2016

Guidance for WIG Ships (Wing-In-Ground Effect Ships)

KR

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GC-07-E

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APPLICATION OF
"Guidance for WIG Ships[Wing-In-Ground Effect Ships]"

1. Unless expressly specified otherwise, the requirements in the Guidance apply to ships for which contracts for construction are signed on or after 1 July 2016.
2. The amendments to the Guidance for 2012 edition and their effective date are as follows;

Effective Date 1 July 2016

CHAPTER 1 GENERAL

- 102. 2 has been amended.
- 103. 15 has been newly added.

CHAPTER 6 MACHINERY

- 102. 4 has been amended.

CHAPTER 7 ELECTRICAL EQUIPMENT AND CONTROL SYSTEMS

- 101. 11 has been amended.

CHAPTER 9 FIRE EXTINCTION

- 110. 5 has been amended.

Annex 3 GUIDANCE ON REVIEW / APPROVAL OF RISK-BASED SHIP DESIGN

- Deleted.

CONTENTS

CHAPTER 1 GENERAL

101. Application

This Guidance is to apply to the Wing-In-Ground Effect Ships (hereafter referred to as "WIG Ships"), and constructed in steel, alloy aluminum or complex materials for hull construction and other structural members.

102. Equivalence

1. Hull structures, equipment, arrangements or scantlings which are not appropriate to apply the requirements of this Guidance or not specified in this Guidance, may be accepted by the Society provided that the Society is satisfied that such hull structures, equipment, arrangements or scantlings are equivalent to those complying with the requirements of this Guidance.

2. In spite of the other requirements in this Guidance, "**Guidance for Approval of Risk-based Ship Design**" may be applied, where it is considered by the Society that it is not practicable or not applicable to apply this Guidance. The Korean Industrial Standards(KS), recognized international standards or other standards considered equivalent by the Society may be applied instead of the requirements of this Guidance where it is acceptable by the Society.

103. Definitions

The definitions of terms used in this Guidance are as followings:

1. "WIG ship" is a ship which flies near above the water surface by using air cushion effect of high pressure generated by aerodynamical interaction between water surface and wing or hull (hereafter referred to as "ground effect"), without contact with the water surface.

2. "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.

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

4. "Design waterline" means the waterline corresponding to the maximum operational weight of the ship with no lift or propulsion machinery active.

5. "Flap" means an element formed as integrated part of, or an extension of, a wing, used to adjust the hydrodynamic or aerodynamic lift of the wing.

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

7. "shoulder station" is an area where passengers can be gathered in the event of an emergency and prepared to abandon the ship, if necessary.

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

9. "Passenger" is every person other than:

(1) the pilot or other person employed or engaged in any capacity on board a ship on the business of that ship
(2) a child under one year of age
(3) person temporarily on board

10. "Passenger WIG ship" is a WIG ship which carries passengers.

11. "General WIG ship" is a noncommercial WIG ship which does not carry passengers or a WIG ship which carries cargoes.

12. "Maximum take-off weight" means the weight up to which the WIG ship can take-off without over load of propulsion machinery at the condition of lightweight plus fuel, passenger and cargo weight.

13. "Small WIG ship" is a WIG ship of which the maximum person on board is not more than 12 person or the maximum take-off weight is not more than 5,670 kg.

14. "Extent of ground effect" is the altitude up to 100 % of mean aerodynamic chord length of WIG ship from mean sea level.

15. "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.

104. Type of WIG ship

WIG ship of type A is a ship which is certified for operation only in ground effect, WIG ship of type B is a ship which is certified to temporarily increase its altitude to a limited height outside the influence of ground effect but not exceeding 150 m, the minimum safe altitude of airplane specified by the International Civil Aviation Organization, above the surface. ⚓

CHAPTER 2 CLASSIFICATION AND SURVEYS

101. Classification

The classification of a WIG ship is to be in accordance with the requirements specified in **Pt 1** of **Rules for the Classification of Steel Ships.**

102. Classification survey

Kinds, due range and survey items of classification survey of a WIG ship are to be in accordance with **Pt 1** of **Rules for the Classification of Steel Ships**, but **Pt 1, Ch 2, Sec 7** (**Surveys of Propeller Shaft and Stern Tube Shaft, Etc.**) is not apply and for Passenger WIG ships Intermediate Survey and Docking Survey are to be carried out within 3 months before or after each anniversary date. However at Annual Survey, Intermediate Survey, Special Survey and Docking Survey the following items are to be surveyed in addition to the survey items specified in **Pt 1** of **Rules for the Classification of Steel Ships.**

1. At Annual Survey

(1) confirming integrity of the envelop of hull such as hull, side hull, wing, tail and other structures, etc. However, it is to apply only for the hull above water line where the survey in dry-dock or on a slipway is not required.
(2) hose test to structures of hull envelop, such as hull, main wing, etc. which require weathertightness.
(3) close-up survey for areas in way of connections between each hull, side hull, wing, tail and other structures, etc. The non-destructive test is to be carried out if deemed necessary by the Surveyor.
(4) confirming the integrity of the internal corridor and internal structure as far as practicable.
(5) confirming the connections of seats to floor
(6) confirming the direction, speed and attitude control system(wing control system, water rudder and air rudder). The operational test is to be carried out if deemed necessary by the Surveyor.
(7) confirming the integrity of towing equipment if fitted.
(8) confirming any alteration to installations and arrangement for structural fire protection.
(9) confirming all sea openings together with valves, cocks and fastenings connecting hull.
(9) visual inspection to propeller blade and shafting as far as practicable. The non-destructive test is to be carried out if deemed necessary by the Surveyor.
(10) external examination for fuel oil tanks
(11) visual inspection to fuel oil system, lubricating oil system, cooling system, exhaust system and hydraulic system.
(12) operational test for fuel oil and lubricating oil cut-off device.
(13) examining the working condition of machinery equipment, The effectiveness test is to be carried out if deemed necessary by the Surveyor.
(14) examining the working condition of electrical equipment, The effectiveness test is to be carried out if deemed necessary by the Surveyor.
(15) general visual inspection to the inside of the cockpit.
(16) examining cables as far as practicable.
(17) confirming the effectiveness of earthing measures to the hull.

2. At Intermediate Survey

(1) examination specified in **Par 1** above
(2) operational test and confirming the installation condition for the direction, speed and attitude control system(wing control system, water rudder and air rudder).
(3) non-destructive examination for the propeller boss area (except controllable pitch propeller) and confirming the propeller balance condition without removal of the propeller.
(4) confirming the condition of the indicators in the cockpit.

3. At Special Survey

(1) examination specified in **Par 2** above
(2) close-up survey for bottom shell plating from the outside of the hull. The non-destructive test is to be carried out if deemed necessary by the Surveyor.
(3) effectiveness test for machinery and control system.

(4) checking and confirming the setting value for the protection of the main engine and generators
(5) water landing and take-off test
(6) non-destructive examination for areas in way of connections by weld, bolt, rivet, etc. between each hull, side hull, tail and other structures, etc.
(7) effectiveness test for special equipment(alarm systems and aerodynamic stabilization systems) specified in **Ch 11.**

4. At Docking Survey

(1) examining the movable parts of wing and tail such as flap, aileron, elevator, rudder, etc. with removal. and confirming the installation and working condition after re-installation.
(2) all propeller shafts are to be opened up for examination, and the after end of the cylindrical part of the shaft and forward one third of the shaft cone, or fillet of the flange, is to be examined by an effective crack detection method. In the case of a keyed propeller attachment at least the forward one third of the shaft cone is to be examined by an effective crack detection method with the key removed. Bearings, oil glands, propellers and fastenings are to be examined. Controllable pitch propellers where fitted are to be opened up and the working parts examined, together with the control gear.
(3) Directional propellers are to be dismantled for examination of the propellers, shafts, gearing, control, electrical and monitoring equipment.

103. Class notation

The class notations assigned to the WIG ships classed with the Society are to be in accordance with the requirements specified in **Pt 1, Ch 1, 201.** of **Rules for the Classification of Steel Ships**. However, the notation "Passenger WIG-A" or "General WIG-A" for WIG ship of type A, "Passenger WIG-B" or "General WIG-B" for WIG ship of type B specified in **Ch 1, 104.** shall be assigned for Passenger WIG Ships or General WIG Ships, as an additional special feature notation.

104. Submission of plans and documents

1. For a WIG ship requiring Classification Survey during Construction, the relevant plans and documents are to be submitted to the Society in accordance with the **Rules for the Classification of Steel Ships.** In addition to this the following plans and/or documents are to be submitted.

(1) materials, scantlings and structures for side hull, wing and tail
(2) other structures such as cowling, nacelle, strut, yoke, etc.
(3) direction, speed and attitude control system(wing control system, water rudder and air rudder)
(4) alarm systems and aerodynamic stabilization systems
(5) cockpit arrangement including the indicators and emergency escape arrangement for pilot
(6) other plans and/or documents deemed necessary by the Society

2. When a WIG ship is constructed in complex material, the lay-up procedures, joint details, raw material lists, moulding procedures and certificates of complex material tests are to be submitted additionally.

3. For a WIG ship requiring Classification Survey after Construction, the relevant plans and documents as required for the Classification Survey during Construction are to be submitted. ⚓

CHAPTER 3 STRUCTURES

101. General

1. The structures of WIG ships are to be satisfied with the operating requirements in either the water surface and the air.

2. The scantling of each structural members are to be determined by direct strength analysis, and the material and results from the calculation should be submitted to the Society. The hull, each member and primary attachment to the hull like wing to maintain the longitudinal strength, other important strength and local strength may be applied to the Korean Airworthiness Standard if deemed necessary by the Society.

3. The design life of WIG ships is to be minimum 25 years.

102. Materials and Weldings

1. The requirements in **Pt 2, Ch 1** of **Rules for Classification of Steel Ships** are to be applied to steels, aluminium alloys or composite materials intended to be used for hull construction of a WIG ship.

2. The welding, rivet connection and FRP bonding are to be carried out in accordance with the procedures for welding, rivet connection and FRP bonding previously approved, with the materials qualified by the Society. Welding is to be carried out by the welders qualified by the Society and rivet connection and FRP bonding are carried out by competent personnel on methods.

103. Structures

1. General requirements of structure

(1) The factor of safety is design factor considering the possibility of very large loads and the uncertainty from materials and design. Unless otherwise provided, a factor of safety of 1.5 should be used.

(2) Limit loads are maximum loads with foreseeable operation conditions and ultimate loads are obtained from limit loads multiplied by the factor of safety.

(3) The air and water loads should be placed in equilibrium with inertia forces, considering each item of mass in the WIG ships. These loads should be distributed to conservatively approximate or closely represent actual conditions. If the deformation due to the loads change the distribution of external or internal load considerably, this change should be considered and acceleration and loads based on full scale measurements may be considered to apply the actual loads.

(4) The structure should be able to support limit loads without permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation. And the structure should be able to support ultimate loads without failure for at least three seconds, except local failures or structural instabilities between limit and ultimate load are acceptable only if the structure can sustain the required ultimate load for at least three seconds. However, when proof of structural strength is shown by dynamic tests simulating actual load conditions, the three second limit does not apply.

(5) If structural safety is not confirmed by structural analysis, substantiating load tests should be carried out. Dynamic tests, including structural flight tests, are acceptable if the design load conditions have been simulated.

2. Emergency landing conditions

The structure should be designed to protect the passenger, although it may be damaged in emergency landing condition. Proper use is made of safety belts and shoulder harnesses provided for in the design. All objects in structure are fixed to prevent the damage of passenger.

3. Fatigue evaluation

(1) Damage tolerance criteria for fatigue evaluation should be approved through the test for material and use of structural member of WIG ships. Particularly in case of composite materials, diversity and environmental effects of damage tolerance criteria should be considered. Unless fatigue

strength for hull structures and other structures are verified according to damage tolerance criteria, evaluations in detail design and construction are to be in accordance with followings:
(A) A fatigue strength investigation in which the structure is shown by tests, or by analysis supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected in service.
(B) A fail safe strength investigation, in which it is shown by analysis, tests, or both that catastrophic failure of the structure is not probable after fatigue failure, or obvious partial failure, of a principal structural element.
(C) The member subjected to fatigue strength evaluation is to be determined by test and operating experience, and evaluation should be performed according to damage tolerance criteria considering the simultaneous damage. The residual strength evaluation should show that the remaining structure is able to withstand critical limit loads, even though the structures are damaged partially according to damage tolerance evaluations.
(D) Each evaluation required should be;
(a) typical loading spectra (e.g., taxi, ground-airground cycles, maneuver, gust)
(b) any significant effects due to the mutual influence of aerodynamic surfaces
(c) any significant effects from propeller slipstream loading, and buffet from vortex impingements

(2) Where bonded joints are used in each wing(including canards, tandem wings, and winglets), empennage and relating structures, moveable control surfaces and their attaching structure, made by composite materials, composite structure should be evaluated as following:
(A) The maximum disbonds of each bonded joint consistent with the capability to withstand the loads should be determined by analysis, tests, or both. Disbonds of each bonded joint greater than this should be prevented by design features.
(B) Proof testing should be conducted on each production article that will apply the critical limit design load to each critical bonded joint.
(C) Repeatable and reliable non-destructive inspection techniques should be established that ensure the strength of each joint.

(3) Structural components for which the damage tolerance limit is shown to be impractical should be shown by component fatigue tests, or analysis supported by tests, to be able to withstand the repeated loads of variable magnitude expected in service.

104. Hull Openings and Tightness test

1. Hull tightness and opening

(1) The hull structure below flooding point in intact stability calculation is to be kept watertight, except where the structure is composited by independent(separate) structure and not effected to maneuvering, stability or flooding of hull, like as main wing, tail or etc.
(2) The hull structure above flooding point (including main wing and tail) are to be kept weathertight. Each weather opening on hull and wing, including external doors, windows and hole covers, is to be kept weathertight, except where the structure is composited by independent(separate) structure and not effected to maneuvering, stability or flooding of hull, like as main wing, tail or etc.

2. Tightness test

(1) After completion of hull, hose testing is to be carried out to each exposed part of hull required to be watertight and weathertight as well as watertight transverse bulkhead to verify structural tightness. The hose test is to be carried out in accordance with **Pt 3, Ch 1, Sec 2** of **Rules for Classification of Steel Ships.**
(2) When hose test cannot be performed without damaging possible machinery, electrical installations, insulation or outfitting already installed, it may be replaced by a careful visual inspection of all the crossings and welded joints, where necessary, dye penetrant test or ultrasonic leak test may be required. ⚓

CHAPTER 4 EQUIPMENT

101. General

Hull equipment, not mentioned in this chapter, is to be in accordance with the Rules for the Classification of Steel Ships, **Pt 4**. However, they can be admitted where the Society admit that they are satisfied with the requirements in this chapter and the equivalent standard thereto(Federal Aviation Regulations, etc).

