (11 to 20 May 2011), instructed the Sub-Committee on Ship Design and Equipment, in conjunction with other relevant sub-committees, to review the *Interim Guidelines for wing-in-ground (WIG) craft* (MSC/Circ.1054 and Corr.1), as amended (MSC/Circ.1126), and submit the reviewed Guidelines to the Committee for approval.

4 The Maritime Safety Committee, at its ninety-ninth session (16 to 25 May 2018), having considered a proposal by the Sub-Committee on Ship Design and Construction at its fifth session, approved the *Guidelines for wing-in-ground craft*, as set out in the annex.

5 Member States are invited to bring the annexed Guidelines to the attention of all parties concerned.

6 This circular revokes MSC/Circ.1054 and Corr.1, and MSC/Circ.1126.

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ANNEX

GUIDELINES FOR WING-IN-GROUND CRAFT

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PREAMBLE

1 Traditionally, the safety of ships has been regulated through instruments such as the International Convention for the Safety of Life at Sea (SOLAS), 1974, and the International Convention on Load Lines, 1966, through provisions under which the ship is self-sufficient for all normal and emergency operational situations. Provision has been made in these conventions for reduced requirements to be applied to near-coastal voyages.

2 New types of craft have been developed in recent years, for which maintenance of internationally acceptable risk levels has been achieved by elimination of some safety hazards and increased reliance on safety-related facilities available in the restricted area of a craft's operation. These craft, which are predominantly of light weight and operate at substantially greater speeds than conventional craft, could not be accommodated under traditional maritime safety instruments. IMO responded first by developing the Code of Safety for Dynamically Supported Craft (1977) and later the International Codes of Safety for High-Speed Craft, 1994 and 2000 (1994 and 2000 HSC Codes). These Codes cover all types of high-speed craft operated in contact with the sea surface, including planing vessels, multihull craft, surface-effect ships and air cushion vehicles.

3 One type of marine vehicle not covered by the 2000 HSC Code is the wing-in-ground (WIG) craft. These craft are supported in their main operational mode solely by aerodynamic forces which enable them to operate at low altitude above the sea surface but out of direct contact with that surface. Accordingly, their arrangement, engineering characteristics, design, construction and operation have a high degree of commonality with those characteristics of aircraft. However, they operate with other waterborne craft and must necessarily utilize the same collision avoidance rules as conventional shipping. *Amendments to the International Regulations for Preventing Collisions at Sea* (resolution A.910(22), adopted by the twenty-second IMO Assembly on 29 November 2001), developed by the Sub-Committee on Safety of Navigation, take into account the operational peculiarities of WIG craft.

4 IMO and ICAO have agreed that any WIG craft capable of flying outside the influence of ground effect at an altitude of more than 150 m, typically referred to as type C craft, should in such a flight be subject to the rules and regulations of ICAO. Other craft, including those with limited "fly-over" capability, should be covered only by the maritime regulatory regime.

5 In view of the configuration of WIG craft, which are between the maritime and aviation regulatory regimes, IMO has developed these Guidelines on a flexible risk management basis with reduced emphasis on prescriptive standards compared to the 2000 HSC Code. Notwithstanding the changed emphasis, the Guidelines are intended to achieve comparable safety standards to those of the 1974 SOLAS Convention and include relevant recommendations adapted from the 2000 HSC Code.

6 Significant differences between WIG craft and high-speed craft reflected in the Guidelines include:

.1 substantially higher speeds of WIG craft and consequently larger distances travelled in a given time at operational speed;

.2 the possibility of "amphibious" WIG craft being operated from land base;

.3 the need for risk and safety levels to be assessed on a holistic basis, recognizing that high levels of operator training, comprehensive and thoroughly implemented procedures, high levels of automation and sophisticated software can all make significant contributions to risk reduction;

.4 reduced ability of WIG craft to carry and deploy equipment and systems traditionally associated with seagoing craft;

.5 changed use of traditional ship terminology, such as stability, for the safety of WIG craft in the operational mode and corresponding increase in the use of aviation terminology, such as controllability; and

.6 the capacity of a WIG craft to mitigate hazards associated with its airborne mode by its ability to land on water at any time.

7 In order to provide as much guidance as possible to those involved in the design, construction and operation of WIG craft, the Guidelines have been prepared in three parts:

.1 part A provides general information applicable to all craft;

.2 part B includes provisions that may be subordinate to measures developed through the safety assessment recommendations of part C; and

.3 part C details the safety assessments required for all craft.

8 Unless expressly provided otherwise, these Guidelines should be applied to WIG craft carrying more than 12 passengers and/or having a full load displacement of more than 10 tonnes. The levels of safety for any WIG craft not covered above shall be to the satisfaction of the Administration, taking into account these Guidelines.

9 In developing these Guidelines, care has been taken to ensure that WIG craft do not impose unreasonable demands on other users of the marine environment and conversely that reasonable accommodation is made by those users to facilitate WIG craft operations.

10 It should be noted that the Guidelines are an initial document on which to base the safe design, construction and operation of these novel craft, but should be reviewed as necessary to reflect experience gained in their implementation and to further improve the safety of these craft, their passengers and crew.

PART A – GENERAL

1 General

1.1 These Guidelines should be applied as a complete set of comprehensive provisions. They contain provisions for wing-in-ground (WIG) craft engaged in international voyages, in particular their design and construction, the equipment that should be provided and the conditions for their operation and maintenance. The Guidelines are intended to set levels of safety which are equivalent to those of conventional ships required by the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, and the International Convention on Load Lines (Load Line), 1966, through the application of constructional and equipment standards in conjunction with strict operational controls.

1.2 The requirements applying to a specific craft in a particular service will, in general, be the risk control measures developed in accordance with the Safety Assessment under part C, which is to be completed for all craft. Information on generally accepted risk control measures is provided in part B. Prescriptive recommendations related to craft systems may be over-ridden by measures developed under part C.

2 General requirements

2.1 The application of the provisions of these Guidelines is subject to the following general requirements:

.1 the Guidelines will be applied in their entirety;

.2 the management of the company operating the craft exercises strict control over its operation and maintenance by a quality-management system;*

.3 the management ensures that only persons qualified to operate the specific type of craft used on the intended route are employed;

.4 the distances covered and the worst intended conditions (including minimum required visibility) in which operations are permitted will be restricted by the imposition of operational limits;

.5 the craft will at all times be in reasonable proximity to a place of refuge;

.6 adequate communications facilities, weather forecasts and maintenance facilities are available within the area of operation;

.7 in the intended area of operation there will be suitable rescue facilities readily available;

.8 areas of high fire risk such as machinery spaces and special category spaces are protected with fire-resistant materials and fire-extinguishing systems to ensure, as far as is practicable, containment and rapid extinguishing of fire;

.9 efficient facilities are provided for the rapid and safe evacuation of all persons into survival craft;

* Refer to the International Safety Management (ISM) Code, adopted by the Organization by resolution A.741(18), as amended.

.10 all passengers and crew are provided with seats; and

.11 no enclosed sleeping berths for passengers are provided.

2.2 Categories and types of WIG craft

2.2.1 Passenger craft may be assisted craft category, as defined in 4.2, or unassisted craft category, as defined in 4.42, depending on the characteristics of the craft and the route which it serves.

2.2.2 The type designation for a craft, type A, type B or type C, relates to its aerodynamic capabilities to perform limited flight outside the ground effect action altitude and is unrelated to the category designation described in 2.2.1.

3 Application

3.1 These Guidelines apply to WIG craft which are engaged in international voyages.

3.2 These Guidelines apply to:

.1 assisted craft and unassisted craft as described in 2.2.1 and defined in 4.2, 4.34 and 4.42;

.2 cargo craft as defined in 4.8; and

.3 any craft proceeding not more than 4 hours from a port of refuge or 200 nm, whichever is the lesser.

3.3 The application of these Guidelines should be verified by the Administration and be acceptable to the Governments of the States in which the craft will be operating.

3.4 These Guidelines do not apply to type C craft while operating in aircraft mode. In this mode such craft are considered as *aircraft* by the International Civil Aviation Organization (ICAO) and should comply with relevant ICAO requirements, taking into account the features of WIG craft. For this reason type C WIG craft are subject to the rules of both ICAO (in aircraft mode) and IMO (in all other modes of operation).

3.5 These Guidelines, unless expressly provided otherwise, do not apply to:

.1 craft of war and troop craft;

.2 pleasure craft not engaged in trade; and

.3 fishing craft.

4 Definitions

4.1 *Administration* means the Government of the State whose flag the craft is entitled to fly.

4.2 *Assisted craft* is any passenger WIG craft:

.1 operating on a route where it has been demonstrated to the satisfaction of the flag and port States that there is a high probability that in the event of an evacuation at any point of the route all passengers and crew can be rescued safely within the least of:

.1 the time to prevent persons in survival craft from exposure causing hypothermia in the worst intended conditions;

.2 the time appropriate with respect to environmental conditions and geographical features of the route; or

.3 four hours; and

.2 carrying not more than 450 passengers.

4.3 *Auxiliary machinery spaces* are spaces containing internal combustion engines of a power output up to and including 110 kW; driving generators; pumps, such as sprinkler, drencher or fire pumps, and bilge pumps; oil filling stations; switchboards of an aggregate capacity exceeding 800 kW; similar spaces and trunks to such spaces.

4.4 *Auxiliary machinery spaces having little or no fire risk* are spaces containing refrigerating, stabilizing, ventilation and air conditioning machinery, switchboards of an aggregate capacity of 800 kW or less, similar spaces and trunks to such spaces.

4.5 *Base port* is a specific port identified in the route operational manual and provided with:

.1 appropriate facilities providing continuous radio communications with the craft at all times while in port and at sea;

.2 means for obtaining a reliable weather forecast for the corresponding region and its due transmission to all craft in operation;

.3 for an assisted craft, access to facilities provided with appropriate rescue and survival equipment; and

.4 access to craft maintenance services with appropriate equipment.

4.6 *Base port State* means the State in which the base port is located.

4.7 *Breadth (B)* means width of the broadest part of the moulded watertight envelope at or below the design waterline in the displacement mode with no lift or propulsion machinery active.

4.8 *Cargo craft* is any WIG craft other than a passenger craft, which machinery and safety systems in any one compartment being disabled, the craft retains the capability to navigate safely. The damage scenarios considered in chapter 1 of part B should not be inferred in this respect.

4.9 *Cargo spaces* are all spaces used for cargo and trunks to such spaces.

4.10 *Continuously manned control station* is a control station which is continuously manned by a responsible member of the crew while the craft is in normal service.

4.11 *Control stations* are those spaces in which the craft's radio or navigating equipment or the emergency source of power and emergency switchboard are located, or where the fire recording or fire control equipment is centralized, or where other functions essential to the safe operation of the craft, such as propulsion control, public address and stabilization systems, are located.

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

4.13 *Crew accommodation* are those spaces allocated for the use of the crew and include cabins, sick bays, offices, lavatories, lounges and similar spaces.

4.14 *Critical design conditions* means the limiting specified conditions, chosen for design purposes, which the craft should retain in displacement mode. Such conditions should be more severe than the "worst intended conditions" by a suitable margin to provide for adequate safety in the survival condition.

4.15 *Design waterline* means the waterline corresponding to the maximum operational weight of the craft with no lift or propulsion machinery active and is limited by the requirements of chapters 1 and 2 of part B.

4.16 *Dynamic air cushion* means a high pressure region originating between the airfoil and a water surface or some other surface as the airfoil moves within the zone of the aerodynamic effect of this surface.

4.17 *Flap* means an element formed as integrated part of, or an extension of, a foil, used to adjust the hydrodynamic or aerodynamic lift of the foil.

4.18 *Flashpoint* means a flashpoint determined by a test using the closed-cup apparatus referenced in the International Maritime Dangerous Goods (IMDG) Code.

4.19 *Foil* means a profiled plate or three dimensional construction at which hydrodynamic or aerodynamic lift is generated when the craft is under way.

4.20 *Ground effect* is a phenomenon of increase of a lift force and reduction of inductive resistance of a wing approaching a surface. The extent of this phenomenon depends on the design of the craft but generally occurs at an altitude less than the mean chord length of the wing.

Maximum vertical extent of ground effect h_{ge} for an actual craft is determined experimentally or by calculations proceeding from a condition:

$$h_{ge} = h \text{ (when } L_h / L_{h=\infty} = k\text{)},$$

where:

L_h – aerodynamic lift force at an altitude h of a craft approaching to a surface;

$L_{h=\infty}$ – aerodynamic lift force of a craft at large altitude $h=\infty$ above the surface and outside ground effect; and k > 1.0 – aerodynamic coefficient, taking into account peculiarities of the craft and agreed by the Administration. In the absence of data it is recommended that k=1.1.

4.21 *Length (L)* means the overall length of the underwater watertight envelope of the rigid hull, excluding appendages, at or below the design waterline in the displacement mode with no lift or propulsion machinery active.

4.22 *Lightweight* is the displacement of the craft in tonnes without cargo, fuel, lubricating oil, ballast water and fresh water in tanks, consumable stores, passengers and crew and their effects.

4.23 *Machinery spaces* are spaces containing internal combustion engines with an aggregate total power output of more than 110 kW, generators, oil fuel units, propulsion machinery, major electrical machinery and similar spaces and trunks to such spaces.

4.24 *Maximum operational weight* means the overall weight up to which operation in the intended mode is permitted by the Administration.

4.25 *Maximum speed* is the speed achieved through the air at the maximum continuous propulsion power for which the craft is certified at maximum operational weight.

4.26 *Muster station* is an area where passengers can be gathered in the event of an emergency, given instructions and prepared to abandon the craft, if necessary. The passenger spaces may serve as muster stations if all passengers can be instructed there and prepared to abandon the craft.

4.27 *Oil fuel unit* is the equipment used for the preparation of oil fuel for delivery to equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 0.18 N/mm^2.

4.28 *Open vehicle spaces* are spaces:

.1 to which any passengers carried have access;

.2 intended for carriage of motor vehicles with fuel in their tanks for their own propulsion; and

.3 either open at both ends or open at one end and provided with adequate natural ventilation effective over their entire length through permanent openings in the side plating or deckhead or from above.

4.29 *Operating compartment* means the enclosed area from which the navigation and control of the craft is exercised.

4.30 *Operating station* means a confined area of the operating compartment equipped with necessary means for navigation, manoeuvring and communication, and from where the functions of navigating, manoeuvring, communication, commanding, conning and lookout are carried out.

4.31 *Operational speed* is the normal operating speed at reduced level of propulsion power in ground effect mode.

4.32 *Organization* means the International Maritime Organization.

4.33 *Passenger* is every person other than:

.1 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

.2 a child under one year of age.

4.34 *Passenger craft* is a craft which carries more than twelve passengers.

4.35 *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.

4.36 *Public spaces* are those spaces allocated for the passengers and include main seating areas, lavatories and similar permanently enclosed spaces allocated for passengers.

4.37 *Service spaces* are those enclosed spaces used for pantries containing food warming equipment but no cooking facilities with exposed heating surfaces, lockers, storerooms and enclosed baggage rooms.

4.38 *Skeg* is a vertical or inclined profiled plate or a volumetric construction, which forms part of or is attached to a wing for the purpose of decreasing the inductive aerodynamic resistance or increasing the effectiveness of static or dynamic air cushions. When operating up to the ground effect mode it can be also used for sliding on the water or other surface and for providing stability.

4.39 *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 for embarking and disembarking, including spaces intended for the carriage of cargo vehicles.

4.40 *Static air cushion* means a high-pressure region generated by directing air from the propulsion engine or other engine underneath the craft's body and/or wings.

4.41 *System Safety Assessment (SSA)* means a systematic, comprehensive evaluation of the implemented systems to establish safety objectives and to show that the relevant safety requirements are met. The method is described in part C.

4.42 *Unassisted craft* is any passenger WIG craft other than an assisted craft, which machinery and safety systems arranged such that, in the event of damage disabling any essential machinery and safety systems in any one compartment, the craft retains the capability to navigate safely.

4.43 *Worst intended conditions* means the specified environmental conditions within which the intended 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.

4.44 *WIG craft* is a multimodal craft which, in its main operational mode, flies by using ground effect above the water or some other surface, without constant contact with such a surface and supported in the air, mainly, by an aerodynamic lift generated on a wing (wings), hull, or their parts, which are intended to utilize the ground effect action.

4.45 WIG craft are categorized according to the following types:

.1 type A: a craft which is certified for operation only in ground effect. Within prescribed operational limitations, the structure and/or the equipment of such a craft should exclude any technical possibility to exceed the flight altitude over the maximum vertical extent of ground effect, as defined in 4.20;

.2 type B: a craft which is certified for main operation in ground effect and to temporarily increase its altitude outside ground effect to a limited height, but not exceeding 150 m above the surface, in case of emergency and for overcoming obstacles; and

.3 type C: a craft which is certified for the same operation as type B; and also for limited operation at altitude exceeding 150 m above the surface, in case of emergency and for overcoming obstacles.

4.46 WIG craft operational modes:

.1 *Amphibian mode* is the special operational mode of amphibian WIG craft over the surface other than water, when at rest or in motion its weight is fully or predominantly supported by appropriate combination of forces of static and dynamic air cushion and/or by vertical forces produced on the hull or other devices due to their contact with such a surface and/or due to sliding on it;

.2 *Displacement mode* means the regime, whether at rest or in motion, where the weight of the craft is fully or predominantly supported by hydrostatic forces;

.3 *Transitional mode* denotes the transient mode from the displacement mode to the planing mode (or amphibian mode) and vice versa;

.4 *Planing mode* denotes the mode of steady state operation of a craft on water surface by which the craft's weight is supported mainly by hydro-dynamic forces;

.5 *Take off/landing mode* denotes the transient mode from the planing mode (or amphibian mode) to the ground effect mode and vice versa;

.6 *Ground effect mode* is the main steady state operational mode of flying the WIG craft in ground effect above water or other surface;

.7 *Fly-over mode* denotes increase of the flying altitude for WIG craft of types B and C within a limited period, which exceeds the vertical extent of the ground effect but does not exceed the minimal safe altitude for an aircraft prescribed by ICAO provisions; and

.8 *Aircraft mode* denotes the flight of a WIG craft of type C above the minimal safe altitude for an aircraft prescribed by ICAO regulations.

4.47 *Wing* denotes an air foil or other air lift generating surface to support the weight of the craft in flight and may include the fuselage.

5 Maximum/minimum allowable altitude of WIG craft in different flight modes

5.1 Main operational mode (ground effect mode) for types A, B and C:

- the maximum allowable altitude corresponds to the maximum vertical extent of ground effect as defined in 4.20.

5.2 Fly-over mode for types B and C for emergency situations:

- the maximum allowable altitude for a flight outside of ground effect should be based on the craft's technical features, taking into account the area of operation, but this altitude is not to exceed 150 m.

5.3 Aircraft mode for type C:

- the minimum altitude of the flight corresponds to the minimum safe altitude for an aircraft prescribed by ICAO regulations. When flying over water it should be at least 150 m; and

- the maximum allowable altitude of the flight is determined in accordance with ICAO provisions.

6 Surveys

6.1 Each craft should be subject to the surveys specified below:

.1 an initial survey before the craft is put into service or before the Wing-in-ground Craft Safety Certificate is issued for the first time;

.2 a renewal survey at intervals specified by the Administration but not exceeding 5 years except where 9.5 or 9.10 are applicable;

.3 a periodical survey within three months before or after each anniversary date of the Wing-in-ground Craft Safety Certificate; and

.4 an additional survey as the occasion arises.

6.2 The surveys referred to in 6.1 should be carried out as follows:

.1 the initial survey should include:

.1 an appraisal of the safety assessment and safety management assumptions made as per part C and limitations proposed in relation to loadings, environment, speed and manoeuvrability;

.2 an appraisal of the data supporting the safety of the design, obtained, as appropriate, from calculations, tests and trials;

.3 a System Safety Assessment (SSA) as required by these Guidelines;

.4 an investigation into the adequacy of the various manuals to be supplied with the craft; and

.5 a complete inspection of the structure, safety equipment, radio installations and other equipment, fittings, arrangements and materials to ensure that they comply with the provisions of the Guidelines, are in satisfactory condition and are fit for the service for which the craft is intended;

.2 the renewal and periodical surveys should commence with an assessment of the continued validity of the safety assessment. These surveys should also include a complete inspection of the structure, including the outside of the craft's bottom and related items, safety equipment, radio installations and other equipment as referred to in 6.2.1 to ensure that they comply with the requirements of the Guidelines, are in satisfactory condition and are fit for the service for which the craft is intended. The inspection of the craft's bottom should be conducted with the craft out of the water under suitable conditions for close-up examination of any damaged or problem areas; and

.3 an additional survey, either general or partial according to the circumstances, should be carried out after a repair resulting from investigations prescribed in 8.3, or whenever any important repairs or renewals are made. The survey should be such as to ensure that the necessary repairs or renewals have been effectively carried out, that the material and workmanship of such repairs or renewals are in all respects satisfactory, and that the craft complies in all respects with the provisions of the Guidelines.

6.3 The periodical surveys referred to in 6.1.3 should be endorsed on the Wing-in-ground Craft Safety Certificate.

6.4 The inspection and survey of the craft, as provided for in these Guidelines, should be carried out by officers of the Administration. The Administration may, however, entrust the inspections and surveys either to surveyors nominated for the purpose or to organizations recognized by it.

6.5 An Administration nominating surveyors or recognizing organizations to conduct inspections and surveys as set forth in 6.4 should, as a minimum, empower any nominated surveyor or recognized organization to:

.1 require repairs to a craft; and

.2 carry out inspections and surveys if requested by the appropriate authorities of a port State.

The Administration should notify the Organization of the specific responsibilities and conditions of the authority delegated to nominated surveyors or recognized organizations.

6.6 When a nominated surveyor or recognized organization determines that the condition of the craft or its equipment does not correspond substantially with the particulars of the Certificate or is such that the craft is not fit to operate without danger to the craft or persons on board, such surveyor or organization should immediately ensure that corrective action is taken and should, in due course, notify the Administration. If such corrective action is not taken, the Certificate should be withdrawn and the Administration should be notified immediately; and, if the craft is in an area under the jurisdiction of another Government, the appropriate authorities of the port State should be notified immediately. When an officer of the Administration, a nominated surveyor or a recognized organization has notified the appropriate authorities of the port State, the Government of the port State concerned should give such officer, surveyor or organization any necessary assistance to carry out their obligations under this section. When applicable, the Government of the port State concerned should ensure that the craft does not continue to operate until it can do so without danger to the craft or the persons on board.

6.7 In every case, the Administration should fully guarantee the completeness and efficiency of the inspection and survey and should undertake to ensure the necessary arrangements to satisfy this obligation.

7 Approvals

The owner of a craft should accept the obligation to supply sufficient information to enable the Administration to fully assess the features of the design. It is strongly recommended that the owner and Administration and, where appropriate, the port State or States commence discussions at the earliest possible stage so that the Administration may fully evaluate the design in determining what additional or alternative requirements should be applied to the craft to achieve the required level of safety.

8 Maintenance of conditions after survey

8.1 The condition of the craft and its equipment should be maintained to conform with the provisions of these Guidelines to ensure that the craft in all respects will remain fit to operate without danger to the craft or the persons on board.

8.2 After any survey of the craft under section 6 has been completed, no change should be made to the structure, equipment, fittings, arrangements and materials covered by the survey without the sanction of the Administration.

8.3 Whenever an accident occurs to a craft or a defect is discovered, either of which affects the safety of the craft or the efficiency or completeness of the structure, equipment, fittings, arrangements and materials, the person in charge or owner of the craft should report at the earliest opportunity to the Administration, the nominated surveyor or recognized organization responsible, who should cause investigations to be initiated to determine whether a survey, as required by section 6, is necessary. If the craft is in an area under the jurisdiction of another Government, the person in charge or the owner should also report immediately to the appropriate authorities of the port State and the nominated surveyor or recognized organization should ascertain that such a report has been made.

9 Wing-in-ground Craft Safety Certificate

9.1 A Certificate called a Wing-in-ground Craft Safety Certificate is issued after completion of an initial or renewal survey to a craft which complies with the provisions of the Guidelines. The Certificate should be issued or endorsed either by the Administration or by any person or organization recognized by it. In every case, that Administration assumes full responsibility for the Certificate.

9.2 A Contracting Government to the Convention may, at the request of the Administration, cause a craft to be surveyed and, if satisfied that the provisions of the Guidelines are complied with, should issue or authorize the issue of a Certificate to the craft and, where appropriate, endorse or authorize the endorsement of a Certificate for the craft in accordance with the Guidelines. Any Certificate so issued should contain a statement to the effect that it has been issued at the request of the Government of the State the flag of which the craft is entitled to fly, and it should have the same force and receive the same recognition as a Certificate issued under 9.1.

9.3 The Certificate should be of the model given in annex 1. If the language used is neither English, French nor Spanish, the text should include a translation into one of these languages.

9.4 The Wing-in-ground Craft Safety Certificate should be issued for a period specified by the Administration which should not exceed 5 years.

9.5 Notwithstanding the requirements of 9.4, when the renewal survey is completed within three months before the expiry date of the existing Certificate, the new Certificate should be valid from the date of completion of the renewal survey to a date not exceeding 5 years from the date of expiry of the existing Certificate.

9.6 When the renewal survey is completed after the expiry date of the existing Certificate, the new Certificate should be valid from the date of completion of the renewal survey to a date not exceeding 5 years from the date of expiry of the existing Certificate.

9.7 When the renewal survey is completed more than 3 months before the expiry date of the existing Certificate, the new Certificate should be valid from the date of completion of the renewal survey to a date not exceeding 5 years from the date of completion of the renewal survey.

9.8 If a Certificate is issued for a period of less than 5 years, the Administration may extend the validity of the Certificate beyond the expiry date to the maximum period specified in 9.4, provided that the surveys required when a Certificate is issued for a period of 5 years are carried out.

9.9 If a renewal survey has been completed and a new Certificate cannot be issued or placed on board the craft before the expiry date of the existing Certificate, the person or organization authorized by the Administration may endorse the existing Certificate and such a Certificate should be accepted as valid for a further period which should not exceed 5 months from the expiry date.

9.10 If a craft, at the time when a Certificate expires, is not in the place in which it is to be surveyed, the Administration may extend the period of validity of the Certificate but this extension should be granted only for the purpose of allowing the craft to proceed to the place where it is to be surveyed, and then only in cases where it appears proper and reasonable to do so. No Certificate should be extended for a period longer than one month, and a craft to which an extension is granted should not, on its arrival at the place where it is to be surveyed, be entitled by virtue of such extension to leave that place without having a new Certificate. When the renewal survey is completed, the new Certificate should be valid to a date not exceeding 5 years from the date of expiry of the existing Certificate before the extension was granted.

9.11 In special circumstances, as determined by the Administration, a new Certificate need not be dated from the date of expiry of the existing Certificate as required by 9.6 or 9.10. In these circumstances, the new Certificate should be valid to a date not exceeding 5 years from the date of completion of the renewal survey.

9.12 If a periodical survey is completed before the period specified in section 6 then:

.1 the anniversary date shown on the relevant Certificate should be amended by endorsement to a date which should not be more than 3 months later than the date on which the survey was completed;

.2 the subsequent periodical survey required by section 6 should be completed at the intervals prescribed by 6.1.3, using the new anniversary date; and

.3 the expiry date may remain unchanged provided one or more periodical surveys are carried out so that the maximum intervals between the surveys prescribed by 6.1.3 are not exceeded.

9.13 A Certificate issued under 9.1 or 9.2 should cease to be valid in any of the following cases:

.1 if the relevant surveys are not completed within the periods specified in 6.1;

.2 if the Certificate is not endorsed in accordance with 6.3; or

.3 upon transfer of the craft to the flag of another State. A new Certificate should only be issued when the Government issuing the new Certificate is fully satisfied that the craft is in compliance with the requirements of 8.1 and 8.2. In the case of a transfer between Governments that are Contracting Governments to the Convention, if requested within 3 months after the transfer has taken place, the Government of the State whose flag the craft was formerly entitled to fly should, as soon as possible, transmit to the Administration a copy of the Certificate carried by the craft before the transfer and, if available, copies of the relevant survey reports.

9.14 The privileges of the Guidelines may not be claimed in favour of any craft unless it holds a valid Certificate.

10 Permit to Operate WIG Craft

10.1 The craft should not operate commercially unless a Permit to Operate WIG Craft is issued and valid in addition to the Wing-in-ground Craft Safety Certificate. Transit voyage without passengers or cargo may be undertaken without the Permit to Operate.

10.2 The Permit to Operate should be issued by the Administration to certify compliance with 2.1.2 to 2.1.7 and stipulate conditions of the operation of the craft and should be drawn up on the basis of the information contained in the route operational manual specified in chapter 17 of part B.

10.3 Before issuing the Permit to Operate, the Administration should consult with each port State to obtain details of any operational conditions associated with the operation of the craft in that State. Any such conditions imposed should be shown by the Administration on the Permit to Operate and included in the route operational manual.

10.4 A port State may inspect the craft and audit its documentation for the sole purpose of verifying its compliance with the matters certified by and conditions associated with the Permit to Operate. Where deficiencies are shown by such an audit, the Permit to Operate ceases to be valid until such deficiencies are corrected or otherwise resolved.

10.5 The provisions of section 9 should apply to the issue and the period of validity of the Permit to Operate.

10.6 The Permit to Operate should be of the model given in annex 2 to these Guidelines. If the language used is neither English, French nor Spanish, the text should include a translation into one of these languages.

11 Control

The provisions of regulation I/19 of the Convention should be applied to include the Permit to Operate in addition to the Certificate issued under section 9.

12 Equivalents

12.1 Where these Guidelines require 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 the 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 these Guidelines.

12.2 Where compliance with any of the provisions of these Guidelines would be impractical for reasons of the particular design of the craft, the Administration may substitute those with alternative provisions, 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 for their acceptance, which the Organization should circulate to its Member Governments for information.

13 Information to be made available

13.1 The Administration should ensure that the management of the company operating the craft has provided the craft with adequate information and guidance in the form of manuals to enable the craft to be operated and maintained safely. These manuals should include a route operational manual, craft operating manual, maintenance manual and servicing schedule. Such information should be updated as necessary.

13.2 The manuals should contain at least the information specified in chapter 17 of part B and information relating to craft operation and maintenance generated in the safety assessment (see part C). They should be in a language understood by the crew. Where this language is not English, a translation into English should be provided of at least the route operational manual and the craft operating manual.

14 Further developments

14.1 Due to ongoing research and development in the design of WIG craft with a different geometry to that envisaged during the formulation of these Guidelines, it is important that these Guidelines do not restrict this progress and the development of new designs.

14.2 A design may be produced which cannot comply with the provisions of these Guidelines. In such a case the Administration should determine the extent to which the provisions of the Guidelines are applicable to the design and, if necessary, develop additional or alternative provisions to provide an equivalent level of safety for the craft. The full application of the safety assessment and safety management provisions of these Guidelines at all times remains a fundamental component of such alternative provisions.

14.3 The foregoing should be considered by the Administration when assessing the granting of equivalents under the Guidelines.

15 Circulation of safety information

15.1 In the event that an Administration has cause to investigate an accident involving a craft to which these Guidelines apply, that Administration should provide a copy of the official report to the Organization, which should invite Member States to note the existence of the report and to obtain a copy.

15.2 In the event that operational experience reveals structural or equipment failures affecting the safety of a design, craft owners should inform the Administration.

16 Review of the Guidelines

16.1 The Guidelines should be reviewed by the Organization at intervals preferably not exceeding four years to consider a revision of existing provisions to take account of new developments in design and technology.

16.2 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 Guidelines during the periodical review.

PART B – INTERIM RECOMMENDATIONS

CHAPTER 1 – BUOYANCY, STABILITY AND SUBDIVISION

1.1 GENERAL

1.1.1 General

1.1.1.1 A craft should be provided with:

.1 stability characteristics and stabilization systems adequate for safety when the craft is operated in all modes except of displacement including adequate provision for the safe landing of the craft in case of any system fault;

.2 additionally, buoyancy and stability characteristics adequate for safety where the craft is operated in the displacement mode, both in the intact condition and the damaged condition; and

.3 stability data providing detail of the craft's buoyancy and stability characteristics in all operational modes, taking account of the craft's manoeuvring characteristics and local increases in wave height and wind strength expected to be encountered in the operational area under the conditions applying to the certification of the craft under these Guidelines.

1.1.1.2 Account should be taken of the effect of icing in all stability calculations for loading conditions where icing may accrete. An example of an established practice for ice accretion allowances is given in annex 3 for the guidance of the Administration in terms of application and adaptation as appropriate for a specific craft. The application of such allowances to individual craft may be dependent on the performance of any de-icing system that may be fitted.

1.1.1.3 Unless the contrary intention appears, for the purpose of this chapter the term "stability" should be taken to include longitudinal stability as well as transverse stability.

1.1.1.4 The provisions of this chapter may be supplemented where considered appropriate:

.1 by the Administration;

.2 to cover special modes of operation, such as amphibious mode;

.3 to address weather and sea conditions in the craft's area of operation; or

.4 to address hazards identified in the safety assessment for the craft.

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

.1 *Downflooding point* means any opening through which flooding of the spaces which comprise the reserve buoyancy could take place while the craft is in the intact or damage condition and heels to an angle past the angle of equilibrium;

.2 *Permeability* of a space means the percentage of the volume of that space which can be occupied by water;

.3 *Watertight* in relation to a structure means capable of preventing the passage of water through the structure in any direction under the head of water likely to occur in the intact or damage condition; and

.4 *Weathertight* means that water will not penetrate into the craft in any wind and wave conditions up to those specified as critical design conditions.

1.1.1.6 Conditions of sufficient stability

In all relevant operational conditions of loading, craft should comply with the following provisions:

.1 in the displacement mode, withstand simultaneous action of the dynamically applied wind pressure and the craft rolling (weather criterion) according to 1.1.3.5;

.2 in the transitional and take off/landing modes of operation, the provisions of 1.1.3.4;

.3 the static stability curve in the displacement mode in calm water should comply with 1.1.3.2;

.4 stability of passenger craft should meet the provisions of section 1.2 and of cargo craft the provisions of section 1.3; and

.5 in all modes of operation should have static and dynamic stability in yaw, pitch, roll, and heave, surge and sway. This stability should be proven by appropriate tests and trials, theoretical calculations, simulation analysis, model tests or sea trials.

1.1.2 Intact buoyancy

1.1.2.1 All craft should have a sufficient reserve of buoyancy at the design waterline to meet the intact and damage stability requirements of this chapter. The Administration may require a larger reserve of buoyancy to permit the craft to operate in any of its intended modes. This reserve of buoyancy should be calculated by including only those compartments which are:

.1 watertight;

.2 accepted as having scantlings and arrangements adequate to maintain their watertight integrity; and

.3 situated in locations below a datum, which may be a watertight deck or equivalent structure of a non-watertight deck covered by a weathertight structure.

1.1.2.2 Arrangements should be provided for checking the watertight integrity of those compartments referred to in 1.1.2.1.

1.1.2.3 Where entry of water into structures above the datum as defined in 1.1.2.1.3 would significantly influence the stability and buoyancy of the craft, such structures should be:

.1 of adequate strength to maintain the weathertight integrity and fitted with weathertight closing appliances; or

.2 provided with adequate drainage arrangements; or

.3 an equivalent combination of both measures.

1.1.2.4 The means of closing openings in the boundaries of weathertight structures should be such as to maintain weathertight integrity in all operational conditions.

1.1.3 Intact stability

1.1.3.1 General

1.1.3.1.1 It should be shown by calculations and/or by trials that in all operational modes and load cases within its operational restrictions a craft will return or can be readily made to safely return to the initial position of draught/altitude, heel and trim when displaced during roll, pitch, yaw or heave motions or when subjected to a transitory force or moment associated with such motions.

1.1.3.1.2 The roll and pitch stability on the first and/or any other craft of a series should be qualitatively assessed during operational safety trials as required by chapter 16 and annex 8. The results of such trials may indicate the need to impose operational limitations in relation to any operational modes, operational areas and loading conditions.

