Chapter 4

ACCOMMODATION AND ESCAPE MEASURES*

** The UK has presented a number of papers to IMO regarding acceleration levels and seat design. Proposals have also been made by other administrations. Whatever proposals are finally adopted significant changes are envisaged to the content of this Chapter.*

Because of the foregoing, submissions should be referred to HQ at the earliest opportunity if problems are encountered in the application of existing Code requirements, with special reference being made to cases where accommodation/escape arrangements fail to satisfy the United Kingdoms proposed revisions.

In respect of domestic craft these should also comply wherever possible with the requirements of the existing code. However consideration will be given to equivalent requirements where necessary and referral should again be made at the earliest opportunity.

4.1 General

4.1.1 Passenger and crew accommodation should be designed and arranged so as to protect the occupants from unfavourable environmental conditions and to minimise the risk of injury to occupants during normal and emergency conditions.

4.1.2 Spaces accessible to passengers should not contain controls, electrical equipment, high temperature parts and pipelines, rotating assemblies or other items, from which injury to passengers could result, unless such items are adequately shielded, isolated, or otherwise protected.

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

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

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

4.2 Public address and information system

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

4.2.2 There should be a public address system covering all areas where passengers and crew have access, escape routes, and places of embarkation into survival craft. The system should be such that flooding or fire in any compartment does not render other parts of the system inoperable.

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

4.2.4 The master should, by means of 4.2.3, be able to request passengers "please be seated" when he finds this appropriate to safeguard passengers and always when the safety level 2 according to table 1 of annex 3, is exceeded.

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

4.3 Design acceleration levels

4.3.1 For passenger craft, superimposed vertical accelerations above 1.0 g at longitudinal centre of gravity should be avoided unless special precautions are taken with respect to passenger safety.

4.3.2 Passenger craft should be designed for the collision load with respect to the safety in, and escape from, the public spaces, crew accommodation and escape routes, including in way of life-saving appliances and emergency source of power. The size and type of craft together with speed, displacement and building material should be taken into consideration when the collision load is determined. The collision design condition should be based on head-on collision at operational speed with a vertical rock with maximum 2 m height above the waterline.

4.3.3 Taking into consideration the provisions of 4.3.2, the collision load should be determined by: $g_{coll}=1.2\left(\frac{P}{g.\Delta}\right)$ where the load P should be taken as the lesser of: $P = 460\,(M.c_L)^{\frac{2}{3}}\,(E.c_H)^{\frac{1}{3}}$, and $P = 9000.M.c_L\,(c_H\,(T + 2))^{\frac{1}{2}}$

where the hull material factor M should be taken as:

M = 1.3 for high tensile steel
M = 1.00 for aluminium alloy
M = 0.95 for mild steel
M = 0.8 for fibre reinforced plastics

where the length factor c_L of the craft is:

$$c_L = \frac{(165 + L)}{245}\left(\frac{L}{80}\right)^{0.4}$$

where the height factor c_H of the craft is:

Factor c_H	Catamaran/surface effect ship	Monohull/hydrofoil	Air-cushionvehicle
c_H	$\frac{T+2+f(D/2)}{2D}$	$\frac{T+2+f(D/2)}{2D}$	$\frac{f}{4}$
where: f=0 for	T + 2 < D -HT	T + 2 < D	-
where: f=1 for	D > T + 2 >D - HT	T + 2 >=D	HT > 2
where: f=2 for	T + 2 >= D	-	HT =< 2

where the kinetic energy of the craft at speed V is: $E = \frac{1}{2}\ \Delta.V^2$ (kN.m)

where the main particulars of the craft are:

L = craft length as defined in chapter 1 (m)
D = craft depth from the underside of keel amidships to the top of the effective hull girder (m)
T = buoyancy tank clearance to skirt tip (m, (negative)) for air-cushion vehicles; lifted clearance from keel to water surface (m, (negative)) for hydrofoils, and craft draught to the underside of keel amidships for all other craft (m)
HT= minimum height from tunnel or wet-deck bottom to the top of the effective hull girder on catamarans and surface effect ships and D for air-cushion vehicle (m)
Δ = craft displacement, being the mean of the lightweight and maximum operational weight (t)
v = operational speed of craft (m/s)
g = gravitational acceleration = 9.806 m/s^2

For hydrofoils, if the result is greater than the deceleration, g_{coll} should be taken as:

$$g_{coll} = \left(\frac{F}{g.\Delta}\right)$$

where:

F = failure load of bow foil assembly applied at the operational waterline (kN)

4.3.4 As an alternative to the requirements of 4.3.3, collision deceleration may be determined by carrying out collision load analysis of the craft in accordance with the assumptions of 4.3.2. If the collision accelerations are determined by both use of the formula referred to in 4.3.3 and the collision load analysis, the lower resulting value may be used as the collision deceleration.