102. Rudder and Steering Gear

1. Design loads

(1) The maximum values of aerodynamic and hydrodynamic forces and torque likely to occur in the range of assumed rudder angles for the appropriate rudder are to be taken as the design loads. The torque on the stock of the rudder when a buffer is fitted in gear is to be taken depending on the buffer characteristics.

(2) Design loads are to be determined by a calculation method or to be based on the model tests and the design loads along the water rudder are to be determined at the maximum speed in the displacement mode and the design loads along the air rudder are to be determined at the maximum speed in the ground effect mode.

2. Calculations of steering gear main components

(1) Bending moments, shear forces and support reactions acting on the steering gear components with regard to the be of the steering gear used, its main dimensions, reliability of supports, etc. are to be proved its effectiveness.

(2) Where only hydrodynamic loads arc taken into consideration as external loads in strength calculations, the reduced stresses in the design sections of the steering gear components are not to exceed 0.5 times the upper yield stress. The specific pressure on the supports is not to be more than that given in the following table.

Material of the pair in friction	Specific pressure P_V (MPa)	
	in backwash	outside backwash
Stainless steel - bronze	-	15.0
Stainless steel - rubber	6.0	8.0
Stainless steel - caprolon	-	6.0

3. Steering gear

(1) Steering gear, the controls and actuating systems of the water rudder are to comply with the requirements of "Standard for Ship's Facilities(Article 73 ~ 77)". When air rudder is not regulated by steering gear in "Standard for Ship's Facilities", the sufficient performances for steering the ship are to be proved by sea trials of the WIG ship.

(2) The water rudder should be provided the main steering gear and auxiliary steering gear. The auxiliary steering gear is not required in case a craft fitted with several rudders, the steering gear allows to shift each rudder independently of other rudders and adequate maneuverability of the ship is ensured with one rudder.

(3) The performance of the steering gear of the air rudder is to be proved the possibility of the safe and rapid collision avoidance, when the craft running at the maximum speed in the ground effect mode.

(4) When the water rudder is installed, the steering gear of the water rudder in the displacement mode is to be capable of putting the rudder over from 30° from one side to 30° on the other side in not more than 15 s, with the craft running at a speed of 7 knots. When a water-jet or other equipment is installed instead of the water rudder, its rotation capability is to be proved at least equivalent to that the rotation capability of the water rudder in this paragraph.

(5) The steering gear of the water rudder may be hand-operated provided it is handled by one man

with a force at the hand-wheel of not more than 120 N. A short-time increase of the force up to 200 N is allowed.

(6) For the water rudder in the displacement mode, it is to be provided with a system of rudder stops permitting to put the rudder over on either side to an angle of not more than 35°. However, when the greater angle is larger in the displacement mode, the relevant values are to be submitted and its effectiveness is to be proved.

103. Anchoring Equipment

1. Each WIG ship is to be provided at least one anchor, anchor wire rope (or chain cable), securing and recovery equipment. However, where the weight of the anchor is less than 25 kg, recovery equipment may be omitted. In such case a WIG ship is to be provided with a device for securing the anchor wire rope (or chain cable) for riding the anchor at ship. However, the WIG ship which is not practicable providing anchoring equipment of this paragraph due to the limited space etc. may not apply.

2. Calculation of anchor and anchor chain etc.

(1) The mass of each bower anchor, Q (kg) is to be not less than:

$$Q = 1.75E$$

where

E = equipment number according to Rules for the Classification of Steel Ships. If a high holding power anchor is used as the bower anchor, the mass of the anchor may amount to 75 % of the anchor mass determined using the above formula.

(2) The length ℓ(m) of the anchor wire rope (chain cable) for the bower anchor is not to be less than:

$$\ell = 7.5\sqrt{Q} + 20$$

where

Q = anchor mass(kg) according to (1)

(3) The breaking strength F_{ST} (kN) of the anchor wire rope (chain cable) is to be not less than:

$$F_{ST} = 0.06\,kQ$$

where

k = holding power factor of the used anchor equal to:

3.0 for normal holding power anchors;

6.0 for high holding power anchors;

Q = anchor mass(kg) according to (1)

(4) Ends of a wire rope are to be spliced into sockets, clamps or thimbles. The wire rope is to be connected with the anchor shackle by means of the joining shackle.

(5) WIG ship not fitted with anchor recovery equipment may be provided with synthetic fibre ropes in lieu of wire ropes (chain cables). The breaking strength F_{syn}(kN) of the synthetic fibre rope is to be not less than:

$$F_{syn} = 0.124\delta_{av}F_{st}^{\;8/9}$$

where

δ_{av} = average relative elongation in breaking a synthetic fibre rope(%), but not less than 30 %

F_{st} = breaking strength (kN) of the wire rope as a whole determined from (3)

(6) The end of the synthetic fibre rope is to be spliced into a thimble and to be secured to the anchor, as far as possible, by a wire rope (chain cable) section at least 10 m long which complies with the requirements of (3). Laying of an anchor wire rope (chain cable) is to provide Its free run when dropping or hoisting the anchor.

(7) In spite of the criteria in (1) ~ (3) and (5), anchor and anchor wire rope may be determined according to the test in actual navigating area and simulation to prove the same performance.

104. Mooring and Towing Arrangements

1. General

(1) Each WIG ship is to be supplied with mooring arrangement for warping to a coastal or floating berth and towing arrangement capable to ensure safe towing. Other arrangements on board the craft may be used for towing purposes.

(2) Mooring and towing arrangements are to be designed and secured so that watertight integrity of WIG ship is not impaired in case of their damage. The safe towing speed is to be determined during delivery trials of the first ship of a series.

2 Calculation of mooring arrangement

(1) The number of mooring ropes (n) on WIG ship is to be not less than:

$$n = 1.5 + 0.004E$$

where

E = equipment number according to **Rules for the Classification of Steel Ships**.

The results of calculations using above formula are to be rounded off to both sides to the nearest figure. In all cases, the number of mooring ropes is not to be less than two.

(2) The length of each mooring rope ℓ(m) is to be not less than 1.5 times the length of the ship with rounding off to the nearest 5 m. When E(equipment number) exceeds 500, the length of a mooring rope may be taken equal to 1.2 L. (where L is the length of WIG ship).

(3) The breaking strength F_{st}(kN) of the wire rope as a whole is to be not less than:

$$F_{st} = 5.0\sqrt{E}$$

where

E = equipment number according to **Rules for the Classification of Steel Ships.**

(4) Mooring ropes may be of steel wire, natural fibre or synthetic fibre material. The breaking strength F_{syn}(kN) of the synthetic fibre rope is to be not less than

$$F_{syn} = 0.074\delta_{av}F_{st}$$

where

δ_{av} = average relative elongation(%) in breaking a synthetic fibre rope, but not less than 30 %.

F_{st} = F_{st}(kN) determined from formula (3).

(5) Irrespective of the breaking strength regulated by formulas (3) and (4), mooring ropes made of natural fibre or synthetic fibre material less than 20 mm in diameter are not to be used. However, when the adequacy of the mooring performance is proved, the use of ropes of less than 20 mm in diameter is allowed. ⚓

CHAPTER 5 STABILITY AND SUBDIVISION

101. General

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

(1) "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.

(2) "Down flooding point" means any opening through which flooding of the spaces which comprise the reserved buoyancy could take place while the craft is in the intact or damage condition and heels to an angle past the angle of equilibrium.

(3) "Permeability" of a space means the percentage of the volume of that space which can be occupied by water.

(4) "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.

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

(6) "Design altitude in calm water" means the altitude when WIG craft is operated as actual speed in ground effect mode under calm water.

(7) "Worst design altitude" means the altitude when WIG craft is operated in ground effect mode under the maximum significant wave height, limited point of operation.

(8) "Amphibian mode" is the special short-term mode of amphibian WIG craft when it is mainly supported by a static air cushion and moves slowly above a surface other than water.

(9) "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.

(10) "Transitional mode" denotes the transient mode from the displacement mode to the step-taxi mode and vice versa.

(11) "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.

(12) "Take off/landing mode" denotes the transient mode from the planing mode to the ground effect mode and vice versa.

(13) "Ground effect mode" is the main steady state operational mode of flying the WIG craft in ground effect.

(14) "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.

2. References for the stability in the displacement mode under the intact and damaged condition should be submitted to verify stability of WIG craft. Moreover, references indicating the characteristic and installation for stability to land safely despite troubles of some equipment under the worst intended condition should be submitted.

3. Account should be taken of the effect of icing in all stability calculations where icing may occur. If there is an ice breaker, that should be considered for stability calculations.

102. Buoyancy

1. All WIG ships should have a sufficient reserve of buoyancy to meet the intact and damage stability requirements. The Society may require a larger reserve of buoyancy to permit the craft to operate in any of its intended modes. And arrangements should be provided for checking the watertight integrity of those compartments. Where the buoyancy are be calculated, watertight compartments below the draught and watertight or weathertight compartments above the draught should be included in.

2. Where entry of water into structures above the datum as defined in **102. 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.

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

103. Intact stability

1. General

(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.
(2) Suitable precautions of arrangement, equipment or operational procedures should be taken against the craft developing dangerous altitudes, 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.
(3) When turning in calm water the inner angle of heel should not:
(A) induce instability in the craft;
(B) 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
(C) exceed the angle at which the skeg makes contact with the water surface when the craft is in the ground effect mode.

2. Intact stability in the displacement mode

(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 **102. 1** (3) and all parts of fixed airfoils excluding flaps and ailerons.
(2) The angle of heel under the combined action of heeling moments due to passenger crowding according to **108. 1** (1) 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.
(3) The stability of WIG craft, which is difficult to apply (1) and (2), should be verified by the results of trials conducted with the craft itself.

3. Stability in the transitional and take off/landing mode

The maintenance of sufficient stability should be verified by trials and documented in the operational procedures in the transitional and take off/landing mode up to the worst intended condition, if the change of WIG craft mode is not concerned with stability. The angle of horizontal heel under combined action of heeling moments due to passenger crowding according to **108. 1** (1) should not exceed 80 % of the wing surface angle in the transitional mode and 50 % in the take off/landing mode.

4. Stability in ground effect mode

(1) Under the worst intended conditions, which are in both of bow wave and bow wind or stern wave and stern wind, the maximum heeling angle should not exceed 90 % of the angle between a part of WIG ship and surface of the ocean when WIG ship having load condition of minimum stability turns along the minimum radius. This angle can be determined according to the flight altitude corresponding to the worst design altitude.
(2) In case WIG ship is specially designed and constructed to be touched a part of hull with the surface of sea in order to reduce the a turning radius in ground effect mode despite (1), a stability on operation should be verified by a trial.

(3) In case WIG ship includes automatic stabilizing equipment controlling the vertical, horizontal and longitudinal direction motion, WIG ship should have an enough stability to be operated safely while automatic stabilizing equipment is not used as the same way.
(4) Under the worst intended conditions, healing angle derived from the combination of more influential factor between effect by passenger concentration of **108. 1** (1) and wind pressure or high speed turn should not exceed the angle that skeg and perpendicular plate of edge of the wing get into the water. the combined healing angle can be determined by a calculation or trial.

5. Stability in fly-over mode

The stability in fly-over mode should be verified by a calculation and test considering significant factors, such as a speed of craft, a distance with the subject, a height and size of the subject, etc.

6. The stability of WIG craft, which is difficult to apply **103. 2** to **5**, should be verified by the results of trials conducted with the craft itself.

7. Stability verification

(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.
(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.
(3) Validation of stability in calm water should be verified by trails.

104. WIG craft weather criteria

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.

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 M_c,

$$M_V < M_c \quad \text{or} \quad K = M_C / M_V > 1.0$$

3. 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 $(\mathrm{N/m^2})$

A_V : windage area (the projected lateral area of the portion of the craft above the acting waterline) $(\mathrm{m^2})$

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)

f : streamline factor, f < 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 5.1** 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 5.1 Wind pressure P_V (Pascal)

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 <
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

4. The amplitude of rolling in the displacement mode is to be determined according to **6** or equivalent method with propulsion and stability equipment inoperative.

5. The recommended scheme for determination of the capsizing moment, M_C, in the displacement mode of operation is given in **104. 6** (1) and (2). For this purpose, the angle of flooding should be taken as the lowest angle of heel corresponding to residual freeboard of 300 mm below:

(1) the lower window sill;
(2) the upper edge of the coaming of the outside entry door; or
(3) other points of flooding.

6. The minimum capsizing moments, M_C, in the displacement mode is to be determined from the static and 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 **Fig 5.1**, where θ_Z is the amplitude of roll and M_k is a line drawn parallel to the abscissa axis such that the shaded areas S1 and S2 are equal.

M_C = OM, if the scale of ordinates represents moments,

M_C = OM × displacement, if the scale of ordinates represents levers.

(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 **Fig 5.2**). 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 to be 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 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, BE is then the capsizing lever. In this case the capsizing moment M_C is determined by multiplication of ordinate BE (in m) by the corresponding displacement in tons

$$M_C = 9.81 \triangle BE \quad \text{(kNm)}$$

(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.

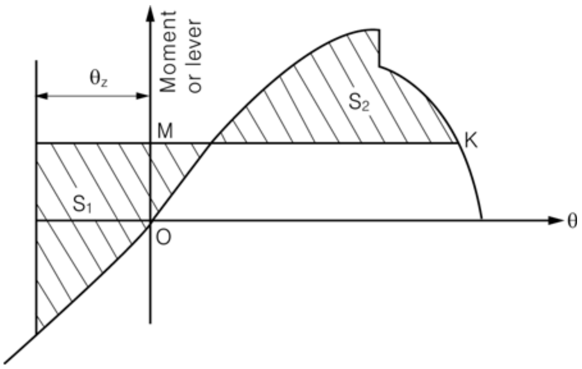

Fig 5.1 Static stability curve

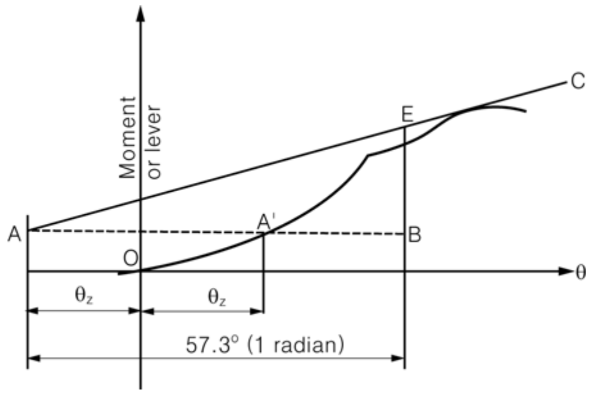

Fig 5.2 Dynamic stability curve

105. Buoyancy and stability in the displacement mode following damage

1. For the purpose of damage stability calculations, the volume and surface permeability should be as follows:

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

* Whichever results in severer condition.