1.1.3.1.3 Suitable precautions of arrangement, equipment or operational procedures should be taken against the craft developing dangerous attitudes, yawing, inclinations or loss of stability subsequent to a collision with a submerged or floating object in displacement, transitional, take-off/landing, planing and surface effects modes, particularly in modes where any part of the craft or its appendages is submerged.

1.1.3.1.4 When turning in calm water the inner angle of heel should not:

.1 induce instability in the craft;

.2 exceed the angle at which the wing makes contact with the water surface necessitating corrective control action when in the ground effect mode in calm water at the design altitude; and

.3 exceed the angle at which the skeg makes contact with the water surface when the craft is in the ground effect mode.

1.1.3.2 Intact stability in the displacement mode

1.1.3.2.1 Craft of all types should comply with corresponding provisions of annex 5 in all permissible loading cases.

1.1.3.2.2 If characteristics of a craft do not suit the application of 1.1.3.2.1 the Administration may allow alternative criteria which are equivalent to those in 1.1.3.2.1 as appropriate for craft type and region of operation.

1.1.3.3 Stability in the ground effect mode

1.1.3.3.1 Definitions

.1 *The focus of altitude* $\overline{X_{F\overline{H}}}$ is the point in the wing chord of action of the increment of lift force caused by the change of the altitude.

.2 *The focus of attack angle* $\overline{X_{F\theta}}$ is the point in the wing chord of action of the increment of lift force caused by the change of the attack angle.

1.1.3.3.2 General

.1 The WIG craft should have stable flight in all normal operational conditions and should return to the original state after influence of short vertical, longitudinal or lateral forces and moments;

.2 Stable flight should be verified by the leading craft test flight: The WIG craft under the scheduled operating conditions can be stable flight in the ground effect mode.

1.1.3.3.3 Longitudinal stability

.1 The longitudinal static stability of craft in flight should be calculated. The following two criteria should be satisfied at the same time:

.1 the focus of altitude $\overline{X_{F\overline{H}}}$ should be in front of the focus of attack angle $\overline{X_{F\theta}}$, which is $\overline{X_{F\theta}}$ - $\overline{X_{F\overline{H}}}$ $>$0; and

.2 the focus of attack angle $\overline{X_{F\theta}}$ should be behind the centre of gravity of the craft $\overline{X_{T}}$, which is $\overline{X_{F\theta}}$ - $\overline{X_{T}}$ $>$0.

.2 The dynamic longitudinal stability of craft in flight should be verified by calculation, simulation test or Actual craft trial. The longitudinal dynamic stability should be satisfied that the motion of the disturbed craft is oscillatory attenuation.

.3 If equipped with automatic motion control system, the verification of the dynamic longitudinal stability of craft should consider the influence of automatic motion control system.

1.1.3.3.4 Lateral stability

.1 The dynamic lateral stability of craft in the ground effect mode should be verified by calculation, simulation test or actual trial. The lateral dynamic stability should be satisfied that the motion of the disturbed craft is oscillatory attenuation.

.2 If equipped with automatic motion control system, the verification of the dynamic lateral stability of craft should consider the influence of automatic motion control system.

.3 The craft can fly stably in the ground effect mode should withstand crosswind corresponding of the service weather restriction, and that should be proved by actual trials of the leading ship, and the heeling angle of craft does not exceed the immersion angle of the skeg. That should be proved by actual trials of the leading ship.

.4 The limit of ultimate heeling angle of craft turning on the calm water in the ground effect mode should be measured by actual trials, that to avoid the instable motion due to wing or skeg contact with the water surface. In addition, the limit of trim angle of craft turning should be measured, that to avoid losing stability due to turning with excessive attack. The limit of heeling angle and trim angle of craft turning in the ground effect mode should be clearly specified in the operation manual of craft.

1.1.3.4 Controllability and stability in other modes should comply with chapter 16.

1.1.3.5 Stability verification

1.1.3.5.1 If the craft is fitted with a system for directing sprays of air engines under a wing or other craft structures to create a static air cushion or for other purposes, then the effect of that system on craft stability should be taken into account.

1.1.3.5.2 For a craft which is designed and certificated to be capable from the displacement mode wholly or partly to mount to a gentle slope shore (and to come down backwards) and to operate in amphibian mode, the maintenance of satisfactory stability during such manoeuvres should be verified by trials and documented in the operational procedures, including transit through the wave breaking zone in all conditions up to the worst allowable conditions for those manoeuvres.

1.1.3.5.3 Validation of the transverse stability of the full scale craft in calm water should be conducted.

1.1.3.6 WIG craft weather criteria

1.1.3.6.1 Craft operation, depending on the operational modes, should be restricted by the worst intended conditions and critical design conditions specified according to the results of trials conducted with the craft itself or with one of the craft of a series of identical craft.

1.1.3.6.2 In the displacement mode of operation, stability is considered to be sufficient if the following conditions are observed when the dynamically applied heeling moment M_v due to the beam wind pressure (in the loading condition with least reserves of stability and subjected to the critical design conditions) is equal or less than the capsizing moment Mc,

$$M_v \leq Mc \text{ or } K = Mc/M_v \geq 1.0$$

1.1.3.6.3 The ability to keep the planing and ground effect modes under the worst intended conditions should be confirmed experimentally during the delivery seakeeping test of the first craft in series.

1.1.3.6.4 The heeling moments due to the wind pressure should be taken as constant during the whole period of heeling and determined as follows:

The heeling moment M_v (kNm) in the displacement mode of operation is calculated as follows:

$$M_v = 0.001\ P_v\ A_v\ Z\ f$$

where:

P_v = wind pressure (N/m^2);

A_v = windage area (the projected lateral area of the portion of the craft above the acting waterline) (m^2);

Z = the windage area lever equal to the vertical distance to the centre of windage from the centre of the projected lateral area of the portion of the craft below the plane of the acting waterline (m); and

f = streamline factor, f $\leq$ 1, determined by model tests in a wind tunnel (f=1 if such data are lacking).

The value of P_v should be determined according to table 1.1.3.6.4 for wind force corresponding to the critical design conditions. This wind force should be at least one Beaufort Scale number higher than that corresponding to the worst intended conditions.

Table 1.1.3.6.4 – Wind pressure P_v, in Pa

Wind force		Vertical distance between the centre of the projected lateral area of the WIG craft and the sea surface, in m						
Beaufort Scale	m/s	1	2	3	4	5	6	7 and more
2	5	15	20	25	25	30	30	35
3	7	50	60	65	70	75	80	85
4	9	95	120	135	145	150	160	165
5	12	155	195	220	235	250	265	275
6	15	240	300	335	360	385	400	415
7	19	435	545	605	655	700	730	750
8	23	705	875	970	1050	1115	1170	1230

1.1.3.6.5 Amplitudes of WIG craft motion for application of intact stability criteria

.1 The amplitudes of rolling for the displacement and planing modes of WIG craft should be calculated according to the methods of annex 4 or otherwise as agreed by the Administration.

.2 The amplitude of rolling Θ_Z is determined in accordance with 1.1.5.3 of annex 4, with a sea state corresponding in displacement mode to the critical design conditions.

.3 The amplitude of rolling in the displacement mode of operation is determined for the craft in beam seas and with propulsion and stability equipment inoperative.

1.1.3.6.6 The recommended scheme for determination of the capsizing moment Mc in the displacement mode of operation is given in 1.1.5.1 and 1.1.5.2 of annex 4. For this purpose, the angle of flooding should be taken as the lowest angle of heel corresponding to residual freeboard of 0.3 m below:

.1 the lower window sill;

.2 the upper edge of the coaming of the outside entry door; and

.3 other points of flooding.

1.1.4 Buoyancy and stability in the displacement mode following damage

1.1.4.1 The provisions of this section apply to all permitted conditions of loading.

1.1.4.2 Except as provided in 1.1.4.3, for the purpose of damage stability calculations, the volume and surface permeability should be as follows:

Spaces	Permeability
Appropriated to cargo or stores	60
Occupied by accommodation	95
Occupied by machinery	85
Intended for liquids	0 or 95*
Appropriated for cargo vehicles	90
Void spaces	95

* Whichever results in the more severe requirements.

1.1.4.3 Notwithstanding 1.1.4.2, permeability determined by direct calculation should be used where a more onerous condition results, and may be used where a less onerous condition results from that provided according to 1.1.4.2.

1.1.4.4 Administrations may permit the use of low-density foam or other media to provide buoyancy in void spaces, provided that satisfactory evidence is provided that any such proposed medium is the most suitable alternative and is:

.1 of closed-cell form if foam, or otherwise impervious to water absorption;

.2 structurally stable under service conditions;

.3 chemically inert in relation to structural materials with which it is in contact or other substances with which the medium is likely to be in contact; and

.4 properly secured in place and easily removable for inspection of the void spaces.

1.1.4.5 Any damage of a lesser extent than that postulated in 1.1.4.6 and 1.1.4.7, as applicable, which would result in a more severe condition should also be investigated. The shape of the damage should be assumed to be a parallelepiped.

1.1.4.6 The following side damages should be assumed anywhere on the periphery of the craft:

.1 the longitudinal extent of damage should be 0.1L, or 3 m + 0.03L or 11 m, whichever is the least;

.2 the transverse extent of penetration into the craft should be 0.2B or 0.05L, whichever is the least. However, where the craft is fitted with inflated side-skirts or with non-buoyant side structures, the transverse extent of penetration should be at least 0.12 of the width of the main buoyancy hull or tank structure; and

.3 the vertical extent of damage should be taken for the full depth of the craft.

1.1.4.7 Damages should be assumed anywhere on the bottom of the craft as follows:

.1 the longitudinal extent of damage should be 0.1L or 3 m + 0.03L or 11 m, whichever is the least;

.2 the transverse extent of damage should be the full breadth of the bottom of the craft or 7 m, whichever is the less; and

.3 the vertical extent of penetration into the craft should be 0.02B or 0.5 m, whichever is the less.

1.1.5 Inclining and stability information

1.1.5.1 Every craft, on completion of build, should be inclined* and the elements of its stability determined. Alternatively, the mass and centre of gravity of the craft may be determined by weighing methods. When it is not possible to accurately determine the craft's vertical centre of gravity by either of these methods, it may be determined by accurate calculation.

1.1.5.2 The master should be supplied by the owner with reliable information relating to the stability of the craft in accordance with the provisions of this paragraph. This information should clearly show all constraints to the loading of the craft in accordance with these Guidelines, including the ranges of acceptable vertical transverse and longitudinal centre of gravity. The information relating to stability should, before issue to the master, be submitted to the Administration for approval, together with a copy thereof for their retention, and should incorporate such additions and amendments as the Administration may in any particular case require.

1.1.5.3 Where any alterations are made to a craft so as to affect materially the stability information supplied to the master, amended stability information should be provided. If necessary, the craft should be re-inclined or re-weighed.

1.1.5.4 A report of each weighing, inclining or lightweight survey carried out in accordance with this chapter and of the calculation therefrom of the light-ship condition particulars should be submitted to the Administration for approval, together with a copy for their retention. The approved report should be placed on board the craft by the owner in the custody of the master and should incorporate such additions and amendments as the Administration may in any particular case require. The amended light-ship condition particulars so obtained from time to time should be used by the master in substitution for such previously approved particulars when calculating the craft's stability.

* A detailed guidance for the conduct of an inclining test may be obtained from annex 1 to the International Code on Intact Stability, 2008, as adopted by the Maritime Safety Committee of the Organization by resolution MSC.267(85), as amended, or equivalent national standards.

1.1.5.5 Following any weighing, inclining or lightweight survey, the master should be supplied with amended stability information if the Administration so requires. The information so supplied should be submitted to the Administration for approval, together with a copy thereof for their retention, and should incorporate such additions and amendments as the Administration may in any particular case require.

1.1.5.6 Stability information demonstrating compliance with this chapter should be furnished in the form of a stability information book which should be kept on board the craft at all times in the custody of the master. The information should include particulars appropriate to the craft and should reflect the craft's loading conditions and modes of operation. All watertight and weathertight structures included in the cross curves of stability and the critical downflooding points and angles should be identified.

1.1.5.7 The operating company of every craft should establish and implement documented operational procedures to ensure that the craft's operational mass and longitudinal centre of gravity can be maintained within the certified limits for the craft. Methods reflected in these procedures may include marking and use of draught marks, regular operational weighing of the craft or marking of the waterline corresponding to the maximum take-off mass and permissible longitudinal centre of gravity for which the craft is certified.

1.1.5.8 Calculations of form stability levers for craft in all operational modes should be carried out on a basis of actual longitudinal centre of gravity.

1.1.6 Loading and stability assessment

On completion of loading of the craft and prior to its departure on a voyage, the master should determine the craft's trim and stability and also ascertain and record that the craft is in compliance with stability criteria of the relevant requirements. The Administration may accept the use of an electronic loading and stability computer or equivalent means for this purpose.

1.1.7 Marking and recording of the design waterline

The design waterline should clearly be marked amidships on the craft's outer sides and should be recorded in the Wing-in-Ground Craft Safety Certificate. This waterline should be distinguished by the notation WIG.

1.2 PROVISIONS FOR PASSENGER CRAFT

1.2.1 General

1.2.1.1 Where compliance with this chapter requires consideration of the effects of passenger weight, the following information should be used:

.1 The distribution of standing passengers is 4 persons per square metre.

.2 Each passenger has a mass of 75 kg.

.3 Vertical centre of gravity of seated passengers is 0.3 m above seat.

.4 Vertical centre of gravity of standing passengers is 1.0 m above deck.

.5 Passengers and luggage should be considered to be in the space normally at their disposal.

.6 Passengers should be distributed on available deck areas towards one side of the craft on the decks where muster stations are located and in such a way that they produce the most adverse heeling moment.

1.2.1.2 The stability of the craft should be verified, taking into account the assumptions in 1.2.1.1, for each of the following loading conditions:

.1 with full number of passengers and cargo and full provisions on board craft;

.2 with full number of passengers and cargo and with 10% of provisions; and

.3 without passengers and cargo and with 10% of provisions.

1.2.1.3 The stability of the craft in all modes of operation, except aircraft mode, should be additionally verified in calm water under the loading condition described in 1.2.1.2.2 but with 50% of the passengers located in their seats on one side from the craft centre line. The remaining passengers should be located in their seats and/or passageways and other spaces not allocated to individual passengers so as to result in maximum heeling moment towards the side on which passengers remain seated.

1.2.1.4 If in the normal operation of the craft a loading condition is used in which the reserves of stability are less than for the loading conditions described in 1.2.1.2 and 1.2.1.3 then the stability for that loading condition should be verified as well.

1.2.2 Intact stability in the displacement mode

1.2.2.1 Craft should have sufficient stability in calm water in all possible and permitted conditions of cargo stowage and with uncontrolled passenger movement so that a residual freeboard of 0.1 m is maintained in way of the datum described in 1.1.2.1.3 and all parts of fixed airfoils excluding flaps and ailerons.

1.2.2.2 The angle of heel under the combined action of heeling moments due to passenger crowding according to 1.2.1.3 and the greater of the moments due to wind and turning being determined experimentally should not exceed 8 degrees or the angle of entrance of the wing into the water, whichever is the less.

1.2.3 Buoyancy and stability in the displacement mode following damage

1.2.3.1 Following any of the postulated damages detailed in 1.1.4.5 to 1.1.4.7, the craft should have sufficient buoyancy and positive stability in still water to simultaneously ensure that:

.1 after flooding has ceased and a state of equilibrium has been reached, the final waterline is not less than 300 mm below the level of the openings described in 1.1.3.6.6;

.2 the angle of inclination of the craft from the horizontal does not normally exceed 10° in any direction. However, where this is clearly impractical, angles of inclination up to 15° immediately after damage but reducing to 10° within 15 min may be permitted provided that efficient non-slip deck surface and suitable holding points, e.g. holes and bars, are provided;

.3 there is a positive freeboard from the damage waterline to survival craft embarkation positions;

.4 any flooding of passenger compartments or escape routes which might occur will not significantly impede the evacuation of passengers;

.5 essential emergency equipment, emergency radios, power supplies and public address systems needed for organizing the evacuation remain accessible and operational; and

.6 the residual stability complies with the appropriate criteria as laid out in annex 5.

1.2.3.2 When damage occurs which does not prevent the safe transition of the craft from the displacement to the planing or ground effect modes, such that the craft may safely proceed without assistance to a port or place of refuge or to meet with a salvage ship, the operational procedures for the craft should not prevent such actions.

1.2.4 Inclining and stability information

1.2.4.1 At periodical intervals not exceeding annually, a weighing or lightweight survey should be carried out on all passenger craft to verify any changes in lightweight displacement and longitudinal centre of gravity. The passenger craft should be re-weighed or re-inclined whenever, in comparison with the approved stability information, a deviation from the lightweight displacement exceeding 0.5% or a deviation of the longitudinal centre of gravity exceeding 0.25% of L is found or anticipated.

1.2.4.2 A report of each weighing, inclining or lightweight survey carried out in accordance with 1.1.5.1 and of the calculation therefrom of the lightweight condition particulars should be submitted to the Administration for approval, together with a copy for their retention. The approved report should be placed on board the craft by the owner in the custody of the master and should incorporate such additions and amendments as the Administration may in any particular case require. The amended lightweight condition particulars so obtained from time to time should be used by the master in substitution for such previously approved particulars when calculating the craft's stability.

1.2.4.3 Following any weighing, inclining or lightweight survey, the master should be supplied with amended stability information if the Administration so requires. The information so supplied should be submitted to the Administration for approval, together with a copy thereof for their retention, and should incorporate such additions and amendments as the Administration may in any particular case require.

1.3 PROVISIONS FOR CARGO CRAFT

1.3.1 Buoyancy and stability in the displacement mode following damage

Following any of the postulated damage detailed in 1.1.4.5 to 1.1.4.7, the craft, in still water, should have sufficient buoyancy and positive stability to simultaneously ensure that:

.1 after flooding has ceased and a state of equilibrium has been reached, the final waterline 150 mm below the level of any opening referred to in 1.1.3.6.6;

.2 the angle of inclination of the craft from horizontal does not normally exceed 15° in any direction. However, where this is clearly impractical, angles of inclination up to 20° immediately after damage but reducing to 15° within 15 min may be permitted provided that efficient non-slip deck surface and suitable holding points, e.g. holes and bars, are provided;

.3 there is a positive freeboard from the damage waterline to survival craft embarkation positions;

.4 essential emergency equipment, emergency radios, power supplies and public address systems needed for organizing the evacuation remain accessible and operational; and

.5 the residual stability complies with the appropriate criteria as laid out in annex 5.

CHAPTER 2 – STRUCTURES

2.1 GENERAL

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 which are directly associated with the structure of the craft.

2.2 MATERIALS

Materials used for the hull and superstructure and the other features referred to in 2.1 should be adequate for the intended use of the craft.

2.3 STRUCTURAL STRENGTH

2.3.1 The structure should be capable of withstanding the static and dynamic loads which can act on the craft under all operating conditions in which the craft is permitted to operate, without such loading resulting in inadmissible deformation or loss of watertightness/ weathertightness or interfering with the safe operation of the craft.

2.3.2 The static and dynamic loads referred to in 2.3.1 include all anticipated loads in all conditions for which the craft is certified to operate, including, for example, emergency landing fully laden in critical design conditions.

2.3.3 Craft should be designed, constructed and maintained in compliance with the structural, mechanical and electrical requirements of a classification society which is recognized by the Administration in accordance with regulation XI-1/1 of the Convention, or with applicable national standards which provide an equivalent level of safety.

2.4 CYCLIC LOADS

Cyclic loads, including those from vibrations which can occur on the craft, should not:

.1 impair the integrity of structure during the anticipated service life of the craft or the service life agreed with the Administration;

.2 hinder normal functioning of machinery and equipment; and

.3 impair the ability of the crew to carry out its duties.

2.5 DESIGN CRITERIA

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.

2.6 TRIALS

If the Administration considers it necessary, it should require full-scale trials to be undertaken in which loads are determined. Cognizance should be taken of the results where these indicate those load assumptions or structural calculations have been inadequate.

CHAPTER 3 – ACCOMMODATION AND ESCAPE MEASURES

3.1 GENERAL

3.1.1 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.

3.1.2 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.

3.1.3 Passenger accommodation should not contain operating controls unless the operating controls are so protected and located that their operation by a crew member could not be impeded by passengers during normal and emergency conditions.

3.1.4 Windows in passenger and crew accommodation should be of adequate strength and suitable for the worst intended conditions specified in the Permit to Operate and be made of material which will not break into dangerous fragments if fractured.

3.1.5 The public spaces, crew accommodation and the equipment therein should be designed so that any person making proper use of these facilities will not suffer injury during the craft's normal and emergency start, stop and manoeuvring in normal cruise and in failure or maloperation conditions.

3.2 PUBLIC ADDRESS AND INFORMATION SYSTEM

3.2.1 A general emergency alarm system should be provided. The alarm should be audible throughout all the accommodation and normal crew working spaces and open decks, and the sound pressure level should be at least 10 dB(A) above ambient noise levels under way in normal cruise operation. The alarm should continue to function after it has been triggered until it is normally turned off or is temporarily interrupted by a message on the public address system.

3.2.2 There should be a public address system covering all areas where passengers and crew have access, escape routes, and places of embarkation into survival craft. The system should be such that flooding or fire in any compartment does not render other parts of the system inoperable. The public address system and its performance standards should be approved by the Administration having regard to the recommendations adopted by the Organization.*

* Refer to the *Recommendations on performance standards for public address systems on passenger ships, including cabling* (MSC/Circ.808) and the Code on Alerts and Indicators, 2009 (resolution A.1021(26)).

3.2.3 All passenger craft should be equipped with illuminated or luminous notices or video information system(s) visible to all sitting passengers, in order to notify them of safety measures.

3.2.4 The master should, by the means specified in 3.2.2 and 3.2.3, be able to request passengers to be seated and/or secure their seat belts when he finds this appropriate to safeguard passengers.

3.2.5 Emergency instructions including a general diagram of the craft showing the location of all exits, routes of evacuation, emergency equipment, life-saving equipment and illustration of lifejacket donning should be available to each passenger and placed near each passenger's seat.

3.3 DESIGN ACCELERATION LEVELS

3.3.1 For passenger craft, superimposed vertical accelerations above 1.0 g at longitudinal centre of gravity for more than one second measured RMS should be avoided unless special precautions are taken with respect to passenger safety.

3.3.2 Passenger craft should be designed with respect to the safety in, and escape from, the public spaces, crew accommodation and escape routes, including in way of life-saving appliances and emergency source of power. The size and type of craft together with its operational mode, speed, displacement and building material should be taken into consideration. Appropriate measures with regard to equipment, training and procedures should be implemented under part C to reduce the risk associated with collision to an acceptable level. Such measures should be detailed in the craft operational manual.

3.3.3 Limiting sea states for operation of the craft should be specified in the Permit to Operate for the operational range of mass and longitudinal centre of gravity and in the worst intended conditions in all modes. Operational information should be available on board for guidance, or the craft should have an instrument system for on-line check of operational performance. As a minimum, an audible and visual alarm should be fitted in the operating compartment to indicate excessive vertical acceleration. Operation of any automatic or electronic flight control system fitted should be based on measurements of linear and angular accelerations in all three axes close to the craft's longitudinal centre of gravity.

3.4 ACCOMMODATION DESIGN

3.4.1 The operating compartment, public spaces and crew accommodation should be located and designed to protect passengers and crew as much as practicable under the collision design condition.

3.4.2 The accommodation should be designed according to the guidelines given in table 3.4.1 or by other methods which have been proven to have equal protective qualities.

3.4.3 Equipment and baggage in public spaces and in the operator's compartment should be positioned and secured so that they remain in the stowed position when exposed to the collision design acceleration according to 3.4.2.

3.4.4 Seats, life-saving appliances and items of substantial mass and their supporting structure should not deform or dislodge under any loads up to those specified in 3.4.2 in any manner that would impede subsequent rapid evacuation of passengers.

3.4.5 There should be adequate handholds on both sides of any passage to enable passengers to steady themselves while moving about.

Table 3.4.1 – Overview general design guidelines*

Design level 1: collision load less than 3g	
1	Seat/seat belts
1.1	Low or high seatback
1.2	No restrictions on seating direction
1.3	Sofas allowed
1.4	No seat belts requirement
2	Tables in general allowed
3	Padding of projecting objects
4	Kiosks, bars, etc., no special restrictions
5	Baggage, no special provisions
6	Large masses, restrainment and positioning
Design level 2: collision load greater than 3g	
1	Seat/seat belts
1.1	High seatback with protective deformation and padding
1.2	Forward or backward seating direction
1.3	No sofas allowed as seat
1.4	Lap belt in seats when no protective structure forward
2	Tables with protective features allowed. Dynamic testing
3	Padding of projecting objects
4	Kiosks, bars, etc., on aft side of bulkheads, or other specially approved arrangements
5	Baggage placed with protection forward
6	Large masses, restrainment and positioning

3.5 SEATING CONSTRUCTION

3.5.1 There should be a seat or berth provided for each passenger and crew member which the craft is certified to carry. Such seats should be arranged in enclosed spaces.

3.5.2 Seats fitted in addition to those required under 3.5.1 and which are not permitted to be used in hazardous navigational situations or potentially dangerous weather or sea conditions need not comply with 3.5 or 3.6. Such seats should be secured according to 3.4.4 and clearly identified as not being able to be used in hazardous situations.

3.5.3 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 emergency equipment or means of escape.

3.5.4 Configuration of the cabin should minimize the possibility of injury and avoid trapping of the passengers after the assumed damage in the collision design condition according to annex 6. Dangerous projections and hard edges should be eliminated or padded.

* Other arrangements may be employed if an equivalent level of safety is achieved.

3.5.5 All seats, their supports and their deck attachments should have good energy-absorbing characteristics and should meet the requirements of annex 6.

3.6 SAFETY BELTS

3.6.1 One-hand-release safety belts of three-point type or with shoulder harness should be provided for all seats from which the craft may be operated for all craft with a collision load exceeding 3 g, as provided in 3.4.2.

3.6.2 Safety belts should be provided on passenger seats and crew seats, if necessary, to obtain the protective performance measures described in annex 6.

3.7 EXITS AND MEANS OF ESCAPE

3.7.1 In order to ensure immediate assistance from the crew in an emergency situation, the crew accommodation, including any cabins, should be located with due regard to easy, safe and quick access to the public spaces from inside the craft. For the same reason, easy, safe and quick access from the operating compartment to the passenger accommodation should be provided. On unassisted craft, exits should provide access to the alternative safe area required by 6.2.1.1.

3.7.2 The design of the craft should be such that all occupants may safely evacuate the craft into survival craft under all 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 the evacuation procedure, and the evacuation time to evacuate all passengers and crew should be demonstrated.

3.7.3 Public spaces, evacuation routes, exits, survival craft stowage, and the embarkation stations should be clearly and permanently marked and illuminated as provided in chapter 7.

3.7.4 Each enclosed public space and similar permanently enclosed space allocated to passengers or crew should be provided with at least two exits, arranged as far as practicable at the opposite ends of the space. Exits should be safely accessible and may comprise part of a normal boarding or disembarkation route.

3.7.5 Exit doors should be capable of being readily operated from inside and outside the craft in daylight and in darkness. The means of operation should be obvious, rapid and of adequate strength.

3.7.6 The closing, latching and locking arrangements for 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. The design of external doors should be such as to eliminate the possibility of jamming by ice or debris.

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

3.7.8 Sufficient space for a crew member should be provided adjacent to exits to facilitate the safe and rapid evacuation of passengers.

3.7.9 All 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.

3.7.10 Footholds, ladders, etc., provided to give access to exits from inside the craft should be of rigid construction and permanently fixed in position. Permanent handholds should be provided wherever necessary to assist persons using exits, and should be suitable for conditions where the craft has developed significant angles of list or trim.

3.7.11 At least two unobstructed evacuation paths should be available for the use of each person. Evacuation paths should be disposed such that adequate evacuation facilities will be available in the event of any likely damage or emergency conditions. Evacuation paths should have adequate lighting supplied from both the main and emergency sources of power.

3.7.12 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 lifejackets. There should be no protrusions in evacuation paths which could cause injury, ensnare clothing, damage lifejackets or restrict evacuation of disabled persons.

3.7.13 Adequate notices should be provided to direct passengers to exits.

3.7.14 Provision should be made on board for embarkation stations, if installed, to be properly equipped for evacuation of passengers into life-saving appliances. Such provision should include handholds, anti-skid treatment of the embarkation deck, and adequate space which is clear of cleats, bollards and similar fittings.

3.8 EVACUATION TIME

3.8.1 "Evacuation time" is the demonstrated time taken for a number of untrained people corresponding to the total number of passengers and crew to escape from the craft following the order to evacuate. The evacuation time should not exceed 7 minutes and 40 seconds or, where the structural fire protection time (T) is less than 30 minutes, a time of:

(T-7)/3 (minutes).

3.8.2 An evacuation procedure, including a critical path analysis, should be developed for the information of the Administration in connection with the approval of fire insulation plans and for assisting the owners and builders in planning the evacuation demonstration required in 3.8.3. The evacuation procedures should include:

.1 the emergency announcement made by the master;

.2 contact with the base port;

.3 the donning of lifejackets;

.4 manning of survival craft and emergency stations;

.5 the shutting down of machinery and oil fuel supply lines;

.6 the order to evacuate;

.7 the deployment of survival craft and marine escape systems;

.8 the bowsing in of survival craft;

.9 the supervision of passengers;

.10 the orderly evacuation of passengers under supervision;

.11 crew checking that all passengers have left the craft;

.12 the evacuation of crew; and

.13 releasing the survival craft from the craft.

3.8.3 Achievement of the required evacuation time (as ascertained in accordance with 3.8.1) should be verified by a practical demonstration conducted under controlled conditions on the craft or an identical craft and should be fully documented and verified for passenger craft by the Administration.

3.8.4 Evacuation demonstrations should be carried out with due concern for the problems of mass movement or panic acceleration likely to arise in an emergency situation when rapid evacuation is necessary. The evacuation demonstrations should be dry shod with the survival craft initially in their stowed positions and be conducted as follows:

.1 The evacuation time on all craft should be the time elapsed from the moment propulsion machinery is shut down and the first abandon craft announcement is given, with any passengers distributed in a normal voyage configuration, until the last person has embarked in a survival craft, and should include the time for passengers and crew to don lifejackets.

.2 For all craft the evacuation time should include the time necessary to launch, inflate and secure the survival craft alongside ready for embarkation.

3.8.5 Where an evacuation path is not shared between evacuation stations on both sides of the craft, the evacuation time for personnel using that path may be verified by an evacuation demonstration which should be performed using the survival craft and exits on one side, for which the critical path analysis indicates the greatest evacuation time, with the passengers and crew allocated to them.

3.8.6 On any other craft where a half trial is impracticable, the Administration may consider a partial evacuation trial using a route which the critical path analysis shows to be the most critical.

3.8.7 The demonstration should be carried out in controlled conditions in the following manner in compliance with the evacuation plan.

.1 The demonstration should commence with the craft afloat in the harbour, in reasonably calm conditions, with machinery and equipment operating in the normal seagoing condition.

.2 All exits and doors inside the craft should be in the same position as they are under normal seagoing condition.

.3 Safety belts, if required, should be fastened.

.4 The evacuation routes for all passengers and crew should be such that no person need enter the water during the evacuation.

3.8.8 For passenger craft, a representative composition of persons with normal health, height and weight should be used in the demonstration, and should consist of different sexes and ages so far as it is practicable and reasonable.

3.8.9 The persons, other than the crew selected for the demonstration, should not have been specially drilled for such a demonstration.

3.8.10 An emergency evacuation demonstration should be carried out for all new designs of high-speed craft and for other craft where evacuation arrangements differ substantially from those previously tested.

3.8.11 The specific evacuation procedure followed during the craft's initial demonstration on which certification is based should be included in the craft operating manual together with the other evacuation procedures contained in 3.8.2. During the demonstration, video recordings should be made, both inside and outside the craft, which should form an integral part of the training manual required by 17.2.

3.9 BAGGAGE, STORES, SHOPS AND CARGO COMPARTMENTS

3.9.1 Provisions should be made to prevent shifting of baggage, stores and cargo compartment contents, having due regard to occupied compartments and accelerations likely to arise. If safeguarding by positioning is not practicable, adequate means of restraint for baggage, stores and cargo should be provided. Shelves and overhead shelves for storage of carry-on baggage in passenger accommodation should be provided with adequate means to prevent the luggage from falling out in any conditions that may occur.

3.9.2 Controls, electric equipment, high-temperature parts, pipelines or other items, the damage or failure of which could affect the safe operation of the craft or which may require access by crew members during a voyage, 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, by unloading or by movement of the contents of the compartment.

3.9.3 Loading limits, if necessary, should be durably marked in those compartments.

3.9.4 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.

3.10 NOISE LEVELS

3.10.1 The noise level in crew and passengers' accommodations should be kept as low as possible to enable the public address system to be heard, and should not in general exceed 75 dB(A).

3.10.2 The maximum noise level in the operating compartment should not in general exceed 65 dB(A) to facilitate communication within the compartment and external radiocommunications.

CHAPTER 4 – DIRECTIONAL, ATTITUDE AND ALTITUDE CONTROL SYSTEMS

4.1 GENERAL

4.1.1 Craft should be provided with means for directional, attitude and altitude control of adequate strength and suitable design to enable the craft's attitude, altitude, heading and direction of travel to be effectively controlled to the maximum extent possible in the prevailing conditions and craft speed without undue physical effort at all speeds and in all conditions for which the craft is to be certificated. The performance should be verified through trials conducted in accordance with chapter 16 and annex 8.

4.1.2 Directional, attitude and altitude control may be achieved by means of air or water rudders, foils, flaps, propellers or jets which may be steerable, 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.

4.1.3 For the purpose of this chapter, a directional, attitude and altitude control system includes any propulsion, lift or steering devices, any mechanical linkages and all power or manual devices, controls and actuating systems.

4.1.4 Attention is drawn to the possibility of interaction between directional, attitude and altitude control systems and stabilization systems. Where such interaction occurs or where dual-purpose components are fitted, the provisions of 11.5 and chapters 15 and 16 should also be observed with, as applicable.

4.2 RELIABILITY

4.2.1 The probability of total failure of all directional, attitude and altitude 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.

4.2.2 A design incorporating a power drive or an actuation system employing powered components for normal directional, attitude and altitude control should provide a secondary means of actuating the device unless a redundant system or an alternative system is provided.

4.2.3 Any secondary means of actuating a directional, attitude and altitude control 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.

4.2.4 Directional, attitude and altitude control systems should be constructed so that a single failure in one drive or system, as appropriate, will not render any other control system inoperable or prevent the craft from being brought to a safe situation. The Administration may allow a short period of time to permit the connection of a secondary control device when the design of the craft is such that such delay will not, in its opinion, hazard the craft.

4.2.5 The SSA conducted under part C should include the directional, attitude and altitude control system.

4.2.6 If necessary to bring the craft to a safe condition, power drives for directional, attitude and altitude control devices, including those required to change propulsion thrust direction, should become operative automatically, and respond correctly, within a time that ensures that the safety of the craft is not prejudiced following power or other failure. Transitional arrangements may be used for this purpose.

4.2.7 Directional, attitude and altitude 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.

4.3 DEMONSTRATIONS

4.3.1 The limits of safe use of any of the control system devices, should be based on demonstrations and a verification process in accordance with chapter 16 and annex 8.

4.3.2 Demonstration in accordance with chapter 16 and annex 8 should determine any adverse effects upon safe operation of the craft in the event of any possible uncontrollable total deflection of any one control device or hard-linked series of devices. 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 should be included in the craft operating manual.

4.4 CONTROL POSITION

4.4.1 All directional, attitude and altitude control systems should be operated from the craft's operating station.

4.4.2 Adequate indications should be provided at the operating station to provide the person controlling the craft with verification of the correct response of the control devices, and also to indicate any abnormal responses or malfunction. The indications of directional, attitude and altitude response or rudder angle indicator should be independent of the system for directional, attitude and altitude control. The logic of such feedback and indications should be consistent with the other alarms and indications so that in an emergency operators are unlikely to be confused.