4.3.5 Compliance with the provisions of 4.1.5 and 4.3.1 should be shown for the actual type of craft, as described in annex 8.

4.3.6 Limiting sea states for operation of the craft should be given in normal operation condition and in the worst intended conditions, at operational speed and at reduced speed as necessary. Operational information should be available on board for guidance, or the craft should have an instrument system for on-line check of operational performance. As a minimum, the system should measure accelerations in three axes close to the longitudinal craft centre of gravity.

4.4 Accommodation design

4.4.1 The public spaces and crew accommodation of high speed craft should be located and designed to protect passengers and crew under the collision design condition. In this respect, these spaces should not be located within a distance of: $\frac{V^2}{20 g_{coll}}$ of the extreme forward end of the top of the effective hull girder of the craft, where the terms V and g_{coll} are as defined in 4.3.3. For this purpose g_{coll} need not be taken as less than 3, and should not be taken as greater than 12.

4.4.2 The accommodation should be designed according to the guidelines given in table 4.4.2 and to performance requirements given in annex 9, or by other methods which have been proven to give equal protective qualities.

4.4.3 Equipment and baggage in public spaces and in the operator's compartment should be positioned and secured so that they remain in the stowed position when exposed to the collision design acceleration according to 4.3.3 and 4.3.4.

4.4.4 Mountings of large masses such as main engines, auxiliary engines, lift fans, transmissions and electrical equipment should be proved by calculations to withstand the collision design acceleration according to 4.3.3 and 4.3.4 without fracturing.

4.4.5 Seats, life-saving appliances and items of substantial mass and their supporting structure should not deform or dislodge under any loads up to those specified in 4.3.3 and 4.3.4 in any manner that would impede subsequent rapid evacuation of passengers.

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

Table 4.4.2 - Overview general design guidelines

Design level 1: g_{coll} less than 3
Seat/seat belts 1.1 Low or high seatback 1.2 No restrictions on seating direction 1.3 Sofas allowed 1.4 No seat belts requirement Tables in general allowed Padding of projecting objects Kiosks, bars, etc., no special restrictions Baggage, no special requirements Large masses restrainment and positioning
Design level 2 g_{coll} = 3 to 12
Seat/seat belts 1.1 High seatback with protective deformation and padding 1.2 Forward or backward seating direction 1.3 No Sofas allowed as seat 1.4 Lap belt in seats when no protective structure forward Tables with protective features allowed. Dynamic testing Padding of projecting objects Kiosks, bars, etc., on aft side of bulkheads, or other specially approved arrangements Baggage placed with protection forward Large masses restrainment and positioning
Design level 3 g_{coll} = above 12
Seat/seat belts 1.1 High seatback with protective deformation and padding 1.2 Forward or backward seating direction 1.3 No Sofas allowed 1.4 Seat belt when necessary to obtain required protection - No belts in backward-facing seats - Three-point belt or belt with shoulder harness in forward-facing seats No tables allowed Padding of projecting objects, specially approved Kiosks, bars, etc., specially approved Baggage placed with protection forward, specially approved Large masses, restrainment and positioning, specially approved

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

4.5 Seating construction

4.5.1 A seat should be provided for each passenger and crew member for which the craft is certified to carry.

4.5.2 Seats fitted in addition to those required under 4.5.1 and which are not permitted to be used in hazardous navigational situations or potentially dangerous weather or sea conditions, need not comply with 4.5 or 4.6. Such seats should be secured according to 4.4.5 and clearly identified as not being able to be used in hazardous situations.

4.5.3 The installation of seats should be such as to allow adequate access to any part of the accommodation space. In particular, they should not obstruct access to, or use of, any essential emergency equipment or means of escape.

4.5.4 Seats and their attachments, and the structure in the proximity of the seats, should be of a form and design, and so arranged, such as to minimise the possibility of injury and to avoid trapping of the passengers after the assumed damage in the collision design condition according to 4.4.1. Dangerous projections and hard edges should be eliminated or padded.

4.5.5 Seat, seat belts, seat arrangement and adjacent parts such as tables should be designed for the actual collision design acceleration as specified in 4.3.3.

4.5.6 All seats, their supports and their deck attachments should have good energy absorbing characteristics and should meet the requirements of annex 9.