Permeability may be also determined by direct calculation.

2. Low-density foam or other media may be used to provide buoyancy in void spaces, if necessary. Any proposed medium should be:
(1) of closed-cell form 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.

3. The possible damages should be assumed to consider all of the reason causing the damage, except that the total loss condition as a part of hull is divided. The craft following damage should have sufficient buoyancy and positive stability in sill water to simultaneously ensure that:
(1) after flooding ceased and a state of equilibrium reached, the final waterline is not to be less than 300 mm below the level of the openings;
(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, bars, etc., 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.

106. Inclining and stability information

1. Every craft, on completion of construction should be inclined and the elements of its stability are to be 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.

2. 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 this society for approval, together with a copy for their retention. The approved report should be placed on board and incorporated when adding or amending.

3. The information should include particulars appropriate to the craft and 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 down flooding points and angles should be identified.

107. Marking of the draft mark and the design waterline

1. The draft mark should clearly be marked on the bow and stern. If it is difficult to read the draft mark, installation directing the draft of the bow and stern should be attached.

2. The design waterline should clearly be marked amidships on the craft's outer sides.

108. Passenger regulations

1. Passenger regulation in the displacement mode should be satisfied with as follows:

(1) Where compliance with this chapter requires consideration of the effects of passenger weight, the following information should be used:
   (A) Each passenger has a mass of 75 kg.
   (B) Vertical centre of gravity of seated passengers is 0.3 m above seat.
   (C) Passengers and luggages should be considered to be in the space normally at their disposal.
   (D) Passengers should be distributed on available deck areas towards one side of the craft on the decks where shoulder stations are located and in such a way that they produce the most adverse heeling moment.

(2) The stability of the craft should be verified according to the assumptions of paragraph (1) for each of the following loading conditions:
   (A) with full number of passengers and cargo and full provisions on board craft
   (B) with full number of passengers and cargo and with 10 % of provisions
   (C) without passengers and cargo and with 10 % of provisions.

(3) The stability of the craft should be verified under the loading condition described in paragraph (2) (B) 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. ⚓

CHAPTER 6 MACHINERY

101. General

Machinery installations, not specified in this chapter, are to be in accordance with the relevant requirements in the Rules for the Classification of Steel Ships. However, it can be accepted where the Society admit that they are satisfied with the requirements in this chapter or equivalent standard such as the Federal Aviation Regulations, etc.

102. Main propulsion and auxiliary machinery

1. General

(1) The machinery, associated piping systems and fittings relating to main machinery and auxiliary power units are to be of a design and construction adequate for the service for which they are intended and are to be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards.

(2) All surfaces of machinery installations with high temperature above 220 °C e.g. thermal oil and exhaust gas lines, silencers, etc and which may be impinged as a result of leakage of flammable fluid, are to be effectively insulated with non-combustible material to prevent the ignition of combustible materials coming into contact with them. Where the insulation is oil absorbent or may permit the penetration of oil, the insulations are to be encased in steel sheathing or equivalent material.

(3) Special consideration is to be given to the reliability of single essential propulsion components.

(4) Means are to 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 is to be given to the malfunctioning of :

(A) a generator set which serves as a main source of electrical power; and

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

(5) Means are to be provided to ensure that the machinery can be brought into operation from the dead craft condition without external aid.

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

(7) Provision is to be made to facilitate cleaning, inspection and maintenance of main propulsion and auxiliary machinery including pressure vessels.

(8) The Society may accept machinery which does not show detailed compliance with the Guidance where it has been used satisfactorily in a similar application, provided that:

(A) the design, construction, testing, installation and prescribed maintenance are together adequate for its use in a marine environment; and

(B) an equivalent level of safety will be achieved.

(9) Such informations as necessary to ensure that machinery can be installed correctly regarding such factors as operating conditions and limitations are to be made available by the manufacturers.

(10) Main propulsion machinery and all auxiliary machinery essential to the propulsion and the safety of the craft are, as fitted in the craft, to 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.

(11) All pressure vessels and associated piping systems are to be of a design and construction adequate for the purpose intended and are to be so installed and protected as to minimize danger to persons on board. In particular, attention is to 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 are to be fitted with adequate means to prevent over-pressures in service.

(12) Arrangements are to 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.

2. Engine general

(1) The engines are to be fitted with adequate safety monitoring and control devices in respect of speed, temperature, pressure and other operational functions. Control of the machinery is to be arranged so that no single failure causes loss of control of machinery. The machinery installation is to be suitable for operation as in an unmanned machinery space, including automatic fire detection system, bilge alarm system, remote machinery instrumentation and alarm system.
(2) The engines are to 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 are not to cause complete engine shutdown. Such safety devices are to be capable of being tested.
(3) At least two independent means of stopping the engines quickly from the operating compartment under any operating conditions are to be available. Duplication of the actuator fitted to the engine is not to be required.
(4) The major components of the engine are to have adequate strength to withstand the thermal and dynamic conditions of normal operation. The engine is not to be damaged by a limited operation at a speed or at temperatures exceeding the normal values but within the range of the protective devices.
(5) The design of the engine is to be such as to minimize the risk of fire or explosion and to enable compliance with the fire precaution requirements.
(6) Provision is to be made to drain all excess fuel and oil to a safe position so as to avoid a fire hazard.
(7) Provision is to be made to ensure that, whenever practical, the failure of systems driven by the engine is not to unduly affect the integrity of the major components.
(8) The ventilation arrangements in the machinery spaces are to be adequate under all envisaged operating conditions. Where appropriate, arrangements are to ensure that enclosed engine compartments are forcibly ventilated to the atmosphere before the engine can be started.
(9) Any engine is to be ensured that the engine is installed so as to avoid damage of structural members and machinery within the craft by an excessive vibration.

3. Gas turbines

(1) Gas turbines are to be designed to operate in the marine environment and are to be free from surge or dangerous instability throughout its operating range up to the maximum steady speed approved for use. The turbine installation is to be arranged to ensure that the turbine cannot be continuously operated within any speed range where excessive vibration, stalling, or surging may be encountered.
(2) The gas turbines are to 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.
(3) The provisions of **2** (6) are to 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.
(4) Turbines are to 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 is to be made available. Provision is to be made for preventing the accumulation of salt deposits on the compressors and turbines and, where appropriate, for preventing the air intake from icing.
(5) In the event of a failure of a shaft or weak link, the broken end is not to 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.
(6) Each engine is to be provided with an emergency overspeed shutdown device connected, where possible, directly to each rotor shaft.
(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 is to be provided for the acoustic enclosure.
(8) The manufacturers are to demonstrate the soundness of the casings. Inter-coolers and heat exchangers are to be hydraulically tested on each side separately.

4. Diesel engines for main propulsion and essential auxiliaries

(1) Any main propulsion system is to 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.
(2) All external high-pressure fuel delivery lines between the high-pressure fuel pumps and fuel nozzles are to be protected with a jacketed tubing system capable of containing fuel from a high pressure line failure. The jacketed tubing system is to include a means for collection of leakages and arrangements are to be provided for an alarm to be given of a fuel line failure.
(3) Engines of a cylinder diameter of 200 mm or a crankcase volume of 0.6 m^3 and above are to be provided with crankcase explosion relief valves of an approved type with sufficient relief area. The relief valves are to be arranged with means to ensure that discharge from them is directed so as to minimize the possibility of injury to personnel.
(4) The lubrication system and arrangements are to 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.
(5) Arrangements are to 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.
(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 are to be such as to minimize the risk of fire or explosion.

5. Transmissions

(1) The transmission is to 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.
(2) The design of shafting, bearings and mounts is to 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.
(3) The strength and fabrication of the transmission are to 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 is to 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.
(4) Where a clutch is fitted in the transmission, normal engagement of the clutch is not to cause excessive stresses in the transmission or driven items. Inadvertent operation of any clutch is not to produce dangerously high stresses in the transmission or driven item.
(5) Provision is to 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.
(6) Where failure of lubricating fluid supply or loss of lubricating fluid pressure could lead to hazardous conditions, provision is to 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.

6. Propulsion and lift devices

(1) The provisions of this section are based on the premise that:
  (A) Propulsion arrangements and lift arrangements may be provided by separate devices, or be integrated into dual-function devices.
  (B) 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.
  (C) 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.
(2) The propulsion and lift devices are to be of adequate strength and stiffness. The design data, calculations and trials, where necessary, are to 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.

(3) The design of propulsion and lift devices is to 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.
(4) Design and testing of propulsion and lift devices are to 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 maneuvering and reversing and to the axial location of rotating parts.
(5) Appropriate arrangements are to be made to ensure that:
  (A) ingestion of debris or foreign matter is minimized; and
  (B) the possibility of injury to personnel from shafting or rotating parts is minimized.

103. Auxiliaries and piping arrangement

1. General

(1) Fluid systems are to 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 are to be extremely remote. Attention is to be directed to the avoidance of flammable liquid impingement on hot surfaces in the event of leakage or fracture of the pipe.
(2) The maximum allowable working pressure in any part of the fluid system is not to 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 is to 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 is to be safeguarded by appropriate relief devices.
(3) Piping are to be pressure-tested to a pressure of the 1.5 times the design pressure. The test on any storage tank or reservoir is to take into account any possible static head in the overflow condition and the dynamic forces arising from craft motions.
(4) Materials used in piping systems are to 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.

2. Arrangement of oil fuel, lubricating oil and other flammable oil

(1) Oil fuel, lubricating oil and other flammable oil lines are to 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 is to be kept to a minimum. Flexible pipes carrying flammable liquids are to be of an approved type.
(2) Fuel oil, lubricating oils and other flammable oils are not to be carried forward of public spaces and crew accommodation.
(3) In a craft in which oil fuel is used, the arrangements for the storage, distribution and utilization of the oil fuel are to be such as to ensure the safety of the craft and persons on board and are at least to comply with the following provisions.
  (A) As far as practicable, all parts of the oil fuel system containing oil under pressure exceeding 0.18 N/mm^2 are not to 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 are to be adequately illuminated.
  (B) The ventilation of machinery spaces is to be sufficient under all normal conditions to prevent accumulation of oil vapour.
  (C) No oil fuel tank is to be situated where spillage or leakage therefrom can constitute a hazard by falling on heated surfaces.
  (D) Every fuel tank is where necessary, to be provided with save-alls or gutters to catch any fuel which may leak from such tanks.
  (E) Safe and efficient means of ascertaining the amount of oil fuel contained in any oil fuel tank are to be provided.
  (F) Oil-level gauges are to be of a type not to allow over-filling of the tanks that will permit release of fuel. The use of cylindrical gauge glasses is to be prohibited.

(G) Provision is to 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 is to discharge to a safe position and, for fuel of flashpoint less than 43°C, is to terminate with approved flame arresters.
(H) Subject to (I), oil fuel pipes and their valves and fittings are to be of steel or other approved materials, except that restricted uses of flexible pipes is to be permissible in positions where the Society is satisfied that they are necessary. Such flexible pipes and end attachments are to be of approved fire-resisting materials of adequate strength and are to be constructed to the satisfaction of the Society.
(I) High-pressure oil fuel pipes and their valves and fittings are to be of seamless steel construction and are to be protected with a jacketed piping system capable of containing and collecting fuel from a high pressure line failure.

(4) The arrangements for the storage, distribution and utilization of oil used in pressure lubrication systems are to 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 are at least to comply with the provisions of (3) (A) and (C) to (G) except that:
(A) 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;
(B) sounding pipes may be permitted in machinery spaces if fitted with appropriate means of closure.

(5) 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 are to be such as to ensure the safety of the craft and persons on board.

(6) In addition to the provisions of **103. 2** (1) to (5), any equipment used to store or transfer flammable liquids automatically or remotely is to have arrangements to prevent overflow spillages.

3. Bilge pumping and drainage systems

(1) Arrangements are to be made for draining any watertight compartment other than the compartments intended for permanent storage of liquid. Where, in relation to particular compartments, drainage is not considered necessary, drainage arrangements may be omitted, but it is to be demonstrated that the safety of the craft will not be impaired.

(2) Bilge pumping arrangements are to 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 is to be such that flooding thereof could not affect the safety of the craft.

(3) The bilge pumping system is to be capable of operation under all possible values of list and trim after the craft has sustained the postulated damage in **Ch 5, 105.** The bilge pumping system is to 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 are to be capable of being operated from the operating compartment.
(A) At least two power pumps connected to the main bilge system are to be provided, one of which may be driven by the propulsion machinery. If the Society 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 (12).
(B) On multi-hull craft each hull is to 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 is to be an independent power pump.

(4) The power operated self-priming bilge pumps may be used for other duties such as fire fighting or general service but not for pumping fuel or other flammable liquids.

(5) Each power bilge pump is to be capable of pumping water through the required bilge pipe at a speed of not less than 2 m/s.

(6) The diameter (d_B) of the bilge main is to 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 **Pt 1**;

B = is for monohull craft, the breadth of the craft in m as defined in **Pt 1** 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).

(7) Internal diameters of suction branches are not to be less than 25 mm. Suction branches are to be fitted with effective strainers.
(8) Sea inlet valves, if any, are to be capable of being closed from the operating compartment.
(9) All bilge suction piping up to the connection to the pumps are to be independent of other piping.
(10) Any space for which bilge pumping arrangements are required is to be provided with a bilge alarm.
(11) For craft with individual bilge pumps, the total capacity Q of the bilge pumps for each hull is not to be less than 2.4 times the capacity of the pump defined in **3** (5) and (6).
(12) In bilge pumping arrangements where a bilge main is not provided, at least one fixed submersible pump is to be provided for each space. The capacity of each pump is to be determined by the formula:

$$Q_n = Q/(N-1) \text{ (minimum of 8 ton/h)}$$

where:

N = number of submersible pumps

Q = total capacity as defined in (11).

However, where accepted by this Society, bilge discharge of small craft having max. flying weight of less than 5,670 kg may be carried out by one (1) portable bilge pump.
(13) Non-return valves are to be fitted in the following components:
(A) bilge valve distribution manifolds;
(B) bilge suction hose connections where fitted directly to the pump or to the main bilge suction pipe; and
(C) direct bilge suction pipes and bilge pump connections to main bilge suction pipe.