CHAPTER 5 – ANCHORING, TOWING AND BERTHING

5.1 GENERAL

5.1.1 WIG craft should be provided with a means of anchoring that is effective in all conditions for which the craft is certified. A primary assumption made in this chapter is that WIG craft will be fitted to be towed but will not generally be capable of towing other vessels.

5.1.2 The arrangements for anchoring, towing and berthing and the local craft structure, the design of the anchor, towing and berthing arrangements and the local craft structure should be such that risks to persons carrying out anchoring, towing or berthing procedures are kept to a minimum.

5.1.3 All anchoring equipment, including bitts, mooring bollards, fairleads, cleats and eyebolts, should be so constructed and attached to the hull that, in use up to design loads, the watertight integrity of the craft will not be impaired. Design loads and any directional limitations assumed should be listed in the craft operating manual.

5.2 ANCHORING

5.2.1 WIG craft should be provided with at least one anchor with its associated cable or cable and warp and means of recovery. Every craft should be provided with adequate and safe means for releasing the anchor and its cable and warp.

5.2.2 Good engineering practice should be followed in the design of any open or enclosed space containing the anchor-recovery equipment to ensure that persons using the equipment are not put at risk. Particular care should be taken with the means of access to such spaces, the illumination and protection from the cable and the recovery machinery.

5.2.3 Adequate arrangements should be provided for two-way voice communication between the operating compartment and persons engaged in dropping, weighing or releasing the anchor.

5.2.4 The anchoring arrangements should be such that any surfaces against which the cable may chafe are designed to prevent the cable from being damaged and fouled. Adequate arrangements should be provided to secure the anchor under all operational conditions.

5.2.5 The craft should be protected so as to minimize the possibility of the anchor and cable damaging the structure during normal operation.

5.3 TOWING

5.3.1 Adequate arrangements should be provided to enable the craft to be towed in the worst intended conditions. Where towage is to be from more than one point, a suitable bridle should be provided.

5.3.2 The towing arrangements should be such that any surface against which the towing cable may chafe (for example, fairleads) is of sufficient radius to prevent the cable being damaged when under load.

5.3.3 The maximum permissible speed at which the craft may be towed should be included in the craft operating manual.

5.4 BERTHING

5.4.1 Where necessary, suitable fairleads, bitts and mooring ropes should be provided.

5.4.2 Adequate storage space for mooring lines should be provided such that they are readily available and secured against the high relative wind speeds and accelerations which may be experienced.

CHAPTER 6 – FIRE SAFETY

6.1 GENERAL

6.1.1 General provisions

6.1.1.1 The following basic principles are underlying the provisions in this chapter and are embodied therein as appropriate, having regard to the category of craft and the potential fire hazard involved:

.1 for unassisted WIG craft, maintenance of the main functions and safety systems of the craft, including propulsion and control, fire-detection, alarms and extinguishing capability of unaffected spaces, after fire in any one compartment on board;

.2 for all other craft, maintenance of the safety systems of the craft, fire-detection, alarms and extinguishing capability of unaffected spaces, after fire in any one compartment on board;

.3 subdivision of the craft by fire-resisting boundaries;

.4 restricted use of combustible materials and materials generating smoke and toxic gases in a fire;

.5 detection, containment and extinction of any fire in the space of origin;

.6 protection of means of escape and access for firefighting;

.7 immediate availability of fire-extinguishing appliances; and

.8 maintenance of structural integrity during firefighting and evacuation time.

6.1.1.2 The provisions of this chapter are based on the following conditions:

.1 Where a fire is detected, the crew should immediately put into action the firefighting procedures and inform the base port of the accident.

.2 The use of fuel with a flashpoint below 43°C is not recommended. However, fuel with a lower flashpoint may be used subject to compliance with the provisions specified in 6.1.4.2.2 to 6.1.4.2.6. The use of fuel with a flashpoint lower than 35°C may be accepted by the Administration, provided that special safety measures are considered.

.3 The repair and maintenance of the craft should be carried out in accordance with the provisions given in chapters 17 and 18.

.4 Pantries and refreshment kiosks which do not contain cooking facilities with exposed heating surfaces should be fitted. Galleys should not be fitted.

.5 Dangerous goods should not be carried, except in accordance with requirements developed by the Organization for this purpose.

.6 Only authorized crew members should be permitted to enter cargo spaces at sea.

6.1.2 Definitions

6.1.2.1 *Fire-resisting divisions* are those divisions formed by bulkheads and decks which comply with the following:

.1 They should be constructed of non-combustible or fire-restricting materials which by insulation or inherent fire-resisting properties satisfy the provisions of 6.1.2.1.2 to 6.1.2.1.6.

.2 They should be suitably stiffened.

.3 They should be so constructed as to be capable of preventing the passage of smoke and flame up to the end of the appropriate fire protection time.

.4 Where required, they should maintain load-carrying capabilities up to the end of the appropriate fire protection time.

.5 They should have thermal properties such that the average temperature on the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 180°C above the original temperature during the appropriate fire protection time.

.6 A test of a prototype bulkhead or deck in accordance with the Fire Test Procedures Code should be required to ensure that it meets the above provisions.

6.1.2.2 *Fire-restricting materials* are those materials which have properties complying with the Fire Test Procedures Code.

6.1.2.3 *Fire Test Procedures Code* means the International Code for Application of Fire Test Procedures, 2010 (2010 FTP Code), as defined in chapter II-2 of the Convention.

6.1.2.4 *Non-combustible material* is 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 in accordance with the Fire Test Procedures Code. Any other material is a combustible material.

6.1.2.5 *Marine evacuation system (MES)* has the same meaning as in 7.1.10.3.

6.1.2.6 Where the words "steel or other equivalent material" occur, *equivalent material* means any non-combustible material which, by itself or due to insulation provided, has structural and integrity properties equivalent to steel at the end of the applicable exposure to the standard fire test (e.g. aluminium alloy with appropriate insulation).

6.1.2.7 *Low flame-spread* means that the surface thus described will adequately restrict the spread of flame, this being determined in accordance with the Fire Test Procedures Code.

6.1.2.8 *Smoke-tight* or *capable of preventing the passage of smoke* means that a division made of non-combustible or fire-restricting materials is capable of preventing the passage of smoke.

6.1.3 Structural fire protection

6.1.3.1 The boundaries of fire hazard areas should be constructed of approved non-combustible materials or other fire-restricting materials having adequate structural properties provided the provisions of this chapter are complied with and the materials are in compliance with the Fire Test Procedures Code.

6.1.3.2 The craft hull should be subdivided into fire hazard areas and low fire hazard areas by the fire-resistant structures.

.1 *Fire hazard areas* include:

- machinery spaces;

- spaces containing dangerous goods;

- store rooms containing flammable liquids;
- auxiliary machinery spaces, as defined in 4.3 of part A;
- crew accommodations; and
- service spaces.

.2 *Low fire hazard areas* include:

- auxiliary machinery spaces having little or no fire risk (APU, etc.);
- cargo spaces;
- fuel tank compartments;
- public spaces;
- tanks, voids and areas of little or no fire risk;
- bond stores containing packaged beverages with alcohol content no exceeding 24% by volume;
- control stations;
- external stairs and open decks used for escape routes;
- muster stations, internal and external;
- deck spaces and enclosed promenades forming survival craft embarkation stations; and
- the craft's side to the waterline in the lightest seagoing condition, superstructure and deck-houses sides situated below and adjacent to the liferaft and MES embarkation areas.

6.1.3.3 Structures bounding fire hazard areas should be constructed to resist the penetration of smoke and flame for 30 min or a lesser time determined in accordance with 3.8.4.

6.1.3.4 The structures specified in 6.1.3.3 should be satisfactorily tested against the appropriate requirements of "test procedures for fire-resisting divisions of high-speed craft" in the Fire Test Procedures Code.

6.1.3.5 The following structures should be constructed as fire-resisting structures, in accordance with 6.1.3.3:

.1 sides, decks, bulkheads bounding machinery spaces and auxiliary machinery spaces, pantries, baggage compartments, excluding uninsulated metallic divisions in contact with the water in the displacement mode with the craft in lightweight condition;

.2 decks and bulkheads separating control stations from the adjacent compartments; and

.3 decks and bulkheads separating cargo compartments from control stations, passenger compartments and evacuation routes.

6.1.3.6 Main load-carrying structures within areas of fire hazard should be arranged to distribute load such that there will be no collapse of the structure of the craft when it is exposed to fire for the appropriate fire protection time. The load-carrying structure should also comply with the relevant provisions of 6.1.3.4 and 6.1.1.1.7.

6.1.3.7 A control station for ventilators, for fuel shut down system, remote control of fire-extinction systems as well as indication panels of fire detection, should be located in the craft operating compartment.

6.1.3.8 Where insulation is installed in areas in which it could come into contact with any flammable fluids or their vapours, its surface should be impermeable to such flammable fluids or vapours. The exposed surfaces of vapour barriers and adhesives used in conjunction with insulation materials should have low flame spread characteristics.

6.1.3.9 Furniture and furnishings in public spaces and crew accommodation should comply with the following standards:

.1 all case furniture should be constructed entirely of approved non-combustible materials, except that combustible veneers may be accepted, but should be made of a material having low flame spread characteristics;

.2 all other furniture, such as chairs, sofas and tables, is constructed with frames of non-combustible materials;

.3 all draperies, curtains and other suspended textile materials have qualities of resistance to the propagation of flame in accordance with the Fire Test Procedures Code;

.4 all upholstered furniture has qualities of resistance to the ignition and propagation of flame in accordance with the Fire Test Procedures Code; and

.5 all deck finish materials comply with the Fire Test Procedures Code.

6.1.3.10 The following surfaces should, as a minimum standard, be constructed of materials having low flame-spread characteristics:

.1 exposed surfaces in corridors and stairway enclosures, and of bulkheads, wall and ceiling linings in all accommodation, service spaces, control stations and internal assembly and evacuation stations; and

.2 surfaces in concealed or inaccessible spaces in corridors and stairway enclosures, accommodation, service spaces, control stations corridors and stairway enclosures.

6.1.3.11 Any thermal or acoustic insulation should be of non-combustible or of fire-restricting material. Vapour barriers and adhesives used in conjunction with insulation, as well as insulation of pipe fittings for cold service systems, need not be non-combustible or fire-restricting, but they should be kept to the minimum quantity practicable and their exposed surfaces should have low flame-spread characteristics.

6.1.3.12 Exposed surfaces in corridors and stairway enclosures, and of bulkheads (including windows) wall and ceiling linings, in all public spaces, crew accommodation, service spaces, control stations and internal assembly and evacuation stations should be constructed of materials which, when exposed to fire, are not capable of producing excessive quantities of smoke or toxic products, this being determined in accordance with the Fire Test Procedures Code.

6.1.3.13 In accommodation and service spaces, control stations, corridors and stairways, air spaces enclosed behind ceilings, panelling or linings should be suitably divided by close-fitting draught stops not more than 14 m apart.

6.1.3.14 Openings in fire-resisting divisions

6.1.3.14.1 The construction of all doors and hatches in fire-resisting divisions, together with associated door frames, coamings and their means of securing when closed, should provide resistance to fire as well as to the passage of smoke and flame equivalent to that of the bulkheads in which they are situated. Also, where a fire-resisting division is penetrated by pipes, ducts, controls, electrical cables or for other purposes, arrangements and necessary testing should be made to ensure that the fire-resisting integrity of the division is not impaired.

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

6.1.3.14.3 Fire doors bounding areas of major fire hazard and stairway enclosures should satisfy the following provisions:

.1 The doors should be either self-closing in all normal operational conditions or kept closed at all times when not required for access.

.2 Self-closing doors may be fitted with a hold-back system capable of both local release and remote fail-safe release from the operating compartment. Hold-back hooks not subject to release from the operating compartment are not permitted.

6.1.3.14.4 The provisions for integrity of fire-resisting divisions of the outer boundaries facing open spaces of a craft should not apply to glass partitions and windows. Similarly, the provisions for integrity of fire-resisting divisions facing open spaces should not apply to exterior doors.

6.1.3.15 For purposes indicated in 6.1.3.9 and 6.1.3.10 it is permitted to use a restricted amount of combustible materials which propagate flame slowly provided that structural, active and other measures are taken for ensuring the necessary level of the fire safety.

6.1.4 Provisions for systems and equipment

6.1.4.1 Ventilation

6.1.4.1.1 Where the methods of fire extinction used in ventilated spaces require the isolation of those spaces to be effective, the main inlets and outlets of all ventilation systems should be capable of being closed from outside the spaces being ventilated. In such cases, the main inlets and outlets of ventilation systems for fire hazard areas should be capable of being closed from the operating compartment.

6.1.4.1.2 All ventilation fans should be capable of being stopped from the operating compartment. The operating procedures for the craft should ensure that this control is always activated before any evacuation unless an emergency shut-off control is provided in a position readily accessible from outside the craft.

6.1.4.1.3 Ventilation ducts for areas of fire hazard should not pass through other spaces, and ducts for ventilation of other spaces should not pass through areas of major fire hazard.

6.1.4.1.4 All dampers fitted on fire-resisting or smoke-tight divisions should also be capable of being manually closed from each accessible side of the division in which they are fitted, and remotely closed from the operating compartment.

6.1.4.1.5 Where, of necessity, a ventilation duct passes through a fire-resisting or smoke-tight division, a fail-safe automatic closing fire damper should be fitted adjacent to the division. The duct between the division and the damper should be insulated to the same standard as required for the fire-resisting division.

6.1.4.2 Fuel system

6.1.4.2.1 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.

6.1.4.2.2 Fuel oil tanks should not be located in or contiguous to areas of major fire hazard. However, flammable fluids of a flashpoint of not less than 60°C may be located within such areas, provided the tanks are made of steel or other equivalent material.

6.1.4.2.3 Every fuel oil pipe which, if damaged, would allow oil to escape from a storage tank should be fitted with a cock or valve directly on the tank capable of being closed from a position outside the space concerned in the event of a fire occurring in the space in which such tanks are situated.

6.1.4.2.4 Pipes, valves and couplings conveying flammable fluids should be of steel or such alternative material satisfactory to a standard* 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.

6.1.4.2.5 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.

6.1.4.2.6 In every craft in which fuel with a flashpoint below 43°C is used, the arrangements for the storage, distribution and utilization of the fuel should be such that, having regard to the hazard of fire and explosion which the use of such fuel may entail, the safety of the craft and of persons on board is preserved. The arrangements should comply, in addition to the provisions of 6.1.4.2.1 to 6.1.4.2.5, with the following provisions:

.1 any part of the fuel system should be located outside the main body of the craft or arranged in such a way that fuel vapour cannot accumulate in enclosed spaces;

* Refer to the *Guidelines for the application of plastic pipes on ships*, adopted by the Organization by resolution A.753(18), as amended.

.2 arrangements should be made to prevent overpressure in any fuel tank or in any part of the oil fuel system, including the filling pipes. Any relief valves and air or overflow pipes should discharge to a position which, in the opinion of the Administration, is safe;

.3 earthed electrical distribution systems should not be used, with the exception of earthed intrinsically safe circuits;

.4 suitable certified safe type* electrical equipment should be used in all spaces where fuel leakage could occur, including the ventilation system. Only electrical equipment and fittings essential for operational purposes be fitted in such spaces;

.5 a fixed vapour-detection system should be installed in each space through which fuel lines pass, with alarms provided at the operating compartment;

.6 any fuel gauge installation should be of intrinsic safe type;

.7 during bunkering operations, no passenger should be on board the craft or in the vicinity of the bunkering station, and adequate "No Smoking" and "No Naked Lights" signs should be posted. Vessel-to-shore fuel connections should be of a type that minimises the chance of ignition of any vapour generated during refuelling and should be suitably grounded during bunkering operations;

.8 the provision of fire detection and extinguishing systems in spaces where non-integral fuel tanks are located should be in accordance with 6.1.5; and

.9 refuelling of the craft should be done at approved refuelling facilities, detailed in the route operational manual, where fire appliances are provided, suitable for the amount and type of fuel being bunkered.

6.1.4.3 Hydraulic system

The hydraulic liquid used should be of non-combustible type.

6.1.4.4 Exhaust system

6.1.4.4.1 Exhaust gas pipes should be arranged so that the risk of fire is kept to a minimum. To this effect, the exhaust system should be insulated and all 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 be shielded and insulated with non-combustible material to protect them from high temperatures.

6.1.4.4.2 The design and arrangement of the exhaust manifolds or pipes should be such as to ensure the safe discharge of exhaust gases.

* Refer to the Recommendations published by the International Electrotechnical Commission and, in particular, publication 92 – Electrical Installations in Ships.

6.1.5 Fire detection systems

6.1.5.1 Fire hazard areas and other enclosed spaces in the accommodation not regularly occupied, or directly observable by the operating crew, such as toilets, stairway enclosures and corridors, should be provided with an approved automatic smoke-detection system to indicate at the operating compartment the location of outbreak of a fire in all normal operating conditions of the installations. Main propulsion machinery compartments should in addition have detectors sensing other than smoke monitored from the operating compartment. When the crew cannot see all passengers on board, manually operated call points should be installed throughout the accommodation spaces and service spaces. One manually operated call point should be located at each exit from these spaces and from areas of major fire hazard, if direct communication with the operating compartment is not possible.

6.1.5.2 The fixed fire-detection and fire alarm systems should comply with the following provisions.

6.1.5.2.1 General requirements

.1 Any required fixed fire-detection and fire alarm system with manually operated call points should be capable of immediate operation at all times.

.2 Power supplies and electric circuits necessary for the operation of the system should be monitored for loss of power or fault conditions as appropriate. Occurrence of a fault condition should initiate a visual and audible fault signal at the control panel which should be distinct from a fire signal.

.3 There should be not less than two sources of power supply for the electrical equipment used in the operation of the fixed fire-detection and fire alarm system, one of which should be an emergency source. The supply should be provided by separate feeders reserved solely for that purpose. Such feeders should run to an automatic change-over switch situated in or adjacent to the control panel for the fire-detection system.

.4 Detectors and manually operated call points should be grouped into sections. The activation of any detector or manually operated call point should initiate a visual and audible fire signal at the control panel and indicating units. If the signals have not received attention within thirty seconds, an audible alarm should be automatically sounded throughout the crew accommodation and service spaces, control stations and machinery spaces. This alarm sounder system need not be an integral part of the detection system.

.5 The control panel should be located in the operating compartment.

.6 Indicating units should, as a minimum, denote the section in which a detector or manually operated call point has operated. One unit should be located in the operating compartment. In craft other than category A, another indicating unit should be located as far away from the operating compartment as practicable, in a location that is easily accessible to responsible members of the crew at all times, when at sea or in port, except when the craft is out of service.

.7 Clear information should be displayed on or adjacent to each indicating unit about the spaces covered and the location of the sections.

.8 Where the fire-detection system does not include means of remotely identifying each detector individually, no section covering more than one deck should normally be permitted, except a section which covers an enclosed stairway. In order to avoid delay in identifying the source of fire, the number of enclosed spaces included in each section should be not more than 10 unless the detection system is fitted with remotely and individually identifiable fire detectors, in which case the sections may cover several decks and serve any number of enclosed spaces.

.9 A section of fire detectors which covers the operating compartment, a service space or an accommodation space, should not include any other fire hazard area.

.10 Detectors should be operated by heat, smoke or other products of combustion, flame, or any combination of these factors. Detectors operated by other factors indicative of incipient fires may be considered by the Administration, provided that they are no less sensitive than such detectors. Flame detectors should only be used in addition to smoke or heat detectors.

.11 Operating procedures for the craft should include regular testing of the function of the detection system and its components in accordance with the manufacturer's recommendations.

.12 The fire-detection system should not be used for any other purpose, except that closing of fire doors and similar functions may be permitted at the control panel.

.13 Fire-detection systems with a zone address identification capability should be so arranged that:

.1 a loop cannot be damaged at more than one point by a fire;

.2 means are provided to ensure that any fault (e.g. power break, short circuit, earth) occurring in the loop should render the whole loop ineffective;

.3 arrangements are made to enable the initial configuration of the system to be restored in the event of failure (electrical, electronic, informatic); and

.4 the first initiated fire alarm should not prevent initiation of further fire alarms by any other detector.

6.1.5.2.2 Installation provisions

.1 Manually operated call points should be installed throughout the accommodation spaces and service spaces. One manually operated call point should be located at each exit and in each corridor at intervals of no more than 20 m.

.2 Smoke detectors should be installed in all stairways, corridors and escape routes within accommodation spaces at intervals of not more than 20 m. Consideration should be given to the installation of special purpose smoke detectors within ventilation ducting.

.3 Where a fixed fire-detection and fire alarm system is required for the protection of spaces other than those specified in .2, at least one detector complying with 6.1.5.2.1.10 should be installed in each such space.

.4 Detectors should be located for optimum performance. Positions near beams and ventilation ducts or other positions where patterns of air flow could adversely affect performance and positions where impact or physical damage is likely should be avoided. In general, detectors which are located on deckheads or ceilings should be a minimum distance of 0.5 m away from bulkheads.

.5 The maximum spacing of detectors should be in accordance with the table below:

Type of detector	Maximum floor area per detector	Maximum distance apart between centres	Maximum distance away from bulkheads
Heat	37 m^2	9 m	4.5 m
Smoke	74 m^2	11 m	5.5 m

The Administration may require or permit other spacings, based upon test data which demonstrate the characteristics of the detectors.

.6 Electrical wiring which forms part of the system should be so arranged as to avoid any enclosed spaces of fire hazard except, where it is necessary, to provide for fire detection or fire alarm in such spaces or to connect to the appropriate power supply.

6.1.5.2.3 Design provisions

.1 The system and equipment should be suitably designed to withstand supply voltage variation and transients, ambient temperature changes, vibration, humidity, shock, impact and corrosion normally encountered in ships.

.2 Smoke detectors, referred to in paragraph 6.1.5.2.2.2 should be certified to operate before the smoke density exceeds 12.5% obscuration per metre, but not until the smoke density exceeds 2% obscuration per metre. Smoke detectors to be installed in other spaces should operate within sensitivity limits to the satisfaction of the Administration, having regard to the avoidance of detector insensitivity or over-sensitivity.

.3 Heat detectors should be certified to operate before the temperature exceeds 78°C but not until the temperature exceeds 54°C, when the temperature is raised to those limits at a rate less than 1°C per minute. At higher rates of temperature rise, the heat detector should operate within temperature limits, having regard to the avoidance to detector insensitivity or over-sensitivity.

.4 At the discretion of the Administration, the permissible temperature of operation of heat detectors may be increased to 30°C above the maximum deckhead temperature in drying rooms and similar spaces of a normal high ambient temperature.

.5 Flame detectors corresponding to 6.1.5.2.1.10 should have sensitivity sufficient to determine flame against an illuminated space background and a false signal identification system.

6.1.5.3 A fixed fire-detection and fire alarm system for machinery spaces should comply with the following provisions:

.1 The fire-detection system should be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in spaces of restricted height and where their use is especially appropriate, detection systems using only thermal detectors should not be permitted. The detection system should initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places.

.2 After installation, the system should be tested under varying conditions of engine operation and ventilation.

6.1.6 Firefighting systems and equipment

6.1.6.1 General provisions

6.1.6.1.1 All craft should be provided with the necessary number of portable fire extinguishers according to 6.1.6.2.

6.1.6.1.2 Unassisted craft certified for carriage of more than 80 passengers and cargo craft of more than 50 m in length should be fitted with a fixed water firefighting system for operation in the displacement mode as follows:

.1 At least one independently driven fire pump. The capacity of the fire pump, acting through a fire main and hoses, should be sufficient to project at least one jet of water to each part of the craft. This should be based on a length of throw of 12 m from nozzle of 12 mm diameter. The minimum pump capacity should be 10 m^3/h.

.2 The fire main should be so arranged that a water jet can be projected to each part of the craft through a single length of hose not exceeding 20 m. At least two fire hydrants should be provided.

.3 Each fire hose should be of non-perishable material. Fire hoses, together with any necessary fittings and tools, should be kept ready for use in conspicuous positions near the hydrants. All fire hoses in interior locations should be connected to the hydrants at all times. One fire hose should be provided for each hydrant as required by .2.

.4 Each fire hose should be provided with a nozzle of an approved dual purpose type (i.e. spray/jet type) incorporating a shutoff.

6.1.6.1.3 In addition, fire hazard areas other than crew accommodation and service spaces in all craft should be protected by approved fixed extinguishing system(s) adequate for the fire hazard that may exist and operable from the operating compartment. For this purpose, main machinery located outside of the watertight and weathertight structure of the craft should be treated as fire hazard areas. In craft other than assisted craft, the system(s) should also be capable of local manual control.

6.1.6.1.4 The firefighting system should meet the provisions of 6.1.6.1 to 6.1.6.3. Depending on size, craft characteristics and operational area, alternative arrangements may be accepted by the Administration.

6.1.6.2 Portable fire extinguishers

Operating compartments, public spaces and service spaces should be provided with portable fire extinguishers of appropriate types. Sufficient portable extinguishers should be provided and so positioned as to be readily available for immediate use. However, the total number of portable fire extinguishers provided needs not exceed the total number of enclosed spaces in the craft but should not be less than two for the smallest of craft. Each extinguisher for use in a personnel compartment should be designed to minimize the hazard of toxic gas concentration. In addition, at least one extinguisher suitable for machinery space fires should be positioned outside each machinery space.

6.1.6.3 Gas fire-extinguishing systems

In all craft where gas is used as the extinguishing medium, the quantity of gas should be sufficient to provide two independent discharges. The second discharge into the space should only be activated (released) manually from a position outside the space being protected. Where the space has a second fixed means of extinguishing installed, the second discharge should not be required.

6.1.6.3.1 General provisions

The fixed fire-extinguishing systems should comply with the following provisions:

.1 The use of a fire-extinguishing medium which, in the opinion of the Administration, either by itself or under expected conditions of use will adversely affect the earth's ozone layer and/or gives off toxic gases in such quantities as to endanger persons should not be permitted.

.2 The necessary pipes for conveying fire-extinguishing medium into protected spaces should be provided with control valves so marked as to indicate clearly the spaces to which the pipes are led. Non-return valves should be installed in discharge lines between cylinders and manifolds. Suitable provision should be made to prevent inadvertent admission of the medium to any space.

.3 The piping for the distribution of fire-extinguishing medium should be arranged and discharge nozzles so positioned that a uniform distribution of medium is obtained.

.4 Means should be provided to close all openings which may admit air to, or allow gas to escape from, a protected space.

.5 Where the volume of free air contained in air receivers in any space is such that, if released in such space in the event of fire, such release of air within that space would seriously affect the efficiency of the fixed fire-extinguishing system, the Administration should require the provision of an additional quantity of fire-extinguishing medium.

.6 Means should be provided for automatically giving audible warning of the release of fire-extinguishing medium into any space in which personnel normally work or to which they have access. The alarm should operate for a suitable period before the medium is released.

.7 The means of control of any fixed gas fire-extinguishing system should be readily accessible and simple to operate and should be grouped together in the operating compartment and, for craft other than assisted craft, in another readily accessible location as far away from the operating compartment as practicable but not likely to be cut off by a fire in a protected space. At each location there should be clear instructions relating to the operation of the system, having regard to the safety of personnel.

.8 Automatic release of fire-extinguishing medium should not be permitted.

.9 Where the quantity of extinguishing medium is required to protect more than one space, the quantity of medium available need not be more than the largest quantity required for any one space so protected.

.10 Pressure containers required for the storage of fire-extinguishing medium should be located outside protected spaces in accordance with 6.1.6.3.1.13.

.11 Means should be provided for the crew to safely check the quantity of medium in the containers.

.12 Containers for the storage of fire-extinguishing medium and associated pressure components should be designed to pressure codes of practice to the satisfaction of the Administration having regard to their locations and maximum ambient temperatures expected in service.

.13 When the fire-extinguishing medium is stored outside a protected space, it should be stored in a room which should be situated in a safe and readily accessible position and should be effectively ventilated. Any entrance to such a storage room should preferably be from the open deck and in any case should be independent of the protected space. Access doors should open outwards, and bulkheads and decks including doors and other means of closing any opening therein, which form the boundaries between such rooms and adjoining enclosed spaces, should be gas tight. Such storage rooms should be treated as control rooms.

.14 Spare parts for the system should be stored on board or at a base port.

6.1.6.3.2 Carbon dioxide systems

In addition to 6.1.6.3.1, the following should be met for CO_2 systems:

.1 For machinery spaces, the quantity of carbon dioxide carried should be sufficient to give a minimum volume of free gas equal to the larger of the following volumes, either:

  .1 40% of the gross volume of the largest machinery space so protected, the volume to exclude that part of the casing above the level at which the horizontal area of the casing is 40% or less of the horizontal area of the space concerned taken midway between the tank top and the lowest part of the casing; or

  .2 35% of the gross volume of the largest machinery space protected, including the casing.

.2 For the purpose of this paragraph the volume of free carbon dioxide should be calculated at 0.56 m^3/kg.

.3 For machinery spaces, the fixed piping system should be such that 85% of the gas can be discharged into the space within 2 min.

.4 Two separate controls should be provided for releasing carbon dioxide into a protected space and to ensure the activation of the alarm. One control should be used to discharge the gas from its storage containers. A second control should be used for opening the valve of the piping which conveys the gas into the protected spaces if the CO_2 protects more than one space.

.5 The two controls should be located inside a release box clearly identified for the particular space if the CO_2 protects more than one space. If the box containing the controls is to be locked, a key to the box should be in a break-glass type enclosure conspicuously located adjacent to the box.

6.1.7 Fire control plans

6.1.7.1 There should be permanently exhibited, for the guidance of the master and officers of the craft, fire control plans showing clearly for each deck the following positions: the control stations, the sections of the craft which are enclosed by fire-resisting divisions together with particulars of the fire alarms, fire detection systems, the sprinkler installations, the fixed and portable fire-extinguishing appliances, the means of access to the various compartments and decks in the craft, the ventilating system (including particulars of the master fan controls, the positions of dampers and identification numbers of the ventilating fans serving each section of the craft), the location of the international shore connection, if fitted, and the position of all means of control referred to in 6.1.4.1.2, 6.1.4.2.3, 6.1.5.1. The text of such plans* should be in the official language of the flag state. However, if the language is neither English, French nor Spanish, a translation into one of those languages should be included.

6.1.7.2 A duplicate set of fire control plans or a booklet containing such plans should be permanently stored in a prominently marked weathertight enclosure outside the deckhouse for the assistance of shore-side firefighting personnel.

* Refer to *Graphical symbols for shipboard fire control plans*, adopted by the Organization by resolution A.952(23).

6.1.8 Fireman's outfit

6.1.8.1 Unassisted craft certified for carriage of more than 80 passengers and cargo craft of more than 50 m in length should carry a fireman's outfit complying with the requirements of 6.1.8.3.

6.1.8.1.1 In addition, there should be provided in unassisted passenger craft for every 80 m, or part thereof, of the aggregate of the length of all passenger spaces and service spaces on the deck which carries such spaces or, if there is more than one such deck, on the deck which has the largest aggregate of such length, one fireman's outfit and one set of personal equipment, comprising the items stipulated in 6.1.8.3.1.1 to 6.1.8.3.1.3.

6.1.8.1.2 The Administration may require additional sets of personal equipment and breathing apparatus, having due regard to the size and type of the craft.

6.1.8.2 Any fireman's outfits and sets of personal equipment should be so stored, adjacent to the operating compartment, as to be easily accessible and ready for use.

6.1.8.3 A fireman's outfit should consist of:

.1 Personal equipment comprising:

  .1 protective clothing of material to protect the skin from the heat radiating from the fire and from burns and scalding by steam or gases. The outer surface should be water-resistant;

  .2 boots and gloves of rubber or other electrically non-conductive material;

  .3 a rigid helmet providing effective protection against impact;

  .4 an electric safety lamp (hand lantern) of an approved type with a minimum burning period of 3 h; and

  .5 an axe.

.2 A breathing apparatus of an approved type which may be either:

  .1 a smoke helmet or smoke mast, which should be provided with a suitable air pump and a length of air hose sufficient to reach from the open deck, well clear of hatch or doorway, to any part of the craft. If, in order to comply with this subparagraph, an air hose exceeding 36 m in length would be necessary, a self-contained breathing apparatus should be substituted or provided in addition, as determined by the Administration; or

  .2 a self-contained compressed-air-operated breathing apparatus, the volume of air contained in the cylinders of which should be at least 1,200 *l*, or other self-contained breathing apparatus, which should be capable of functioning for at least 30 min. A number of spare charges, suitable for use with the apparatus provided, should be available on board.

.3 For each breathing apparatus a fireproof lifeline of sufficient length and strength should be provided capable of being attached by means of a snaphook to the harness of the apparatus or to a separate belt in order to prevent the breathing apparatus becoming detached when the lifeline is operated.

6.2 PROVISIONS FOR PASSENGER CRAFT

6.2.1 Arrangement

6.2.1.1 For unassisted craft, the public spaces should be divided into zones according to the following:

.1 The craft should be divided into at least two zones. The mean length of each zone should not exceed 20 m.

.2 For the occupants of each zone there should be an alternative safe area to which it is possible to escape in case of fire. The alternative safe area should be separated from other passenger zones by smoke-tight divisions of non-combustible materials or fire-restricting materials extending from deck to deck. The alternative safe area can be another passenger zone, provided the additional number of passengers may be accommodated in an emergency.

.3 The alternative safe area should, as far as practicable, be located adjacent to the passenger zone it is intended to serve. There should be at least two exits from each passenger zone, located as far away from each other as possible, leading to the alternative safe area. Escape routes should be provided to enable all passengers and crew to be safely evacuated from the alternative safe area.

6.2.1.2 Assisted craft need not be divided into zones.

6.2.1.3 The operating compartment, stowage positions of life-saving appliances, escape routes and places of embarkation into survival craft should not, as far as practicable, be located adjacent to any fire hazard areas.

6.2.2 Ventilation

The ventilation fans of each zone in the accommodation spaces should also be capable of being independently controlled from the operating compartment.

6.2.3 Fire extinguishers

The following number of hand fire extinguishers must be conveniently located and evenly distributed in passenger compartments:

Passenger capacity	Number of extinguishers
12 to 30	1
31 to 60	2
61 to 200	3
201 to 300	4
301 to 400	5
401 to 500	6
501 to 600	7
601 to 700	8

6.3 PROVISIONS FOR CARGO CRAFT

6.3.1 Arrangement

Crew accommodation areas should be located adjacent to operating compartments, life-saving appliances stowage positions, escape routes and places of embarkation into survival craft.

6.3.2 Cargo spaces

6.3.2.1 Cargo spaces, except open deck areas or refrigerated holds, should be provided with an approved automatic smoke-detection system complying with 6.1.5.2 to indicate at the control station the location of outbreak of a fire in all normal operating conditions of the installations and should be protected by an approved fixed quick-acting fire-extinguishing system complying with 6.1.6.1.3 operable from the control station.

6.3.2.2 For cargo spaces, the quantity of carbon dioxide available should, unless otherwise provided, be sufficient to give a minimum volume of free gas equal to 30% of the gross volume of the largest cargo space so protected in the craft.

CHAPTER 7 – LIFE-SAVING APPLIANCES AND ARRANGEMENTS

7.1 GENERAL AND DEFINITIONS

7.1.1 Life-saving appliances and arrangements should enable abandonment of the craft in accordance with the provisions of 3.7 and 3.8.

7.1.2 Except where otherwise provided in these Guidelines, the life-saving appliances and arrangements required by this chapter should meet the detailed specifications set out in the LSA Code* and, where required, be approved by the Administration.

7.1.3 Before giving approval to life-saving appliances and arrangements, the Administration should ensure that such life-saving appliances and arrangements:

- .1 are tested to confirm that they comply with the provisions of this chapter, in accordance with the recommendations of the Organization;* or
- .2 have successfully undergone, to the satisfaction of the Administration, tests which are substantially equivalent to those specified in those recommendations.

7.1.4 Before giving approval to novel life-saving appliances or arrangements, the Administration should ensure that such appliances or arrangements:

- .1 provide safety standards at least equivalent to the provisions of this chapter and have been evaluated and tested in accordance with the recommendations of the Organization;** or

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* The International Life-Saving Appliance Code, adopted by the Maritime Safety Committee of the Organization by resolution MSC.48(66), as amended.