4.6 Safety belts

4.6.1 One-hand-release safety belts of 3 point type or with shoulder harness should be provided for all seats from which the craft may be operated for all craft with the g_{coll} acceleration from the collision design acceleration exceeding 3g, as prescribed in 4.3.3.

4.6.2 Safety belts should be provided on passenger seats and crew seats, if necessary, to obtain the protective performance measures described in annex 9.

4.7 Exits and means of escape

4.7.1 For the same reason, easy, safe and quick access from the operating compartment to the passenger accommodation should be provided. In order to ensure immediate assistance from the crew in an emergency situation, the crew accommodation, including any cabins, should be located with due regard to easy, safe and quick access to the public spaces from inside the craft.

4.7.2 The design of the craft should be such that all occupants may safely evacuate the craft into survival craft under all emergency conditions, by day or by night. The positions of all exits which may be used in an emergency, and of all life-saving appliances, the practicability of the evacuation procedure, and the evacuation time to evacuate all passengers and crew should be demonstrated.

4.7.3 Public spaces, evacuation routes, exits, lifejacket stowage, survival craft stowage, and the embarkation stations should be clearly and permanently marked and illuminated as required in chapter 12.

4.7.4 Each enclosed public space and similar permanently enclosed space allocated to passengers or crew should be provided with at least two exits arranged in the opposite ends of the space. Exits should be safely accessible and should provide a route to a normal point of boarding or disembarking from the craft.

4.7.5 Subdivision of public spaces to provide refuge in case of fire may be required in compliance with 7.4.4.1 and 7.11.1.

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

4.7.7 The closing, latching and locking arrangements for exits should be such that it is readily apparent to the appropriate crew member when the doors are closed and in a safe operational condition, either in direct view or by an indicator. The design of external doors should be such to eliminate the possibility of jamming by ice or debris.

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

4.7.9 Sufficient space for a crew member should be provided adjacent to exits for ensuring the rapid evacuation of passengers.

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

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

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

4.7.13 The dimensions of passages, doorways and stairways which form part of evacuation paths should be such as to allow easy movement of persons when wearing lifejackets. There should be no protrusions in evacuation paths which could cause injury, ensnare clothing, damage lifejackets or restrict evacuation of disabled persons.

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

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

4.8 Evacuation time

4.8.1 The provisions for evacuation should be designed such that the craft can be evacuated under controlled conditions in a time of one third of the structural fire protection time (SFP) provided in 7.4.2 for major fire hazard areas after subtracting a period of 7 min for initial detection and extinguishing action.

$$\text{Evacuation time} = \frac{(SFP - 7)}{3} \quad \text{(min)}$$

where: SFP = structural fire protection time (min)

4.8.2 An evacuation procedure, including a critical path analysis, should be developed for the information of the Administration in connection with the approval of fire insulation plans and for assisting the owners and builders in planning the evacuation demonstration required in 4.8.3.
The evacuation procedures should include:

.1 the emergency announcement made by the master;

.2 contact with base port;

.3 the donning of lifejackets;

.4 manning of survival craft and emergency stations;

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

.6 the order to evacuate;

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

.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; and

.14 the marshalling of survival craft by the rescue boat where provided.

4.8.3 Achievement of the required evacuation time (as ascertained in accordance with 4.8.1) should be verified by a practical demonstration conducted under controlled conditions in the presence of the Administration, and should be fully documented and verified for passenger craft by the Administration.

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

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

.2 The evacuation time on a category B craft and cargo craft should be the time elapsed from the moment the order to abandon the craft is given, until the last person has embarked in a survival craft. Passengers and crew may be wearing lifejackets and prepared for evacuation, and they may be distributed among muster stations.

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

4.8.5 The evacuation time should 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.

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

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

.1 The demonstration should commence with the craft afloat in harbour, in reasonably calm conditions, with all 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.

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

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

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

4.8.11 The specific evacuation procedure followed during the craft's initial demonstration on which certification is based should be included in the craft operating manual together with the other evacuation procedures contained in 4.8.2. During the demonstration video recordings should be made both inside and outside the craft which should form an integral part of the training manual required by 18.2.

4.9 Baggage. stores, shops and cargo compartments

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

4.9.2 Controls, electric equipment, high temperature parts, pipelines or other items, the damage or failure of which could affect the safe operation of the craft or which may require access by crew members during a voyage, should not be located in baggage, store and cargo compartments unless such items are adequately protected so that they cannot be damaged or, where applicable, operated inadvertently by loading, unloading or by movement of the contents of the compartment.

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

4.9.4 Having regard to the purpose of the craft, the closures of the exterior openings of the luggage and cargo compartments as well as special category spaces should be appropriately weathertight.

4.10 Noise levels

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

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