4. Ballast systems

(1) Water ballast is not in general to 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 is to be fitted, or other alternative means such as discharge to shore facilities are to 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.
(2) Where a fuel transfer system is used for ballast purposes, the system is to be isolated from any water ballast system and meet the requirements for fuel systems and the International Convention for the Prevention of Pollution from Ships.

5. The cooling arrangements provided are to 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.

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

7. Machinery spaces are to 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 are to be adequately ventilated appropriate for the purpose of those spaces. The ventilation arrangements are to be adequate to ensure that the safe operation of the craft is not put at risk.

8. Exhaust systems

(1) Exhaust systems are to be so arranged as to minimize the risk of intake of exhaust gases into manned spaces, air-conditioning systems, and engine intakes.
(2) Pipes through which exhaust gases are discharged through the hull in the vicinity of the waterline are to 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.
(3) Exhausts are to 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 7 ELECTRICAL EQUIPMENT AND CONTROL SYSTEMS

101. General

1. Electrical equipment and control systems, not mentioned in this chapter, are able to be in accordance with **Pt 6** of **Rules for the Classification of Steel Ships.** However, it may be acceptable to the Society that they are satisfied with the requirements in this chapter and the equivalent standard thereto, such as (Federal Aviation Regulation, etc).

2. The System Safety Assessment (SSA) should include the electrical system, taking into account the effects of electrical failure on the system and the possibility of faults occurring simultaneously or consecutively.

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 system would affect both supplies.

4. The securing arrangements for heavy item such as accumulator batteries, should prevent excessive movement during the accelerations.

5. Precautions should be taken to minimize risk of supplies to essential and emergency services being interrupted by the inadvertent or accidental opening of switches or circuit breakers.

6. Electronic equipment essential for propulsion and altitude control purposes should be approved and installed according to a recognized IEC Standard.

7. Unless otherwise stated in the national or international standards, all equipment are to be operated satisfactorily with the variations from its rated value shown as in the followings.

(1) Voltage and frequency variations for a.c. distribution system

Type of variations	Variations	
	Permanent	Transient
Frequency	± 5 %	± 10 % (5 sec)
Voltage	+ 6 %, -10 %	± 20 % (1.5 sec)

(2) Voltage variations for d.c distribution system

Parameters	Variations
Voltage tolerance (continuous)	± 10 %
Voltage cyclic variation deviation	5 %
Voltage ripple(*a.c.* r.m.s. over steady *d.c.* voltage)	10 %

(3) Voltage variations for battery system

Systems	Variations
Components connected to the battery during charging (see Note)	+30 %, -25 %
Components not connected to the battery during charging	+20 %, -25 %
(Note) Different voltage variations as determined by the charging/discharging characteristics, including ripple voltage from the charging device, may be considered.	

8. The total harmonic distortion(THD) in the voltage waveform in the distribution systems is not to exceed 8 % and any single order harmonics not to exceed 3 %.

9. Equipment required to remain operational in an emergency is to be supplied from emergency source of power automatically within 15 seconds in the event of failure of the main supply.

10. Where arrangements are made for the supply of electricity from a source on shore, means are to be provided permanently for checking the phase sequence (for three-phase alternating current) or the polarity (for direct current).

11. Lighting fittings on the craft is to be provided in accordance with **Pt 6, Ch 1** of **Rules for the Classification of Steel Ships.**

12. Sources of power for navigational equipment and radio equipment are to comply with the following requirements.

(1) All electrical power for navigational equipment and radio equipment is to be supplied from main source of electrical power. In case of failure of the main source of electrical power, it is to be supplied from emergency source of electrical power.
(2) Where installation of the reserve source of electrical power is impracticable, navigational equipment and radio equipment, in case of failure of the main source of electrical power, are to be supplied from accumulator battery used as the emergency source of electrical power. However the accumulator battery is not able to be used as a starter battery.
(3) All electrical power for navigational equipment and radio equipment that require electrical power for their operation is to be supplied by two independent feeders using switch and protection equipment from the switchboard. Electrical power to the switchboard busbars from the main, reserve or emergency sources, is to be supplied by two independent feeders.

13. Electrical bonding and protection against lightning and static electricity are to comply with the following requirements.

(1) For metallic components, there is to be an electrical bonding to the WIG frame and components are to be designed so that a strike will not endanger the WIG.
(2) For nonmetallic components, they are to be designed so as to minimize the effect of a strike and acceptable means of diverting the resulting electrical current are to be provided so as not to endager the WIG.

102. Main source of electrical power

1. The main source of electrical power should consist of at least two generating sets (generators or accumulator batteries) and the main switchboards should be located in a dry space to minimize the risk of fire. However, alternative device instead of main switchboard can be used for small WIG or WIG operated by 1 operator.

2. The capacity of these generating sets shall be such that, in the event of any one generating set being stopped or failing, it will still be possible to supply those services necessary to provide the normal operational conditions of propulsion and safety. It shall also be possible to supply services for heating, domestic refrigeration, mechanical ventilation, and sanitary and fresh water.

3. The arrangements of the craft's main source of electrical power should be possible to supply all services regardless of the speed of the propulsion machinery.

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.

5. Where charging units or converters constitute an essential part of the electrical supply system, the system should be so arranged as to ensure the same continuity of supply.

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.

7. 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 Society.

8. The main source of electrical power system should be able to provide normal operation of propulsion engine at any load. Automatic load-dependent disconnection of non-essential consumers may be allowed.

103. Emergency source of electrical power

1. A self-contained emergency source of electrical power should be provided.

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 **Ch 5**, operable in that condition and readily accessible.

3. The location of the emergency source of electrical source and any associated transforming equipment, the transitional source of emergency power, the emergency switchboard and the emergency lighting switchboards 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 and main switchboard will not interfere with the supply, control and distribution of emergency electrical power.

4. Distribution system should be so arranged that the feeders from the main and emergency sources be separated both vertically and horizontally as widely as practicable.

5. The emergency source of electrical power should be automatically connected the emergency switchboard in the event of failure of the main source of electrical power and the electrical power should be supplied to equipment as referred to in **11**. It also may be either a generator or an accumulator battery, which shall comply with the following:

(1) Where the emergency source of electrical power is a generator, it should be driven by a suitable prime mover with an independent supply of fuel having a flash point which meets the regulations and be provided with a transitional source of emergency electrical power according to the below **12**.

(2) Where the emergency source of electrical power is an accumulator battery, it should be capable of 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.

6. Where accumulator batteries are used as emergency source of power, an indicator should be mounted in a suitable space at the WIG's operating compartment to indicate discharges.

7. 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.

8. Only emergency circuits should be fed by the emergency switchboard.

9. 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 WIG is upright and when WIG has a list or trimming because of WIG's damage.

10. Where accumulator batteries are installed to supply emergency, back up or engine start-up services, provisions should be made to charge them from a reliable on-board 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 minimized. Means for efficient air ventilation should be provided.

11. The emergency source of power should be capable of supplying simultaneously the following services:

(1) for a period of 5 hours about the following emergency lighting

(A) at the stowage positions of life-saving appliances

(B) at all escape routes, such as alleyways, stairways, exit from accommodation and service spaces, embarkation points etc.

(C) in the public spaces

(D) in the machinery spaces and main emergency generating spaces, including their control positions

(E) in control stations
(F) at the stowage positions for any firemen's outfits fitted
(2) for a period of 5 hours about the following equipment
(A) main navigation lights, except for "not under command" lights
(B) electrical internal communication equipment for announcements for passengers and crew required during evacuation
(C) fire-detection and general alarm system and manual fire alarms
(D) remote control devices of fire-extinguishing systems, if electrical
(3) for a period of 4 hours of intermittent operation about the following equipment
(A) the daylight signalling lamps, if they have no independent supply from their own accumulator battery
(B) the craft's whistle, if electrically driven
(4) for a period of 5 hours about the following equipment
(A) craft radio facilities and their other facilities
(B) 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 hours about "not under command" lights
(6) for a period of 10 minutes about power drives for directional control devices, including those required to direct thrust forward and astern, unless there is a manual alternative acceptable to the Society.

12. The transitional source of emergency electrical power is the 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 normal voltage and be of sufficient capacity and so arranged as to supply automatically in the event 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 minutes, the load specified in **11** (1) to **11** (3).

13. The above provision, **12** may be considered satisfied without the installation of a transitional source of emergency electrical power if each of the services 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.

14. 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 requirement will be met if main and emergency feeders passing through any such zone are separated both vertically and horizontally as widely as practicable.

104. Starting arrangements for generating sets

1. The generating sets should be capable of being readily started in their cold condition at a temperature of 0℃. 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.

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. However, the installation of the second source of energy is not necessary in case a bundle of propulsion engines are installed.

3. The stored energy of the emergency generating set should be maintained at all times and comply with the followings:

(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.
(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.

105. Steering and attitude control

1. Where steering and/or altitude control of a craft is essentially dependent on the continuous availability of electric power, it should be served by at least two independent circuits, one 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. These circuits should be provided with short circuit protection and an overload alarm. Where steering and/or altitude control of a craft is not essentially dependent on the continuous availability of electric power, it is to comply with fail-safe conditions including mechanical or hydraulic methods in the event of power failure.

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, 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 in any one of the phases.

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 the above **3**.

4. The provisions of **Ch 11, 102.** for power supply of the directional control systems and stabilization systems of the craft should be met.

106. Precautions against shock, fire and other hazards of electrical origin

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 55V d.c. or 55V a.c. 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 250V by safety isolating transformers supplying only one consuming device ; or
(3) constructed in accordance with the principle of double insulation.

2. All electrical apparatus should be so constructed and so installed as not to cause injury when handled or touched in the normal manner.

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. Dead-front type switchboards are to be installed for voltage between poles, or to earth, exceeding 55V d.c. or 55V a.c. Where necessary, nonconducting mats or gratings should be provided at the front and rear of the switchboard.

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 Society may accept a device for manual checking of the insulation level as long as the performance and safety are proved.

5. Cables and wiring

(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.
(2) All metal sheaths and armour of cables should be electrically continuous and should be earthed.
(3) 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 Society may permit the use of special types of cables such as radio frequency cables as long as there is nothing wrong about safety.

(4) 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.
(5) 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 Society.
(6) Cables and wiring should be installed and supported in such manner as to avoid chafing or other damage.
(7) 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.

6. Each separate circuit should be protected against short circuit and against overload, except as permitted in section **105.** or where the Society may exceptionally otherwise permit because safety is proved. For supplies with 400 cycles, the impedance of the circuits should be observed.

7. When the protective device is a fuse, it should be placed on the load side of the disconnect switch serving the protected circuit.

8. 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.

9. Accumulator batteries should be suitably housed, and compartments used primarily for their accommodation should be properly constructed and efficiently ventilated.

10. 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. The following additional provisions from (1) to (9) should be met, and provisions from (10) to (15) should be met also for nonmetallic craft:
(1) The electrical distribution voltages throughout the craft may be either direct current or alternating current and should not exceed:
(A) 500 V for power, cooking, heating, and other permanently connected equipment, and
(B) 250 V for lighting, internal communications and receptacle outlets.
(2) For electrical power distribution, earthed system with non hull-return are acceptable.
(3) Earthed electrical distribution system 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) Effective means should be provided so that voltage may be cut off from each and every circuit and subcircuit and from all apparatus as may be necessary to prevent danger.
(6) Electrical equipment should be so designed that the possibility of accidentally touching live parts, rotating or moving parts as well as heated surfaces which might cause burns or initiate fire is minimized.
(7) 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.
(8) The rating or appropriate setting of the overload protective device for each circuit should be permanently indicated at the location of the protection device.
(9) 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 minimize risk of faults, e.g. use of single core cables with additional sleeve over the insulation of each core, with shrouded terminals.
(10) In order to minimize 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 waterborne. The bonding of isolated components inside the structure is not generally necessary, except in fuel tanks.

(11) Each refueling point should be provided with a means of bonding the fuelling equipment to the craft.
(12) 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.
(13) 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.
(14) Secondary conductors provided for the equalization of static discharges, bonding of 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.
(15) 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 8 FIRE PROTECTION

101. General

1. Fire protection system not specified in this chapter is to be in accordance with the Rules for the Classification of Steel Ships. However, satisfaction of equivalent standard such as the Federal Aviation Regulation, etc. specified in this chapter may be permitted by the Society.

2. The following basic principles are to be complied to apply requirements of this chapter:

(1) maintenance of main functions and the safety systems of the WIG ship including propulsion, control, fire-detection, alarms and extinguishing capability of unaffected spaces, after fire in any one compartment on board
(2) subdivision of the craft by fire-resisting boundaries
(3) restricted use of combustible materials and materials generating smoke and toxic gases in a fire
(4) detection, containment and extinction of any fire in the space of origin
(5) protection of means of escape and access for fire fighting
(6) immediate availability of fire-extinguishing appliances
(7) maintenance of structural integrity during fire fighting and evacuation time

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

(1) The use of fuels with a flashpoint below 43°C is not recommended. However, fuels with a lower flashpoint may be used subject to compliance with the provisions specified in **116. 2** to **116. 6.**
(2) Pantries are not to contain cooking facilities with exposed heating surfaces and galleys should not be fitted.
(3) Dangerous goods are not to be carried, except in accordance with requirements developed by IMDG Code.

4. Adequacy of requirements of **Appendix 1** specified in **104.** and **105.** of this chapter is considered to be satisfactory provided that a certificate is issued after passing the test according to the test procedure specified in **Appendix 1**.

102. Definitions

Terms and definitions used in this Chapter are as follows:

1. "Fire-resisting divisions" are those divisions as formed by bulkheads and decks which comply with the followings:

(1) They should be constructed of non-combustible or fire-restricting materials which by insulation or inherent fire-resisting properties satisfy the provisions of (2) to (4).
(2) 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.
(3) 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.
(4) A test of a prototype bulkhead or deck in accordance with the FTP Code should be required to ensure that it meets the provisions of (1) to (3).

2. "Fire-restricting materials" are those materials which have properties complying with the FTP Code. Fire Test Procedures (FTP) Code means the International Code for Application of Fire Test Procedures, as defined in chapter II-2 of the Convention.

3. "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 FTP Code. Any other material is a combustible material.

4. "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).

5. "Low flame-spread" means that the surface thus described will adequately restrict the spread of flame, this being determined in accordance with the FTP Code.

6. "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.

7. “Verification time” means the tested time taken for a number of untrained passengers corresponding to the number of seats and crew to escape from the craft after a alarm has been initiated.

8. “Cowling“ is covering for an engine of a WIG ship.