* Refer to the *Revised recommendation on testing of life-saving appliances*, adopted by the Maritime Safety Committee of the Organization by resolution MSC.81(70), as amended.

** Refer to the Code of Practice for the Evaluation, Testing and Acceptance of Prototype Novel Life-Saving Appliances and Arrangements, adopted by the Organization by resolution A.520(13).

.2 have successfully undergone, to the satisfaction of the Administration, evaluation and tests which are substantially equivalent to those recommendations.

7.1.5 Before accepting life-saving appliances and arrangements that have not been previously approved by the Administration, the Administration should be satisfied that life-saving appliances and arrangements comply with the provisions of this chapter.

7.1.6 Except where otherwise provided in these Guidelines, life-saving appliances required by this chapter for which detailed specifications are not included in the LSA Code should be to the satisfaction of the Administration.

7.1.7 The Administration should require life-saving appliances to be subjected to such production tests as are necessary to ensure that the life-saving appliances are manufactured to the same standard as the approved prototype.

7.1.8 Procedures adopted by the Administration for approval should also include the conditions whereby approval would continue or would be withdrawn.

7.1.9 The Administration should determine the period of acceptability of life-saving appliances which are subject to deterioration with age. Such life-saving appliances should be marked with a means for determining their age or the date by which they should be replaced.

7.1.10 For the purposes of this chapter, unless expressly provided otherwise:

.1 *Embarkation station* is the place from which a survival craft is boarded. An embarkation station may also serve as a muster station, provided there is sufficient room, and the muster station activities can safely take place there.

.2 *Immersion suit* is a protective suit which reduces the body heat-loss of a person wearing it in cold water.

.3 *Marine evacuation system (MES)* is an appliance designed to rapidly transfer a large number of persons from an embarkation station by means of a passage to a floating platform for subsequent embarkation into associated survival craft or directly into associated survival craft.

.4 *Rescue boat* is a boat designed to assist and rescue persons in distress and to marshal survival craft.

.5 *Survival craft* is a craft capable of sustaining the lives of persons in distress from the time of abandoning the craft.

7.2 COMMUNICATIONS

Craft should be provided with communications equipment and facilities in accordance with the requirements of the Convention in relation to:

.1 radio life-saving appliances;

.2 distress flares;

.3 onboard communication and alarm systems; and

.4 on passenger craft, public address systems.

7.3 PERSONAL LIFE-SAVING APPLIANCES

7.3.1 Passengers should not have access to exposed decks in normal operating conditions. However, where they have such access, personal life-saving appliances should be provided in accordance with the 2000 HSC Code.*

7.3.2 A lifejacket complying with the requirements of paragraph 2.2.1 or 2.2.2 of the LSA Code should be provided for every person on board the craft and, in addition:

.1 a number of lifejackets suitable for children equal to at least 10% of the number of passengers on board should be provided or such greater number as may be required to provide a lifejacket for each child. These lifejackets should be stowed in readily accessible and conspicuous places;

.2 every passenger craft should carry lifejackets for not less than 5% of the total number of persons on board. These lifejackets should be stowed in readily accessible and conspicuous places;

.3 a sufficient number of lifejackets should be carried for persons on watch and for use at remotely located survival craft and rescue boat stations; and

.4 all lifejackets should be fitted with a light, which complies with the requirements of paragraph 2.2.3 of the LSA Code.

7.3.3 Lifejackets should be so placed as to be readily accessible and their positions should be clearly indicated.

7.3.4 An immersion suit, of an appropriate size, complying with the requirements of paragraph 2.3 of the LSA Code should be provided for every person assigned to crew any rescue boat fitted to the craft.

7.3.5 An immersion suit or anti-exposure suit should be provided for each member of the crew assigned, in the muster list, to duties in an MES party for embarking passengers into survival craft. These immersion suits or anti-exposure suits need not be required if the craft is constantly engaged on voyages in warm climates where, in the opinion of the Administration, such suits are unnecessary.

7.4 MUSTER LIST, EMERGENCY INSTRUCTIONS AND MANUALS

7.4.1 Clear instructions to be followed in the event of an emergency should be provided for each person on board.

7.4.2 Muster lists complying with the requirements of regulation III/37 of the Convention should be exhibited in conspicuous places throughout the craft including the operating compartment and any machinery or crew accommodation spaces.

7.4.3 Illustrations and instructions in appropriate languages should be posted in public spaces and be conspicuously displayed at muster stations, at other passenger spaces and near each seat to inform passengers of:

.1 their assembly station;

* International Code of Safety for High-Speed Craft, 2000, adopted by the Maritime Safety Committee of the Organization by resolution MSC.97(73), as amended.

.2 the essential actions they must take in an emergency; and

.3 the method of donning lifejackets.

7.4.4 Every passenger craft should have passenger assembly stations:

.1 in the vicinity of, and which provide ready access for all the passengers to, the embarkation stations unless in the same location; and

.2 which have ample room for the marshalling and instruction of passengers.

7.4.5 A training manual complying with the provisions of 17.2.3 should be provided for the crew at each base port and, where practicable, on board the craft.

7.5 OPERATING INSTRUCTIONS

Poster or signs should be provided on or in the vicinity of survival craft and their launching controls and should:

.1 illustrate the purpose of controls and the procedures for operating the appliance and give relevant instructions and warnings;

.2 be easily seen under emergency lighting conditions; and

.3 use symbols in accordance with the recommendations of the Organization.*

7.6 SURVIVAL CRAFT STOWAGE

7.6.1 Survival craft should be securely stowed as close as possible to the passenger accommodation and embarkation stations. The stowage should be such that each survival craft can 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 lines and the arrangements of the bowsing lines should be such as to maintain the survival craft suitably positioned for embarkation. The Administrations may permit the use of adjustable securing and/or bowsing lines at exits where more than one survival craft is used. The securing arrangements for all securing and bowsing lines should be of sufficient strength to hold the survival craft in position during the evacuation process.

7.6.2 Survival craft should be so stowed as to permit release from their securing arrangements at or near to their stowage position on the craft and from a position at or near to the operating compartment.

7.6.3 So far as is practicable, survival craft should be distributed in such a manner that there is an equal capacity on both sides of the craft.

7.6.4 The launching procedure for inflatable liferafts should, where practicable, initiate inflation. Where it is not practicable to provide automatic inflation of liferafts (for example, when the liferafts are associated with an MES), the arrangement should be such that the craft can be safely and efficiently evacuated within the time specified in 3.8.1.

* Refer to Symbols related to life-saving appliances and arrangements, adopted by the Organization by resolution A.760(18).

7.6.5 Survival craft should be capable of being launched and then boarded from the designated embarkation stations in all operational conditions and also in all conditions of flooding after receiving damage to the extent described in chapter 1.

7.6.6 Survival craft launching stations should be in such positions as to ensure safe launching having particular regard to clearance from machinery, equipment and overhanging portions of the craft structure.

7.6.7 During preparation and launching, the survival craft and the area of water into which it is to be launched should be adequately illuminated by the lighting supplied from the main and emergency sources of electrical power required by chapter 11.

7.6.8 Means should be available to prevent any discharge of water onto survival craft when launched.

7.6.9 Each survival craft should be stowed:

.1 so that neither the survival craft nor its stowage arrangements will interfere with the operation of any other survival craft or rescue boat at any other launching station;

.2 in a state of continuous readiness;

.3 fully equipped; and

.4 as far as practicable, in a secure and sheltered position and protected from damage by fire and explosion.

7.6.10 Every liferaft should be stowed with its painter permanently attached to the craft and with a float free arrangement complying with the requirements of paragraph 4.1.6 of the LSA Code so that, as far as practicable, the liferaft floats free and, if inflatable, inflates automatically should the craft sink.

7.6.11 Any rescue boats fitted to the craft should be stowed:

.1 in a state of continuous readiness for launching in not more than 5 min;

.2 in a position suitable for launching and recovery; and

.3 so that neither the rescue boat nor its stowage arrangements will interfere with the operation of survival craft at any other launching station.

7.6.12 Rescue boats and survival craft should be secured and fastened so that they at least withstand the loads likely to arise due to a defined horizontal collision load for the actual craft and the vertical design load at the stowage position.

7.7 SURVIVAL CRAFT AND RESCUE BOAT EMBARKATION AND RECOVERY ARRANGEMENTS

7.7.1 Embarkation stations should be readily accessible from accommodation and work areas. If the designated muster stations are other than the passenger spaces, the muster stations should be readily accessible from the passenger spaces, and the embarkation stations should be readily accessible from the muster stations.

7.7.2 Evacuation routes, exits and embarkation points should comply with the provisions of 3.7.

7.7.3 Alleyways, stairways and exits giving access to the muster and embarkation stations should be adequately illuminated by lighting supplied from the main and emergency source of electrical power required by chapter 11.

7.7.4 MES or equivalent means of evacuation should be provided in order to avoid persons entering the water to board survival craft. Such MES or equivalent means of evacuation should be so designed as to enable persons to board survival craft in all operational conditions and also in all conditions of flooding after receiving damage to the extent prescribed in chapter 1.

7.7.5 Subject to survival craft and rescue boat embarkation arrangements being effective within the environmental conditions in which the craft is permitted to operate and in all undamaged and prescribed damage conditions of trim and heel, where the freeboard between the intended embarkation position and the waterline is not more than 1.5 m, the Administration may accept a system where persons board liferafts directly.

7.7.6 Arrangements for embarkation of any rescue boat fitted in accordance with these Guidelines should be such that the rescue boat can be launched directly from the stowed position and recovered rapidly when loaded with its full complement of persons and equipment.

7.7.7 A safety knife should be provided at each MES embarkation station.

7.8 LINE-THROWING APPLIANCE

A line-throwing appliance complying with the requirements of paragraph 7.1 of the LSA Code should be provided.

7.9 OPERATIONAL READINESS, MAINTENANCE AND INSPECTIONS

7.9.1 Operational readiness

Before the craft leaves port and at all times during the voyage, all life-saving appliances should be in working order and ready for immediate use.

7.9.2 Maintenance

Appropriate instructions, procedures and information for the maintenance of life-saving appliances provided in accordance with this chapter should be included in the craft's Safety Management System and carried out in accordance with that system.

7.9.3 Spares and repair equipment

Spares and repair equipment should be provided at the base port for life-saving appliances and their components which are subject to excessive wear or consumption and need to be replaced regularly.

7.9.4 Weekly inspection

The following tests and inspections should be carried out weekly:

.1 all survival craft, rescue boats and launching appliances should be visually inspected to ensure that they are ready for use;

.2 all engines in rescue boats should be run ahead and astern for a total period of not less than 3 min provided the ambient temperature is above the minimum temperature required for starting the engine; and

.3 the general emergency alarm system should be tested.

7.9.5 Monthly inspections

Inspection of the life-saving appliances, including survival craft equipment should be carried out monthly using the checklist required by regulation III/36.1 of the Convention to ensure that they are complete and in good order. A report of the inspection should be entered in the log-book.

7.9.6 Servicing of inflatable liferafts, inflatable lifejackets and inflated rescue boats

Every inflatable liferaft, inflatable lifejacket and MES should be serviced:

.1 at intervals not exceeding 12 months, provided where in any case this is impracticable, the Administration may extend this period by one month; and

.2 at an approved servicing station which is competent to service them, maintains proper servicing facilities and uses only properly trained personnel.*

7.9.7 All repairs and maintenance of inflated rescue boats should be carried out in accordance with the manufacturer's instructions.

7.9.8 Periodic servicing of hydrostatic release units

Hydrostatic release units should be serviced:

.1 at intervals not exceeding 12 months, provided where in any case this is impracticable, the Administration may extend this period by one month; and

.2 at a servicing station which is competent to service them, maintains proper servicing facilities and uses only properly trained personnel.

7.10 SURVIVAL CRAFT AND RESCUE BOATS

7.10.1 All craft should carry:

.1 survival craft with sufficient capacity as will accommodate not less than 100% of the total number of persons the craft is certified to carry, subject to a minimum of two such survival craft being carried;

.2 in addition, survival craft with sufficient aggregate capacity to accommodate not less than 10% of the total number of persons the craft is certified to carry;

.3 in the event of any one survival craft being lost or rendered unserviceable, sufficient survival craft to accommodate the total number of persons the craft is certified to carry;

* Refer to the *Recommendation on conditions for the approval of servicing stations for inflatable liferafts*, adopted by the Organization by resolution A.761(18).

.4 where passengers or crew have access outside the craft during a voyage, at least one rescue boat for retrieving persons from the water, but not less than one such boat on each side when the craft is certified to carry more than 450 passengers; and

.5 craft of less than 30 m in length are exempted from the requirements of .4 provided the craft meets all of the following provisions:

.1 the craft is arranged to allow a helpless person to be recovered from the water;

.2 recovery of the helpless person can be observed from the operating compartment;

.3 the craft is sufficiently manoeuvrable to close in and recover persons in the worst intended conditions; and

.4 each survival craft is fitted with a search and rescue transponder (SART).

7.10.2 Where the Administration considers it appropriate, in view of the sheltered nature of the voyages and the suitable climatic conditions of the intended area of operations, the Administration may permit the use of open reversible inflatable liferafts complying with annex 7 on assisted craft as an alternative to liferafts complying with paragraph 4.2 or 4.3 of the LSA Code.

CHAPTER 8 – MACHINERY

8.1 GENERAL

8.1.1 General

8.1.1.1 The machinery, associated piping systems and fittings relating to main machinery and auxiliary power units should be of a design and construction adequate for the service for which they are intended and should be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards. The design should have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.

8.1.1.2 All surfaces with temperatures exceeding 220°C where impingement of flammable liquids may occur as a result of a system failure should be insulated using firewalls, shrouds or other equivalent systems. The insulation should be impervious to flammable liquids and vapours.

8.1.1.3 Special consideration should be given to the reliability of single essential propulsion components and a separate source of propulsion power sufficient to give the craft a navigable speed, especially in the case of unconventional arrangements, may be required.

8.1.1.4 Means should be provided whereby normal operation of propulsion machinery can be sustained, restored or safely shut down if one of the essential auxiliaries becomes inoperative. Special consideration should be given to the malfunctioning of:

.1 a generating set which serves as a main source of electrical power; and

.2 a source of essential service or supply to a main propulsion engine or main source of electrical power, such as fuel oil supply, pressurised lubricating oil, aspiration air, cooling water or engine starting or control systems.

However, for assisted and cargo craft, a partial or complete reduction in propulsion capability from normal operation may be accepted if the failure does not directly or indirectly lead to a condition that endangers the craft or personnel.

8.1.1.5 Means should be provided to ensure that the machinery can be brought into operation from the dead craft condition without external aid.

8.1.1.6 All parts of machinery, hydraulic, pneumatic and other systems and their associated fittings which are under internal pressure should be subjected to appropriate tests including a pressure test before being put into service for the first time.

8.1.1.7 Provision should be made to facilitate cleaning, inspection and maintenance of main propulsion and auxiliary machinery including pressure vessels.

8.1.1.8 The reliability of machinery installed in the craft should be adequate for its intended purpose.

8.1.1.9 The Administration may accept machinery which does not show detailed compliance with the present Guidelines where it has been used satisfactorily in a similar application, provided that it is satisfied:

.1 that the design, construction, testing, installation and prescribed maintenance are together adequate for its use in a marine environment; and

.2 that an equivalent level of safety will be achieved.

8.1.1.10 A system safety assessment should include machinery systems and their associated controls.

8.1.1.11 Such information as is necessary to ensure that machinery can be installed correctly regarding such factors as operating conditions and limitations should be made available by the manufacturers.

8.1.1.12 Main propulsion machinery and all auxiliary machinery essential to the propulsion and the safety of the craft should, as fitted in the craft, be designed to operate when the craft is upright and when inclined at any angle of trim, heel, roll or pitch the craft may achieve in any normal operational mode within the range of allowable operating conditions.

8.1.1.13 All pressure vessels and associated piping systems should be of a design and construction adequate for the purpose intended and should be so installed and protected as to minimise 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 pressure vessel and associated piping system 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 subsequent specified intervals, to a pressure suitably in excess of the working pressure.

8.1.1.14 Arrangements should be provided to ensure that any liquid cooling system is rapidly detected and alarmed (visual and audible) and means instituted to minimize the effects of such failures on machinery serviced by the system.

8.1.2 Engine (general)

8.1.2.1 The engines should be fitted with adequate safety monitoring and control devices in respect of speed, temperature, pressure level and other operational functions. Control of the machinery should be from the craft's operating compartment and should be arranged so that no single failure causes loss of control of machinery. The machinery installation should be suitable for operation as in an unmanned machinery space*, including automatic fire detection system, bilge alarm system, remote machinery instrumentation and alarm system.

8.1.2.2 The engines should be protected against overspeed, loss of lubricating oil pressure, loss of cooling medium, high temperature, malfunction of moving parts and overload. Safety devices may provide warnings but should not cause complete engine shutdown. Such safety devices should be capable of being tested.

8.1.2.3 At least two independent means of stopping the engines quickly from the operating compartment under any operating conditions should be available. Duplication of the actuator fitted to the engine should not be required.

8.1.2.4 The major components of the engine should have adequate strength to withstand the thermal and dynamic conditions of normal operation. 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.

8.1.2.5 The design of the engine should be such as to minimise the risk of fire or explosion and to enable compliance with the fire precaution requirements of chapter 6.

8.1.2.6 Provision should be made to drain all excess fuel and oil to a safe position so as to avoid a fire hazard.

8.1.2.7 Provision should be made to ensure that, whenever practical, the failure of systems driven by the engine should not unduly affect the integrity of the major components.

8.1.2.8 The ventilation arrangements in the machinery spaces should be adequate under all envisaged operating conditions. Where appropriate, arrangements should ensure that enclosed engine compartments are forcibly ventilated to the atmosphere before the engine can be started.

8.1.2.9 Any engines should be so installed as to avoid excessive vibration within the craft.

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* Refer to part E of chapter II-1 of the Convention.

8.1.3 Gas turbines

8.1.3.1 Gas turbines should be designed to operate in the marine environment and should be free from surge or dangerous instability throughout its operating range up to the maximum steady speed approved for use. The turbine installation should be arranged to ensure that the turbine cannot be continuously operated within any speed range where excessive vibration, stalling, or surging may be encountered.

8.1.3.2 The gas turbines should be designed and installed such that any reasonably probable shedding of compressor or turbine blades will not endanger the craft, other machinery, occupants of the craft or any other persons.

8.1.3.3 The provisions of 8.1.2.6 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.

8.1.3.4 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. Provision should be made for preventing the accumulation of salt deposits on the compressors and turbines and, where appropriate, for preventing the air intake from icing.

8.1.3.5 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 these provisions.

8.1.3.6 Each engine should be provided with an emergency overspeed shutdown device connected, where possible, directly to each rotor shaft.

8.1.3.7 Where an acoustic enclosure is fitted which completely surrounds the gas generator and the high pressure oil pipes, a fire detection and extinguishing system should be provided for the acoustic enclosure.

8.1.3.8 Details of the manufacturers' proposed automatic safety devices to guard against hazardous conditions arising in the event of malfunction in the turbine installation should be assessed as part of the SSA specified in part C.

8.1.3.9 The manufacturers should demonstrate the soundness of the casings. Intercoolers and heat exchangers should be hydraulically tested on each side separately.

8.1.4 Diesel engines for main propulsion and essential auxiliaries

8.1.4.1 Any main diesel propulsion system should have satisfactory torsional vibration and other vibrational characteristics verified by individual and combined torsional and other vibration analyses for the system and its components from power unit through to propulsor.

8.1.4.2 All external high-pressure fuel delivery lines between the high-pressure fuel pumps and fuel nozzles should be protected with a jacketed tubing system capable of containing fuel from a high-pressure line failure. The jacketed tubing system should include a means for collection of leakages and arrangements should be provided for an alarm to be given of a fuel line failure.

8.1.4.3 Engines of a cylinder diameter of 200 mm or a crankcase volume of 0.6 m^3 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 minimise the possibility of injury to personnel.

8.1.4.4 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.

8.1.4.5 Arrangements should be provided to ensure that visual and audible alarms are activated in the event of either lubricating oil pressure or lubricating oil level falling below a safe level, considering the rate of circulation of oil in the engine.

8.1.4.6 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 should be such as to minimise the risk of fire or explosion.

8.1.5 Transmissions

8.1.5.1 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.

8.1.5.2 The design of shafting, bearings and mounts should be such that hazardous whirling and excessive vibration could not occur at any speed up to 105% of the shaft speed attained at the designed overspeed trip setting of the prime mover.

8.1.5.3 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 throughout its operational life. Compliance should be demonstrated by suitably conducted tests, and by designing for sufficiently low stress levels, combined with the use of fatigue resistant materials and suitable detail design. Torsional vibration or oscillation likely to cause failure may be acceptable if it occurs at transmission speeds which would not be used in normal craft operation, and it is recorded in the craft operating manual as a limitation.

8.1.5.4 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.

8.1.5.5 Provision should be made such that a failure in any part of the transmission, or of a driven component, will not cause damage which might hazard the craft or its occupants.

8.1.5.6 Where failure of lubricating fluid supply or loss of lubricating fluid pressure could lead to hazardous conditions, 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.

8.1.6 Propulsion and lift devices

8.1.6.1 The provisions of this section are based on the premise that:

.1 Propulsion arrangements and lift arrangements may be provided by separate devices, or be integrated into dual-function devices.

.2 Propulsion devices are those which directly provide propulsive thrust and include machinery items having a primary function of contributing to that thrust, including any associated ducts, vanes, and nozzles.

.3 Lift devices are those devices which generate lifting force on the craft and include arrangements which direct air flow from propellers or gas jets from engines to produce such force.

8.1.6.2 The propulsion and lift devices should be of adequate strength and stiffness. The design data, calculations and trials, where necessary, should establish 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.

8.1.6.3 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 they are subjected to spray, debris, salt, sand, icing, etc.

8.1.6.4 Design and testing of propulsion and lift devices should pay due regard, as appropriate, to any pressure which could be developed as a result of any duct blockage, in terms of steady and cyclic loadings, loadings due to external forces and of the use of the devices in manoeuvring and reversing and to the axial location of rotating parts.

8.1.6.5 Appropriate arrangements should be made to ensure that:

.1 ingestion of debris or foreign matter is minimized; and

.2 the possibility of injury to personnel from shafting or rotating parts is minimized.

8.2 REQUIREMENTS FOR PASSENGER CRAFT

8.2.1 Independent means of propulsion for unassisted craft

Unassisted craft should be provided with at least two independent means of propulsion so that the failure of one engine or its support systems would not cause the failure of the other engine or engine systems.

8.2.2 Means for return to a port of refuge for unassisted craft

Unassisted craft should be capable of maintaining the essential machinery and control so that, in the event of a fire or other casualties in any one compartment on board other than the operating compartment, the craft can return to a port of refuge under its own power. In this regard, duplication of machinery controls in the operating compartment is not required in another space, but those controls should be arranged in accordance with 8.1.2.1.

8.3 REQUIREMENTS FOR CARGO CRAFT

8.3.1 Essential machinery and control

Cargo craft should be capable of maintaining the essential machinery and control in the event of a fire or other casualties in any one compartment on board, other than the operating compartment. The craft need not be able to return to a place of refuge under its own power.

CHAPTER 9 – AUXILIARY SYSTEMS

9.1 GENERAL

9.1.1 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. Attention should be directed to the avoidance of flammable liquid impingement on hot surfaces in the event of leakage or fracture of the pipe.

9.1.2 The maximum allowable working pressure in any part of the fluid system should not be greater than the design pressure, 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 minimum 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.

9.1.3 Tanks and piping should be pressure-tested 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.

9.1.4 Materials used in piping systems should be compatible with the fluid conveyed and selected giving due regard to the risk of fire. Non-metallic piping material may be permitted in certain systems provided the integrity of the hull and watertight decks and bulkheads is maintained.*

9.2 ARRANGEMENT OF OIL FUEL, LUBRICATING OIL AND OTHER FLAMMABLE OIL

9.2.1 The provisions of 6.1.1.2.2 apply to the use of oil as fuel.

9.2.2 Oil fuel, lubricating oil and other flammable oil lines should be screened or otherwise suitably protected to avoid, as far as practicable, oil spray or oil leakages onto hot surfaces, into machinery air intakes or other sources of ignition. The number of joints in such piping systems should be kept to a minimum. Flexible pipes carrying flammable liquids should be of an approved type.**

9.2.3 Fuel oil, lubricating oils and other flammable oils should not be carried forward of public spaces and crew accommodation.

9.2.4 Oil fuel arrangements

In a craft in which oil fuel is used, the arrangements for the storage, distribution and utilization of the oil fuel should be such as to ensure the safety of the craft and persons on board and should at least comply with the following provisions.

* Refer to the *Guidelines for the application of plastic pipes on ships*, adopted by the Organization by resolution A.753(18), as amended.

** Refer to MSC/Circ.647 on *Guidelines to minimize leakages from flammable liquid systems for improving reliability and reducing risk of fire*.

9.2.4.1 As far as practicable, all parts of the oil fuel system containing oil under pressure exceeding 0.18 N/mm^2 should not be placed in a concealed position such that defects and leakage cannot readily be observed. The machinery spaces in way of such parts of the oil fuel system should be adequately illuminated.

9.2.4.2 The ventilation of machinery spaces should be sufficient under all normal conditions to prevent accumulation of oil vapour.

9.2.4.3 Location of fuel tanks should be in accordance with 6.1.4.2.2.

9.2.4.4 No oil fuel tank should be situated where spillage or leakage therefrom can constitute a hazard by falling on heated surfaces. Reference is made to the fire safety requirements in 6.1.4.2.

9.2.4.5 Oil fuel pipes should be fitted with cocks or valves in accordance with 6.1.4.2.3.

9.2.4.6 Every fuel tank should, where necessary, be provided with save-alls or gutters to catch any fuel which may leak from such tanks.

9.2.4.7 Safe and efficient means of ascertaining the amount of oil fuel contained in any oil fuel tank should be provided.

9.2.4.7.1 Fuel-level gauges and indicators should be installed and be of a type acceptable to the Administration. Such means should not allow overfilling of the tanks that will permit release of fuel. The use of cylindrical gauge glasses should be prohibited.

9.2.4.8 Provision should be made to prevent overpressure in any oil tank or in any part of the oil fuel system, including the filling pipes. Any relief valves and air or overflow pipes should discharge to a safe position and, for fuel of flashpoint less than 43°C, should terminate with flame arresters in accordance with the standard developed by the Organization.*

9.2.4.9 Subject to 9.2.4.10, oil fuel pipes and their valves and fittings should be of steel or other approved material, except that restricted use of flexible pipes should be permissible in positions where the Administration is satisfied that they are necessary. Such flexible pipes and end attachments should be of approved fire-resisting materials of adequate strength and should be constructed to the satisfaction of the Administration.

9.2.4.10 High-pressure oil fuel pipes and their valves and fittings should be of seamless steel construction and should be protected with a jacketed piping system capable of containing and collecting fuel from a high pressure line failure.

9.2.5 Lubricating oil arrangements

The arrangements for the storage, distribution and utilization of oil used in pressure lubrication systems should be such as to ensure the safety of the craft and persons on board. The arrangements made in machinery spaces and, whenever practicable, in auxiliary machinery spaces should at least comply with the provisions of 9.2.4.1 and 9.2.4.4 to 9.2.4.8 except that:

.1 this does not preclude the use of sight-flow glasses in lubricating systems provided they are shown by test to have a suitable degree of fire resistance;

* Refer to the *Revised standards for the design, testing and locating of devices to prevent the passage of flame into cargo tanks* (MSC/Circ.373/Rev.1).

.2 sounding pipes may be permitted in machinery spaces if fitted with appropriate means of closure; and

.3 lubricating oil storage tanks with a capacity of less than 500 *l* may be permitted without remote operated valves as required in 9.2.4.5.

9.2.6 Arrangements for other flammable oils

The arrangements for storage, distribution and utilization of other flammable oils employed under pressure in power transmission systems, control and activating systems and heating systems should be such as to ensure the safety of the craft and persons on board. In locations where means of ignition are present, such arrangements should at least comply with the provisions of 9.2.4.4 and 9.2.4.7 and with the provisions of 9.2.4.8 and 9.2.4.9 in respect of strength and construction.

9.2.7 Arrangements within machinery spaces

In addition to the provisions of 9.2.1 to 9.2.6, the oil fuel and lubricating oil systems should comply with the following.

9.2.7.1 Any equipment used to store or transfer flammable liquids automatically or remotely should have arrangements to prevent overflow spillages.

9.3 BILGE PUMPING AND DRAINAGE SYSTEMS

9.3.1 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 should be demonstrated that the safety of the craft will not be impaired.

9.3.2 Bilge pumping arrangements should be provided to allow every watertight compartment located below the water level in the worst anticipated damage condition other than those intended for permanent storage of liquid to be drained. The capacity or position of any such compartment should be such that flooding thereof could not affect the safety of the craft.

9.3.3 The bilge pumping system should be capable of operation under all possible values of list and trim after the craft has sustained the damage in 1.1.4.5. The bilge pumping system should be so designed as to prevent water flowing from one compartment to another. The necessary valves and pumps for operation of the bilge system arranged for any compartment should be capable of being operated from the operating compartment.

9.3.3.1 At least two power pumps connected to the main bilge system should be provided, one of which may be driven by the propulsion machinery. If the Administration is satisfied that the safety of the craft is not impaired, bilge pumping arrangements may be dispensed with in particular compartments. Alternatively, the arrangement may be in accordance with the provisions of 9.3.12.

9.3.3.2 On multi-hull craft each hull should be provided with at least two power pumps, unless a bilge pump in one hull is capable of pumping bilge in the other hull. At least one pump in each hull should be an independent power pump.

9.3.4 The power operated self-priming bilge pumps may be used for other duties such as firefighting or general service but not for pumping fuel or other flammable liquids.

9.3.5 Each power bilge pump should be capable of pumping water through the required bilge pipe at a speed of not less than 2 m/s.

9.3.6 The diameter (d_B) of the bilge main should be calculated according to the following formula, except that the actual internal diameter of the bilge main may be rounded off to the nearest size of a recognized standard:

$$d_B = 25 + 1.68 (L(B + D))^{0.5}$$

where:

d_B = the internal diameter of the bilge main (mm);

L = the length of the craft (m) as defined in part A;

B = is for monohull craft, the breadth of the craft in m as defined in part A and for multi-hull craft, the breadth of a hull at or below the design waterline (m); and

D = is the moulded depth of watertight structure of the craft (m).

9.3.7 Internal diameters of suction branches should meet the requirements of the Administration but should not be less than 25 mm. Suction branches should be fitted with effective strainers.

9.3.8 Sea inlet valves should be capable of being closed from the operating compartment.

9.3.9 All bilge suction piping up to the connection to the pumps should be independent of other piping.

9.3.10 Any space for which bilge pumping arrangements are required should be provided with a bilge alarm.

9.3.11 For craft with individual bilge pumps, the total capacity Q of the bilge pumps for each hull should not be less than 2.4 times the capacity of the pump defined in 9.3.5 and 9.3.6.

9.3.12 In bilge pumping arrangements where a bilge main is not provided, at least one fixed submersible pump should be provided for each space. The capacity of each pump should be determined by the formula:

$Q_n = Q/(N-1)$ (tonnes/h) with a minimum of 8 tonnes/h

where:

N = number of submersible pumps; and

Q = total capacity as defined in 9.3.11.

9.3.13 Non-return valves should be fitted in the following components:

.1 bilge valve distribution manifolds;

.2 bilge suction hose connections where fitted directly to the pump or to the main bilge suction pipe; and

.3 direct bilge suction pipes and bilge pump connections to main bilge suction pipe.

9.4 BALLAST SYSTEMS

9.4.1 Water ballast should not in general be carried in tanks intended for oil fuel. In craft in which it is not practicable to avoid putting water in oil fuel tanks, oily-water separating equipment should be fitted, or other alternative means such as discharge to shore facilities should be provided for disposing of the oily-water ballast. The provisions of this paragraph are without prejudice to the provisions of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), in force.

9.4.2 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 and MARPOL 73/78 in force.

9.5 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.

9.6 ENGINE AIR INTAKE SYSTEMS

Arrangements should provide sufficient air to the engine and should give adequate protection against salt, water, leaking fuel and industrial accumulation. Means are to be provided against damage due to ingress of foreign matter.

9.7 VENTILATION SYSTEMS

Machinery spaces should be adequately ventilated so as to ensure that when machinery therein is operating at full power in all weather conditions, including heavy weather, an adequate supply of air is maintained to the spaces for the efficient operation of the machinery and safe entry by personnel as necessary. Auxiliary machinery spaces should be adequately ventilated appropriate for the purpose of those spaces. The ventilation arrangements should be adequate to ensure that the safe operation of the craft is not put at risk.

9.8 EXHAUST SYSTEMS

9.8.1 All engine exhaust systems should be adequate to assure the correct functioning of the machinery and that safe operation of the craft is not put at risk. The exhaust system should be constructed and arranged to ensure the safe discharge of exhaust gases without fire hazard, overheating of adjacent components and penetrated structure.

9.8.2 Exhaust systems should be so arranged as to minimize the risk of intake of exhaust gases into manned spaces, air-conditioning systems, and engine intakes.

9.8.3 Pipes through which exhaust gases are discharged through the hull in the vicinity of the waterline should be fitted with erosion/corrosion resistant shut-off flaps or other devices on the shell or pipe end and acceptable arrangements made to prevent water flooding the space or entering the engine exhaust manifold.

9.8.4 Gas turbine engine exhausts should be arranged so that hot exhaust gases are directed away from areas to which personnel have access, either on board the craft or in the vicinity of the craft when berthed.

CHAPTER 10 – REMOTE CONTROL, ALARM AND SAFETY SYSTEMS

10.1 DEFINITIONS

10.1.1 *Remote control systems* comprise all equipment necessary to operate units from a control position where the operator cannot directly observe the effect of his actions.

10.1.2 *Back-up control systems* comprise all equipment necessary to maintain control of essential functions required for the craft's safe operation when the main control systems have failed or malfunctioned.

10.2 GENERAL

10.2.1 Failure of any remote or automatic control systems should initiate an audible and visual alarm and should not prevent normal manual control.

10.2.2 Manoeuvring and emergency controls should permit the operating crew to perform the duties for which they are responsible in the correct manner without difficulty, fatigue or excessive concentration.

10.3 EMERGENCY CONTROLS

In all craft, the station or stations in the operating compartment from which control of craft manoeuvring and/or of its main machinery is exercised should be provided, within easy reach of the crew member at that station, with controls for use in an emergency to:

.1 activate fixed fire-extinguishing systems;

.2 close ventilation openings and stop ventilating machinery supplying spaces covered by fixed fire-extinguishing systems, if not incorporated in .1;

.3 shut off fuel supplies to machinery in main and auxiliary machinery spaces;

.4 disconnect all electrical power sources from the normal power distribution system (the operating control should be guarded to reduce the risk of inadvertent or careless operation); and

.5 stop main engine(s) and auxiliary machinery.

10.4 ALARM SYSTEM

10.4.1 Alarm systems should be provided which announce at the craft's control position, by visual and audible means, malfunctions or unsafe conditions. Alarms should be maintained until they are accepted and the visual indications of individual alarms should remain until the fault has been corrected, when the alarm should automatically reset to the normal operating condition. If an alarm has been accepted and a second fault occurs before the first is rectified, the audible and visual alarms should operate again. Alarm systems should incorporate a test facility.

10.4.1.1 Emergency alarms giving indication of conditions requiring immediate action should be distinctive and in full view of crew members in the operating compartment, and should be provided for the following:

.1 activation of a fire-detection system;

.2 total loss of normal electrical supply;

.3 overspeed of main engines;

.4 thermal runaway of any permanently installed nickel-cadmium battery;

.5 approaching of WIG craft's altitude and attitude to the borders of range of admissible values and an exceeding of their limits; and

.6 linear or angular accelerations exceeding 90% of the design limitations of the craft for more than one second.

10.4.1.2 The alarm required by 10.4.1.1.5 should operate with sufficient safety margin to prevent inadvertent stalling and must be clear and distinctive to the pilot in straight and turning flight. The warning may be furnished either through the inherent aerodynamic qualities of the craft or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself. If a warning device is used, it must provide a warning in all craft configurations. The stall warning must begin at a speed exceeding the stalling speed (i.e. the speed at which the craft stalls or the minimum speed demonstrated) by seven percent or at any lesser margin if the stall warning has enough clarity, duration, distinctiveness, or similar properties.

10.4.1.3 Additional alarms and warning signals should be fitted in the operating compartment as required by the Administration. These may include:

.1 exceeding the limiting value of any craft, machinery or system parameter other than engine overspeed;

.2 failure of normal power supply to any powered control devices;

.3 activation of any bilge alarm;

.4 operation of any automatic bilge pump;

.5 failure of compass system;

.6 low level of a fuel tank contents;

.7 fuel oil tank overflow;

.8 extinction of any navigation light;

.9 low level of contents of any fluid reservoir the contents of which are essential for normal craft operation;

.10 failure of any connected electrical power source;

.11 failure of any ventilation fan installed for ventilating spaces in which inflammable vapours may accumulate; and

.12 fuel line failure.

10.4.1.4 All warnings required by 10.4.1.1 and 10.4.1.2 should be provided at all stations at which control functions may be exercised.

10.4.2 The alarm system should meet appropriate constructional and operational provisions for required alarms.*

10.4.3 Equipment monitoring the passenger, cargo and machinery spaces for fire and flooding should, so far as is practicable, form an integrated sub-centre incorporating monitoring and activation control for all emergency situations. This sub-centre may require feedback instrumentation to indicate that actions initiated have been fully implemented.

CHAPTER 11 – ELECTRICAL INSTALLATIONS

11.1 GENERAL

11.1.1 Electrical installations should be such that:

.1 all electrical auxiliary services necessary for maintaining the craft in normal operation and habitable conditions will be ensured without recourse to the emergency source of electrical power;

.2 electrical services essential for safety will be ensured under various emergency conditions; and

.3 the safety of passengers, crew and craft from electrical hazards will be ensured.

The System Safety Assessment (SSA) should include the electrical system, taking into account the effects of electrical failure on the systems being supplied. In cases where faults can occur without being detected during routine checks on the installations, the analysis should take into account the possibility of faults occurring simultaneously or consecutively.

11.1.2 The electrical system should be designed and installed so that the probability of the craft being at risk of failure of a service is extremely remote.

11.1.3 Where loss of a particular essential service would cause serious risk to the craft, the service should be fed by at least two independent circuits both fed in such a way that no single failure in the electrical supply or distribution systems would affect both supplies.

11.1.4 The securing arrangements for heavy items, i.e. accumulator batteries, should prevent excessive movement during the accelerations according to 3.4.4.

11.1.5 Precautions should be taken to minimise risk of supplies to essential and emergency services being interrupted by the inadvertent or accidental opening of switches or circuit-breakers.

11.1.6 Electronic equipment essential for propulsion and attitude control purposes should be approved and installed according to a recognized IEC Standard.

* Refer to the Code on Alerts and Indicators, 2009, adopted by the Organization by resolution A.1021(21).

11.2 MAIN SOURCE OF ELECTRICAL POWER

11.2.1 A main source of electrical power of sufficient capacity to supply all those services mentioned in 11.1.1 should be provided. The main source of electrical power should consist of at least two generating sets supplying two main switchboards.

11.2.2 The capacity of these generating sets should be such, that in the event of any one generating set being stopped or failing in the ground effect mode, it will still be possible to supply those services necessary to provide the normal operational conditions of propulsion, attitude control in ground effect and safety. Minimum comfortable conditions of habitability should also be ensured which include at least adequate services for cooking, heating or cooling, domestic refrigeration, mechanical ventilation, and sanitary and fresh water.

11.2.3 The arrangements of the craft's main source of electrical power should be such that the services referred to in 11.1.1.1 can be maintained regardless of the speed of the propulsion machinery.

11.2.4 One source of power independent from the main propulsion plant should be capable of providing the electrical services necessary to start the main propulsion plant from dead craft condition.

11.2.5 Where charging units or converters constitute an essential part of the electrical supply system required by this section, the system should be so arranged as to ensure the same continuity of supply as is stated in 11.2.2.

11.2.6 A main electric lighting system, which should provide illumination throughout those parts of the craft normally accessible to and used by passengers and crew should be supplied from the main source of electrical power.

11.2.7 The two main switchboards should be located in a dry space with a minimum risk of fire.

11.2.8 The connection of generating sets and any other duplicated equipment should be equally divided between the two switchboards. The generators should operate in single operation. Equivalent arrangements may be permitted to the satisfaction of the Administration.

11.2.9 Separation and duplication of electrical supply should be provided for duplicated consumers of essential services. During normal operation the systems may be connected to the same power-bus, but facilities for easy separation should be provided. Each system should be able to supply all equipment necessary to maintain the control of propulsion, steering, stabilization, navigation, lighting and ventilation, and allow starting of the largest essential electric motor at any load. Automatic load-dependent disconnection of non-essential consumers may be allowed.

11.3 EMERGENCY SOURCE OF ELECTRICAL POWER

11.3.1 A self-contained emergency source of electrical power should be provided.

11.3.2 The emergency source of electrical power, any associated transforming equipment, transitional source of electrical power, emergency switchboard and emergency lighting switchboard should be located above the waterline in the final condition of damage as referred to in chapter 1, operable in that condition and readily accessible.

11.3.3 The location of the emergency source of electrical power and any associated transforming equipment, the transitional source of emergency power, the emergency switchboard and the emergency electrical lighting switchboards in relation to the main source of electrical power, any associated transforming equipment and the main switchboard should be such as to ensure that a fire or other casualty in spaces containing the main source of electrical power, any associated transforming equipment, will not interfere with the supply, control, and distribution of emergency electrical power. As far as practicable, the space containing the emergency source of electrical power, any associated transforming equipment, the transitional source of emergency electrical power and the emergency switchboard should not be contiguous to the boundaries of main machinery spaces or those spaces containing the main source of electrical power, any associated transforming equipment, or the main switchboard.

11.3.4 Distribution systems should be so arranged that the feeders from the main and emergency sources be separated both vertically and horizontally as widely as practicable.

11.3.5 The emergency source of electrical power may be either a generator or an accumulator battery, which should comply with the following:

.1 Where the emergency source of electrical power is a generator, it should be:

.1 driven by a suitable prime mover with an independent supply of fuel having a flash point which meets the provisions of 6.1.1.2.2;

.2 started automatically upon failure of the electrical supply from the main source of electrical power and should be automatically connected to the emergency switchboard. Those services referred to in 11.4 should then be transferred to the emergency generating set. The automatic starting system and the characteristic of it be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable, subject to a maximum of 15 s; and

.3 provided with a transitional source of emergency electrical power according to 11.4; and

.2 Where the emergency source of electrical power is an accumulator battery, it should be capable of:

.1 carrying the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage;

.2 automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power; and

.3 immediately supplying at least those services specified in 11.4.

11.3.6 The emergency switchboard should be installed as near as is practicable to the emergency source of electrical power.

11.3.7 Where the emergency source of electrical power is a generator, the emergency switchboard should be located in the same space unless the operation of the emergency switchboard would thereby be impaired.

11.3.8 No accumulator battery fitted in accordance with this section should be installed in the same space as the emergency switchboard. An indicator should be mounted in a suitable space at the craft's operating compartment to indicate when the batteries constituting either the emergency source of electrical power or the transitional source of emergency electrical power referred to in 11.3.5.1.3 are being discharged.

11.3.9 The emergency switchboard should be supplied during normal operation from one main switchboard by an interconnection feeder which should be adequately protected at the main switchboard against overload and short circuit and which should be disconnected automatically at the emergency switchboard upon failure of the main source of electrical power. A manual switchover to the other main switchboard must be possible.

11.3.10 In order to ensure ready availability of the emergency source of electrical power, only emergency circuits should be fed by the emergency switchboard.

11.3.11 The emergency generator and its prime mover and any emergency accumulator battery should be so designed and arranged as to ensure that they will function at full rated power when the craft is upright and when the craft has a list or trimming in accordance with 8.1.1.12, including any damage cases considered in chapter 1, or is in any combination of angles within those limits.

11.3.12 Where accumulator batteries are installed to supply emergency, back up or engine start-up services, provisions should be made to charge them in situ from a reliable onboard supply. Charging facilities should be designed to permit the supply of services, regardless of whether battery is on charge or not. Means should be provided, by which the batteries on board can be checked before each journey (e.g. minimum allowable voltage at a laid down load). The risk of overcharging or overheating the batteries should be minimised. Means for efficient air ventilation should be provided. A total number of two battery systems and two chargers for all battery services except for radio installations should be sufficient.

11.3.13 For unassisted craft, the emergency electrical power available should be sufficient to supply all the services that are essential for safety in an emergency. The emergency source of electrical power should be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:

.1 for a period of 12 h, emergency lighting:

  .1 at the stowage positions of life-saving appliances;

  .2 at all escape routes, such as alleyways, stairways, exits from service spaces, embarkation points, etc.;

  .3 in the passenger compartments;

  .4 in the machinery spaces and main emergency generating spaces including their control positions;

  .5 in control stations; and

  .6 at the stowage positions for any fireman's outfits provided in accordance with chapter 6;

.2 for a period of 12 h:

.1 the navigation lights, and other lights required by the International Regulations for Preventing Collisions at Sea, 1972, in force;

.2 electrical internal communication equipment for announcements for passengers and crew required during evacuation;

.3 fire detection and general alarm system and manual fire alarms; and

.4 remote control devices of fire-extinguishing systems, if electrical;

.3 for a period of 4 h on intermittent operation:

.1 the daylight signalling lamps, if they have no independent supply from their own accumulator battery; and

.2 the craft's whistle, if electrically driven;

.4 for a period of 12 h:

.1 the navigational equipment as recommended in chapter 12;

.2 essential electrically powered instruments and controls for propulsion machinery, if alternate sources of power are not available for such devices;

.3 the firefighting systems recommended in 6.1.6;

.4 the emergency bilge pump and all equipment essential for the operation of electrically powered remote controlled bilge valves as recommended in chapter 9; and

.5 craft radio facilities and other loads as set out in 13.12.2; and

.5 for a period of 12 hours, any essential power drives for directional control devices including those required to direct thrust forward and astern.

11.3.14 For assisted craft, the emergency source of power should be capable of supplying simultaneously the following services:

.1 for a period of 5 h emergency lighting:

.1 at the stowage positions of life-saving appliances;

.2 at all escape routes, such as alleyways, stairways, exits from accommodation and service spaces, embarkation points, etc;

.3 in the public spaces;

.4 in the machinery spaces and main emergency generating spaces, including their control positions;

.5 in control stations; and

.6 at the stowage positions for any firemen's outfits fitted in accordance with chapter 6;

.2 for a period of 5 h;

.1 main navigation lights, except for "not under command" lights;

.2 electrical internal communication equipment for announcements for passengers and crew required during evacuation;

.3 fire-detection and general alarm system and manual fire alarms; and

.4 remote control devices of fire-extinguishing systems, if electrical;

.3 for a period of 4 h of intermittent operation:

.1 the daylight signalling lamps, if they have no independent supply from their own accumulator battery; and

.2 the craft's whistle, if electrically driven;

.4 for a period of 5 h:

.1 craft radio facilities and other loads as set out in chapter 13; and

.2 essential electrically powered instruments and controls for propulsion machinery, if alternate sources of power are not available for such devices;

.5 for a period of 12 h, the "not under command" lights; and

.6 for a period of 10 min, power drives for directional control devices, including those required to direct thrust forward and astern, unless there is a manual alternative acceptable to the Administration as complying with 4.2.3.

11.3.15 Transitional source of emergency electrical power

The transitional source of emergency electrical power recommended in 11.3.5.1.3 may consist of an accumulator battery suitably located for use in an emergency which should operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage and be of sufficient capacity and so arranged as to supply automatically in the event of failure of either the main and emergency source of electrical power at least the following services, if they depend upon an electrical source for their operation for a period of 30 min, the load specified in 11.3.14.1 to 11.3.14.3.

11.3.16 The provisions of 11.3.15 may be considered satisfied without the installation of a transitional source of emergency electrical power if each of the services recommended by that paragraph have independent supplies, for the period specified, from accumulator batteries suitably located for use in an emergency. The supply of emergency power to the instruments and controls of the propulsion and direction systems should be uninterruptible.

11.3.17 Provisions should be made for the periodic testing of the complete emergency system, including the emergency consumers recommended in 11.3.13 or 11.3.14 and 11.3.15, and should include the testing of automatic starting arrangements.

11.3.18 Distribution systems should be so arranged that fire in any main vertical zone will not interfere with services essential for safety in any other such zone. This provision will be met if main and emergency feeders passing through any such zone are separated both vertically and horizontally as widely as is practicable.

11.4 STARTING ARRANGEMENTS FOR GENERATING SETS

11.4.1 The generating sets should be capable of being readily started in their cold condition at a temperature of 0°C. If this is impracticable, or if lower temperatures are likely to be encountered, provisions should be made for heating arrangements to ensure ready starting of the generating sets.

11.4.2 The main generating set (emergency generator set) should be equipped with starting devices with a stored energy capability of at least six (three) consecutive starts. The source of stored energy should be protected to preclude critical depletion by the automatic starting system. A second source of energy should also be provided for an additional six (three) starts.

11.4.3 The stored energy of the emergency generating set should be maintained at all times, as follows:

.1 electrical and hydraulic starting systems should be maintained from the emergency switchboard;

.2 compressed air starting systems may be maintained by the main or auxiliary compressed air receivers through a suitable non-return valve or by an emergency air compressor which, if electrically driven, is supplied from the emergency switchboard; and

.3 all of these starting, charging and energy storing devices should be located in the emergency generator space. These devices should not be used for any purpose other than the operation of the emergency generating set. This does not preclude the supply to the air receiver of the emergency generating set from the main or auxiliary compressed air system through the non-return valve fitted in the emergency generator space.

11.5 STEERING AND ATTITUDE CONTROL

11.5.1 Where steering and/or attitude control of a craft is essentially dependent on the continuous availability of electric power, it should be served by at least three independent circuits, two of which should be fed from the main switchboards and one from the emergency source of electric power including the transitional source, both located in such a position as to be unaffected by fire or flooding affecting the main source of power. Failure of either supply should not cause any risk to the craft or passengers during switching to the alternative supply and such switching arrangements should meet the provisions in 4.2.6. These circuits should be provided with short circuit protection and an overload alarm.

11.5.2 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 craft's operating compartment that will indicate failure of any one of the phases.

11.5.3 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 in accordance with 11.5.2.

11.5.4 The provisions of chapters 4 and 15 for power supply of the directional control systems and stabilization systems of the craft should be met.

11.6 PRECAUTIONS AGAINST SHOCK, FIRE AND OTHER HAZARDS OF ELECTRICAL ORIGIN

11.6.1 Exposed metal parts of electrical machines or equipment which are not intended to be live but which are liable under fault conditions to become live should be earthed unless the machines or equipment are:

.1 supplied at a voltage not exceeding 55 V direct current or 55 V, root-mean-square between conductors; auto-transformers should not be used for the purpose of achieving this voltage; or

.2 supplied at a voltage not exceeding 250 V by safety isolating transformers supplying only one consuming device; or

.3 constructed in accordance with the principle of double insulation.

11.6.2 All electrical apparatus should be so constructed and so installed as not to cause injury when handled or touched in the normal manner.

11.6.3 Main and emergency switchboards should be so arranged as to give easy access, as may be needed, to apparatus and equipment, without danger to personnel. The sides and the rear and, where necessary, the front of switchboards should be suitably guarded. Exposed live parts having voltages to earth exceeding a voltage to be specified by the Administration should not be installed on the front of such switchboards. Where necessary, non-conducting mats or gratings should be provided at the front and rear of the switchboard.

11.6.4 When a distribution system, whether primary or secondary, for power, heating or lighting, with no connection to earth is used, a device capable of continuously monitoring the insulation level to earth and of giving an audible and visual indication of abnormally low insulation values should be provided. For limited secondary distribution systems the Administration may accept a device for manual checking of the insulation level.

11.6.5 Cables and wiring

11.6.5.1 Power cables and control or communication cables as well as cables of each main supply and emergency supply should be installed on separated cable runs. Power and control cables for emergency consumers should be fire-resistant when they pass through fire risk areas. Where, for safety reasons, a system has duplicated supply and/or control cables, the cable routes should be placed as far apart as possible. All metal sheaths and armour of cables should be electrically continuous and should be earthed.

11.6.5.2 All electric cables and wiring external to equipment should be at least of a halogen-free flame-retardant type and should be so installed as not to impair their original flame-retarding properties. Where necessary for particular applications, the Administration may permit the use of special types of cables such as radio frequency cables, which do not comply with the foregoing.

11.6.5.3 Cables and wiring serving essential or emergency power, lighting, internal communications or signals should, so far as practicable, be routed clear of machinery spaces and their casing and other high fire risk areas. Where practicable, all such cables should be run in such a manner as to preclude their being rendered unserviceable by heating of the bulkheads that may be caused by a fire in an adjacent space.

11.6.5.4 Where cables which are installed in hazardous areas introduce the risk of fire or explosion in the event of an electrical fault in such areas, special precautions against such risks should be taken to the satisfaction of the Administration.

11.6.5.5 Cables and wiring should be installed and supported in such manner as to avoid chafing or other damage.

11.6.5.6 Terminations and joints in all conductors should be so made as to retain the original electrical, mechanical, flame-retarding and, where necessary, fire-resisting properties of the cable.

11.6.6.1 Each separate circuit should be protected against short circuit and against overload, except as permitted in section 11.5 or where the Administration may exceptionally otherwise permit. For supplies with 400 cycles the impedance of the circuits should be observed.

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

11.6.6.3 When the protective device is a fuse it should be placed on the load side of the disconnect switch serving the protected circuit.

11.6.7 Lighting fittings should be so arranged as to prevent temperature rises which could damage the cables and wiring, and to prevent surrounding material from becoming excessively hot.

11.6.8 All lighting and power circuits terminating in a bunker or cargo space should be provided with a multiple-pole switch outside the space for disconnecting such circuits.

11.6.9.1 Accumulator batteries should be suitably housed, and compartments used primarily for their accommodation should be properly constructed and efficiently ventilated.

11.6.9.2 Electrical or other equipment, which may constitute a source of ignition of flammable vapours, should not be permitted in compartments likely to contain such vapours.

11.6.10 The following additional provisions from .1 to .7 should be met, and provisions from .8 to .13 should be met also for non-metallic craft:

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

  .1 500 V for power, cooking, heating, and other permanently connected equipment; and

  .2 250 V for lighting, internal communications and receptacle outlets.

.2 For electrical power distribution earthed systems with non hull-return are acceptable. Where applicable, the provisions of 6.1.4.2.6.3 or 6.1.4.2.6.4 should also be met.

.3 Effective means should be provided so that voltage may be cut off from each and every circuit and sub-circuit and from all apparatus as may be necessary to prevent danger.

.4 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 minimised.

.5 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.

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

.7 Where it is impracticable to provide electrical protective devices for certain cables supplied from batteries, e.g. within battery compartments and in engine starting circuits, unprotected cable runs should be kept as short as possible and special precautions should be taken to minimise risk of faults, e.g. use of single core cables with additional sleeve over the insulation of each core, with shrouded terminals.

.8 In order to minimise the risk of fire, structural damage, electrical shock and radio interference due to lightning strike or electrostatic discharge, all metal parts of the craft should be bonded together, in so far as possible in consideration of galvanic corrosion between dissimilar metals, to form a continuous electrical system, suitable for the earth return of electrical equipment and to connect the craft to the water when water-borne. The bonding of isolated components inside the structure is not generally necessary, except in fuel tanks.

.9 Each refuelling point should be provided with a means of bonding the fuelling equipment to the craft.

.10 Metallic pipes capable of generating electrostatic discharges, due to the flow of liquids and gases, should be bonded so as to be electrically continuous throughout their length and should be adequately earthed.

.11 Primary conductors provided for lightning discharge currents should have a minimum cross section of 50 mm^2 in copper or equivalent surge carrying capacity in aluminium.

.12 Secondary conductors provided for the equalisation of static discharges, bonding or equipment, etc., but not for carrying lightning discharges should have a minimum cross-section of 5 mm^2 copper or equivalent surge current carrying capacity in aluminium.

.13 The electrical resistance between bonded objects and the basic structure should not exceed 0.05 Ohm, except where it can be demonstrated that a higher resistance will not cause a hazard. The bonding path should have sufficient cross-sectional area to carry the maximum current likely to be imposed on it without excessive voltage drop.

CHAPTER 12 – NAVIGATIONAL EQUIPMENT

12.1 NAVIGATION (GENERAL)

12.1.1 This chapter only covers items of navigational equipment which relate to the navigation of the craft as distinct from the safe functioning of the craft. The following paragraphs represent the minimum provisions for normal safe navigation unless it is demonstrated to the Administration that an equivalent level of safety is achieved by other means.

12.1.2 The navigational equipment and its installation should be to the satisfaction of the Administration.

12.1.3 The information provided by navigational systems should be so displayed that the probability of misreading is reduced to a minimum and should be capable of giving readings to an optimum accuracy.

12.1.4 In applying the provisions of this chapter to small craft and those on restricted voyages, the Administration should be guided by the provisions of regulation V/1.4 of the Convention, while taking into account the navigational requirements and characteristics of the craft relative to those of craft of similar size and purpose covered by the Convention.

12.2 COMPASSES

12.2.1 Craft should be provided with a magnetic compass which is capable of operating without electrical supply, and which may be used for steering purposes. This compass should be suitably selected, mounted and fitted with the required correcting devices so as to be suitable for the area of operation and speed and motion characteristics of the craft.

12.2.2 The compass card or repeater, where fitted, should be capable of being easily read from the position at which the craft is normally controlled.

12.2.3 Each magnetic compass should be properly adjusted and its table or curve of residual deviations should be available at all times.

12.2.4 Care should be taken in siting a magnetic compass or magnetic sensing element so that magnetic interference is eliminated or minimized as far as is practicable.

12.2.5 Passenger craft certified to carry 100 passengers or less should, in addition to the compass recommended in 12.2.1, be provided with an instrument, suitable for the speed and motion characteristics and area of operation of the craft, providing a heading reference of accuracy at least equivalent to that provided by a magnetic compass.

12.2.6 Cargo craft and passenger craft certified to carry more than 100 passengers should, in addition to the compass recommended in 12.2.1, be provided with a gyro-compass or a system with equivalent effectiveness which should be suitable for the speed and motion characteristics and area of operation of the craft.

12.3 SPEED AND DISTANCE MEASUREMENT

12.3.1 Craft should be provided with devices to measure speed and distance through air and water.

12.3.2 Speed- and distance-measuring devices on craft fitted with an automatic radar plotting aid should be capable of measuring speed and distance through the water.

12.4 ECHO-SOUNDING DEVICE

Any WIG craft operated in shallow water should be fitted with an echo-sounding device which will give an indication of depth of water to a sufficient degree of accuracy for use when the craft is in the displacement mode.

12.5 RADAR INSTALLATIONS

12.5.1 WIG craft intended for operation in conditions with restricted visibility or during dark periods should be provided with at least one azimuth-stabilized radar operating in the X-band (3 cm).

12.5.2 Craft of 450 gross tonnage and upwards or craft certified to carry more than 450 passengers should be provided with at least two radar installations one of which should be capable of providing appropriate warnings for collision avoidance. A second radar may also be provided in craft of less than 450 gross tonnage or certified to carry 450 passengers or less where environmental conditions so require.

12.5.3 At least one radar should be equipped with facilities for plotting which are at least as effective as a reflector plotter.

12.5.4 Adequate communication facilities should be provided between the radar observer and the person in immediate charge of the craft.

12.5.5 Each radar installation provided should be suitable for the intended craft speed, motion characteristics and commonly encountered environmental conditions.

12.5.6 Each radar installation should be mounted so as to be as free as practicable from vibration.

12.6 OTHER ELECTRONIC POSITIONING SYSTEMS

All craft should be fitted with appropriate electronic navigation equipment. This should include, as a minimum, Global Positioning System (GPS) receiver, Automatic Identification System (AIS), Automatic Radar Plotting Aid (ARPA) and Electronic Chart Display and Information System (ECDIS). In assisted craft and small cargo craft, where the fitting of all of this equipment is impracticable, the Administration may accept alternative means of meeting the functions of this equipment, provided that such acceptance is shown by the SSA not to result in a hazardous or catastrophic effect.

12.7 RUDDER ANGLE INDICATOR

Craft should be provided with an indicator showing the rudder angle for operation in the displacement mode through to the planing mode. In craft without such a rudder, the indicator should show the direction of steering thrust.

12.8 AERODYNAMIC RATE OF TURN INDICATOR

An aerodynamic rate-of-turn indicator for use in ground effect and other air-borne operational modes should be provided unless the Administration determines otherwise. Means should be provided to warn the operator if an operationally dictated maximum rate of turn is being reached.

12.9 SEARCHLIGHT

WIG craft intended for operation in conditions with restricted visibility or during dark periods should be equipped with at least one adequate searchlight, which should be controllable from the operating station.

12.10 NIGHT VISION EQUIPMENT

When operational conditions justify the provision of night vision enhancement equipment, such equipment should be fitted.

12.11 STEERING ARRANGEMENT AND PROPULSION INDICATORS

12.11.1 The steering arrangement should be so designed that the craft turns in the same direction as that of the wheel, tiller, joystick or control lever.

12.11.2 Craft should be provided with indicators showing the mode of the propulsion system(s).

12.12 AUTOMATIC STEERING AID (AUTOMATIC PILOT EQUIPMENT)

12.12.1 Craft should, where appropriate, be equipped with automatic pilot equipment.

12.12.2 Provision should be made to change from the automatic to manual mode by an override under the immediate control of the person in control of the craft.

12.13 OBSTACLE DETECTION AND AVOIDANCE SYSTEM

WIG craft should be provided with an obstacle detection and avoidance system, if required by the Administration, which is capable of at least:

.1 processing data of the craft's position, heading and speed;

.2 locating all fixed, floating and semi-submerged obstacles relative to the craft position and the predicted course;

.3 calculating a collision avoiding trajectory, including crash stop;

.4 giving alarm to the operating compartment crew, if a collision-avoiding manoeuvre is necessary; and

.5 displaying the collision-avoiding trajectory in the operating compartment.

12.14 AUTOMATIC IDENTIFICATION SYSTEM

12.14.1 Craft should be provided with an automatic identification system (AIS).

12.14.2 AIS should:

.1 provide automatically to appropriately equipped shore stations, other vessels and aircraft information, including the craft's identity, type, position, course, speed, navigational status and other safety-related information;

.2 receive automatically such information from similarly fitted vessels;

.3 monitor and track vessels; and

.4 exchange data with shore based facilities.

12.14.3 The requirements of 12.14.2 should not apply where international agreements, rules or standards provide for the protection of navigational information.

12.14.4 AIS should be operated taking into account the guidelines adopted by the Organization.

12.15 VOYAGE DATA RECORDER

12.15.1 To assist in casualty investigations, passenger craft of 150 gross tonnage and upwards and cargo craft of 3,000 gross tonnage and upwards should be provided with a voyage data recorder (VDR). For smaller passenger craft, the Administration should apply the standards for carriage of VDR as far as is reasonable and practicable.

12.15.2 The voyage data recorder system, including all sensors, should be subjected to an annual performance test. The test should be conducted by an approved testing or servicing facility to verify the accuracy, duration and recoverability of the recorded data. In addition, tests and inspections should be conducted to determine the serviceability of all protective enclosures and devices fitted to aid location. A copy of the certificate of compliances issued by the testing facility, stating the date of compliance and the applicable performance standards, should be retained on board the craft.

12.16 PERFORMANCE STANDARDS

12.16.1 All equipment to which this chapter applies should be of a type approved by the Administration. Subject to 12.16.2, such equipment should conform to performance standards not inferior to those adopted by the Organization.

12.16.2 The Administration should require that manufacturers have a quality control system audited by a competent authority to ensure continuous compliance with the type approval conditions. Alternatively, the Administration may use final product verification procedures where compliance with the type approval certificate is verified by a competent authority before the product is installed on board craft.

12.16.3 Before giving approval to navigational systems or equipment embodying new features not covered by this chapter, the Administration should ensure that such features support functions at least as effective as those required by this chapter.

12.16.4 When equipment for which performance standards have been developed by the Organization is carried on craft in addition to the equipment required by this chapter, such additional equipment should be subject to approval and should, as far as practicable, comply with performance standards not inferior to those adopted by the Organization.

CHAPTER 13 – RADIOCOMMUNICATIONS

The provisions of chapter 14 of the 2000 HSC Code should be applied to all craft.

CHAPTER 14 – OPERATING COMPARTMENT LAYOUT

14.1 DEFINITIONS

14.1.1 *Operating area* is the operating compartment and those parts of the craft on both sides of, and close to, the operating compartment which extend to the craft's side.

14.1.2 *Workstation* is a position at which one or several tasks constituting a particular activity are carried out.

14.1.3 *Docking workstation* is a place equipped with necessary means for docking the craft.

14.1.4 *Primary controls* are all control equipment necessary for the safe operation of the craft when it is under way, including those required in an emergency situation.

14.2 GENERAL

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

14.3 FIELD OF VISION FROM THE OPERATING COMPARTMENT

14.3.1 The operating station should be placed so that the operating crew positioned in the navigating workstations are able clearly view the horizon through a horizontal arc from the bow to 30 degrees abaft the beam on either side. Engines and propulsion equipment should not adversely affect this field of vision.

14.3.2 Blind sectors should be as few and as small as possible, and not adversely affect the keeping of a safe look-out from the operating station. If stiffeners between windows are to be covered, this should not cause further obstruction inside the wheelhouse.

14.3.3 The view of the sea surface from the operating station, when the navigators are seated, should not be obscured by more than one craft length through the arc specified in 14.3.1 irrespective of the craft's operational mode, draught, altitude, trim and deck cargo.

14.3.4 Where it is considered necessary by the Administration, the field of vision from the navigating workstation should permit the navigators from this position to utilise leading marks astern of the craft for track monitoring.

14.3.5 The field of vision any workstation used for docking, should permit one navigator to safely manoeuvre the craft to a berth.

14.4 OPERATING COMPARTMENT

14.4.1 The design and arrangement of the operating compartment, including location and layout of the individual workstations, should ensure the required field of vision for each function.

14.4.2 The craft's operating compartment should not be used for purposes other than navigation, communications and other functions essential to the safe operation of the craft, its engines, passengers and cargo.

14.4.3 The arrangement of equipment and means for command, navigation, manoeuvring, control, communication and other essential instruments should be located sufficiently close together to enable both the officer in charge and any assisting officer to receive all necessary information and to use the equipment and controls, as required, while they are seated. If necessary, the equipment and means serving these functions should be duplicated.

14.4.4 If a separate workstation for supervision of engine performance is placed in the operating compartment, the location and use of this workstation should not interfere with the primary functions to be performed in the operating station.

14.4.5 The location of the radio equipment should not interfere with the primary navigational functions in the operating station.

14.4.6 The design and layout of the operating compartment and the relative positions of the primary controls should be assessed against the essential operational manning level. The design and layout of the primary and communication controls should form an integrated operational and emergency control centre from which the craft can be controlled under all likely operational and emergency events by the operating crew without the necessity for any crew member to vacate the compartment.

14.4.7 The relative positions of the primary controls and the seats should be such that each operating crew member, with the seat suitably adjusted and without prejudicing compliance with 14.2, can:

.1 without interference, produce full and unrestricted movement of each control both separately and with all practical combinations of movement of other controls; and

.2 at all workstations, exert adequate control forces for the operation to be performed.

14.4.8 When a seat at a workstation from which the craft may be operated has been adjusted so as to suit the occupant, subsequent change of seat position to operate any control should not be acceptable.

14.4.9 In craft where the Administration considers the provision of a safety belt 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 14.4.8, except in respect of controls which it can be shown will only be required on very rare occasions and which are not associated with the need for safety restraint.

14.4.10 The integrated operating station should contain equipment which provides relevant information to enable the officer in charge and any assisting officer to carry out navigational and safety functions safely and efficiently.

14.4.11 Adequate arrangements should be made to prevent passengers from distracting the attention of the operating crew.

14.5 INSTRUMENTS AND CHART TABLE

14.5.1 Instruments, instrument panels and controls should be permanently mounted in consoles or other appropriate places, taking into account operation, maintenance and environmental conditions. However, this should not prevent the use of new control or display techniques, provided the facilities offered are not inferior to recognized standards.
14.5.2 All instruments should be logically grouped according to their functions. In order to reduce to a minimum the risk of confusion, instruments should not be rationalized by sharing functions or by inter-switching.

14.5.3 Instruments required for use by any member of the operating crew should be plainly visible and easily read:

.1 with minimum practicable deviation from his normal seating position and line of vision; and

.2 with the minimum risk of confusion under all likely operating conditions.

14.5.4 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. Emergency controls such as for the launching of liferafts and the monitoring of the firefighting systems should be in separate and clearly defined positions within the operating area.

14.5.5 Instruments and controls should be provided with means for screening and dimming in order to minimize glare and reflections and prevent them being obscured by strong light.

14.5.6 Surfaces of console tops and instruments should have dark glare-free colours.

14.5.7 Instruments and displays providing visual information to more than one person should be located for easy viewing by all users concurrently. If this is not possible, the instrument or display should be duplicated.

14.5.8 If considered necessary by the Administration, the operating compartment should be provided with a suitable table for chart work together with lighting appropriate for that purpose. Chart-table lighting should be screened.

14.6 LIGHTING

14.6.1 A satisfactory level of lighting should be available to enable the operating personnel to adequately perform all their tasks both at sea and in port, by day and night. There should be only a limited reduction in the illumination of essential instruments and controls under likely system fault conditions.

14.6.2 Care should be taken to avoid glare and stray image reflection in the operating area environment. High contrast in brightness between work area and surroundings should be avoided. Non-reflective or matt surfaces should be used to reduce indirect glare to a minimum.

14.6.3 A satisfactory degree of flexibility within the lighting system should be available to enable the operating personnel to adjust the lighting intensity and direction as required in the different areas of the operating compartment and at individual instruments and controls.
14.6.4 Red light should be used to maintain dark adaptation whenever possible in areas or on items of equipment requiring illumination in the operational mode, other than the chart table.

14.6.5 During hours of darkness, it should be possible to discern displayed information and control devices.

14.6.6 Reference is made to additional provisions on lighting in 11.3.13 and 11.3.14.

14.7 WINDOWS

14.7.1 Divisions between windows, located in the front, on the sides and in the doors, should be kept to a minimum. No division should be installed immediately forward of the operating stations.

14.7.2 Administrations should be satisfied that a clear view through the operating compartment windows is provided at all times regardless of weather conditions. The means provided for maintaining the 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.

14.7.3 Arrangements should be provided so that as far as practicable the forward view from operating stations is not adversely affected by solar glare or unwanted reflection. Neither polarized nor tinted window glass should be fitted.

14.7.4 The windows should be made of material which will not break into dangerous fragments if fractured.

14.8 COMMUNICATION FACILITIES

14.8.1 Such means as are necessary should be provided to enable the crew to communicate between, and have access to, each other and with other occupants of the craft in both normal and emergency conditions.

14.8.2 Means to communicate between the operating compartment and spaces containing essential machinery, including any emergency steering position, irrespective of whether the machinery is remotely or locally controlled, should be provided.

14.8.3 Means for making public address and safety announcements from control stations to all areas to which passengers and crew have access should be provided.

14.8.4 Provisions should be made for means to monitor, receive and transmit radio safety messages at the operating compartment.

14.9 TEMPERATURE AND VENTILATION

The operating compartment should be equipped with adequate temperature and ventilation control systems.

14.10 COLOURS

The surface materials inside the operating compartment should have a suitable colour and finish to avoid reflections.

14.11 SAFETY MEASURES

The operating area should be free of physical hazard to the operating personnel and have non-skid flooring in dry and wet conditions and adequate handrails. Doors should be fitted with devices to prevent them moving, whether they are open or closed.