9. “Nacelle" is an enclosed compartment of a WIG ship which contains an engine.

103. Structural fire protection

1. The boundaries of fire hazard areas are to 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 FTP Code.

2. The ship hull is to be subdivided into fire hazard areas and low fire hazard areas by the fire-resistant structures.

(1) "Fire hazard areas" include:
 (A) machinery spaces
 (B) spaces containing dangerous goods
 (C) store rooms containing flammable liquids
 (D) auxiliary machinery spaces containing driving generators, bilge pumps, oil filling stations and switchboards and similar spaces except where small bilge pumps of special type are installed in non-hazardous spaces or appendages which are divided from hull and they are demonstrated to be safe.
 (F) passenger accommodations.

(2) "Low fire hazard areas" include:
 (A) auxiliary machinery spaces having little or no fire risk
 (B) cargo spaces
 (C) fuel tank compartments
 (D) public spaces
 (E) tanks, voids and areas of little or no fire risk
 (F) bond stores containing packaged beverages with alcohol content no exceeding 24 % by volume
 (G) control stations
 (H) external stairs and open decks used for escape routes
 (I) shoulder stations, internal and external
 (J) deck spaces and enclosed promenades forming survival ship embarkation stations
 (K) the ship’s side to the waterline in the lightest seagoing condition, superstructure and deck-houses sides situated below and adjacent to the life-raft embarkation areas.

(3) Structures bounding fire hazard areas are to be constructed to resist the penetration of smoke and flame for 30 min or a lesser time determined in accordance with **Ch 10, 126. 4.**

(4) Connecting sections(bulkhead, deck, side shell) of accommodation areas(control stations, crew compartments and passenger compartments) and fire hazard areas other than accommodation areas are to be fire resistant or to be divided by distance which has been demonstrated by tests that a fire does not spread to accommodation spaces except a WIG ship of a maximum takeoff weight less than 5,670 kg which is demonstrated by the test that a fire in a fire hazard area does not spread to an accommodation area.

(5) 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 ship when it is exposed to fire for the appropriate fire protection time.

(6) A control station for ventilators, for fuel shut down system, remote control of fire-extinction systems as well as indication panels of fire detection, is to be located in the ship control station.

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

(8) Furniture and furnishings in public spaces and crew accommodation are to comply with the following provisions:

(A) All case furniture is to be constructed entirely of approved non-combustible materials, except that combustible veneers may be accepted, but is to be made of a material having low flame spread characteristics.
(B) All other furniture is to be constructed with frames of non-combustible materials and to be in accordance with the FTP Code.
(C) All draperies, curtains and other suspended textile materials are to have qualities of resistance to the propagation of flame in accordance with the FTP Code.
(D) All deck finish materials comply with the FTP Code.

(9) The following surfaces are to be constructed of materials not capable of producing excessive quantities of smoke or toxic products and having low flame-spread characteristics:
(A) 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
(B) surfaces in concealed or inaccessible spaces in corridors and stairway enclosures, accommodation, service spaces, control stations corridors and stairway enclosures.

(10) Any thermal or acoustic insulation is to 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 are to be kept to the minimum quantity practicable and their exposed surfaces are to have low flame-spread characteristics.

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

(12) Openings in fire-resisting divisions are to comply with the following provisions:
(A) The construction of all doors and hatches in fire-resisting divisions, together with associated door frames, coamings and their means of securing when closed, is to provide resistance to fire as well as to the passage of smoke and flame equivalent to that of the bulkheads in which 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 is to be made to ensure that the fire-resisting integrity of the division is not impaired.
(B) It is to be possible for each door to be opened and closed from each side of the bulkhead by one person only.
(C) Fire doors bounding areas of major fire hazard and stairway enclosures are to satisfy the following provisions.
(a) The doors are to be either self-closing in all normal operational conditions or kept closed at all times when not required for access.
(b) Self-closing doors may be fitted with a hold-back system capable of both local release and remote fail-safe release from the control station. Hold-back hooks not subject to release from the control station are not permitted.
(D) The provisions for integrity of fire-resisting divisions of the outer boundaries facing open spaces of a WIG ship are not to apply to glass partitions and windows. Similarly, the provisions for integrity of fire-resisting divisions facing open spaces are not to apply to exterior doors.

104. Passenger and crew compartment interiors

Passenger and crew compartment interiors are to be meet the following provisions:

1. The materials should be at least flame resistant.

2. Smoking is to be prohibited and there should be at least one illuminated sign (using either letters or symbols) notifying all passengers that smoking is prohibited. Signs which notify that smoking is prohibited should be legible to each passenger seated in the passenger cabin under all probable lighting conditions when illuminated.

3. In addition to Para **2**, for passenger WIG ships the following requirements apply:

(1) Each disposal receptacle for towels, paper, or waste should be fully enclosed and constructed of at least fire resistant materials and should contain fires likely to occur in it under normal use. The ability of the disposal receptacle to contain those fires under all probable conditions of wear, misalignment, and ventilation expected in service should be demonstrated by test.
(2) Lavatories should have “"No Smoking" or “"No Smoking in Lavatory" placards located conspicuously on each side of the entry door. The placards should have red letters at least 1.27 cm

high on a white background at least 2.54 cm high (a “No Smoking” symbol may be included on the placard).

(3) Materials (including finishes or decorative surfaces applied to the materials) used in each compartment occupied by the crew or passengers should meet the following provisions.

(A) Interior ceiling panels, interior wall panels, partitions, galley structure, large cabinet walls, structural flooring, and materials used in the construction of stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps), which are subject to vertical test in accordance with Appendix 1, should be self extinguishing. The average burn length may not exceed 15.24 cm and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.

(B) Floor covering, textiles (including draperies and upholstery), seat cushions, padding, decorative and non-decorative coated fabrics, leather, trays and galley furnishings, electrical conduit, thermal and acoustical insulation and insulation covering, air ducting, joint and edge covering, cargo compartment liners, insulation brakes, cargo covers and transparencies, molded and thermoformed parts, air ducting joints, and trim strips (decorative and chafing) should be self extinguishing when tested vertically in accordance with **Appendix 1**. The average burn length may not exceed 20.32 cm and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.

(C) Acrylic windows and signs, parts constructed in whole or in part of elastomeric materials, edge-lighted instrument assemblies consisting of two or more instruments in a common housing, seat-belts, shoulder harnesses, and cargo and baggage tie-down equipment, including containers, bins, pallets, etc., used in passenger or crew compartments, may not have an average burn rate greater than 6.35 cm per minute when tested horizontally in accordance with **Appendix 1**.

(D) Except for electrical wire cable insulation, and for small parts (such as knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys, and small electrical parts), materials in items not specified in (A), (B) or (C) may not have a burn rate greater than 10.16 cm per minute when tested horizontally in accordance with **Appendix 1**.

4. Pipe lines, tanks, or equipment containing fuel, oil, or other flammable fluids may not be installed in passenger and crew compartment unless adequately shielded, isolated, or otherwise protected so that any breakage or failure of such an item would not create a hazard.

5. Materials located on the cabin side of the firewall should be self-extinguishing or be located at such a distance from the firewall, or otherwise protected by proven methods, so that ignition will not occur if the firewall is subjected to a flame temperature of not less than 1,093℃. For self-extinguishing materials, a vertical self-extinguishing test should be conducted in accordance with Appendix 1 and the average burn length of the material may not exceed 15.24 cm and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the material test specimen may not continue to flame for more than an average of 3 seconds after falling.

105. Cargo compartment fire protection.

1. Sources of heat within each cargo compartment that are capable of igniting the compartment contents should be shielded and insulated.

2. Each cargo compartment should be constructed of materials that meet the appropriate provisions of **104. 3** (3)

3. In addition Para **1** and Para **2**, for passenger WIG ships, each cargo compartment should be:

(1) Located where the presence of a fire would be easily discovered by the pilots when seated at their duty station, or it should be equipped with a smoke or fire detector system to give a warning at the pilots' station, and provide sufficient access to enable a pilot to effectively reach any part of the cargo compartment with a portable fire extinguisher, or

(2) Equipped with a smoke or fire detector system to give a warning at the pilots' station and have ceiling and sidewall liners and floor panels constructed of materials that have been subjected to and meet the 45 degree angle test of **Appendix 1**. The flame may not penetrate (pass through) the material during application of the flame or subsequent to its removal. The average flame

time after removal of the flame source may not exceed 15 seconds, and the average glow tune may not exceed 10 seconds. The compartment should be constructed to provide fire protection that is not less than that required of its individual panels; or.

(3) Constructed and sealed to contain any fire within the compartment.

106. Installation of combustion heater

Combustion heaters are not to be installed on WIG ships except those used for propulsion and power generation.

107. Flammable fluid fire protection

1. In each area where flammable fluids or vapors might escape by leakage of a fluid system, there should be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazard if ignition does occur.

2. For application of Para **1** the following factors should be considered:

(1) Possible sources and paths of fluid leakage, and means of detecting leakage
(2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials
(3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices
(4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing mediums
(5) Ability of WIG ship components that are critical to safety of flight to withstand fire and heat.

3. If action by the flight crew is required to prevent or counteract a fluid fire (e.g., equipment shutdown or actuation of a fire extinguisher), quick acting means should be provided to alert the crew.

4. Each area where flammable fluids or vapors might escape by leakage of a fluid system should be identified and defined.

108. Designated fire zones

1. Designated fire zones are as follows:

(1) Power section for engines
(2) Accessory section for engines
(3) Any complete power plant compartment in which there is no isolation between the power section and the accessory section
(4) Compressor and accessory sections for turbine engines
(5) Combustor, turbine and tailpipe sections that contain lines or components carrying flammable fluids or gases
(6) Any complete power-plant compartment in which there is no isolation between compressor, accessory, combustor, turbine, and tailpipe sections.

2. Any auxiliary power unit compartment

3. Any fuel-burning heater, and other combustion equipment installation

109. Fire protection of flight controls, engine mounts, and other flight structure

Flight controls, engine mounts, and other flight structure located in designated fire zones, or in adjacent areas that would be subjected to the effects of fire in the designated fire zones, should be constructed of fireproof material or be shielded so that they are capable of withstanding the effects of a fire. Engine vibration isolators should incorporate suitable features to ensure that the engine is retained if the non-fireproof portions of the isolators deteriorate from the effects of a fire.

110. Nacelle areas behind fire-walls

Components, pipe lines, and fittings located behind the engine-compartment firewall should be constructed of such materials and located at such distances from the firewall that they will not suffer damage sufficient to endanger the WIG ship if a portion of the engine side of the firewall is subjected to a flame temperature of not less than 1,093℃(2,000˚F) for 15 minutes.

111. Pipe lines, fittings and components

1. Except as provided in Para **2**, each component, pipe line, and fitting carrying flammable fluids, gas, or air in any area subject to engine fire conditions should be at least fire resistant, except that flammable fluid tanks and supports which are a part of and attached to the engine should be fire-proof or be enclosed by a fireproof shield unless damage by fire to any non-fireproof part will not cause leakage or spillage of flammable fluid. An integral oil sump of less than 23.7 L(25 quart) capacity on a reciprocating engine need not be fireproof nor be enclosed by a fireproof shield. Components should be shielded or located so as to safeguard against the ignition of leaking flammable fluid. Flexible hose assemblies (hose and end fittings) are not to be used unless they have been shown to be suitable for the particular application.

2. Para **1** does not apply to the followings:

(1) Pipe lines, fittings which are already approved as part of a type certificated engine
(2) Vent and drain lines, and their fittings, whose failure will not result in, or add to, a fire hazard.

112. Shutoff means

1. Each multiengine WIG ship is to apply the following provisions:

(1) Each engine installation should have means to shut off or otherwise prevent hazardous quantities of fuel, oil, deicing fluid, and other flammable liquids from flowing into, within, or through any engine compartment, except in pipe lines, fittings, and components forming an integral part of an engine.
(2) The closing of the fuel shutoff valve for any engine may not make any fuel unavailable to the remaining engines that would be available to those engines with that valve open.
(3) Operation of any shutoff means may not interfere with the later emergency operation of other equipment such as propeller feathering devices.
(4) Each shutoff should be outside of the engine compartment unless an equal degree of safety is provided with the shutoff inside the compartment.
(5) Not more than 0.95 L(1 quart) of flammable fluid may escape into the engine compartment after engine shutoff. For those installations where the flammable fluid that escapes after shutdown cannot be limited to one quart, it should be demonstrated that this greater amount can be safely contained or drained overboard.
(6) There should be means to guard against inadvertent operations of each shutoff means, and to make it possible for the crew to reopen the shutoff means in flight after it has been closed:

2. Turbine engine installations need not have an engine oil system shutoff in case of the followings.

(1) The oil tank is integral with, or mounted on, the engine
(2) All oil system components external to the engine are fireproof.

3. Power operated valves should have means to indicate to the crew when the valve has reached the selected position and should be designed so that the valve will not move from the selected position under vibration conditions likely to exist at the valve location.

113. Cowling and nacelle

1. Each cowling should be constructed and supported so that it can resist any vibration, inertia, and air loads to which it may be subjected in operation.

2. There should be means for rapid and complete drainage of each part of the cowling in the normal voyage and flight attitudes. No drain may discharge where it will cause a fire hazard.

3. Cowling and nacelle are to be at least fire resistant. the whole cowling and nacelle do not need to be fire resistant where it has been demonstrated by tests complying with **103. 2** (4) that a fire does not spread to other compartment such as passenger compartments.

4. Each part behind an opening in the engine compartment cowling should be at least fire resistant for a distance of at least 61 cm(24 inches) aft of the opening.

5. Each part of the cowling subjected to high temperatures due to its nearness to exhaust system ports or exhaust gas impingement, should be fireproof.

6. Each nacelle of a multiengine with supercharged engines should be designed and constructed so that with the landing gear retracted, a fire in the engine compartment will not burn through a cowling or nacelle and enter a nacelle area other than the engine compartment.

114. Structural fire protection of interior surfaces of wall surrounding machinery space

Despite of this chapter, where a machinery space is in the ship, structural fire protection of interior surfaces of walls(including ceilings and floors) surrounding machinery space is to be A-60 class insulation or equivalent.

115. Ventilation

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 are to be capable of being automatically closed from inside and outside of 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 control station. However, if ventilation system of the space is natural ventilation type and can be closed outside of the space, the requirement of closing capability at control station may not apply.

2. All ventilation fans are to be capable of being stopped from the control station. The operating procedures for the WIG ship 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.