CHAPTER 15 – AERODYNAMIC STABILIZATION SYSTEMS

This chapter has been developed on the assumption that the fitting and operation of stabilization systems is most applicable to the ground effect mode. Where a craft is fitted with hydrodynamic stabilization control systems within the meaning of chapter 16 of the 2000 HSC Code, that system should comply with the requirements of that Code. Where conflict exists between the aerodynamic meaning of terms used in this chapter and the marine terminology used elsewhere in these Guidelines, the aerodynamic meaning is intended to be followed.

15.1 DEFINITIONS

15.1.1 *Stabilization system* is a system intended to stabilize the main parameters of the craft's attitude: roll, flight trim, pitch, heading and altitude and control the craft's motions: roll, pitch, yaw and heave. This term excludes devices not associated with the safe operation of the craft. The main elements of a stabilization system may include the following:

.1 devices such as rudders, foils, flaps, skirts, fans, tilting and steerable propellers, pumps for moving fluids;

.2 power drives actuating stabilization devices; and

.3 stabilization equipment for accumulating and processing data for making decisions and giving commands such as sensors, logic processors and automatic safety control.

15.1.2 *Stabilization device* means a device listed in 15.1.1.1 with the aid of which forces for controlling the craft's attitude are generated.

15.1.3 *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.

15.1.4 *Automatic control system* is a system which enables the craft's heading and/or altitude to be maintained without operator input.

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 the 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 In case of failure of any automatic equipment or stabilization device, or of its power drive, the parameters of craft motion should remain within safe limits.

15.2.3 Craft fitted with an automatic stabilization system should be provided with an automatic safety control unless 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 operating station.

15.2.4 The parameters and the levels at which any automatic safety control activates to decrease speed and put the craft safely in the displacement or other safe mode should take account of the demonstrated safe values of altitude, roll, flight trim, pitch, yaw and associated accelerations 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 an automatic stabilization system should be demonstrated to be satisfactory, having regard to the purpose and service conditions of the craft.

15.2.6 The SSA specified in part C should include analysis of any stabilization system applying to the craft. Such analysis should be implemented by systematic process to secure sufficient reliability.

15.3 LONGITUDINAL AND HEIGHT CONTROL SYSTEMS

15.3.1 Craft fitted with an automatic stabilization system should be provided with an automatic safety control unless the redundancy arrangements are such that this control is not required by 15.2.3. Foreseeable malfunctions should have only minor effects on automatic control system operation and should be capable of being readily counteracted by the operating crew.

15.3.2 The parameters and levels at which any automatic safety control activates to decrease speed and put the craft safely into the displacement or other safe mode should take account of the safety levels and of the safe values of motions appropriate to the particular craft and service.

15.4 DEMONSTRATIONS

15.4.1 The limits of safe use of any of the stabilization control system devices should be based on demonstrations and a verification process in accordance with chapter 16 and annex 8.

15.4.2 Demonstration in accordance with chapter 16 and annex 8 should determine any adverse effects upon safe operation of the craft in the event of an uncontrollable total deflection of any one control device. 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 should be included in the craft operating manual.

CHAPTER 16 – HANDLING, CONTROLLABILITY AND PERFORMANCE

16.1 General

The operational safety of the craft in normal service conditions and in equipment failure situations should be demonstrated by full-scale tests of the craft itself or an identical craft. The objective of tests is to determine information to be included in the craft operating manual in relation to:

.1 handling and performance limitations;

.2 actions to be taken in the event of any foreseeable failure of equipment, systems or structure; and

.3 limitations to be observed for safe operation following the failures listed in .2.

16.2 PROOF OF COMPLIANCE

Information on controllability and performance should be contained in the operating manual. It should include the craft performance characteristics exhibited during the manoeuvres prescribed in 16.5.3, 16.6 and 16.7. The parameters of the worst intended conditions in all operating modes should be included. Compliance with the performance characteristics listed should be demonstrated in accordance with part C and through trials carried out in accordance with annex 8.

16.3 WEIGHT AND CENTRE OF GRAVITY

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

16.4 EFFECT OF FAILURES

The effect of any likely failure in control devices, services or components (e.g. power operation, power assistance, attitude and altitude control systems) should be assessed in order that a safe level of craft operation can be maintained. Effects of failure identified as being critical according to part C should as far as practicable be verified through the trials conducted in accordance with annex 8.

16.5 CONTROLLABILITY AND MANOEUVRABILITY

16.5.1 The effort required to operate the controls in the worst intended conditions should not be 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 controllability and performance, the Administration should pay particular attention to the following aspects during normal operation and during and subsequent to failures:

.1 yawing;

.2 turning;

.3 stopping in normal and emergency conditions;

.4 for all operational modes other than the displacement mode, stability about three axes and in heave;

.5 trim and flight trim;

.6 plough in; and

.7 lift power limitations.

16.5.4 The terms in 16.5.3 are defined as follows:

.1 *Turning* is the change of direction of a craft's track at its normal maximum operating speed in specified wind and sea conditions.

.2 *Yaw* is change of direction of a craft's heading without a change in the craft's track.

.3 *Trim*, when applied to the displacement or other modes up to and including planing, means the difference between forward and aft draughts.

.4 *Flight trim* means the condition of the craft whereby control surface settings are such that the craft attitude and direction is maintained without significant operator input.

.5 *Plough in* is an involuntary motion involving sustained increase in drag of a craft at speed, usually associated with partial collapse of an air cushion.

.6 *Lift power limitations* are those limitations imposed upon machinery and components which provide lift in operational modes other than the displacement mode.

16.6 CHANGE OF OPERATING SURFACE AND MODE

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

16.7 SURFACE IRREGULARITIES

Factors which limit the ability of the craft to operate over irregular, sloping or discontinuous sea or land surfaces should be determined, as applicable, and included in the craft operating manual.

16.8 ACCELERATION AND DECELERATION

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

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.

16.12 NIGHT OPERATION

The schedule of tests should include sufficient operation to evaluate the adequacy of internal and external lighting and visibility under conditions of normal and emergency electrical power supply in all operational modes and during docking manoeuvres.

CHAPTER 17 – OPERATIONAL PROVISIONS

17.1 CRAFT OPERATIONAL CONTROL

17.1.1 The Wing-in-ground Craft Safety Certificate, the Permit to Operate WIG Craft or certified copies thereof, and copies of the route operational manual, craft operating 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 Permit to Operate WIG Craft, in the Wing-in-ground Craft Safety Certificate, or in documents referred to therein.

17.1.3 The Administration should issue a Permit to Operate WIG Craft when it is satisfied that the operator has made adequate provisions from the point of view of safety generally, including the following matters specifically, and should revoke the Permit to Operate if such provisions are not maintained to its satisfaction:

.1 the suitability of the craft for the service intended, having regard to the safety limitations associated with the craft's certification and detailed in operational manuals, in conjunction with meteorological and sea conditions likely to be encountered in the intended area of operation;

.2 the arrangements for obtaining weather information on the basis of which the commencement of a voyage may be authorized;

.3 provision in the area of operation of a base port fitted with facilities in accordance with 17.1.4;

.4 the designation of the person responsible for decisions to cancel or delay a particular voyage, e.g. in the light of the weather information available;

.5 sufficient crew complement required for operating the craft, deploying and manning survival craft, the supervision of passengers, vehicles and cargo in both normal and emergency conditions as defined in the Permit to Operate. The crew complement should be such that two officers are on duty in the operating compartment when the craft is under way, one of whom may be the master;

.6 crew qualifications and training, including competence in relation to the particular type of craft and service intended, and their instructions in regard to safe operational procedures;

.7 restrictions with regard to working hours, rostering of crews and any other arrangements to prevent fatigue, including adequate rest periods;

.8 the training of crew in craft operation and emergency procedures;

.9 the maintenance of crew competence in regard to operation and emergency procedures;

.10 safety arrangements at terminals and compliance with any existing safety arrangements, as appropriate;

.11 traffic control arrangements and compliance with any existing traffic control, as appropriate;

.12 restrictions and/or provisions relating to position fixing and to operation by night or in restricted visibility, including the use of radar and/or other electronic aids to navigation, as appropriate;

.13 additional equipment which may be required, due to the specific characteristics of the service intended, for example, night operation;

.14 communication arrangements between craft, coast radio stations, base ports radio stations, emergency services and other ships, including radio frequencies to be used and watch to be kept;

.15 the keeping of records to enable the Administration to verify:

  .1 that the craft is operated within the specified parameters,

  .2 the observance of emergency and safety drills/procedures;

  .3 the hours worked by the operating crew;

  .4 the number of passengers on board;

  .5 compliance with any law to which the craft is subject; and

  .6 maintenance of the craft and its machinery in accordance with approved schedules;

.16 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;

.17 the existence and use of adequate instructions regarding:

.1 loading of the craft so that weight and centre of gravity limitations can be effectively observed and cargo is, when necessary, adequately secured;

.2 the provision of adequate fuel reserves; and

.3 action in the event of foreseeable emergencies; and

.18 provision of contingency plans by operators for foreseeable incidents including all land-based activities for each scenario. The plans should provide operating crews with information regarding search and rescue (SAR) authorities and local administrations and organizations which may complement the tasks undertaken by crews with the equipment available to them.*

17.1.4 The Administration should determine the maximum allowable distance from a base port or place of refuge after assessing the provisions made under 17.1.3.

17.2 CRAFT DOCUMENTATION

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

17.2.1 Craft operating manual

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

.1 leading particulars of the craft (weight and centre of gravity ranges, etc.);

.2 description of the craft and its equipment;

.3 procedures for checking the integrity of buoyancy compartments;

.4 details arising from compliance with the requirements of chapter 1 likely to be of direct practical use to the crew in an emergency;

.5 damage control procedures;

.6 description and operation of machinery systems;

.7 description and operation of auxiliary systems;

.8 description and operation of remote control and warning systems;

.9 description and operation of electrical equipment;

* Refer to the *International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual*, adopted by the Organization by resolution A.894(21), and *Use of Radar Transponders for Search and Rescue Purposes*, adopted by resolution A.530(13).

.10 cargo loading procedures and limitations, including maximum operational weight, centre of gravity position, distribution of load and securing of load in accordance with chapter VI of the Convention;

.11 description and operation of fire-detection and fire-extinguishing equipment;

.12 drawings indicating the structural fire protection arrangements;

.13 description and operation of radio equipment and navigational aids;

.14 information regarding the handling of the craft as determined in accordance with chapter 16;

.15 maximum permissible towing speeds and towing loads, where applicable;

.16 procedure for launching, retrieval, dry-docking or lifting, including limitations;

.17 in particular, the manual should provide information, in clearly defined chapters approved specifically by the Administration, relating to:

.1 indication of emergency situations or malfunctions jeopardizing safety, required actions to be taken and any consequential restrictions on operation of the craft or its machinery;

.2 evacuation procedures;

.3 operating limitations, including the worst intended conditions; and

.4 limiting values of all machinery parameters requiring compliance for safe operation; and

.18 with regard to information on machinery or system failures, data should take into account the results of any SSA reports developed during the craft design.

17.2.2 Route operational manual

The route operational manual should include at least the following information:

.1 evacuation procedures;

.2 operating limitations, including the worst intended conditions such as sea height, sea and air temperatures, and wind conditions;

.3 procedures for operation of the craft within the limitations of .2;

.4 the elements of applicable contingency plans for primary and secondary rescue assistance in the case of foreseeable incidents, including land-based arrangements and activities for each incident;

.5 arrangements for obtaining weather information;

.6 identification of the "base port(s)";

.7 identification of the person responsible for decisions to cancel or delay voyages;

.8 identification of crew complement, functions and qualifications;

.9 restrictions on working hours of crew;

.10 safety arrangements at terminals;

.11 traffic control arrangements and limitations, as appropriate;

.12 specific route conditions or requirements relating to position fixing, operations by night and in restricted visibility, including the use where practicable of radar, ARPA, GPS, ECDIS, AIS or other electronic aids to navigation; and

.13 communication arrangements between craft, coast radio stations, base ports radio stations, emergency services and other ships, including radio frequencies to be used and watch to be kept.

17.2.3 Training manual

The training manual, which may comprise several volumes, should contain instructions and information, in easily understood terms, illustrated wherever possible, on evacuation, fire and damage control appliances and systems and on the best methods of survival. Any part of such information may be provided in the form of audio-visual aids in lieu of the manual. The following should be explained in detail:

.1 donning lifejackets and immersion suits, as appropriate;

.2 muster at the assigned stations;

.3 boarding, launching and clearing the survival craft and rescue boats;

.4 method of launching from within the survival craft;

.5 release from launching appliances;

.6 methods and use of devices for protection in launching areas, where appropriate;

.7 illumination in launching areas;

.8 use of all survival equipment;

.9 use of all detection equipment;

.10 with the assistance of illustrations, the use of radio life-saving appliances;

.11 use of drogues;

.12 use of engine and accessories;

.13 recovery of survival craft and rescue boats, including stowage and securing;

.14 hazards of exposure and the need for warm clothing;

.15 best use of the survival craft facilities in order to survive;

.16 methods of retrieval, including the use of helicopter rescue gear (slings, baskets, stretchers), breeches-buoy and shore life-saving apparatus and craft's line-throwing apparatus;

.17 all other functions contained in the muster list and emergency instructions;

.18 instructions for emergency repair of the life-saving appliances;

.19 instructions in the use of fire protection and fire-extinguishing appliances and systems;

.20 guidelines for use of fireman's outfit in a fire, if fitted;

.21 use of alarms and communications associated with fire safety;

.22 methods for surveying damage;

.23 use of damage control appliances and systems, including operation of watertight doors and bilge pumps; and

.24 for passenger craft, control of and communication with passengers in an emergency.

17.2.4 Maintenance and servicing manual

The craft maintenance and servicing manual should contain as a minimum:

.1 detailed, illustrated description of all craft structure, machinery installations and all installed equipment and systems required for safe operation of the craft;

.2 specifications and quantities of all replenishable fluids and of structural materials which may be required for repairs;

.3 operational limitations of machinery in terms of values of parameters, vibration and consumption of replenishable fluids;

.4 limitations of wear of structure or machinery components, including lives of components requiring calendar or operating time replacement;

.5 detailed description of procedures, including any safety precautions to be taken or special equipment required, to remove and install main and auxiliary machinery, transmissions, propulsion and lift devices and flexible structure components;

.6 test procedures to be followed subsequent to replacement of machinery or system components or for malfunction diagnosis;

.7 procedure as applicable for launching, recovery, lifting or dry-docking the craft, including any weight, centre of gravity or attitude limitations;

.8 procedure for weighing the craft and establishing the position of longitudinal centre of gravity (LCG);

.9 where craft may be dismantled for transportation, instructions should be provided for dismantling, transport and re-assembly; and

.10 a servicing schedule, included in the maintenance manual or published separately, detailing the routine servicing and maintenance operations required to maintain the operational safety of the craft and its machinery and systems.

17.3 TRAINING AND QUALIFICATIONS

17.3.1 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 and model of craft concerned and the service intended. More than one crew member should be trained to perform all essential operational tasks in both normal and emergency situations.

17.3.2 The Administration should specify an appropriate level of operational training for the master and each member of the crew and, if necessary, the periods at which appropriate re-validation training should be carried out.

17.3.3 The Administration should issue a type rating certificate to the master and all officers having an operational role following successful completion of approved training, including practical tests commensurate with the operational tasks on board the particular type and model of craft concerned. The type rating training should cover at least the following items:

.1 knowledge and competent operation of all onboard propulsion and control systems, including communication and navigational equipment, steering, electrical, hydraulic and pneumatic systems and bilge and fire pumping;

.2 the failure mode of the control, steering and propulsion systems and proper response to such failures;

.3 handling characteristics of the craft and the limiting operational conditions;

.4 operational communication and navigation procedures;

.5 intact and damage stability and survivability of the craft in damage condition;

.6 location and use of the craft's life-saving appliances, including survival craft equipment;

.7 location and use of escapes in the craft and the evacuation of passengers;

.8 location and use of fire protection and fire-extinguishing appliances and systems in the event of fire on board;

.9 location and use of damage control appliances and systems, including operation of watertight doors and bilge pumps;

.10 cargo and vehicle stowage and securing systems;

.11 methods for control of and communication with passengers in an emergency;

.12 location and use of all other items listed in the training manual; and

.13 the International Regulations for Preventing Collisions at Sea, 1972, particularly as they apply to WIG craft operations.

17.3.4 The type rating certificate for a particular type and model of craft should only be valid for service on the route to be followed when it is so endorsed by the Administration following the completion of a practical test over that route.

17.3.5 The type rating certificate should be re-validated every two years and the Administration should lay down the procedures for re-validation.

17.3.6 All crew members should receive instructions and training, as specified in 17.3.3.6 to .9.

17.3.7 The Administration should specify standards of physical fitness and frequency of medical examinations, having regard to the route and craft concerned.

17.3.8 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 valid type rating certificate appropriately endorsed or recognised by the country of operation and held by a master or crew member, in conjunction with the current and valid licence or certificate issued by a flag State should be acceptable as evidence of satisfactory training, experience and qualification to the Administration of the country in which the craft is to operate.

17.4 MANNING OF SURVIVAL CRAFT AND SUPERVISION

17.4.1 There should be a sufficient number of trained persons on board for mustering and assisting untrained persons.

17.4.2 There should be a sufficient number of crew members, who may be deck officers or certificated persons, on board for operating the survival craft, rescue boats and launching arrangements required for abandonment by the total number of persons on board.

17.4.3 A deck officer or certificated person should be placed in charge of each survival craft to be used. However, the Administration, having due regard to the nature of the voyage, the number of persons on board and the characteristics of the craft, may permit a deck officer, certificated person or persons practised in the handling and operation of liferafts to be placed in charge of each liferaft.

17.4.4 The person in charge of survival craft should have a list of the survival craft crew and should see that the crew under command are acquainted with their duties.

17.4.5 Every rescue boat should have a person assigned who is capable of operating the engine and carrying out minor adjustments.

17.4.6 The master should ensure the equitable distribution of persons referred to in 17.4.1 to 17.4.3 among the craft's survival craft.

17.5 EMERGENCY INSTRUCTIONS AND DRILLS

17.5.1 On or before departure, passengers should be instructed in the use of lifejackets and the action to be taken in an emergency. The attention of the passengers should be drawn to the emergency instructions provided in 7.4.1 and 7.4.3.

17.5.2 Emergency fire and evacuation drills for the crew should be held on board the craft at intervals not exceeding one week for passenger craft and one month for cargo craft.

17.5.3 Each member of each crew should participate in at least one evacuation, fire and damage control drill per month.

17.5.4 Onboard drills should, as far as practicable, be conducted to simulate an actual emergency. Such simulations should include instruction and operation of the craft's evacuation, fire and damage control appliances and systems.

17.5.5 Onboard instruction and operation of the craft's evacuation, fire and damage control appliances and systems should include appropriate cross-training of crew members.

17.5.6 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 lifejacket donning should be available to each passenger and crew member. It should be placed near each passenger seat and in a prominent place within each crew work and rest space.

17.5.7 Records

The date when musters are held, details of abandon craft drills and fire drills, drills of other life-saving appliances and onboard training should be recorded in such log-book as may be prescribed by the Administration. If a full muster, drill or training session is not held at the appointed time, an entry should be made in the log-book stating the circumstances and the extent of the muster, drill or training session held. A copy of such information should be forwarded to the operator's management.

17.5.8 Evacuation drills

17.5.8.1 Evacuation drill scenarios should vary each week so that different emergency conditions are simulated.

17.5.8.2 Each evacuation craft drill should include:

.1 summoning of crew to muster stations with the alarm required by 7.2.1.3 and ensuring that they are made aware of the order to abandon craft specified in the muster list;

.2 reporting to stations and preparing for the duties described in the muster list;

.3 checking that crew are suitably dressed;

.4 checking that lifejackets are correctly donned;

.5 donning of immersion suits or thermal protective clothing by appropriate crew members;

.6 testing of emergency lighting for mustering and abandonment; and

.7 giving instructions in the use of the craft's life-saving appliances and in survival at sea.

17.5.8.3 Rescue boat drill

17.5.8.3.1 As far as is reasonable and practicable, rescue boats should be launched each month as part of the evacuation drill, with their assigned crew aboard, and manoeuvred in the water. In all cases this provision should be complied with at least once every three months.

17.5.8.3.2 If rescue boat launching drills are carried out with the craft making headway, such drills should, because of the dangers involved, be practised in sheltered waters only and under the supervision of an officer experienced in such drills.*

17.5.8.4 Individual instructions may cover different parts of the craft's life-saving system, but all the craft's life-saving equipment and appliances should be covered within any period of one month on passenger craft and two months on cargo craft. Each member of the crew should be given instructions which should include but not necessarily be limited to:

.1 operation and use of the craft's inflatable liferafts;

.2 problems of hypothermia, first-aid treatment of hypothermia and other appropriate first-aid procedures; and

.3 special instructions necessary for use of the craft's life-saving appliances in severe weather and severe sea conditions.

17.5.9 Fire drills

17.5.9.1 Fire drill scenarios should vary each week so that all likely emergency conditions are simulated over a period of not more than 6 months.

17.5.9.2 Each fire drill should include, as applicable:

.1 summoning of crew to fire stations;

.2 reporting to stations and preparing for the duties described in the muster list;

.3 donning of fireman's outfits, where fitted;

.4 operation of fire doors and fire dampers;

.5 operation of fire pumps and firefighting equipment;

.6 operation of communication equipment, emergency signals and general alarm;

.7 operation of fire-detection system; and

.8 instruction in the use of the craft's firefighting equipment and sprinkler and drencher systems, if fitted.

* Refer to the STCW Convention, 1978, as amended, for requirements related to training for the purpose of launching lifeboats and rescue boats from ships making headway through the water.

17.5.10 Damage control drills

17.5.10.1 Damage control drill scenarios should vary each week so that emergency conditions are simulated for different damage conditions.

17.5.10.2 Each damage control drill should include, as applicable:

.1 summoning of crew to damage control stations;

.2 reporting to stations and preparing for the duties described in the muster list;

.3 operation of watertight doors and other watertight closures;

.4 operation of bilge pumps and testing of bilge alarms and automatic bilge pump starting systems; and

.5 instruction in damage survey, use of the craft damage control systems and passenger control in the event of an emergency.

17.6 PROVISIONS FOR PASSENGER CRAFT

17.6.1 Type rating training

17.6.1.1 For all crew members, the type rating training should cover the control and evacuation of passengers additionally to 17.3.6.

17.6.1.2 When a craft carries cargoes, the craft should comply with the provisions of 17.7 in addition to this section.

17.6.2 Emergency instructions

Attention of passengers should be drawn to the provisions of the emergency instructions on boarding.

17.7 PROVISIONS FOR CARGO CRAFT

Type rating training

For all crew members, the type rating training should cover knowledge of cargo and vehicles storage area securing systems.

CHAPTER 18 – INSPECTION AND MAINTENANCE PROVISIONS

18.1 The inspection and maintenance measures implemented on a craft should be to the satisfaction of the Administration. These measures may be carried out directly by the operator's organization or by any organization on which the operator may call in the maintenance of the 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, communication and allocation of responsibilities.

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

.1 routine preventive inspection and maintenance should be performed to a schedule approved by the Administration, including:

.1 inspection and maintenance having regard at least in the first instance to the manufacturer's schedule;

.2 daily inspections by the crew; and

.3 routine checks on operational mass and centre of gravity;

.2 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;

.3 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. If appropriate, the effect of a modification should be assessed in accordance with part C and the Administration may require that its safety be demonstrated through trials;

.4 appropriate arrangements should be provided for informing the master of the serviceable state of his craft and its equipment;

.5 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;

.6 the master should report to the maintenance organization any defects and repairs which are known to have occurred during operations; and

.7 records of defects and their correction should be maintained and those defects of recurrent nature, or those which adversely affect craft or personal safety, should be reported to the Administration.

18.3 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.

PART C – SAFETY ASSESSMENT AND SAFETY MANAGEMENT

The safety assessment process provides a rational basis for the assessment of the safety of a craft by applying basic objective requirements for craft functions and for those systems installed on board the craft that perform these functions. Moreover, specific requirements are generated in the assessment process where the risk associated with particular failure conditions warrants this.

The present part is organized as follows:

A brief summary of the underlying probability concept and some basic definitions are given in chapter 1 below. Safety of WIG craft must be ensured throughout the entire service life. The processes and methods employed vary in the different phases of the life cycle and are accordingly grouped in two separate chapters: safety assessment for craft systems and safety management covering the operational phase.

The first, described in chapter 2 (Safety assessment for WIG craft systems), constitutes a thorough assessment of potential failures and the outcome of potential failures occurring alone or in combination. It covers the phases from initial design to commissioning of the craft. The second, described in chapter 3 (Safety management), is primarily concerned with the operational phase of the craft and seeks to ensure safe management and operation.

CHAPTER 1 – USE OF PROBABILITY CONCEPT

1 GENERAL

1.1 The safety assessment process is based on the principle that an inverse relationship should exist between the probability of an occurrence and the severity of its effect. This principle is illustrated in table 1, relating the category of effect to acceptable levels of probability.

1.2 To ensure consistency in the application of the safety assessment process the following definitions apply.

2 DEFINITIONS

2.1 *Common cause* means an occurrence that affects several elements which are otherwise considered independent or redundant.

2.2 *Failure* is a loss of function or a malfunction of a system or part of a system.

2.3 *Failure condition* is a condition with an effect on the craft and its occupants caused by one or more failures, taking into account relevant adverse operational or environmental conditions. A failure condition is classified according to the severity of its effects.

2.4 *Failure effect* is the consequence of a failure condition at craft, system or item level. Failure effects are categorized as follows:*

.1 *Minor effect* means the effect of failure conditions that does not significantly reduce craft safety, and which involve crew actions that are well within their capabilities. Failure conditions with a minor effect may include, for example, a slight reduction in safety margins or functional capabilities, a slight increase in crew workload, or some inconvenience to occupants.

.2 *Major effect* means the effect of failure conditions that reduces the capability of the craft or the ability of the crew to cope with adverse operating conditions to the extent that there would be, for example, a significant reduction in safety margins or functional capabilities, a significant increase in crew work load or in conditions impairing crew efficiency, or discomfort to occupants, possibly including injuries.

.3 *Hazardous effect* means the effect of failure conditions that reduces the capability of the craft or the ability of the crew to cope with adverse operating conditions to the extent that there would be, for example, a large reduction in safety margins or functional capabilities, physical distress or higher workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely, or serious or fatal injuries to a relatively small number of occupants.

.4 *Catastrophic effect* means the effect of failure conditions that leads to a loss of the craft and/or multiple fatalities.

.5 *Hazard* is a potentially unsafe condition resulting from failures, malfunctions, external events, errors, or a combination of these.

2.5 *Probability level* means an acceptable probability range and should be established as the risk per hour in ground effect operation, based on the expected mean operating time for the craft. Five probability levels are distinguished:

.1 *Extremely improbable* failure conditions would be unlikely to arise in the entire operational life of all craft of one type (at worst 10^{-9}).

.2 *Extremely remote* failure conditions are unlikely to occur when considering the total operational life of all craft of one type, but nevertheless have to be considered as being possible (at worst 10^{-7}).

.3 *Remote* failure conditions are unlikely to occur to each craft during its total life but may occur several times when considering the total operational life of a number of craft of a type (at worst 10^{-5}).

.4 *Reasonably probable* failure conditions could arise several times in the life of a craft (between 10^{-5} and 10^{-3}).

.5 *Frequent* failure conditions are those having a probability greater than 10^{-3}.

2.6 *Risk* means the frequency (probability) of occurrence and the associated level of hazard.

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* Refer to the US Joint Aviation Requirement (JAR) 25 and the Advisory Material – Joint (AMJ) 25.1309.

2.7 *Safety assessment* means a systematic evaluation of the craft functions and the design of systems performing these functions. It uses recognized methods to identify failure conditions, establish safety objectives and requirements and evaluate the implemented system.

2.8 *Safety requirement* means a statement in a specification that can be validated and against which an implementation can be verified.

CHAPTER 2 – SAFETY ASSESSMENT FOR WIG CRAFT SYSTEMS

Safety of WIG craft can only be achieved by a thorough assessment of potential failures, occurring separately or in combination, and of the effect of these failures on the craft and its occupants. The assessment process seeks to identify critical failure conditions, to assess their effect on the craft and its occupants, and to derive safety objectives for the systems concerned. Its main objective is to provide insight into the craft's failure characteristics and thereby assist the Administration in evaluating the levels of safety proposed for the craft's operation. Furthermore, the assessment should state clearly those procedures upon which safety depends during the operational life of the craft, so that the level of safety can be maintained. Section 1 below describes the individual steps involved in the safety assessment procedure.

Different analysis techniques may be applied in the various stages of the assessment process. Section 2 contains guidance and suggestions on suitable methods for conducting the safety assessment.

1 SAFETY ASSESSMENT PROCESS

1.1 Application

1.1.1 Safety assessment provides for a systematic examination of the craft functions and craft systems associated with the safe performance of these functions. A safety assessment should be conducted for each craft before entry into service.

1.1.2 For craft of the same design and having the same equipment, one safety assessment for the lead craft will be sufficient but each of the craft should be subject to the same trial programme.

1.1.3 If in the course of the service life of the craft changes are made to the design or operation of the craft or its systems, the effect of these changes on the results of the safety assessment should be examined, documented and reported to the Administration.

1.1.4 The safety assessment should be conducted for the craft itself and for systems installed on the craft. The systems considered should include, but not be limited to:

.1 propulsion system;

.2 electrical system;

.3 auxiliary systems;

.4 control systems, including directional, altitude and trim control; and

.5 navigational equipment.

1.2 Assessment team

1.2.1 An assessment team should be established and should include the builder or designer, experts having the necessary knowledge and experience in the design and/or operation for the specific evaluation at hand, and a safety engineer familiar with the different steps of the assessment process. Other members may include craft operators, equipment manufacturers and human factor experts.

1.2.2 The level of expertise and experience that individuals should have to participate in the team will vary depending on the system complexity and the type of analysis being performed.

1.3 Assessment process

1.3.1 General

1.3.1.1 The basic principles described below are based on established procedures outside the marine industry.* They provide the methods to evaluate the craft functions and the design of systems performing these functions. The safety assessment process should ensure that all relevant failure conditions are identified and that all significant combinations of failures, which could cause those failures conditions, are taken into account.

1.3.1.2 The safety assessment is conducted in parallel with the design and construction of the craft. Accordingly, three phases may be distinguished:

.1 Generation of requirements

Depending on the criticality of functional failures at craft and system level, safety objectives are assigned to the various failure conditions identified. These safety objectives are expressed as probability levels and probability budgets that should be met by the implemented system, item and hardware/software configuration.

.2 Design implementation

During implementation account should be taken of the failure rate budgets assigned to hardware and software items.

.3 Verification

In the verification phase it should be demonstrated that the hardware and software actually implemented meet the relevant safety requirements.

1.3.1.3 Different processes are employed in the phases of the development cycle as illustrated in figure 1:

.1 Functional Hazard Assessment (FHA) in the concept development stage;

.2 Preliminary System Safety Assessment (PSSA) during the design phase; and

.3 System Safety Assessment (SSA) in the verification phase.

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* Refer to SAE Aerospace Recommended Practice ARP 4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment (1996).

1.3.1.4 There is likely to be some overlap between the phases and the assessment process is iterative in nature. Individual activities will hence be revisited as the design evolves and becomes more defined.

1.3.1.5 The Functional Hazard Assessment (FHA) is conducted at the beginning of the development cycle. It should clearly identify and classify failure conditions associated with the craft's functions. These failure condition classifications establish the safety objectives. In table 1, the failure condition classifications (category of effect) are related to the safety objectives, expressed as levels of probability. The output of the FHA forms the starting point for the Preliminary System Safety Assessment (PSSA).

1.3.1.6 The Preliminary System Safety Assessment (PSSA) is a systematic analysis of the proposed system architecture. Its purpose is to show how failures at a lower hierarchical level can lead to the functional hazards identified in the FHA. The PSSA should provide the designer with all necessary safety requirements of the system and demonstrate that the proposed architecture can meet the safety objectives identified by the FHA.

1.3.1.7 The PSSA is an interactive process and conducted at different development stages. At the lowest level, the PSSA determines the safety related design requirements of hardware and software. The PSSA usually takes the form of a Fault Tree Analysis (Dependence Diagram and Markov Analysis may also be used). It should also address safety issues arising from common cause considerations.

1.3.1.8 The System Safety Assessment (SSA) is a systematic assessment of the actual system to demonstrate that safety objectives from the FHA and derived safety requirements from the PSSA are actually met. The SSA is usually based on the PSSA Fault Tree Analysis.

1.3.1.9 Activities typically performed in the FHA, PSSA and SSA are described below under the respective headings.

1.3.2 Functional Hazard Assessment (FHA)

1.3.2.1 Scope of analysis

1.3.2.1.1 The scope of a safety assessment varies depending on factors such as system complexity, level of service experience, and criticality of system failures. Before starting a detailed analysis of system failures it is therefore necessary to make a preliminary assessment in order to establish the required depth of analysis.

1.3.2.1.2 An FHA is performed at two levels, i.e. at craft level and at system level.

1.3.2.1.3 The craft level FHA is a high level, qualitative assessment of the basic functions of the craft. A craft level FHA should identify and classify the failure conditions associated with the craft level functions. The classification of these failure conditions establishes the safety objectives that a craft should meet (see table 1).

1.3.2.1.4 The system level FHA is also a qualitative assessment which is iterative in nature and becomes more defined as the development progresses. It considers a failure or combination of failures that affect a craft function. Lower level hardware or software items are not assessed in the system level FHA.

1.3.2.1.5 The output of the craft level FHA is the starting point for craft level fault trees, while the system level FHA is used to generate top level events for PSSA fault trees. In both cases the fault trees (Dependence Diagrams may also be used) can be used to derive lower level safety provisions.

1.3.2.2 Procedures for FHA

1.3.2.2.1 FHA carried out at craft and at system level use the same principles. The FHA process is a top down approach for identifying functional failure conditions and assessing their effects. This assessment is made following the steps listed below. A description of the FHA method following these steps is provided in section 2 (Safety assessment methods).

.1 identification of all craft and system functions;

.2 identification and description of failure conditions associated with these functions;

.3 determination of the effects of the failure condition;

.4 classification of failure condition effects;

.5 assignment of safety objectives/probability requirements; and

.6 identification of means of compliance.

1.3.2.2.2 The analysis should take account of the environmental conditions the craft is likely to encounter en route.

1.3.2.2.3 During the execution of the FHA a list should be compiled describing:

.1 the craft configuration following the loss of systems examined in the FHA;

.2 resulting operational limitations; and

.3 the action required of the crew.

1.3.2.2.4 The results of the FHA should be documented following the format given in section 1.4.1 below. They represent the input data and information for the PSSA process.

1.3.3 Preliminary System Safety Assessment (PSSA)

1.3.3.1 Scope of analysis

1.3.3.1.1 For each significant failure condition identified in the FHA, a PSSA should be performed. Significant failure conditions are those classified as catastrophic, hazardous or major. Catastrophic and hazardous failure conditions should be subject to a qualitative and quantitative analysis. For failure conditions identified as major a less thorough qualitative analysis is sufficient when the systems are not complex or when relevant service experience is available.

1.3.3.1.2 The PSSA process examines the proposed system architecture with a view to identifying individual failures and combinations of failures that can cause the functional hazards identified by the FHA. The main purpose of the PSSA is to determine whether the chosen design can meet the safety objectives identified by the FHA and to derive safety requirements for systems and equipment associated with the function under consideration. The PSSA process is iterative in nature and continuous throughout the design cycle.

1.3.3.1.3 Since each significant failure condition should be analysed by a PSSA, there are likely to be several PSSAs performed for a craft.

1.3.3.2 Procedures for PSSA

1.3.3.2.1 The PSSA process should identify the sequence of events resulting from individual failures or combinations of failures that can lead to the functional hazards identified by the FHA. It should also show how the FHA requirements can be satisfied by the chosen design. The process uses a top-down approach that seeks to identify all basic events that contribute to the functional hazards.

1.3.3.2.2 The assessment draws on established risk assessment methods of which the following should be applied in the PSSA process:

.1 Fault Tree Analysis (FTA) or Dependence Diagrams (DD);

.2 Failure Modes Effect and Criticality Analysis (FMECA);

.3 Failure Modes and Effects Summary (FMES); and

.4 Zonal Hazard Analysis (ZHA).

More information on these methods is provided in section 2.

1.3.3.2.3 FTA, or DD, is a top-down approach that allows the logical representation of many basic events (e.g. failure modes from FMECA) that combine to produce events at higher levels (e.g. failure conditions from FMES, ZHA or FHA). Its main purpose is to derive safety requirements for the basic events.

1.3.3.2.4 An FMECA provides for a systematic examination of potential failure modes of equipment. It seeks to identify causes, analyse effects on system operation, quantify occurrence probabilities (failure rates), and identify corrective actions, i.e. design modifications.

1.3.3.2.5 The FMES summarizes lower level failure modes with the same effect derived from previously performed FMECAs.

1.3.3.2.6 The objective of a ZHA is to identify potential areas of risk arising from the design of the installation (segregation, separation, protection, etc.) and the operation (maintenance tasks, etc.).

1.3.3.2.7 The results of the PSSA should be documented following the format given in section 1.4.2 below. The outputs from the PSSA are the inputs for the SSA process.

1.3.4 System Safety Assessment (SSA)

1.3.4.1 Scope of analysis

The SSA is the final step in the assessment process. It integrates results of the previously performed FHA, PSSA and flight/performance tests. While FHA and PSSA are used during the design process to derive safety requirements, an SSA is a verification tool to show that the implemented design satisfies the requirements established by the FHA and PSSA.

1.3.4.2 Procedures for SSA

1.3.4.2.1 For each PSSA there should be a corresponding SSA. The verification process should be supported by data sheets for which an example is shown in table 2. In these data sheets requirements for specific failure conditions generated in the FHA and PSSA process are correlated with the results obtained in the SSA for the implemented design.

1.3.4.2.2 The results of the SSA should be documented following the format given in section 1.4.3 below. The "inspection activities" referred to in the documentation (section 1.4.3 below) relate to scope and intervals of safety related checks to be performed by the operator and the Administration during the service life of the craft. The documentation should include those activities (regular checks by the crew, maintenance tasks, inspections) necessary to satisfy the safety requirements established by the PSSA.

1.3.4.2.3 Means of verification include tests, analysis, demonstration and inspection.

1.4 Documentation

The results of the Safety Assessment should be documented in a report addressing the three main elements of the assessment process: Functional Hazard Assessment, Preliminary System Safety Assessment and System Safety Assessment. The report should provide the following information so that there is traceability of the steps taken in developing the analysis.

1.4.1 Functional Hazard Assessment (FHA)

.1 FHA input function list covering all craft systems (see example in table 3).

.2 Environmental and emergency/abnormal configuration list.

.3 For each system:

- .1 system definition (block diagram, boundaries, interfaces, operational limits);
- .2 system description (operational procedures, maintenance regime);
- .3 functional description (top-down description: system → components);
- .4 functional relationship with external systems;
- .5 FHA worksheets (see example in table 4);
- .6 supporting material for classification of failure conditions;

.7 verification methods and requirements; and

.8 system summary.

.4 Conclusions.

1.4.2 Preliminary System Safety Assessment (PSSA)

.1 Planned compliance method with FHA requirements.

.2 List of failure conditions for further analysis.

.3 Fault trees or Dependence Diagrams.

.4 Lower level safety requirements.

.5 Updated list of verification methods and requirements.

.6 Operational requirements (maintenance tasks, checks, etc.).

1.4.3 System Safety Assessment (SSA)

.1 Updated failure condition list, including classifications.

.2 Fault trees or Dependence Diagrams showing compliance with safety requirements.

.3 Documentation showing how requirements for the design of the system items installation (segregation, separation, protection, etc.) have been incorporated.

.4 Verification that safety requirements from the PSSA are incorporated into the design and/or testing process.

.5 Results of the non-analytic verification process, for example tests, simulations, demonstrations, inspection activities.

2 SAFETY ASSESSMENT METHODS

The assessment process described in section 1 employs a number of standard risk assessment techniques. The present section provides some guidance on how the different types of analysis should be applied to WIG craft systems. As all methods are well established, further background information can readily be found in the literature.

2.1 Functional Hazard Assessment (FHA)

2.1.1 The starting point for a FHA is a comprehensive description of the craft and its systems. This includes a complete breakdown of all systems and subsystems. The FHA is a function driven process that can be performed at an early design stage where system knowledge is still incomplete and subject to change.

2.1.2 The FHA comprises six main steps as outlined below:

.1 *Identification of all craft and system functions*

A function list is created at craft and at system level, taking into account both internal and external functions. Table 3 gives an example of an input function data sheet.

.2 *Identification and description of failure conditions associated with these functions*

Multiple failures should be considered, especially when the effect of a certain failure depends on the availability of another system. Failure conditions to be considered include:

.1 loss of function (detected/undetected);

.2 malfunction (detected/undetected);

.3 incorrect function;

.4 reduced performance;

.5 interrupted function; and

.6 inadvertent function.

.3 *Determination of the effects of failure conditions*

Failure conditions should be examined with respect to their effect at craft and system level and with respect to the effect on the crew, occupants and the environment. All operational modes, environmental conditions and emergency/ abnormal situations should be taken into account when evaluating the effect of failure conditions. If effects cannot be determined by the analyst, the associated failure condition should be further examined using simulation techniques, model tests or full scale tests.

.4 *Classification of failure condition effects*

The effect of failure conditions is classified according to the following categories: catastrophic, hazardous, major, minor, no safety effect (see section 2 of chapter 1 and table 1). Material used to support the classification should be documented. The need for further supporting material (e.g. simulations or tests) should be identified.

.5 *Assignment of safety objectives/probability requirements*

For each failure condition probability requirements (see table 1) and qualitative design requirements should be assigned and documented. The design requirements may relate to the craft, systems and items.

.6 *Identification of means of compliance*

For each failure condition, the measures foreseen to comply with the safety objectives should be identified and documented.

2.2 Failure Modes Effect and Criticality Analysis (FMECA)

2.2.1 An FMECA is performed for components or items that contribute to functional failures identified as hazardous or catastrophic. These are, for example, parts associated with basic events in fault trees. Procedures for FMECA are documented in the literature.* The level of detail should correspond to the level of indenture in the system hierarchy at which functional failures are postulated. The analysis is an iterative process that evolves as the design becomes more defined.

2.2.2 The FMECA process is facilitated by worksheets as shown in table 5. An important aspect of an FMECA is concerned with obtaining reliable data for failure mode rates under similar environmental and operational conditions to those envisaged for the system being analysed. Failure rate data may be obtained from handbooks in the public domain,** from industry sources or by computational methods.

2.3 Failure Modes and Effects Summary (FMES)

The FMES summarizes all failure modes with the same effect from previously performed FMECAs. Its purpose is to combine into a single event all item failures with the same effect on the system, thereby simplifying the fault tree. Compared to an FMECA, it is a higher level type of analysis where the failure effects of the FMECAs are failure modes for the FMES. The FMES failure rates are obtained by adding the individual failure rates of contributing low level, independent, failure modes. The FMES process is facilitated by worksheets as shown in table 6.

2.4 Fault Tree Analysis (FTA)

2.4.1 FTA is employed in the PSSA process to determine the causes leading to undesirable top events identified in the FHA. It is a graphical representation of events, or more often combinations of events, that contribute to the top event. It provides the link between the different analysis methods described in the present section by:

.1 using failure conditions identified as hazardous or catastrophic in the FHA as top event;

.2 generating basic events that may have to be further analysed in an FMECA;

.3 demonstrating how combinations of basic events lead to failure modes derived by FMES and ZHA;

.4 quantifying failure rate budgets for basic or intermediate events; and

.5 deriving permissible failure rates for basic events.

2.4.2 Principles and procedures for FTA are well documented in the literature.***

2.4.3 Instead of FTA, Dependence Diagrams may also be used to achieve the same objectives.

---

* Refer to, for example, British Standard 5760, Part 5.

** Refer to, for example, Reliability Analysis Center: Nonelectronic Parts Reliability Data and Failure Mode/ Mechanism Distributions.

*** Refer to, for example, Ref. 2 or British Standard 5760, Part 7.

2.4.4 In the SSA process, FTA is used to demonstrate that the safety objectives for the top events are satisfied by the actually implemented design.

2.5 Zonal Hazard Analysis (ZHA)

2.5.1 Starting point for a ZHA is the definition of specific zones within the craft that are, for example, separated by bulkheads or other parts of the structure. The analysis is performed initially based on design drawings and later on mock-ups or the final craft. For each of the zones four aspects are addressed in the analysis:

.1 Compliance with installation rules

Compliance with the provisions in these Guidelines relating to equipment installation should be demonstrated.

.2 Interaction between systems

The analysis should identify intrinsically hazardous items (e.g. fuel lines) and show that failures (e.g. fuel leakage) do not cause cascade type failures in neighbouring systems.

.3 Maintenance errors

Improper equipment installation may increase the likelihood of maintenance errors. The analysis should identify such areas and recommend alternative designs.

.4 Environmental effects

Consideration should be given to the effect of environmental conditions such as lightning strike, bird strike, water ingress, etc.

2.5.2 Details of the analysis technique are *inter alia* given in the SAE Aerospace Recommended Practice (ARP) 4761. Results of the analysis should be recorded in data sheets as shown in table 7.

CHAPTER 3 – SAFETY MANAGEMENT

When the craft enters service, safety assessment does not stop. It is important that a management system is in place that ensures that all those aspects identified in the safety assessment relating to operational procedures, regular checks and maintenance tasks are implemented so that safety standards can be upheld. The appropriate mechanism for this is provided by the International Safety Management (ISM) Code, requiring the operator to implement a Safety Management System (SMS). The SMS should incorporate results from the PSSA and SSA, in particular with reference to:

.1 crew operational procedures;

.2 emergency procedures and actions;

.3 procedures related to the control of hazardous situations and accidents;

.4 maintenance procedures for equipment whose sudden failure may have a hazardous or catastrophic effect;

.5 inspection intervals and methods; and

.6 control of documents and data relevant for the SMS as well as the integrity and operation of the craft.

Table 1 – Correlation between levels of probability and categories of effect

Probability (quantitative)	$10^{-0}\frac{1}{h}$	$10^{-3}\frac{1}{h}$	$10^{-5}\frac{1}{h}$	$10^{-7}\frac{1}{h}$	$10^{-9}\frac{1}{h}$
Probability (descriptive) **FAA**	**Probable**		**Improbable**		**Extremely Improbable**
JAA	**Frequent**	**Reasonably Probable**	**Remote**	**Extremely Remote**	
Category of Effect	**Minor**		**Major**	**Hazardous**	**Catastrophic**
Effect on craft, occupants and environment	- slight reduction in safety margins or functional capabilities; or - slight increase in crew workload; or - some inconvenience to occupants		- significant reduction in safety margins or functional capabilities; or - significant increase in crew workload; or - discomfort to occupants; or - possibly injuries to occupants; or - localized structural damage; or - moderate environmental pollution	- large reduction in safety margins or functional capabilities; or - large increase in crew workload, so that the crew may not be able to perform tasks accurately or completely; or - serious or fatal injuries to a relatively small number of occupants; or - large structural damage; or - significant environment pollution	- loss of craft; or - multiple fatalities; or - large environmental pollution with long-term effects

Table 2 – SSA verification data sheet

<table>
<tr><th colspan="5">SSA verification data sheet</th><th>Sheet ____ of ___
Issue :
Date :</th></tr>
<tr><th colspan="3">FHA/PSSA requirement</th><th colspan="3">Implemented design</th></tr>
<tr><th>No.</th><th>Failure condition</th><th>Objectives</th><th>Event</th><th>Probability</th><th>SSA/FTA reference</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</table>

Table 3 – Input function list

List of functions worksheet			Sheet ____ of ____ Issue : Date :
Function No.	**Function**	**System Subsystem Equipment**	**Equipment-ID-No.**

Table 4 – FHA worksheet

Functional hazard analysis worksheet						Sheet ____ of ___ Issue : Date :
System: Subsystem:			Function:			
Item No.	Failure condition	Mission phase	Failure effects	Classification	Objec-tives	Remarks

Table 5 – Component FMECA worksheet

Component FMECA worksheet							Sheet ____ of ____ Issue : Date :	
System: Subsystem:				FTA reference:				
Item No.	Item	Item Failure mode	Mode Failure rate	Mission phase	Failure effects	Detection method	Classification	Remarks

Table 6 – FMES worksheet

FMES worksheet						Sheet ____ of __ Issue : Date :
System: Subsystem:						
Item No.	Failure mode	Failure rate	Effects on system	Failure cause (FMECA Ref.)	Detectability	Remarks

Table 7 – Zonal Hazard Analysis data sheet

<table>
<tr><td colspan="6">ZHA: Hazard Identification data sheet</td><td>Sheet ____ of ____
Issue :
Date :</td></tr>
<tr><td colspan="2">System:
Zone:
Zone number:</td><td colspan="5">System: Subsystem:
Equipment:</td></tr>
<tr><td>ID</td><td>Hazardous element</td><td>Hazardous condition</td><td>Initiator event</td><td>Effects</td><td>Probability</td><td>Safety measures/ Means of compliance</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</table>

Assessment process:	Functional Hazard Assessment (FHA)	Preliminary System Safety Assessment (PSSA)		Design implementation	System Safety Assessment (SSA)
Purpose of process:	- Identify and classify failure conditions - Establish safety objectives	- Establish system and item safety requirements - Develop specifications for hardware procurement			- Verify that safety requirements defined in FHA and PSSA are satisfied
Development cycle:	Concept development	Preliminary design	Detailed design	Procurement	Design validation

Figure 1 – Relationship between safety assessment processes and the different phases of the development cycle

ANNEX 1

FORM OF WING-IN-GROUND CRAFT SAFETY CERTIFICATE AND RECORD OF EQUIPMENT

WING-IN-GROUND CRAFT SAFETY CERTIFICATE

This Certificate should be supplemented by a Record of Equipment

(Official seal) (State)

Issued under the provisions of the

GUIDELINES FOR WING-IN-GROUND CRAFT
(MSC.1/Circ.1592)

under the authority of the Government of

....
(full designation of the State)

by ....
(full official designation of the competent person or
organization authorized by the Administration)

Particulars of craft*

Name of craft ....

Manufacturer's model and hull number
....

Distinctive number or letters ....

IMO number**...

Port of registry ....

Gross tonnage ....

Design waterline corresponding to draughts at draught marks of .... forward, ... aft

* Alternatively, the particulars of the craft may be placed horizontally in boxes.

** In accordance with the IMO ship identification number scheme, adopted by the Organization by resolution A.1117(30).

Category Assisted passenger craft/unassisted passenger craft/cargo craft*

Craft type WIG craft, Type A/B/C, monohull/multihull/other (give detail ....)*

Date on which keel was laid or craft was at
a similar stage of construction or on which
a major conversion was commenced ....

THIS IS TO CERTIFY:

1 That the above-mentioned craft has been duly surveyed in accordance with the applicable provisions of the Guidelines for wing-in-ground craft.

2 That the survey showed that the structure, equipment, fittings, radio station arrangements and materials of the craft and the condition thereof are in all respects satisfactory and that the craft complies with the relevant provisions of the Guidelines.

3 That the life-saving appliances are provided for a total number of ..... persons and no more as follows:
....
....

4 That, in accordance with 12 of part A, the following equivalents have been granted in respect of the craft:

paragraph	....	equivalent arrangement	....
	....		....

This certificate is valid until ....

Completion date of the survey on which this certificate is based: ………………………………..
(*dd/mm/yyyy*)

Issued at ....
(Place of issue of certificate)

.... ………...
(Date of issue) (Signature of authorized official issuing the certificate)

....
(Seal or stamp of the issuing authority, as appropriate)

Endorsement for periodical surveys

This is to certify that, at a survey required by 6 of part A, this craft was found to comply with the relevant provisions of the Guidelines.

* Delete as appropriate.

Periodical survey: Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

Periodical survey: Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

Periodical survey: Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

Periodical survey: Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

Endorsement to extend the Certificate if valid for less than 5 years where 9.8 of part A applies

This craft complies with the relevant requirements of the Guidelines, and this Certificate should, in accordance with 9.8 of part A, be accepted as valid until ……………..............................

Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

Endorsement where the renewal survey has been completed and 9.9 of part A applies

This craft complies with the relevant provisions of the Guidelines, and this Certificate should, in accordance with 9.9 of part A, be accepted as valid until ....………………

Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

Endorsement to extend the validity of the Certificate until reaching the port of survey where 9.10 of part A applies

This Certificate should, in accordance with 9.10 of part A, be accepted as valid until .....………

Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

Endorsement for the advancement of the anniversary date where 9.12 of part A applies

In accordance with 9.12 of part A, the new anniversary date is ....……………….................

Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

In accordance with 9.12 of part A, the new anniversary date is ....………

Signed: ....
(Signature of authorized official)
Place: ....
Date: ....

....
(Seal or stamp of authority, as appropriate)

**RECORD OF EQUIPMENT FOR
WING-IN-GROUND CRAFT SAFETY CERTIFICATE**

This Record should be permanently attached to
the Wing-in-Ground Craft Safety Certificate

**RECORD OF EQUIPMENT FOR COMPLIANCE WITH
THE GUIDELINES FOR WING-IN-GROUND CRAFT**

1 Particulars of craft

Name of craft ....

Manufacturer's model and hull number ....

Distinctive number or letters ....

IMO number* ....

Category: Assisted passenger craft/unassisted passenger craft/cargo craft**

Craft Type: WIG craft, Type A/B/C, monohull, multihull, other (give detail ....)**

Number of passengers for which certified ....

Minimum number of persons with required qualifications to operate the radio installations.....

* In accordance with the IMO ship identification number scheme adopted by the Organization by resolution A.1117(30).

** Delete as appropriate.

2 Details of life-saving appliances

1	Total number of persons for which life-saving appliances are provided	....
2	Total number of lifeboats	....
2.1	Total number of persons accommodated by them	....
2.2	Number of partially enclosed lifeboats complying with SOLAS regulation III/42	....
2.3	Number of totally enclosed lifeboats complying with SOLAS regulation III/44	....
2.4	Other lifeboats	
2.4.1	Number	....
2.4.2	Type	....
3	Number of rescue boats	....
3.1	Number of boats which are included in the total lifeboats shown above	....
4	Liferafts complying with SOLAS regulations III/38 to 40 for which suitable means of launching are provided	....
4.1	Number of liferafts	....
4.2	Number of persons accommodated by them	....
5	Open reversible liferafts (Annex 7 of the Guidelines)	....
5.1	Number of liferafts	....
5.2	Number of persons accommodated by them	....
6	Number of Marine Evacuation System (MES)	....
6.1	Number of persons served by them	....
7	Number of lifebuoys	....
8	Number of lifejackets	....
8.1	Number suitable for adults	....
8.2	Number suitable for children	....

9	Immersion suits	....
9.1	Total number	....
9.2	Number of suits complying with the requirements for lifejackets	....
10	Number of anti-exposure suits	....
10.1	Total number	....
10.2	Number of suits complying with the requirements for lifejackets	....
11	Radio installations used in life-saving appliances	....
11.1	Number of radar transponders	....
11.2	Number of two-way VHF radiotelephone apparatus	....

3 Details of radio facilities

1	Primary systems	....
1.1	VHF radio installation:	....
1.1.1	DSC encoder	....
1.1.2	DSC watch receiver	....
1.1.3	Radiotelephony	....
1.2	MF radio installation:	....
1.2.1	DSC encoder	....
1.2.2	DSC watch receiver	....
1.2.3	Radiotelephony	....
1.3	MF/HF radio installation:	....
1.3.1	DSC encoder	....
1.3.2	DSC watch receiver	....
1.3.3	Radiotelephony	....
1.3.4	Direct-printing radiotelegraphy	....
1.4	Ship earth station providing a recognized mobile satellite service	....
2	Secondary means of alerting	....
3	Facilities for reception of maritime safety information	....
3.1	NAVTEX receiver	....
3.2	EGC receiver	....
3.3	HF direct-printing radiotelegraph receiver	....
4	Satellite EPIRB	....

4.1	COSPAS-SARSAT	....
4.2	Inmarsat	....
5	VHF EPIRB	....
6	Ship's radar transponder	....
7	Two-way on-scene radiocommunications 121.5 MHz & 123.1 MHz	....

4 Methods used to ensure availability of radio facilities
(chapter 13 of the Guidelines)

4.1 Duplication of equipment ....

4.2 Shore-based maintenance ....

4.3 At-sea maintenance capability ....

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at ....
(Place of issue of the Record)

....
(Date of issue)

....
(Signature of duly authorized official issuing the Record)

....
(Seal or stamp of the issuing authority, as appropriate)

ANNEX 2

FORM OF PERMIT TO OPERATE WIG CRAFT

PERMIT TO OPERATE WIG CRAFT

Issued under the provisions of the

GUIDELINES FOR WING-IN-GROUND CRAFT
(MSC.1/Circ.1592)

1 Name of craft ....

2 Manufacturer's model and hull number ....

3 Distinctive number or letters ....

4 IMO number* ....

5 Port of registry ....

6 Category of craft: Assisted passenger craft/unassisted passenger craft/cargo craft**

7 Name of operator ....
....

8 Areas or routes of operation ....
....
....

9 Base port(s) ....

10 Maximum distance from place of refuge ....
....

11 Number of:

.1 passengers maximum permitted ....

.2 manning scale required ....

12 Worst intended conditions ....
....
....

* In accordance with the IMO ship identification number scheme, adopted by the Organization by resolution A.1117(30).

** Delete as appropriate.

13 Other operational restrictions ....
....
....

This permit confirms that the service mentioned above has been found to be in accordance with the general provisions of 2.2 to 2.7 of part A.

THIS PERMIT is issued under the authority of the Government of ....
....

THIS PERMIT is valid until ....
subject to the Wing-in-Ground Craft Safety Certificate remaining valid.

Issued at ....
(Place of issue of permit)

....
(Date of issue)

....
(Signature of duly authorized official issuing the permit)

....
(Seal or stamp of the issuing authority, as appropriate)

ANNEX 3

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 should be made in the stability calculations:

.1 30 kg/m^2 on exposed weather decks and gangways;

.2 7.5 kg/m^2 for projected lateral area of each side of the craft above the waterplane;

.3 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 should be computed by increasing the total projected area of continuous surfaces by 5% and the static moments of this area by 10%; and

.4 reduction of stability due to asymmetric ice accumulations in cross-structure.

1.2 For craft operating in areas where ice accretion may be expected:

.1 Within the areas defined in 2.1, 2.3, 2.4 and 2.5 known to have icing conditions significantly different from those in 1.1, ice accretion requirements of one half to twice the required allowance may be applied.

.2 Within the area defined in 2.2, where ice accretion in excess of twice the allowance required by 1.1 may be expected, more severe allowances than those given in 1.1 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 annex for the following:

.1 duration of the voyage in terms of the period spent in reaching the destination and returning to port; and

.2 consumption rates during the voyage for fuel, water, stores and other consumables.

2 Areas of icing conditions

In the application of section 1, the following icing areas should apply:

.1 The area north of latitude 65°30'N, between longitude 28°W and the west coast of Iceland; north of the north coast of Iceland; north of the rhumb line running from latitude 66°N, longitude 15°W to latitude 73°30' N, longitude 15°E, north of latitude 73°30' N between longitude 15°E and 35°E, and east of longitude 35°E, as well as north of latitude 56°N in the Baltic Sea.

.2 The area north of latitude 43°N bounded in the west by the North American coast and the east by the rhumb line running from latitude 43°N, longitude 48°W to latitude 63°N, longitude 28°W and thence along longitude 28°W.

.3 All sea areas north of the North American continent, west of the areas defined in subparagraphs .1 and .2 of this paragraph.

.4 The Bering and Okhotsk Seas and the Tartary Strait during the icing season.

.5 South of latitude 60°S.

A chart to illustrate the areas is attached.

3 Special requirements

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

.1 designed to minimize the accretion of ice; and

.2 equipped with such means for removing ice as the Administration may require.

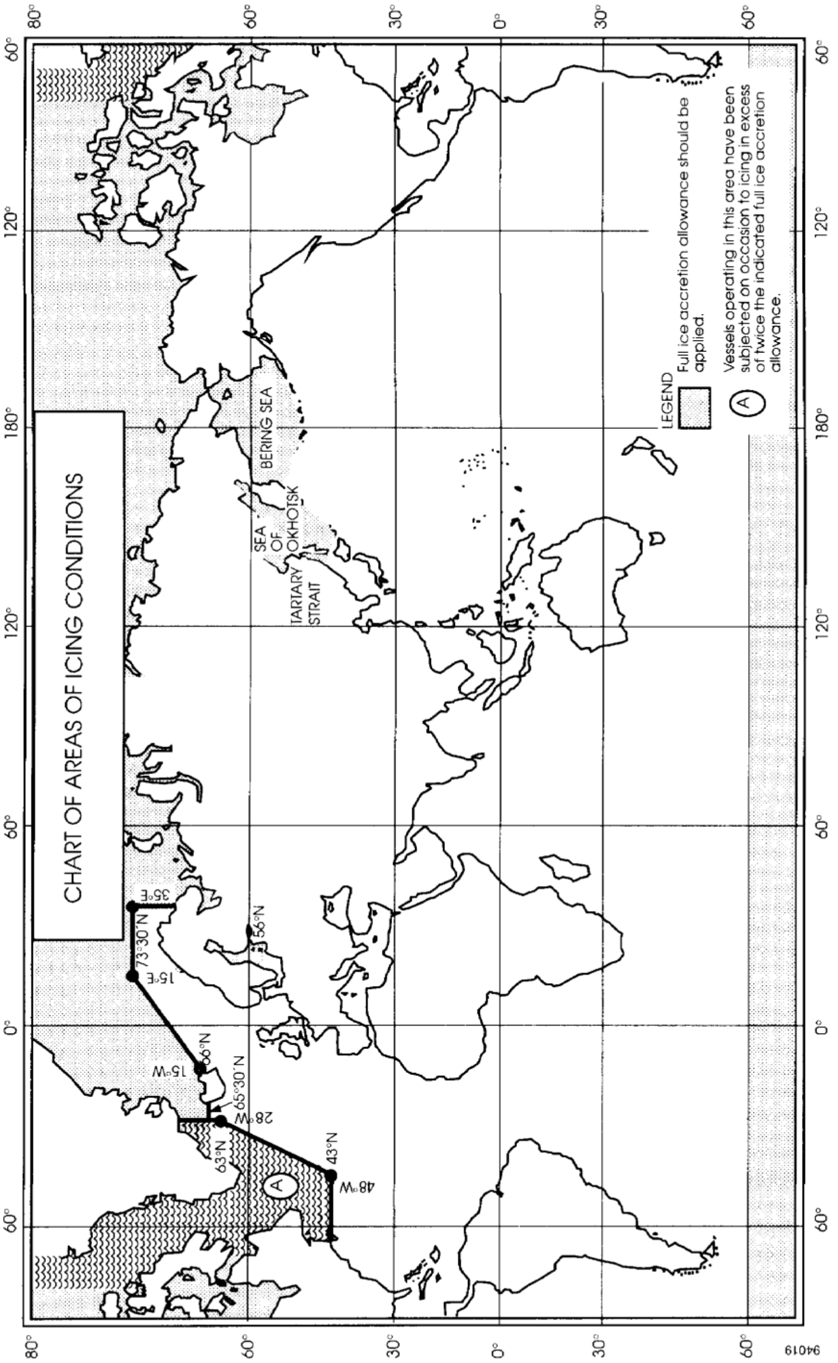
CHART OF AREAS OF ICING CONDITIONS
BERING SEA
SEA OF OKHOTSK
TARTARY STRAIT
73°30'N
35°E
15°E
66°N
15°W
65°30'N
28°W
63°N
43°N
48°W
56°N
LEGEND
Full ice accretion allowance should be applied.
Vessels operating in this area have been subjected on occasion to icing in excess of twice the indicated full ice accretion allowance.
94019

ANNEX 4

METHODS RELATING TO THE INTACT STABILITY INVESTIGATION OF HYDROFOIL ASSISTED WING-IN-GROUND CRAFT

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 the provisions of 1.1.3 and 1.1.4 below.

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:

$$M_R = 0.196 \frac{V_o^2}{L} \cdot \Delta \cdot \mathrm{KG} \qquad (\mathrm{kNm})$$

where:

M_R = moment of heeling;

V_o = speed of the craft in the turn (m/s);

Δ = displacement (t);

L = length of the craft at the waterline (m); and

KG = height of the centre of gravity above keel (m).

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 the windage area Z.

$$M_v = 0.001\ P_vA_vZ\ (kNm)$$

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 the windage area, are given in table 1.

Table 1 –Typical wind pressures, 100 nautical miles from land, for Beaufort scale 7

Z above waterline (m)	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
P_v (Pa)	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 or dynamic stability curves taking rolling into account.

.1 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 × displacement, if the scale of ordinates represents levers.

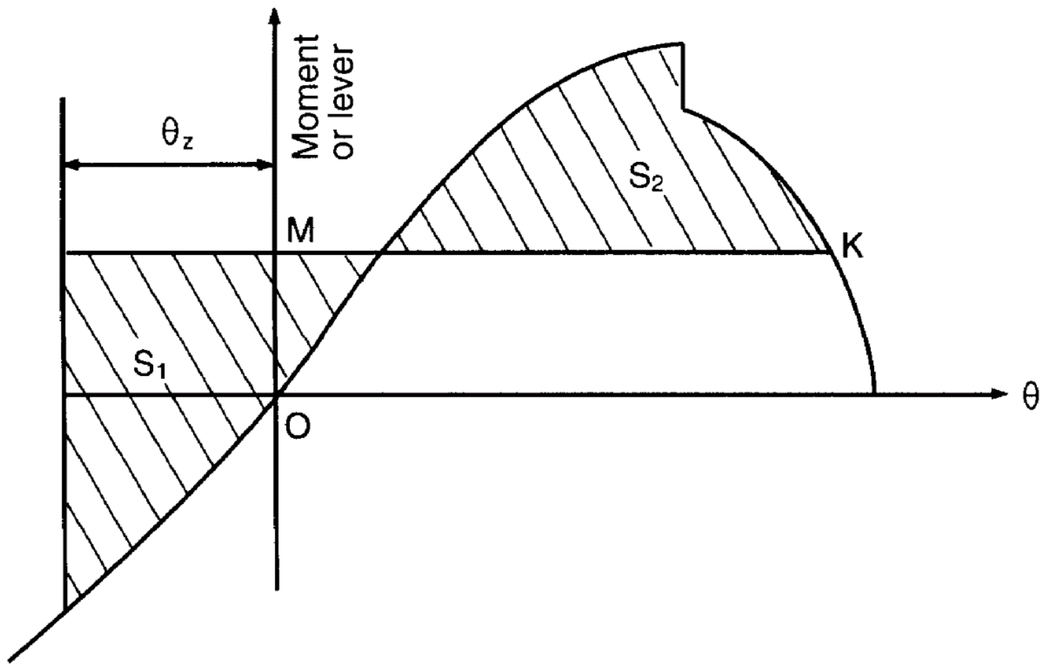

Figure 1 – Static stability curve

.2 When the dynamic stability curve is used, first an auxiliary point A should 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 tons)

$$M_c = 9.81\ \Delta\ \overline{BE} \quad \text{(kNm)}$$

.3 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°.

.4 The effectiveness of the stability curves should be limited to the angle of flooding.

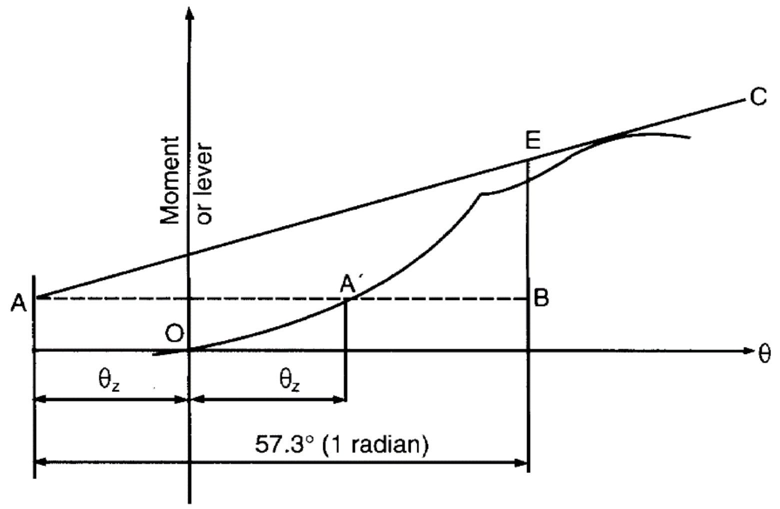

Figure 2 – Dynamic stability curve

ANNEX 5

RESIDUAL STABILITY

1 Stability criteria in the intact condition

A multihull craft, in the intact condition, should have sufficient stability when rolling in a seaway to successfully withstand the effect of either passenger crowding or high-speed turning as described in 1.4. The craft's stability should be considered to be sufficient provided compliance with this paragraph is achieved.

1.1 Area under the GZ curve

The area (A_1) under the GZ curve up to an angle θ should be at least:

$A_1 = 0.055 \times 30°/\theta$ (m.rad)

where θ is the least of the following angles:

.1 the downflooding angle;

.2 the angle at which the maximum GZ occurs; and

.3 30°.

1.2 Maximum GZ

The maximum GZ value should occur at an angle of at least 10°.

1.3 Heeling due to wind

The wind heeling lever should be assumed constant at all angles of inclination and should be calculated as follows:

$$HL_1 = \frac{P_i . A . Z}{9800\Delta} \text{ (m) (see figure 1)}$$

$HL_2 = 1.5\ HL_1$ (m) (see figure 1)

where:

P_i* = 500 (Pa);

A = projected lateral area of the portion of the ship above the lightest service waterline (m²);

Z = vertical distance from the centre of A to a point one half the lightest service draught (m); and

Δ = displacement (t).

* The value of P_i for ships in restricted service may be reduced, subject to the approval of the Administration.

1.4 Heeling due to passenger crowding or high-speed turning

Heeling due to the crowding of passengers on one side of the craft or to high-speed turning, whichever is the greater, should be applied in combination with the heeling lever due to wind (HL_2).

1.4.1 Heeling due to passenger crowding

When calculating the magnitude of the heel due to passenger crowding, a passenger crowding lever should be developed using the assumptions stipulated in these Guidelines.

1.4.2 Heeling due to high-speed turning

When calculating the magnitude of the heel due to the effects of high-speed turning, a high-speed turning lever should be developed using the following formula:

$$TL = \frac{1}{g}\frac{V_o^{\,2}}{R}\left(KG - \frac{d}{2}\right) \quad (m)$$

where:

TL = turning lever (m);

V_o= speed of craft in the turn (m/s);

R = turning radius (m);

KG = height of vertical centre of gravity above keel (m);

d = mean draught (m); and

g = acceleration due to gravity (m/s^2).

1.5 Rolling in waves (figure 1)

The effect of rolling in a seaway upon the craft's stability should be demonstrated mathematically. In doing so, the residual area under the GZ curve (A_2), i.e. beyond the angle of heel (θ_h), should be at least equal to 0.028 m·rad up to the angle of roll θ_r. In the absence of model test or other data θ_r should be taken as 15° or an angle of (θ_d - θ_h), whichever is less.

2 Criteria for residual stability after damage

2.1 The method of application of criteria to the residual stability curve is similar to that for intact stability except that the craft in the final condition after damage should be considered to have an adequate standard of residual stability provided:

.1 the required area A_2 should be not less than 0.028 m·rad (figure 2 refers); and

.2 there is no requirement regarding the angle at which the maximum GZ value should occur.

2.2 The wind heeling lever for application on the residual stability curve should be assumed constant at all angles of inclination and should be calculated as follows:

$$HL_3 = \frac{P_d \, .A \, .Z}{9800\Delta}$$

where:

P_d = 120 (Pa);

A = projected lateral area of the portion of the ship above the lightest service waterline (m^2);

Z = vertical distance from the centre of A to a point one half of the lightest service draught (m); and

Δ = displacement (t).