3. Ventilation ducts for areas of fire hazard are not to pass through other spaces, and ducts for ventilation of other spaces are not to pass through areas of major fire hazard. However, for WIG ship of a maximum takeoff weight less than 5,670kg, where heat exchangers are fitted on exhaust gas pipes of a main engine for radiators in passenger compartments and crew compartments or air conditioners using a main engine in similar methods are installed, this provision may not apply provided that ducts passing through other compartments are able to be closed and insulated.

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.

5. Where, of necessity, a ventilation duct passes through a fire-resisting or smoke-tight division, a fail-safe automatic closing fire damper is to 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.

116. Fuel system

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 except a WIG ship of a maximum takeoff weight less than 5,670 kg.

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

3. Every fuel oil pipe which, if damaged, would allow oil to escape from a storage tank is to 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. Closing devices includes non-electromagnetic and non-electrical anti-siphon valves or devices which are able to close leakage of fuel oil.

4. Pipes, valves and couplings conveying flammable fluids are to be of steel or such alternative material satisfactory to **Pt 5, Ch 6, 102.** of the Rules for the Classification of Steel Ships 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 except a flexible pipe which is a parts of approved machinery installation or approved auxiliary machinery.

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 shielded.

6. In every WIG ship in which fuel with a flash point below 43°C is used, the arrangements for the storage, distribution and utilization of the fuel are to be such that, having regard to the hazard of fire and explosion which the use of such fuel may entail, the safety of the WIG ship and of persons on board is preserved. The arrangements should comply, in addition to the provisions of Para **1** to Para **5**, with the following provisions:

(1) Any part of the fuel system is to be located outside the main body of the WIG ship or arranged in such a way that fuel vapour cannot accumulate in enclosed spaces.
(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.
(3) Earthed electrical distribution systems should not be used, with the exception of earthed intrinsically safe circuits.
(4) Only electrical equipment and fittings essential for operational purposes be fitted in all spaces where fuel leakage could occur
(5) A fixed vapour-detection system should be installed in each space through which fuel lines pass, with alarms provided at the operating compartment. However, spaces which oil vapour is discharged immediately from and then fixed vapour-detection system need not to be installed in, such as spaces in which air-cooled engines or air cooled auxiliary machinery, may not applied.
(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 'Caution: Inflammable' signs should be posted. Vessel-to-shore fuel connections are to be of a type that minimizes the chance of ignition of any vapour generated during refueling and are to be suitably grounded during bunkering operations.

117. Hydraulic system

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

118. Exhaust system

The exhaust system is to 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 exhaust 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. ⚓

CHAPTER 9 FIRE EXTINCTION

101. General

Fire fighting system not specified in this chapter is to be in accordance with the Rules for the Classification of Steel Ships. However, satisfaction of equivalent standard such as Federal Aviation Regulation, etc. specified in this chapter may be permitted by the Society.

102. Fire detection system general

1. Fire detection system in a WIG ship is composed of detectors, indication boards, control boards and alarm system and is to remotely identify location and operational status of detectors.

2. 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, are to 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.

3. For spaces where a person in the WIG ship is able to monitor an outbreak of fire, fire detection system may not be installed.

103. General requirements of fire detection system

1. Fire detection system installed according to **102.** are to be in compliance with the following provisions.

(1) 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. The control panel should be located in the operating compartment.

(2) 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.

(3) 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 and subsequent action 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.

(4) Indicating units should denote the section in which a detector or manually operated call point has operated. One unit should be located in the operating compartment.

(5) 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. Detectors should be operated by heat, smoke or other products of combustion, flame, or any combination of these factors. Flame detectors should only be used in addition to smoke or heat detectors.

(6) Fire detection system is to comply with the following provisions:

(A) a loop should not be damaged at more than one point by a fire.

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

(C) arrangements are to be made to enable the initial configuration of the system to be restored in the event of failure in electrical, electronic or informatic systems.

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

2. Fire detection system installed in the WIG ship is to be in compliance with the following provisions:

(1) Manually operated call points should be installed at each exit of all spaces 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.

(3) Positions where patterns of air flow could adversely affect performance and impact or physical damage are 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.
(4) The maximum spacing of detectors should be in accordance with the following table.

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

(5) Electrical wiring which forms part of the fire detection 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.

104. Fire-detection system for machinery space

1. Except where the effectiveness is demonstrated, detection system using only thermal detectors should not be permitted. After installation, the system should be tested under varying conditions of engine operation and ventilation.

2. Nevertheless the requirements of Para **1**, where the machinery space of a WIG ship contains only main propulsion engines and remote monitoring system(e.g., CCTV) are provided to monitor such a machinery space, fire-detection system may not provided for the machinery space.

105. General requirement of fire extinguishers

1. Each WIG ship is to be provided with the necessary number of portable fire extinguishers according to **106.**

2. For a WIG ship of a maximum takeoff weight of 5,670 kg or more, fixed fire extinguishers, which are able to be controlled in control station, are to be installed in fire hazard areas except crew accommodation, service space and passenger compartments. A main machinery space located outside of watertight areas and weathertight compartments of WIG ship is regarded as a fire hazard area.

106. Arrangement of portable fire extinguisher

Portable fire extinguisher provided in WIG ship is to be in compliance with the following provisions:

1. There is to be at least one portable fire extinguisher available in the pilot compartment that is located within easy access of the pilot while seated. However, where the pilot compartment and passenger compartment are not divided, sufficient capacity and number of portable fire extinguisher which are enough to extinguish a fire in pilot compartment and passenger compartment are to be provided.

2. There is to be at least one portable fire extinguisher located conveniently in the passenger compartment of each WIG ship accommodating more than 6 passengers. Total number of portable fire extinguisher does not need to be in excess of number of enclosed spaces but is to be at least two.

3. The type and quality of each extinguishing medium used for portable fire extinguishers should be appropriate to the kinds of fire likely to occur where that medium is to be used. Each extinguisher for use in a personnel compartment should be designed to minimize the hazard of toxic gas concentrations.

107. Fixed gas fire-extinguishing system

1. For gas fire-extinguishing systems for enclosed machinery spaces and cargo spaces in the ship, the quantity of gas should be sufficient to provide two independent discharges and automatic release of fire-extinguishing medium is not to be permitted.

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

(1) The use of a fire-extinguishing medium which will adversely affect the earth's ozone layer and/or gives off toxic gases in such quantities as to endanger persons is not 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 except machinery space for air-cooled engine of natural ventilation system.

(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, an additional quantity of fire-extinguishing medium is to be provided.

(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 is to be arranged in the operating compartment and there should be clear instructions relating to the operation of the system, having regard to the safety of personnel.

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

(9) Containers for the storage of fire-extinguishing medium and associated pressure components should be designed having regard to their locations and maximum ambient temperatures expected in service.

(10) 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. 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.

3. In addition to Para **2**, the followings should be met for carbon dioxide system:

(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:

(A) 40 % of the gross volume of the largest protected machinery space.

(B) 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.

(C) 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 CO2 protects more than one space.

108. Fire control plans

For a WIG ship of a maximum takeoff weight of 5,670 kg or more, fire control plans showing the following locations are to be displayed at each deck. The text of such plans should be in Korean and English.

1. The control stations

2. Compartments of the WIG ship which are enclosed by fire-resisting division with following equipment and system:

(1) Fire detection system including alarm system
(2) The fixed and portable fire-extinguishing appliances
(3) The means of access to the various compartments and decks
(4) Ventilating system including particulars of the master fan controls, the positions of dampers and identification numbers of the ventilating fans serving each section.

3. The location of the international shore connection, if fitted, and the position of all means of control.

109. Lavatory fire protection

For WIG ships with a passenger capacity of 20 or more, each lavatory is to be equipped with a smoke detector system or equivalent that provides a warning light in the control station, or provides a warning light or audible warning in the passenger compartment that would be readily detected by a flight attendant and each lavatory is to be equipped with a fixed fire extinguisher for each disposal receptacle for towels, paper, or waste, located within the lavatory. The extinguisher is to be designed to discharge automatically into each disposal receptacle upon occurrence of a fire in that receptacle.

110. Provision for passenger WIG ship

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

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

3. For the passenger WIG ship, the following number of portable fire extinguishers should be conveniently located and evenly distributed in passenger compartments in addition to portable fire extinguishers provided according to **106.**

Passenger capacity	Number of extinguishers
13 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

4. Fire fighting appliances in compliance with the followings are to be provided:

(1) Fire fighting appliances are to be provided in machinery spaces except sections such as the combustor, turbine and tailpipe, of which flames are able to be controlled.
(2) The fire-extinguishing system for a nacelle should be able to simultaneously protect each compartment of the nacelle for which protection is provided.

5. Fire-extinguishing mediums for fixed fire-extinguishing systems should have thermal stability over the temperature range likely to be experienced in the compartment in which they are stored. If any toxic extinguishing medium is used, provisions should be made to prevent harmful concentrations of fluid or fluid vapors (from leakage during normal operation or as a result of discharging the fire extinguisher) from entering any personnel compartment, even though a defect may exist in the extinguishing system. This must be shown by test except for built-in carbon dioxide fire extinguishing systems following.

(1) 2.26 kg(5 lb) or less of carbon dioxide will be discharged, under established fire control procedures, into any ship compartment, or
(2) Protective breathing equipment is available for each ship crew member.

6. Each extinguishing medium container should have a pressure relief to prevent bursting of the container by excessive internal pressures. The discharge end of each discharge line from a pressure relief connection should be located so that discharge of the fire-extinguishing medium would not damage the WIG ship. The pipe line should also be located or protected to prevent clogging caused by ice or other foreign matter.

7. A means should be provided for each fire-extinguishing medium container to indicate that the container has discharged or that the charging pressure is below the established minimum necessary for proper functioning. The temperature of each container should be maintained, under intended operating conditions, to keep appropriate pressure. If a pyrotechnic capsule is used to discharge the extinguishing medium, each container should be installed so that temperature conditions will not cause hazardous deterioration of the pyrotechnic capsule.

8. No material in any fire-extinguishing system may react chemically with any extinguishing medium so as to create a hazard.

111. Provision for general WIG ship

1. The operating compartment, stowage positions of life-saving appliances, escape routes and places of embarkation into survival craft is to be located adjacent to crew accommodation and service space.

2. Cargo spaces are to comply with the following provisions:

(1) Cargo spaces, except open deck areas or refrigerated holds, should be provided with an approved automatic smoke-detection system complying with 103. 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 **107.** readily operable from the control station.

(2) For cargo spaces, the quantity of carbon dioxide available is to 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 10 EVACUATION INSTALLATIONS

101. General

1. Means concerned accommodation area and escape is to be in accordance with this chapter. The requirements, not specified in this chapter, are to be in accordance with Rules for the Classification of Steel Ships. However, the Society may accept, provided that the it is satisfied with other regulations such as the Federal Aviation Regulation, etc. equivalent to those required in this chapter.

2. Equipment in the cabin, the public room and the crew accommodation area is designed to avoid injury of person on board during normal and emergent start, stop and operation. The windows installed in the passenger accommodation and working area are to be made of material which is not dangerous piece in case of breakage.

102. Access doors

1. External access doors should not be located with respect to any propeller blade or any other potential hazard so as to endanger persons using the door.

2. Each external access doors for the passengers or crew should comply with the following requirements:

(1) There should be means to lock and safeguard the door against inadvertent opening during operating by persons, by cargo, or as a result of mechanical failure.
(2) The door should be openable from the inside and the outside when the internal locking mechanism is in the locked position.
(3) There should be a means of opening which is simple and obvious and is arranged and marked inside and outside so that the door can be readily located, unlocked, and opened, even in darkness. Marking should be indicated for the external help.
(4) Access doors should meet the marking requirements of **106.**
(5) The door should be reasonably free from jamming as a result of hull deformation in an emergency landing.
(6) Auxiliary locking devices that are actuated externally to the WIG craft may be used but such devices should be overridden by the normal internal opening means.
(7) Each access door should be openable from both the inside and outside, even though persons may be crowded against the door on the inside of the WIG craft.
(8) If inward opening doors are used, there should be a means to prevent occupants from crowding against the door to the extent that would interfere with opening the door.
(9) There should be a provision for direct visual inspection of the locking mechanism to determine if the external door, for which the initial opening movement is not inward, is fully closed and locked.
(10) There should be a visual warning means to signal a crew member if the external door is not fully closed and locked.

3. External access doors for WIG craft are to be complying with following requirements and the static loads:

(1) Each passenger entry door should qualify as a floor level emergency exit. This exit should have a rectangular opening of not less than 61 cm(24 inch) wide by 122 cm(48 inch) high, with corner radii not greater than one-third the width of the exit.
(2) Where passenger boarding doors are equipped with integral stairs, those stairs are to be designed to not reduce emergency escape efficiency through passenger boarding door after inertia load corresponding following static ultimate load coefficient are occurred.
(A) 4.5 g above
(B) 9.0 g forward
(C) 1.5 g side
(D) 6.0 g below.
However, in case that the effect of collision design acceleration which is calculated in accordance with **105.** is verified, above value could be replaced by collision design acceleration.

4. Where bathroom doors are installed, it is designed that person is not locked up in bathroom. In case that a locking device is installed, it could be opened outside of bathroom.

103. Access doors and escape equipment

1. All passengers could be embarked safely to the life boat in case of emergency in the WIG craft and this requirement is to be verified that all access doors, location of life saving appliance, action possibility of escape procedure and escape time could be used readily in an emergency.

2. Public spaces, escape ways, access doors, life jacket store rooms, life boast embarkation location are to be marked clearly and permanently and lighting devices for those places to be installed.

3. Not less than two emergency doors are to be installed far from each other in the closed public spaces and areas which is permanently closed and passengers and crew could stay.

4. Public spaces which is used for shelter area in fire are not to be adjacently arranged to fire risk area.

5. Locking devices for exit doors are to be assured whether doors are closed or normally operated through the crew's direct check or indicators. External doors are to be designed not to adhere by attachment of ice or floaters.

6. Spaces for crews are to be enough in way of exit doors to escape passengers safely and promptly.

7. Steps and ladder, etc. through access doors in WIG craft are to be of strong structures and fixed permanently. Hand grips are to be installed to use suitably in WIG craft's longitudinal and transversal inclined cases for person using exit doors.

8. All of people could use not less than two escape ways without obstacles. Escape ways and equipment are to be arranged to use in case of damage and emergency, etc. Lighting equipment in the escape ways is to be supplied by main or emergency source of electrical power.

9. Width and height for access ways, doors and stairs consisting of escape ways are to be enough size for person wearing life jacket. There is no protrusion which causes injury to people or life jackets, looks clothing and limit an escape for the handicapped in the escape ways.

10. Meanings which guides passengers to the exit are to be provided.

11. Hand grips and non slip measures are to be provided in order that passengers could board life boat in the embarkation location where cleat and bollard, etc. are not installed.

104. Emergency escape

1. Emergency escape equipment for WIG craft is to be installed to satisfy emergency escape test procedure of **Appendix 2** in the condition of the maximum number of boarding person. Emergency escape is to be completed until time specified in **101. 1** provided that the watertight integrity in WIG craft's upper deck below is keeping.

2. Emergency lighting complying with the requirement **108.** is to be used only during escape test specified in the requirement of para. **1**.

105. Emergency exits for pilots

Emergency escape door is to be located in the pilot room and the following requirements are to be satisfied in the event of WIG craft which pilots could not easily approach the emergency access doors for passenger or has more than twenty passengers.

1. There should be either one emergency exit on each side of the WIG craft, or a top hatch emergency exit in the pilot area.

2. Each emergency exit should have a size and shape of at least 48~50 cm(19~20 inch) unobstructured rectangular opening.

106. Emergency exits

1. Emergency exits should be located to allow escape without crowding in any probable crash. The WIG craft should have at least the following emergency exits:

(1) For all WIG crafts with seating capacity of two or more, excluding WIG crafts with canopies, at least one emergency exit on the opposite side of the cabin from the main door specified in **102.**

(2) If the pilot compartment is separated from the cabin by a door that is likely to block the pilot's escape in a minor crash, there should be an exit in the pilot's compartment.
(3) Emergency exits should not be located with respect to any propeller disk or any other potential hazard so as to endanger persons using that exit.

2. Emergency exits should be movable windows, panels, canopies, or external doors, openable from both inside and outside the airplane, that provide a clear and unobstructed opening large enough to admit a 48 cm × 66 cm(19 inch × 26 inch) ellipse. Auxiliary locking devices used to secure the airplane should be designed to be overridden by the normal internal opening means. The inside handles of emergency exits that open outward should be adequately protected against inadvertent operation. In addition, each emergency exit should ;

(1) be readily accessible, requiring no exceptional agility to be used in emergencies;
(2) have a method of opening that is simple and obvious;
(3) be arranged and marked for easy location and operation, even in darkness;
(4) have reasonable provisions against jamming by hull deformation;

3. The proper functioning of each emergency exit should be shown by tests.

4. For the WIG craft for passengers, the emergency exit complying with the following requirements to be installed.

(1) The types for emergency exits should be complying with 25.807 (a) in the Airplane Technical Standard of Korea Government, or equivalent.
(2) Exits consisting of one pair do not need to be totally symmetry or same size, however, the number of chairs for passenger specified in (5) are to be in accordance with the smaller one.
(3) Emergency exits are to be uniformally arranged by considering the distribution of passenger's chairs.
(4) The locations of the emergency exits to be complying with following requirements.
(A) If only one floor-level exit per side is prescribed, and the WIG craft does not have a tailcone or ventral emergency exit, the floor-level exits should be in the rearward part of the passenger compartment unless another location affords a more effective means of passenger evacuation.
(B) If more than one floor-level exit per side is prescribed, and the WIG crafts does not have a combination cargo and passenger configuration, at least one floor-level exit should be located in each side near each end of the cabin.
(C) For a WIG craft that is required to have more one passenger emergency exit for each side of the hull, no passenger emergency exit shall be more than 18 m(60 ft) from any adjacent passenger emergency exit on the same side of the same deck of the hull, as measured parallel to the WIG craft's longitudinal axis between the nearest exit edges.
(5) Maximum allowable number of the passenger's chair to be complying with 25.807 (g) in the Airplane Technical Standard of Korea Government, or equivalent. And, WIG crafts with only one aisle for passengers could not exceed three on one row of both sides of aisle.
(6) The following exits to be complying with the requirements of this chapter and to be easily accessed:
(A) Additionally installed emergency exits in the cabin other than minimum requirements
(B) Tailcone exit for passengers.
(7) If the requirements of the emergency exit specified in (5) are not satisfied, the emergency exit which is complying with 25.807 in the Air Technical Standard of Korea Government, or equivalent should be additionally installed.

5. Emergency exits which are installed in accordance with **4** in the WIG crafts for passengers should comply with following requirements:

(1) Each emergency exit, including a crew emergency exit, should be a movable door or hatch in the external walls of the hull, allowing unobstructed opening to the outside. Additionally, the means which make it see outside in case that the emergency exits are closed should be installed in the each emergency exit. In this case, if there is no obstacle between the emergency exit and the means for the external view, the means for seeing outside are located in the emergency exits or the means for external view nearby. The means for external views could flash the expected area which the evacuating passengers reach when all lights are shut down.
(2) Each emergency exit should be openable from the inside and the outside except that sliding window emergency exits in the crew area need not be openable from the outside of other approved exits are convenient and readily accessible to the crew area. Each emergency exit should be capable of being opened, when there is no hull deformation, under the following conditions:

(A) Within 10 seconds measured from the time when the opening means is actuated to the time when the exit is fully opened.
(B) The case that passengers are crowded to the direction of the emergency exit in the WIG craft.

(3) If a single power-operated system is the primary system for operating more than one exit in an emergency, each exit should be capable of meeting the requirements of (2) in the event of failure of the primary system. Manual operation of the exit (after failure of the primary system) is acceptable.
(4) Each emergency exit should be shown by tests or by a combination of analysis and tests, to meet the requirements of (2) and (3).
(5) When required by the operating rules for any large passenger-carrying turbojet-powered WIG craft, tailcone exit should comply with the following:
(A) Designed and constructed so that it cannot be opened during flight ; and
(B) Marked with a placard readable from a distance of 76.2 cm and installed at a conspicuous location near the means of opening the exit, stating that the exit has been designed and constructed so that it cannot be opened during flight.
(6) The emergency exits should have the means keeping the emergency exit opened in case of open state in the emergency. Where the emergency exit is open state, the special control should not be required to keep the open state and it is possible to close the exit by the active control.

6. Applying the requirements of **1** to **5**, the main exit which passengers use could be regarded as the emergency exit.

107. Emergency exit marking

1. Each emergency exit and external door in the passenger compartment should be externally marked and readily identifiable from outside the WIG craft by the followings:

(1) A permanent decal or placard should be provided on or adjacent to the emergency exit which shows the means of opening the emergency exit, including any special instructions.
(2) The contour of escape door is to be indicated by colorful line with width of 5 cm.
(3) The light and darkness distinguishing hull external surface clearly is/are to be provided. In case that the reflection rate of darkness is below 15 %, the reflection rate of lightness to be above 45% to contrast darkness. The "reflection rate" means the rate of reflection for the quantity of lightness objective gets. In case that the reflection rate of darkness is above 15 %, the difference between those reflection rate and lightness reflection rate is to be not less than 30 %.
(4) The escape doors located in the hull side such as the tail part should have the method for external open which should be marked by the red. However, in case that the red is not visible due to the hull color, chrome yellow may be used. In case that opening means for escape door is provided on the one side of hull, those content is to be indicated on the other side.

2. In addition, the exits and doors should be internally marked with the word "exit" by a sign which has white letters 2.5 cm high on a red background 5 cm high, be self-illuminated or independently, internally-electrically illuminated, and have a minimum brightness of at least 160 microlamberts. The color may be reversed if the passenger compartment illumination is essentially the same. The location of the emergency exit for passengers should be indicated by the marking which crew and passengers could see it when they are accessed through the cabin aisles and the following requirements should be marked.

(1) Each emergency exit should be conspicuously marked on the higher place, where the above space of emergency exit is narrow. However, if the emergency exits could be easily found by one of marking, only one marking could be indicated for the two or more than two exits.
(2) The marking for the emergency exit for passengers should be indicated beside each emergency exit for passengers. However, if the emergency exits could be easily found by one of marking, only one marking could be indicated for the two or more than two exits.
(3) The emergency exit blocked by a bulkhead or partition should be indicated by one marking above the bulkhead or partition. However, if it is impossible to mark on this place, it could be marked on other place.
(4) The term of "Exit" could be used instead of "Emergency Exit".

3. For the location of the emergency exit, the following requirements are to be satisfied:

(1) The identity and location of each emergency exit should be recognizable from a distance equal to the width of the cabin.

(2) Means should be provided to assist occupants in locating the emergency exits in conditions of dense smoke.
(3) The location of the operating handle and instructions for opening each emergency exit from inside the WIG crafts should be shown by marking that is readable from a distance of 76 cm. Each passenger entry door operating a handle to be complying with followings:
   (A) Be self-illuminated with an initial brightness of at least 160 microlamberts; or
   (B) Be conspicuously located and well illuminated by the emergency lighting even in conditions of occupant crowding at the door.
(4) Each passenger entry door with a locking mechanism that is released by rotary motion of the handle should be marked:
   (A) With red arrow, with a shaft of at least 1.9 cm wide of the shafts, extending along at least 70 degrees of arc at a radius approximately equal to three-fourths of the handle length.
   (B) So that the center line of the exit handle is within : 2.5 cm of the projected point of the arrow when the handle has reached full travel and has released the locking mechanism, and
   (C) With the word "open" in red letters, 2.5 cm high, placed horizontally near the head of the arrow.

108. Emergency lighting

1. For passengers, emergency lighting is to comply with the following requirements:
(1) An emergency lighting system, independent of the main cabin lighting system, should be installed. However, the source of general cabin illumination may be common to both emergency and main lighting system if the power supply to the emergency lighting system is independent of the power supply to the main lighting system.
(2) The emergency lights should be operable manually from the flightcrew station and be provided with automatic activation. The cockpit control device should have "on," "off," and "armed" positions so that, when armed in the cockpit, the lights will operate by automatic activation.
(3) When armed, the emergency lighting system, should activate and remain lighted when:
   (A) The normal electrical power of the WIG craft is lost; or
   (B) The WIG craft is subject to an impact that results in a deceleration in excess of 2 g and a velocity change in excess of 1 m per-second, acting along the longitudinal axis of the airplane; or
   (C) Any other emergency condition exists where automatic activation of the emergency.
(4) The emergency lighting system should provide internal lighting, including:
   (A) Illuminated emergency exit marking and locating signs including those required in **107. 2**;
   (B) Sources of general illumination in the cabin that provide an average illumination of not less than 0.54 lux and an illumination at any point of not less than 0.11 lux when measured along the center line of the main passenger aisle(s) and at the seat armrest height; and
   (C) Floor proximity emergency escape path marking that provides emergency evacuation guidance for the airplane occupants when all sources of illuminations more than 1.2 m above the cabin aisle floor are totally obscured.
   The lighting should be installed on the passway floor between the main passway and exit in order to luminous intensity of the lighting should be exceed 0.21 lux when it is measured within 15 cm high through center line of passenger exit way parallel to the floor.
   (D) When the passway indication lighting for the emergency exit located in nearby floor is shut down, the passway for the emergency exit should be confirmed by checking the indication and visual characteristic on 1.2 m high from cabin's floor.
(5) The energy supply to each emergency lighting unit should provide the required level of illumination for at least 10 minutes at the critical ambient conditions after activation of the emergency lighting system.
(6) If rechargeable batteries are as the energy supply for the emergency lighting system, they may be recharged from the main electrical power system of the WIG crafts provided the charging circuit is designed to preclude inadvertent battery discharge into the charging circuit faults. If the emergency lighting system does not include a charging circuit, battery condition monitors are required.
(7) Components of the emergency lighting system, including batteries, wiring, relays, lamps, and switches, should be capable of normal operation after being subjected to the inertia forces resulting from the ultimate load factors prescribed in **102. 3** (2).
(8) The emergency lighting system should be designed so that after any single transverse vertical separation of the hull during a crash landing:

(A) At least 75 percent of all electrically illuminated emergency lights required by **108.** is to remain operative; and
(B) Each electrically illuminated exit sign required by **107. 2** and **3** is to remain operative, except those that are directly damaged by the hull separation.

2. The lighting for the emergency exit is to comply with following requirements.

(1) Each required by **107. 2** and **3** should have red letters at least 3.8 cm high on an illuminated white background, and an area of at least 135 cm^2 excluding the letters. The lighted background-to-letter contract should be at least 10:1. The letter height to stroke-width ratio may be more than 7:1 or less than 6:1. These signs should be internally electrically illuminated with a background brightness of at least 85.65 cd/m^2 and a high-to-low background contrast greater than 3:1.
(2) Each passenger emergency exit sign required by **107. 1** should have red letters at least 3.8 cm(1.5 inch) high on a white background having an area of at least 135 cm^2 excluding the letters. These signs should be internally electrically illuminated or self-illuminated by other than electrical means and should have an initial brightness of at least 1.27 cd/m^2. The colors may be reversed in the case of a sign that is self-illuminated by other than electrical means.
(3) For WIG crafts that have a passenger seating configuration, of nine seats or less excluding pilot seats, that are required by **107. 1** through. **3** should have red letters at least 2.5 cm(1 inch) high on a white background at least 5 cm high. These signs may be internally electrically illuminated, or self-illuminated by other than electrical means, with an initial brightness of at least 0.509 cd/m^2. The colors may be reversed in the case of a sign that is self-illuminated by other than electrical means.
(4) The emergency lighting on the main wing is to comply with the following:
(A) Not less than 0.32 lux (measured normal to the direction of the incident light) on a 0.18 m^2 area where an evacuee is likely to make his/her first step outside the cabin.
(B) Not less than 0.32 lux on the ground surface with the landing gear extended (measured normal to the direction of the incident light) where an evacuee using the established escape route would normally make first contact with the ground.

3. The WIG crafts with maximum landing weight of not more than 5,670 kg which complys with requirement of **110.** for the emergency lighting functions could be exempted.

109. Accessibility for the emergency exit

1. For the WIG craft for passengers, access to window-type emergency exits may not be obstructed by seats or seat backs.

2. In addition to Para **1**, the following requirements are to be satisfied to access the emergency exit.

(1) The passageway leading from the aisle to the passenger entry door should be unobstructed and at least 50 cm wide.
(2) There should be enough space next to the passenger entry door to allow assistance in evacuation of passengers without reducing the unobstructed width of the passageway below 50 cm.
(3) If it is necessary to pass through a passageway between passenger compartments to reach required emergency exit from any seat in the passenger cabin, the passageway should be unobstructed; however, curtains may be used if they allow free entry through the passageway.
(4) No door may be installed in any partition between passageway compartments unless that door has a means to latch it in the open position. The latching means should be able to withstand the loads imposed upon it by the door when the door is subjected to the inertia loads resulting from the ultimate static load factors prescribed in **110. 3** (2).
(5) If it is necessary to pass through a door-way separating the passenger cabin from other areas to reach a required emergency exit from any passenger seat, the door should have a means to latch it in the open position. The latching means should be able to withstand the loads imposed upon it by the door when the door is subject to the inertia loads resulting from the ultimate static load factors prescribed in **102. 3** (2).
(6) If it is possible to evacuate within the evacuation time specified in **110.**, the aisle between passengers' chairs may be less than 50 cm.