2.3 The same values of roll angle should be used as for the intact stability.

2.4 The downflooding point is important and is regarded as terminating the residual stability curve. The area A_2 should therefore be truncated at the downflooding angle.

2.5 The stability of the craft in the final condition after damage should be examined and shown to satisfy the criteria, when damaged as stipulated in these Guidelines.

2.6 In the intermediate stages of flooding, the maximum righting lever should be at least 0.05 m and the range of positive righting lever should be at least 7°. In all cases, only one breach in the hull and only one free surface need to be assumed.

3 Application of heeling levers

3.1 In applying the heeling levers to the intact and damaged curves, the following should be considered:

.1 for intact condition:

.1 wind heeling lever - steady wind (HL_1); and

.2 wind heeling lever (including gusting effect) plus either the passenger crowding or speed turning levers whichever is the greater (*HTL*).

.2 for damage condition:

.1 wind heeling lever - steady wind (HL_3); and

.2 wind heeling lever plus heeling lever due to passenger crowding (HL_4).

3.2 Angles of heel due to steady wind

3.2.1 The angle of heel due to steady wind when the heeling lever HL_1, obtained as in 1.3, is applied to the intact stability curve should not exceed 16°.

3.2.2 The angle of heel due to steady wind when the heeling lever HL_3, obtained as in 2.2, is applied to the residual stability curve after damage, should not exceed 20°.

MULTIHULL CRAFT CRITERIA

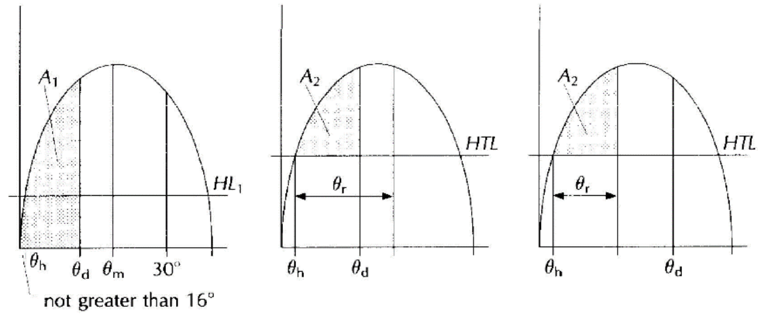

Figure 1 – Intact stability

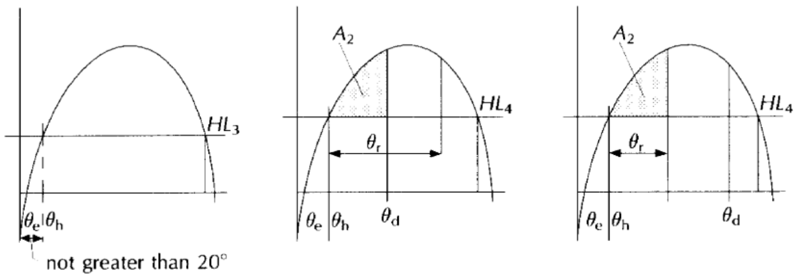

Figure 2 – Damage stability

HL_1	=	heeling lever due to wind;
HTL	=	heeling lever due to wind + gusting + (passenger crowding or turning);
HL_3	=	heeling lever due to wind;
HL_4	=	heeling lever due to wind + passenger crowding;
θ_m	=	angle of maximum GZ;
θ_d	=	angle of downflooding;
θ_r	=	angle of roll;
θ_e	=	angle of equilibrium, assuming no wind, passenger crowding or turning effects;
θ_h	=	angle of heel due to heeling lever HL_1, HTL, HL_3 or HL_4;
A_1	≥	area required by 1.1; and
A_2	≥	0.028 m·rad.

ANNEX 6

CRITERIA FOR TESTING AND EVALUATION OF REVENUE AND CREW SEATS

1 Purpose and scope

The purpose of these criteria is to provide provisions for revenue and crew seats, seat anchorages and seat accessories and their installation to minimize the possibility of occupant injury and/or disruption of egress/ingress if the craft suffers a collision.

2 Static seat tests

2.1 The provisions of this paragraph are applicable for crew and revenue seats in craft having a design collision load of less than 3g.

2.2 All seats to which this paragraph applies, along with their supports and deck attachments, should be designed to withstand at least the following static forces applied in the direction of the craft:

.1 forward direction: a force of 2.25 kN;

.2 after direction: a force of 1.5 kN;

.3 transverse direction: a force of 1.5 kN;

.4 vertically downward: a force of 2.25 kN; and

.5 vertically upward: a force of 1.5 kN.

If these forces are applied in the fore or aft direction of the seat, they should be applied horizontally to the seat back 350 mm above the seat bottom. If the forces are applied in the transverse seat direction, they should be applied horizontally to the seat bottom. Vertical upward forces should be evenly distributed to the corners of the seat bottom frame. Vertical downward forces should be uniformly distributed over the seat bottom. If a seating unit consists of more than one seating position, these forces should be applied at each seating position concurrently during the tests.

2.3 When the forces are applied to a seat, consideration should be given to the direction in which the seat is to face in the craft.

2.4 Each seating unit to be tested should be attached to the support structure similar to the manner in which it will be attached to the deck structure in the craft. Although a rigid support structure can be used for these tests, a support structure, having the same strength and stiffness as the support structure in the craft, is preferred.

2.5 The forces described in 2.2.1 to 2.2.3 above should be applied to the seat through a cylindrical surface having a radius of 82 mm and a width at least equal to the width of the seat. The surface should be equipped with at least one force transducer able to measure the forces specified.

2.6 The seat should be considered acceptable if:

.1 under the influence of the forces referred to in 2.2.1 to 2.2.3 above, the permanent displacement measured at the point of application of the force is not more than 400 mm;

.2 no part of the seat, the seat mountings or the accessories become completely detached during the tests;

.3 the seat remains firmly held, even if one or more of the anchorages is partly detached, and all of the locking systems remain locked during the whole duration of the test (adjustment and locking systems need not be operational after the tests); and

.4 rigid parts of the seat with which the occupant may come into contact should present a curved surface with a radius of at least 5 mm.

2.7 The provisions of section 3 below may be used in lieu of the provisions of this section provided that the accelerations used for the tests are at least 3 g.

3 Dynamic seat tests

3.1 For all seats, the seat supporting structure, the attachment to the deck structure, the lap belt, if installed, and shoulder harness, if installed, should be designed to withstand the maximum acceleration force that can be imposed upon them during a design collision. Consideration should be given to the orientation of the seat relative to the acceleration force (i.e. whether the seat is forward-, or aft-facing).

3.2 The acceleration pulse to which the seat is subjected should be representative of the collision time-history of the craft. If the collision time-history is not known or cannot be simulated, the acceleration time-history envelope shown in the figure below can be used.

3.3 In the test frame, each seat unit and its accessories (e.g. lap belts and shoulder harnesses) should be attached to the support structure similar to the manner in which it will be attached to the deck structure in the craft. The support structure can be a rigid surface; however, a support structure having the same strength and stiffness as the support structure in the craft is preferred. Other seats and/or tables with which an occupant may come in contact during a collision should be included in the test frame in an orientation and with a method of attachment typical of that in the craft.

3.4 During the dynamic seat test, a fiftieth percentile anthropomorphic test dummy, corresponding to the Hybrid II or Hybrid III (preferred) human surrogate (unless a more advanced test dummy is available), should be placed in the seat in an upright seating position. If a typical seating unit is composed of more than one occupant seat, a test dummy should be placed in each occupant seat in the unit. The dummy, or dummies, should be secured in the seat unit in accordance with procedures of recognized national standards* and be secured using only the lap belt and shoulder harness if they are installed. Tray tables and other such devices should be placed in the position that would cause the greatest potential for an occupant to become injured.

* Recognized national standards include ECE 80 with addendum 79, ADR 66/00 from Australia and NCHRIP eport 350 from the United States. Other national standards equivalent to these standards may be considered acceptable.

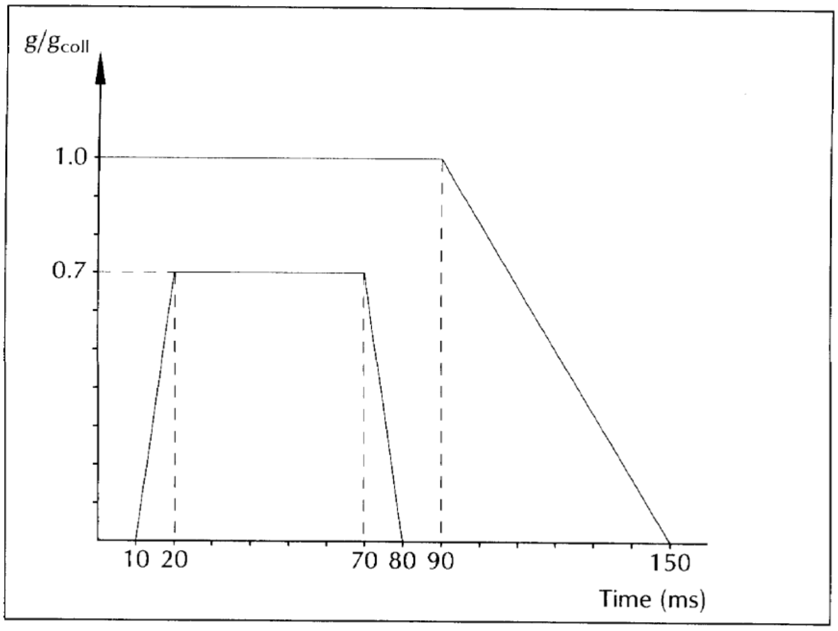

Figure – Acceleration time-history envelope

3.5 The test dummy should be instrumented and calibrated, in accordance with the requirements of a recognized national standard, so as to permit calculation of the head injury criterion, calculation of the thoracic trauma index, measurement of force in the femur, and measurement, if possible, of extension and flexion of the neck, measurement of the maximum relative pelvis acceleration, and measurement of the maximum pelvis load in the direction of the spine.

3.6 If more than one dummy is used in the tests, the dummy located in the seat having the highest potential for an occupant to be injured should be the one instrumented. The other dummy or dummies need not be instrumented.

3.7 The tests should be conducted and the instrumentation should be sampled at a rate sufficient to reliably show response of the dummy in accordance with the requirements of a recognized national standard.

3.8 The seat unit tested in accordance with the provisions of this section should be considered acceptable if:

.1 The seat unit and tables installed in the seat unit or area do not become dislodged from the supporting deck structure and do not deform in a manner that would cause the occupant to become trapped or injured.

.2 The lap belt should remain attached on the test dummy's pelvis during the impact. The shoulder harness, if installed, remains attached and in the immediate vicinity of the test dummy's shoulder during the impact. After the impact, the release mechanisms should be operative.

.3 The following acceptability criteria are met:

.1 the head injury criterion (HIC), calculated in accordance with the formula below, does not exceed 500

$$HIC = (t_2 \cdot t_1)\left[\frac{1}{t_2 \cdot t_1}\int_{t_1}^{t_2} a(t)\,dt\right]^{2.5}$$

where t_1 and t_2 are the beginning and ending times (in seconds) of the interval in which the HIC is a maximum, and $a(t)$ is the resultant measured acceleration in the head of the dummy in g;

.2 the thoracic trauma index (TTI), calculated in accordance with the formula below, does not exceed 30 g except for periods totalling less than 3 ms

$$TTI = \frac{g_R + g_{LS}}{2}$$ or acceleration at the centre of gravity

where:

g_R is the acceleration in g of either the upper or lower rib; and

g_{LS} is the acceleration in g of the lower spine;

.3 neck flexion does not exceed 88 Nm, if measured;

.4 neck extension does not exceed 48 Nm, if measured; and

.5 the force in the femur does not exceed 10 kN, except that it cannot exceed 8 kN for periods totalling more than 20 ms.

.4 Loads on the upper torso harness straps do not exceed 7.8 kN or a total of 8.9 kN if dual straps are used.

ANNEX 7

OPEN REVERSIBLE LIFERAFTS

1 General

All open reversible liferafts should:

.1 be constructed with proper workmanship and materials;

.2 not be damaged in stowage throughout an air temperature range of -18°C to +65°C;

.3 be capable of operating throughout an air temperature range of -18°C to +65°C and a seawater temperature range of -1°C to +30°C;

.4 be rot-proof, corrosion-resistant and not unduly affected by seawater, oil or fungal attack;

.5 be stable and maintain their shape when inflated and fully laden; and

.6 be fitted with retro-reflective material, where it will assist in detection, and in accordance with the recommendations adopted by the Organization.*

2 Construction

2.1 The open reversible liferaft should be so constructed that when it is dropped into the water in its container from a height of 10 m, the liferaft and its equipment will operate satisfactorily. If the open reversible liferaft is to be stowed at a height of more than 10 m above the waterline in the lightest seagoing condition, it should be of a type which has been satisfactorily drop-tested from at least that height.

2.2 The open reversible floating liferaft should be capable of withstanding repeated jumps on to it from a height of at least 4.5 m.

2.3 The open reversible liferaft and its fittings should be so constructed as to enable it to be towed at a speed of 3 knots in calm water when loaded with its full complement of persons and equipment, with the sea-anchor deployed.

2.4 The open reversible liferaft when fully inflated should be capable of being boarded from the water whichever way up it inflates.

2.5 The main buoyancy chamber should be divided into:

.1 not less than two separate compartments, each inflated through a non-return inflation valve on each compartment; and

* Refer to the *Recommendation on the Use and Fitting of Retro-Reflective Materials on Life-Saving Appliances*, adopted by the Organization by resolution A.658(16).

.2 the buoyancy chambers should be so arranged that in the event of one of the compartments being damaged or failing to inflate, the intact compartment should be able to support, with positive freeboard over the open reversible liferaft's entire periphery, the number of persons which the liferaft is permitted to accommodate, each having a mass of 75 kg and seated in their normal positions.

2.6 The floor of the open reversible liferaft should be waterproof.

2.7 The open reversible liferaft should be inflated with a non-toxic gas by an inflation system complying with the requirements of regulation III/39 of the Convention. Inflation should be completed within the period of one minute at an ambient temperature of between 18°C and 20°C and within a period of three minutes at an ambient temperature of -18°C. After inflation the open reversible liferaft should maintain its form when loaded with its full complement of persons and equipment.

2.8 Each inflatable compartment should be capable of withstanding a pressure equal to at least three times the working pressure and should be prevented from reaching a pressure exceeding twice the working pressure either by means of relief valves or by a limited gas supply. Means should be provided for fitting the topping-up pump or bellows.

2.9 The surface of the buoyancy tubes should be of non-slip material. At least 25% of these tubes should be of a highly visible colour.

2.10 The number of persons which an open reversible liferaft should be permitted to accommodate should be equal to the lesser of:

.1 the greatest whole number obtained by dividing by 0.096 the volume, measured in cubic metres, of the main buoyancy tubes (which for this purpose should not include the thwarts, if fitted) when inflated; or

.2 the greatest whole number obtained by dividing by 0.372 the inner horizontal cross-sectional area of the open reversible liferaft measured in square metres (which for this purpose may include the thwart or thwarts, if fitted) measured to the innermost edge of the buoyancy tubes; or

.3 the number of persons having an average mass of 75 kg, all wearing lifejackets, that can be seated inboard of the buoyancy tubes without interfering with the operation of any of the liferaft's equipment.

3 Open reversible liferaft fittings

3.1 Lifelines should be securely becketed around the inside and outside of the open reversible liferaft.

3.2 The open reversible liferaft should be fitted with an efficient painter of a length suitable for automatic inflation on reaching the water. For open reversible liferafts accommodating more than 30 persons an additional bowsing-in line should be fitted.

3.3 The breaking strength of the painter system, including its means of attachment to the open reversible liferaft, except the weak link required by regulation III/39 of the Convention, should be:

.1 7.5 kN for open reversible liferafts accommodating up to 8 persons;

.2 10.0 kN for open reversible liferafts accommodating 9 to 30 persons; and

.3 15.0 kN for open reversible liferafts accommodating more than 30 persons.

3.4 The open reversible liferaft should be fitted with at least the following number of inflated ramps to assist boarding from the sea whichever way up the raft inflates:

.1 one boarding ramp for open reversible liferafts accommodating up to 30 persons; or

.2 two boarding ramps for open reversible liferafts accommodating more than 30 persons; such boarding ramps should be 180° apart.

3.5 The open reversible liferaft should be fitted with water pockets complying with the following provisions:

.1 the cross-sectional area of the pockets should be in the shape of an isosceles triangle with the base of the triangle attached to the buoyancy tubes of the open reversible liferaft;

.2 the design should be such that the pockets fill to approximately 60% of capacity within 15 s to 25 s of deployment;

.3 the pockets attached to each buoyancy tube should normally have aggregate capacity of between 125 *l* and 150 *l* for inflatable open reversible liferafts up to and including the 10-person size;

.4 the pockets to be fitted to each buoyancy tube on liferafts certified to carry more than 10 persons should have, as far as practicable, an aggregate capacity of 12 N·litres, where N is the number of persons carried;

.5 each pocket on a buoyancy tube should be attached so that when the pocket is in the deployed position it is attached along the full length of its upper edges to, or close to, the lowest part of the lower buoyancy tube; and

.6 the pockets should be distributed symmetrically round the circumference of the liferaft with sufficient separation between each pocket to enable air to escape readily.

3.6 At least one manually controlled lamp complying with the provisions should be fitted on the upper and lower surfaces of the buoyancy tubes.

3.7 Suitable automatic drain arrangements should be provided on each side of the floor of the liferaft in the following manner:

.1 one for open reversible liferafts accommodating up to 30 persons; or

.2 two for open reversible liferafts accommodating more than 30 persons.

3.8 The equipment of every open reversible liferaft should consist of:

.1 one buoyant rescue quoit, attached to not less than 30 m of buoyant line with a breaking strength of at least 1 kN;

.2 two safety knives of the non-folding type, having a buoyant handle, should be fitted attached to open reversible liferaft by light lines. They should be stowed in pockets so that, irrespective of the way in which the open reversible liferaft inflates, one will be readily available on the top surface of the upper buoyancy tube in a suitable position to enable the painter to be readily cut;

.3 one buoyant bailer;

.4 two sponges;

.5 one sea-anchor permanently attached to the open reversible liferaft in such a way as to be readily deployable when the open reversible liferaft inflates. The position of the sea-anchor should be clearly marked on both buoyancy tubes;

.6 two buoyant paddles;

.7 one first-aid outfit in a waterproof case capable of being closed tightly after use;

.8 one whistle or equivalent sound signal;

.9 two hand flares;

.10 one waterproof electric torch suitable for Morse signalling together with one spare set of batteries and one spare bulb in a waterproof container;

.11 one repair outfit for repairing punctures in buoyancy compartments; and

.12 one topping-up pump or bellows.

3.9 Where appropriate, the equipment should be stowed in a container which, if it is not an integral part of, or permanently attached to, the open reversible liferaft, should be stowed and secured to the open reversible liferaft and be capable of floating in water for at least 30 min without damage to its contents. Irrespective of whether the equipment container is an integral part of, or is permanently attached to, the open reversible liferaft, the equipment should be readily accessible irrespective of which way up the open reversible liferaft inflates. The line which secures the equipment container to the open reversible liferaft should have a breaking strength of 2 kN or a breaking strength of 3:1 based on the mass of the complete equipment pack, whichever is the greater.

4 Containers for open reversible inflatable liferafts

4.1 The open reversible liferafts should be packed in a container that is:

.1 so constructed as to withstand conditions encountered at sea;

.2 of sufficient inherent buoyancy, when packed with the liferaft and its equipment, to pull the painter from within and to operate the inflation mechanism should the craft sink; and

.3 as far as practicable, watertight, except for drain holes in the container bottom.

4.2 The container should be marked with:

.1 maker's name or trademark;

.2 serial number;

.3 the number of persons it is permitted to carry;

.4 non-SOLAS reversible;

.5 type of emergency pack enclosed;

.6 date when last serviced;

.7 length of painter;

.8 maximum permitted height of stowage above waterline (depending on drop-test height); and

.9 launching instructions.

5 Markings on open reversible inflatable liferafts

The open reversible liferafts should be marked with:

.1 maker's name or trademark;

.2 serial number;

.3 date of manufacture (month and year);

.4 name and place of service station where it was last serviced; and

.5 number of persons it is permitted to accommodate on the top of each buoyancy tube, in characters not less than 100 mm in height and of a colour contrasting with that of the tube.

6 Instructions and information

Instructions and information required for inclusion in the craft's training manual and in the instructions for onboard maintenance should be in a form suitable for inclusion in such training manual and instructions for onboard maintenance. Instructions and information should be in a clear and concise form and should include, as appropriate, the following:

.1 general description of the open reversible liferaft and its equipment;

.2 installation arrangements;

.3 operational instructions, including use of associated survival equipment; and

.4 servicing requirements.

ANNEX 8

PROCEDURES FOR DEMONSTRATION OF OPERATIONAL SAFETY

This annex applies to all craft.

Tests to evaluate operational safety should be conducted on the prototype craft of a new design or of a design incorporating new features which may modify the results of a previous testing. The test should be carried out to a schedule agreed between the Administration and the manufacturer.

Where conditions of service warrant additional testing (e.g. low temperature), the Administration or base port State authorities, as appropriate, may require further demonstrations. Functional descriptions, technical and system specifications relevant to understanding and evaluation of craft performance should be available.

The object of these tests is to provide essential information and guidance to enable the craft to be operated safely under normal and emergency conditions within the design envelope of take-off mass, centre of gravity, speed and environmental conditions.

The following procedures should be applied for the verification of craft performance.

1 Definitions

1.1 Normal operating conditions

The wind and sea conditions in which the craft can safely operate at any heading and if in ground effect, at any allowable altitude while operated manually with auto-pilot assistance or with any automatic control system in normal mode.

1.2 Worst intended conditions

Has the meaning defined in part A of these Guidelines.

1.3 Minor effect

Has the meaning defined in part C of these Guidelines.

1.4 Tolerable risk

Level of risk, whereby the combination of the probability and likely consequences of an event can be demonstrated as acceptable to the Administration. This demonstration may be through actual trial or by risk analysis as described in part C of these Guidelines.

1.5 Flight-trim

To be interpreted as defined in chapter 16 of part B of these Guidelines.

1.6 Flight-trim speed

Speed to which a flight-trimmed craft will return after being disturbed by an external force.

1.7 Flight-trim angle

Angle to which a flight-trimmed craft will return after being disturbed by an external force.

1.8 Minimum normal ground effect speed

Lowest speed at which craft can be operated in ground effect throughout proven load and stability range, allowing sufficient safety margin for reasonable foreseeable transient variations in operating conditions.

1.9 Maximum normal ground effect speed

Highest speed at which the craft is normally operated in ground effect through its proven load and stability range allowing sufficient safety margin for reasonable foreseeable transient variations in operating conditions.

1.10 Maximum safe speed

The maximum speed at which the craft will continue to demonstrate safe stability characteristics. This speed should be no less than midway between maximum normal ground effect speed and absolute maximum craft speed.

1.11 Absolute maximum craft speed

Speed beyond which craft aerodynamic stability in ground effect cannot be assured. Craft controllability may also be jeopardised beyond this speed.

1.12 Landing speed range

Range of speeds that allow operator to maintain craft control throughout a landing manoeuvre.

2 General

2.1 The craft should meet the applicable operational provisions in chapter 16 of part B of these Guidelines and this annex for all extremes of passenger and load configurations for which certification is required. The limiting sea state related to the different modes of operation should be verified by tests and analyses of a craft of the type for which certification is requested.

2.2 Operational control of the craft should be in accordance with procedures established by the owner or operator for operation in service. Procedures should be established for starting and shutting down the craft, moving the craft on the ground, transferring it to and from the water, and operating in displacement, transition, planing, take-off/landing, ground effect and any other airborne modes.

2.3 The procedures established under 2.2 should:

.1 demonstrate that normal manoeuvres and craft responses to failures are consistent in performance;

.2 use methods or devices that are safe and reliable; and

.3 include allowance for any time lag in the execution of procedures that may reasonably be expected in service.

2.4 Procedures required by this annex should be conducted over water of sufficient depth so that craft performance will not be affected.

2.5 Tests should be conducted through a range of mass and centre of gravity configurations sufficient to establish a safe operating envelope for every craft.

2.6 Testing should be conducted through a range of wind and sea conditions sufficient to establish a safe operating envelope for the craft in all of the circumstances described in 2.2.

2.7 No manoeuvre during either normal or emergency operations should require exceptional operator skill or excessive force on the craft controls.

2.8 The test regime assumes that passengers and cargo are secured during the transition, planing and take-off and landing stages of craft operation.

3 Performance trials

Tests are to be conducted in all modes of operation under the range of conditions described in 2.5 and 2.6.

3.1 Ground operations

For craft intended to be controlled by the operator when on the ground, the following criteria should be met:

.1 The craft should demonstrate a stable attitude on flat ground when manoeuvring on its undercarriage. The limit of gradient up or down which the craft may safely be manoeuvred should be established.

.2 The craft should not show any tendency to spin horizontally in cross winds up to the designed maximum wind velocity.

.3 Operation of wheel brakes, if fitted, should not cause the craft to pitch nose down or spin horizontally.

3.2 Displacement mode

The following tests should be conducted to establish and/or confirm craft performance parameters in displacement mode:

.1 Establish that the craft freeboard meets design and regulatory specifications.

.2 Propulsion systems: Tests should be conducted to confirm that procedures for starting, engaging, disengaging, stopping are safe and effective.

.3 Establish maximum safe operating speeds in both normal and worst intended conditions.

.4 Determine turning radius and rate of turn.

.5 Establish and confirm stopping distance and procedures in both normal and emergency situations.

.6 Confirm berthing and anchoring procedures can be performed safely.

.7 Establish/confirm the effects of failures as described in 4.3, appropriate for the displacement mode, and procedures to deal with failures.

3.3 Transition mode

The following tests should be conducted to establish and/or confirm performance parameters as the craft moves from displacement to planing mode:

.1 Establish the speed at which the craft transits to planing mode in the range of configurations and conditions described in 2.5 and 2.6.

.2 Confirm that the craft is stable and controllable during transition.

.3 Determine procedures for safe transition to planing mode.

.4 Establish/confirm the effects of failures as described in 4.3, appropriate for the transition mode, and procedures to deal with failures.

3.4 Planing mode

The following tests should be conducted to establish and/or confirm performance parameters for craft in planing mode:

.1 Establish the range of speeds at which the craft will operate in planing mode in both normal and worst intended operating conditions.

.2 Determine the range of loading conditions for which the craft displays a safe and stable condition.

.3 Establish maximum velocity of 90º cross wind in which craft is controllable.

.4 Determine maximum rate of turn and minimum turn radius in both normal and worst intended operating conditions.

.5 Confirm that water spray does not impair operator visibility.

.6 Establish/confirm procedures for safe operation of the craft in planing mode.

.7 Establish/confirm the effects of failures as described in 4.3, appropriate for the planing mode, and procedures to deal with failures.

3.5 Take-off

The following tests should be conducted to establish and/or confirm craft performance parameters during take-off:

.1 Establish the speeds at which the craft takes off over the range of load configurations in normal and worst intended conditions.

.2 Determine the distance, from rest, to achieve take-off in the range of conditions described in 3.5.1.

.3 Confirm that craft is aerodynamically stable and controllable during take-off.

.4 Confirm that surface impacts during take-off do not cause horizontal or vertical accelerations that are likely to have more than a minor effect on craft or personnel.

.5 Establish/confirm maximum velocity of 90º cross wind in which craft can safely take-off.

.6 Confirm that water spray does not impair operator visibility.

.7 Establish/confirm operating procedures to ensure a safe take-off manoeuvre is performed.

.8 Establish/confirm the effects of failures as described in 4.3, appropriate for the take-off mode, and procedures to deal with failures.

3.6 Ground effect mode

The following tests should be conducted to establish and/or confirm craft performance parameters in ground effect:

.1 Determine the range of loading conditions for which the craft is stable about its three primary axes.

.2 The following control criteria must be demonstrated when the craft is flight-trimmed in ground effect mode:

.1 Elevator controls should have the following characteristics for all speeds within the craft's normal ground effect speed range:

A push on the elevator control should cause the craft to flight-trim forward and increase speed from its previous flight-trim angle and speed. A pull should have the opposite effect. Airspeed and flight-trim angle should return to within 10% of original flight-trim speed and angle when the elevator control pressure is released.

.2 Longitudinal control must be demonstrated as follows:

The elevator control force/speed curve must have a stable slope at all speeds within a range which is the greater of 15% of the flight-trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the flight-trim speed (except that the speed range need not include speeds below minimum normal ground effect speed or greater than maximum safe speed, nor speeds that require an elevator control force of more than 20 kg), with:

.1 the centre of gravity in the most adverse position;

.2 the most critical weight between the maximum take-off and maximum landing weights;

.3 75% of maximum continuous power for reciprocating engines or for turbine engines, the maximum cruising power selected by the applicant as an operating limitation, except that the power need not exceed that required at maximum normal safe ground effect speed; and

.4 the craft flight flight-trimmed for level flight with the power required in .3 above.

.3 Lateral-directional control

The rudder control force/speed curve gradient must meet requirements through the speed range between maximum normal ground effect speed and maximum safe speed, except that the dihedral effect (aileron deflection opposite the corresponding rudder input) may be negative, provided the divergence is gradual, easily recognised, and easily controlled by the operator.

.4 Any short period oscillation about any single axis, which occurs within the normal ground effect speed range, must be substantially dampened with the primary controls both free and in a fixed position. Any combined lateral-directional oscillation, which occur within the normal ground effect speed range must be positively dampened with the controls free and must be controllable with the primary controls without requiring exceptional operator skills.

.3 Determine the controllability of the craft when out of flight-trim in accordance with:

From an initial condition with the craft flight-trimmed within normal ground effect speed range the craft must have satisfactory manoeuvring stability and controllability with the degree of out-of-flight-trim in the craft nose-up direction which results from the greater of:

.1 a three-second movement of the longitudinal flight-trim system at its normal rate for the particular flight condition with no aerodynamic load (or an equivalent degree of flight-trim for craft that do not have a power-operated flight-trim system), except as limited by stops in the flight-trim system; and

.2 the maximum flight mis-flight-trim that can be sustained by the autopilot, if fitted, while maintaining level flight in the high-speed ground effect condition.

.4 *Craft speed*

.1 Determine the range of safe operating speeds at which the craft will operate in ground effect mode in both normal and worst intended conditions.

.2 Investigate relationship between craft speed and altitude in ground effect mode.

.3 The following speed increase and recovery characteristics must be met:

.1 Operating conditions and characteristics likely to cause inadvertent speed increases (including upsets in pitch and roll) must be simulated with the craft flight-trimmed at any speed within the normal ground effect speed range. These conditions and characteristics include gust upsets, inadvertent control movements, low control force gradient in relation to control friction and passenger movement.

.2 Allowing for operator reaction time after effective inherent or artificial speed warning occurs, it must be shown that the craft can be recovered to a normal attitude and its speed reduced to maximum normal ground effect speed, without:

.1 exceptional operator strength or skill;

.2 exceeding the absolute maximum craft speed or its structural limitations; and

.3 buffeting that would impair the operator's ability to read the instruments or control the craft for recovery.

.3 With the craft flight-trimmed at any speed up to maximum normal ground effect speed, there must be no reversal of the response to control input about any axis at any speed up to maximum safe speed. Any tendency to pitch, roll, or yaw must be mild and readily controllable, using normal operating techniques. When the craft is flight-trimmed at maximum normal ground effect speed, the slope of the elevator control force/speed curve need not be stable at speeds greater than maximum safe speed, but there must be a push force at all speeds to absolute maximum craft speed and there must be no sudden or excessive reduction of elevator control force as that speed is reached.

.5 *Turning*

Determine the following characteristics in normal and worst intended operating conditions:

.1 maximum safe angle of bank;

.2 maximum rate of turn; and

.3 minimum turn radius.

.6 Confirm that the maximum change of lateral or longitudinal centre of gravity that may be caused by the movement of passengers or cargo, is able to be counteracted with operator control input.

.7 Establish/confirm the effects of failures as described in 4.3, appropriate for the ground effect mode, and procedures to deal with failures.

3.7 Landing

The following tests should be conducted to establish and/or confirm craft performance parameters during landing:

.1 Determine the minimum distance required in normal and worst intended conditions to perform the landings specified below. The distance should be measured from the point of touchdown to the position of the craft when stopped:

.1 normal landing;

.2 emergency landing; and

.3 power-off landing.

.2 Confirm that the craft is stable and controllable throughout the landing phase.

The elevator control force/speed curve must have a stable slope, and the force may not exceed 35 kg, through the range of speeds specified as acceptable for landing with:

.1 maximum landing weight;

.2 power or thrust off on the engines; and

.3 the craft flight-trimmed for minimum normal ground effect speed with power or thrust off.

.3 Confirm that surface impacts during landing on flat water do not cause horizontal or vertical acceleration that are likely to have more than a minor effect on the craft or personnel.

.4 Perform a "hands-free" landing from steady state flight in ground effect mode to simulate total loss of ability to manipulate the control surfaces in fixed position when power-off.

.5 Establish/confirm maximum velocity of 90º cross wind in which the craft can land safely.

.6 Confirm that spray does not impair operator visibility.

.7 Establish/confirm operating procedures for normal emergency and power off landing.

.8 Establish/confirm the effects of failures as described in 4.3, appropriate for the transition mode, and procedures to deal with failures.

4 Effects of failures or malfunctions

4.1 General

4.1.1 The limits of safe operation, special handling procedures and any operational restrictions should be examined and developed as a result of full-scale trials conducted by simulating possible equipment failures.

4.1.2 The failures to be examined should be those leading to major or more severe effects as determined from the evaluation of the SSA in accordance with part C of these Guidelines.

4.1.3 Failures to be examined should be agreed between the craft manufacturer and the Administration and each single failure should be examined in a progressive manner.

4.1.4 The failures to be examined should be single failure events unless a single failure has an immediate and inevitable secondary effect.

4.1.5 If the manufacturer or Administration believes that a simulation of any failure or malfunction could endanger the craft or personnel, the effects of that failure or malfunction may be deduced by calculation and/or analysis in accordance with part C of these Guidelines. In the event, the Administration may require that systems or procedures be introduced or changed to reduce the risk to a tolerable level or may impose operational limits to achieve the same result.

4.2 Objectives of tests

Examination of each failure should result in:

.1 Determining safe limits of craft operation at the time of failure or malfunction beyond which the failure or malfunction will result in a degradation of safety beyond a tolerable level.

.2 Determining crew members' actions, if any, to minimize or counter the effect of the failure.

.3 Determining craft or machinery restrictions to be observed with the failure present to enable the craft to continue to provide a place of refuge in the case of assisted and cargo craft and to enable the craft to continue to a place of refuge in the case of unassisted craft.

4.3 Failures to be examined

Equipment failures should include, but not be limited to, the following:

.1 total loss of propulsion power;

.2 total loss of lift power;

.3 total failure of control of one propulsion system;

.4 involuntary application of full propulsion thrust (positive or negative) on one system;

.5 failure of control of one directional control system;

.6 involuntary full deflection of one directional control system;

.7 failure of control of flight-trim control system;

.8 involuntary full deflection of one flight-trim control system element;

.9 total loss of electrical power; and

.10 loss of flight instrumentation.

4.4 "Dead ship" test

In order to establish craft motions and direction of laying to wind and waves, for the purpose of determining the conditions of a craft evacuation, the craft should be stopped and all main machinery shut down for sufficient time that the craft's heading relative to wind and waves has stabilised. This test should be carried out on an opportunity basis to establish patterns of the design's "dead ship" behaviour under a variety of wind and sea states.

4.5 Operating compartment functionality

Prior to and throughout the trial program a qualitative evaluation should be conducted as to the contribution of the operating compartment layout to the safe operation of the craft. Particular attention should be paid to the following:

.1 operator comfort to minimise fatigue including noise, vibration levels, temperature and ventilation control;

.2 visibility from operating position including any obstructions;

.3 location of and forces required to operate primary controls;

.4 accuracy and readability of all instrumentation; and

.5 ease of use and interpretation of navigation and collision avoidance systems.

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