3. Accessibility in accordance with the types of the emergency exit to comply with 25.813 (a) and (c) in the Airplane Technical Standard of Korea Government.

4. The following space is required necessary in order that crew help passengers evacuation.

(1) The space helping passengers should be square space enough to help people evacuating with standing on the passenger room floor. The aisle's width without the obstruction that is required in evacuation exit should not be decreased due to the space helping passenger.
(2) More than one hand-grip is to be installed in the each auxiliary space in order that crew are not fall down.

110. Evacuation time

1. 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 the following formula. In this case "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.

$$(T-7)/3 \qquad \text{(minutes)}$$

2. An evacuation procedure, including a critical path analysis, should include the followings:
(1) the emergency announcement made by the master
(2) contact with the base port
(3) the donning of life-jackets
(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
(13) releasing the survival craft from the craft

3. Achievement of the required evacuation time (as ascertained in accordance with **1**) should be verified by a practical demonstration in accordance with emergency evacuation test procedure of [**Annex 3**].

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

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.

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

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.

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.

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

10. Demonstration should be carried out for all new designed WIG craft where evacuation arrangements differ substantially from those previously tested.

111. Noise levels

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 not exceed in general 75 dB(A).

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

3. Notwithstanding the requirements in **1** and **2**, in case that the communication with each other and external one in condition of wearing headset is possible in the operating compartment, the maximum noise should not exceed in general 90 dB(A). ⚓

CHAPTER 11 SPECIAL INSTALLATIONS

101. Alarm System

1. Alarm system 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.

(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:
(A) activation of a fire-detection system;
(B) total loss of normal electrical supply;
(C) overspeed of main engines;
(D) thermal runaway of any permanently installed nickel-cadmium battery
(E) wing stall; and
(F) linear or angular accelerations exceeding 90% of the design limitations of the craft for more than one second.

(2) The alarm required by (1) (E) should operate with sufficient safety margin to prevent inadvertent stalling and should be clear and distinctive to the pilot in straight and turning flight. The stall warning may be recognized either through the inherent aerodynamic qualities of the craft or by a alarm device and should 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.

(3) Additional alarms and warning signals should be fitted in the operating compartment. These may include:
(A) exceeding the limiting value of any craft, machinery or system parameter other than engine overspeed
(B) failure of normal power supply to any powered control devices
(C) activation of any bilge alarm
(D) operation of any automatic bilge pump
(E) failure of compass system
(F) low level of a fuel tank contents
(G) fuel oil tank overflow
(H) extinction of any navigation light
(I) low level of contents of any fluid reservoir the contents of which are essential for normal craft operation
(J) failure of any connected electrical power source
(K) failure of any ventilation fan installed for ventilating spaces in which inflammable vapours may accumulate, and
(L) fuel line failure

(4) All warnings required by (1), (2) and (3) should be provided at all stations at which control functions may be exercised.

2. The alarm system should meet appropriate constructional and operational provisions for required alarms.

3. Monitoring equipment for the passenger, cargo and machinery spaces for fire and flooding should, as far as 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. However, individual operating center may be accepted instead of this sub-centre for small WIG ships.

102. Aerodynamic Stabilization System

1. Definitions

Where conflict exists between the aerodynamic meaning of terms used in this chapter and elsewhere in this Guideline, the aerodynamic meaning is intended to be followed.

(1) "Stabilization system" is a system intended to stabilize the main parameters of the craft's altitude: 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.
(2) The main elements of a stabilization system may include the following:
 (A) devices such as rudders, foils, flaps, skirts, fans, tilting and steerable propellers, pumps for moving fluids.
 (B) power drives actuating stabilization devices, and
 (C) stabilization equipment for accumulating and processing data for making decisions and giving commands such as sensors, logic processors and automatic safety control.
(3) "Stabilization device" means a device as enumerated in (2) (A) with the aid of which forces for controlling the craft's altitude are generated
(4) "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.
(5) "Automatic control system" is a system which enables the craft's heading and altitude to be maintained without operator input.

2. General requirements

(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.
(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.
(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.
(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.
(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.

3. Longitudinal and height control system

(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 **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.
(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. ⚓

ANNEX 1 FIRE PROTECTION TEST PROCEDURE

Acceptable test procedure for self-extinguishing materials for compliance with Ch 8, 104. and 105.

1. Conditioning

Specimens should be conditioned to 21±15℃(70±5˚F), and at 50±5 % relative humidity until moisture equilibrium is reached or for 24 hours. Only one specimen at a time may be removed from the conditioning environment immediately before subjecting it to the flame.

2. Specimen configuration

Except as provided for materials used in electrical wire and cable insulation and in small parts, materials should be tested either as a section cut from a fabricated part as installed in the WIG craft or as a specimen simulating a cut section, such as a specimen cut from a flat sheet of the material or a model of the fabricated part. The specimen may be cut from any location in a fabricated part; however, fabricated units, such as sandwich panels, may not be separated for a test.

The specimen thickness should be no thicker than the minimum thickness to be qualified for use in the WIG craft, except that :

(1) Thick foam parts, such as seat cushions, should be tested in 1.3 cm;
(2) When compliance with **Ch 8, 104. 3** (4) for materials used in small parts that should be tested, the materials should be tested in no more than 0.32 cm;
   (A) In the vertical tests of para. **4**, the two long edges and the upper edge are to be held securely;
   (B) In the horizontal test of para. **5**, the two long edges and the edge away from the flame are to be held securely;
   (C) The exposed area of the specimen is to be at least 5.08 cm wide and 30.48 cm long, unless the actual size used in the WIG craft is smaller; and
   (D) The edge to which the burner flame is applied should not consist of the finished or protected edge of the specimen but should be representative of the actual cross section of the material or part installed in the WIG craft. When performing the test prescribed in para. **6** of this Annex, the specimen should be mounted in metal frame so that all four edges are held securely and the exposed area of the specimen is at least 20.3 cm × 20.3 cm.

3. Apparatus

Except as provided in para. **7**, tests should be conducted in accordance with the Federal Test Method Standard 1971 Method 5903 (revised Method 5902), or with some other approved equivalent method. Specimens which are too large for the cabinet should be tested in similar draft-free conditions.

4. Vertical test

A minimum of three specimens should be tested and the results averaged. For fabrics, the direction of weave corresponding to the most critical flammability conditions should be parallel to the longest dimension. Each specimen should be supported vertically. The specimen should be exposed to a Bunsen or Tirrill burner with a nominal 0.95 cm tube adjusted to give a flame of 3.8 cm in height. The minimum flame temperature measured by a calibrated thermo-couple pyrometer in the center of the flame should be 843℃(1550˚F). The lower edge of the specimen should be 1.9 cm above the top edge of the burner. The flame should be applied to the center line of the lower edge of the specimen. For materials covered by **Ch 8, 104. 3** (1) and **5**, the flame should be applied for 60 seconds and then removed. For materials covered by **Ch 8, 104. 3** (2), the flame should be applied for 12 seconds and then removed. Flame time, burn length, and flaming time of drippings, if any, should be recorded. The burn length determined in accordance with para **8** should be measured to the nearest 2.5 mm.

5. Horizontal test

A minimum of three specimens should be tested and the results averaged. Each specimen should be supported horizontally. The exposed surface when installed in the WIG craft should be face down for the test. The specimen should be exposed to a Bunsen burner or Tirrill burner with a nominal 9.5 mm tube adjusted to give a flame of 3.8 cm in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame should be 843℃(1550°F). The specimen should be positioned so that the edge being tested is 1.9 cm above the top of, and on the center line of, the burner. The flame should be applied for 15 seconds and then removed. A minimum of 25.4 cm of the specimen should be used for timing purposes, approximately 3.8 cm should burn before the burning front reaches the timing zone, and the average burn rate should be recorded.

6. Forty-five degree test

A minimum of three specimens should be tested and the results averaged. The specimens should be supported at an angle of 45 degrees to a horizontal surface. The exposed surface when installed in the aircraft should be face down for the test. The specimens should be exposed to a Bunsen or Tirrill burner with a nominal 9.5 mm tube adjusted to give a flame of 3.8 cm in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame should be 843℃(1550°F). Suitable precautions should be taken to avoid drafts. The flame should be applied for 30 seconds with one-third contacting the material at the center of the specimen and then removed. Flame time, glow time, and whether the flame penetrates (passes through) the specimen should be recorded.

7. Sixty-degree test

A minimum of three specimens of each wire specification (make and size) should be tested. The specimen of wire or cable (including insulation) should be placed at an angle of 60 degrees with the horizontal in the cabinet specified in para. **7**, with the cabinet door open during the test or placed within a chamber approximately 61 cm high × 30.5 × 30.5 cm, open at the top and at one vertical side (front), that allows sufficient flow of air for complete combustion but is free from drafts. The specimen should be parallel to and approximately 15.2 cm from the front of the chamber. The lower end of the specimen should be held rigidly clamped. The upper end of the specimen should pass over a pulley or rod and should have an appropriate weight attached to it so that the specimen is held tautly throughout the flammability test. The test specimen span between lower clamp and upper pulley or rod should be 61 cm and should be marked 20.4 cm from the lower end to indicate the central point for flame application. A flame from a Bunsen or Tirrill burner should be applied for 30 seconds at the test mark. The burner should be mounted underneath the test mark on the specimen, perpendicular to the specimen and at an angle of 30 degrees to the vertical plane of the specimen. The burner should have a nominal bore of 9.5 mm, and should be adjusted to provide a 7.6 cm high flame with an inner cone approximately one-third of the flame height. The minimum temperature of the hottest portion of the flame, as measured with a calibrated thermocouple pyrometer, may not be less than 954℃(1750°F). The burner should be positioned so that the hottest portion of the flame is applied to the test mark on the wire. Flame time, burn length, and flaming time of drippings, if any, should be recorded. The burn length determined in accordance with para. **8** of this appendix should be measured to the nearest 2.5 mm. Breaking of the wire specimen is not considered a failure.

8. Burn length

Burn length is the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring, or enbrittlement, but not including areas sooted, stained, warped, or discolored, nor areas where material has shrunk or melted away from the heat source. ⚓

ANNEX 2 EMERGENCY EVACUATION TEST PROCEDURE

The following test criteria and procedures should be used for compliance with Ch 10, 104. 1:

1. The emergency evacuation should be conducted with exterior ambient light levels of no greater than prior to the activation of the airplane emergency lighting system. The source(s) of the initial exterior ambient light level may remain active or illuminated during the actual demonstration. There should, however, be no increase in the exterior ambient light level except for that due to activation of the WIG ship emergency lighting system.

2. The WIG ship should be in a normal attitude with floating on the surface.

3. Unless the WIG ship is equipped with an off-wing descent means, Marine Evacuation System(MES) may be used for descent from the wing to the surface. Safety equipment such as inverted life rafts may be placed on the surface to protect participants. No other equipment that is not part of the emergency evacuation equipment of the WIG ship may be used to aid the participants in reaching the surface.

4. Except as provided in paragraph **1** of this annex, only the WIG ship's emergency lighting system may provide illumination.

5. All emergency equipment required for the planned operation of the WIG ship should be installed.

6. Each internal door or curtain should be in the takeoff configuration.

7. Each crew member should be seated in the normally assigned seat for takeoff and should remain in the seat until receiving the signal for commencement of the demonstration. Each crew member should be a person having knowledge of the operation of exits, emergency equipment, etc.

8. A representative passenger load of persons in normal health should be used as follows:

(1) At least 40 percent of the passenger load should be female.
(2) At least 35 percent of the passenger load should be over 50 years of age.
(3) At least 15 percent of the passenger load should be female and over 50 years of age.
(4) Three life-size dolls, not included as part of the total passenger load, should be carried by passengers to simulate live infants 2 years old or younger.
(5) Crew members, mechanics, and training personnel, who maintain or operate the WIG ship in the normal course of their duties, may not be used as passengers.

9. No passenger may be assigned a specific seat. No employee of the applicant may be seated next to an emergency exit.

10. Seat belts and shoulder harnesses (as required) should be fastened.

11. Before the start of the demonstration, approximately one-half of the total average amount of carry-on baggage, blankets, pillows, and other similar articles should be distributed at several locations in aisles and emergency exit access ways to create minor obstructions.

12. No prior indication may be given to any crew member or passenger of the particular exits to be used in the demonstration.

13. The applicant may not practice, rehearse, or describe the demonstration for the participants nor may any participant have taken part in this type of demonstration within the preceding 6 months.

14. Prior to entering the demonstration WIG ship, the passengers may also be advised to follow directions of crew members but may not be instructed on the procedures to be followed in the demonstration, except with respect to safety procedures in place for the demonstration or which have to do with the demonstration site. Prior to the start of the demonstration, the pre-takeoff passenger briefing may be given. Flight attendants may assign demonstration subjects to assist persons from the bottom of a Marine Evacuation System, consistent with their approved training program.

15. The WIG ship should be configured to prevent disclosure of the active emergency exits to demonstration participants onboard until the start of the demonstration.

16. Exits used in the demonstration should consist of one exit from each exit pair. The demonstration may be conducted with the Marine Evacuation System(MES), if provided, inflated and the exits open at the beginning of the demonstration. In this case, all exits should be configured such that the active exits are not disclosed to the occupants. If this method is used, the exit preparation time for each exit utilized should be accounted for, and exits that are not to be used in the demonstration should not be indicated before the demonstration has started. The exits to be used should be representative of all of the emergency exits on the WIG ship. At least one floor level exit should be used.

17. Except as provided in paragraph **3** of this section, all evacuees should leave the WIG ship by a means provided as part of the onboard equipment.

18. The applicant's approved procedures should be fully utilized, except the crew members should take no active role in assisting others inside the cabin during the demonstration.

19. The evacuation time period is completed when the last occupant has evacuated the WIG ship and is on the surface. Provided that the acceptance rate of the Marine Evacuation System(MES) is no greater than the acceptance rate of the means available on the WIG ship for descent from the wing during an actual crash situation, evacuees using Marine Evacuation System(MES) allowed by paragraph **3** of this annex are considered to be on the surface when they are on the Marine Evacuation System(MES). ⚓

GUIDANCE FOR WIG SHIPS
(WING-IN-GROUND EFFECT SHIPS)

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