BUREAU VERITAS MARINE & OFFSHORE

RULES FOR CLASSIFICATION

RULES FOR THE CLASSIFICATION OF **NAVAL SHIPS**

PART D

SERVICE NOTATIONS

NR483 D DT R08

EDITION DECEMBER 2026



BUREAU VERITAS MARINE & OFFSHORE
RULES FOR CLASSIFICATION

NR483 D DT R08 DECEMBER 2026

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CLASSIFICATION AND SURVEYS
NR483 A DT R08 DECEMBER 2026

PART B
HULL AND STABILITY
NR483 B DT R08 DECEMBER 2026

PART C
MACHINERY, SYSTEMS AND FIRE PROTECTION
NR483 C DT R08 DECEMBER 2026

PART D
SERVICE NOTATIONS
NR483 D DT R08 DECEMBER 2026

PART E
ADDITIONAL CLASS NOTATIONS
NR483 E DT R08 DECEMBER 2026

BUREAU VERITAS MARINE & OFFSHORE

Tour Alto
4 place des Saisons
92400 Courbevoie - France
+33 (0)1 55 24 70 00

marine-offshore.bureauveritas.com/rules-guidelines

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Rules for Classification
NR483

RULES FOR THE CLASSIFICATION OF NAVAL SHIPS

Part D
Service Notations

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Part D
Service Notations

CHAPTER 1
FRIGATE

Section 1 General

Section 2 Machinery and Systems

Section 3 Electrical Installations

Section 4 Fire Protection

Section 1 General

1 General

1.1 Application

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **frigate**, as defined in Pt A, Ch 1, Sec 2, [4.2].

1.1.2 Ships dealt with in this Chapter are to comply with:

- Part A
- NR216 Materials and Welding
- applicable requirements according to Tab 1.

Table 1 : Applicable requirements

Item	Reference
Ship arrangement	• Part B
Hull	• Part B
Stability	• Part B
Machinery and systems	• Part C • Ch 1, Sec 2
Electrical installations	• Part C • Ch 1, Sec 3
Automation	• Part C
Fire protection, detection and extinction	• Part C • Ch 1, Sec 4

Section 2 Machinery and Systems

1 General

1.1 Application

1.1.1 Ships assigned the service notation **frigate** are to comply with the general requirements of Part C, Chapter 1. In addition they are to comply with the provisions of this Section.

2 Main propulsion

2.1 Availability

2.1.1 According to the mission of this type of ships, a special consideration will be given to the general arrangement of the main propulsion.

Therefore the main propulsion system is to comply at least with the requirements of the additional class notation **AVM-APM** as defined in Pt E, Ch 3, Sec 1.

Section 3 Electrical Installations

1 General

1.1 Applicability

1.1.1 In addition to the requirements given in Part C, Chapter 2 and Part C, Chapter 3, the following requirements are applicable for ships assigned the service notation **frigate**.

For weapons and sensors which are not considered within classification scope as essential services according to [2.1], all the electrical installations (electrical generators, main power sources, cable networks) up to and including the secondary switchboards are concerned by this Chapter. Nevertheless each weapon or sensor is considered as potential source of ignition and then requirements concerning electrical monitoring and safety devices/systems for fire protection are applicable.

1.2 Environmental conditions

1.2.1 Pt C, Ch 2, Sec 1, Tab 4 is to be replaced by Tab 1 of this Section.

Table 1 : Second characteristic numeral

Second characteristic numeral	Brief description of location	Frequency range (Hz)	Displacement amplitude (mm)	Acceleration amplitude g
1	Machinery spaces, command and control stations, accommodation spaces, exposed decks, cargo spaces	from 2,0 to 13,2 from 13,2 to 100	1,0 –	– 0,7
2	Masts	from 2,0 to 13,2 from 13,2 to 50	3,0 –	– 2,1
3	On air compressors, on diesel engines and similar	from 2,0 to 25,0 from 25,0 to 100	1,6 –	– 4,0

2 Design of electrical installation

2.1 Essential services

2.1.1 In complement of the requirements of Pt C, Ch 2, Sec 1, [3.11], the following services are to be considered as secondary essential services:

- combat management systems
- weapons and sensors, including signature control and aviation systems, only considered as potential sources of ignition
- command and control systems integrated in the bridge or damage control stations
- internal and external communications systems required in the present Rules
- command and control equipment of locally operated safety systems
- boats launching and crew recovery systems.

2.1.2 Services for habitability are those intended for minimum comfort conditions for people on board, and specially in engine control room, safety room and operation control room.

Examples of equipment for maintaining conditions of habitability:

- lightning (50%)
- galleys (75%)
- mechanical ventilation (50%)
- heating and air conditioning (≥ 50%)
- refrigerated stores (100%)
- hospital (100%)
- drinking water production (100%)
- electric generators and associated power sources supplying the above equipment.

2.2 Specific power supply

2.2.1 Power supply to weapons and sensors, and combat management systems are to be designed so as to comply with the requirements of STANAG 1008.

2.2.2 In addition to the requirements of Pt C, Ch 2, Sec 3, [3.7], high voltage may be used for shore supply.

Section 4 Fire Protection

1 General

1.1 Application

1.1.1 Unless otherwise specified, the provisions of this Section apply to the ships having the following service notation **frigate**.

1.1.2 The following provisions apply in addition to the requirements of Part C, Chapter 4.

1.2 Documents to be submitted

1.2.1 The interested party is to submit to the Society the documents listed in Tab 1.

Table 1 : Documentation to be submitted

No	I/A**(1)**	Document **(2)**
1	A	Structural fire protection showing the purpose of the various spaces of the ships, the fire rating of bulkheads and decks, means of closings of openings in A and B class divisions, draught stops, and completed with the indication of material of other bulkhead and of ceilings and lining
2	A	Natural and mechanical ventilation systems showing the penetrations on A class divisions, location of dampers, means of closing, arrangements of air conditioning rooms
3	A	Means of escape and access to spaces
4	A	Automatic fire detection systems and manually operated call points
5	A	Fire pumps and fire main including pumps head and capacity, hydrant and hose locations **(2)**
6	A	Arrangement of fixed fire-extinguishing systems **(2)**
7	A	Arrangement of sprinkler or sprinkler equivalent systems **(2)**
8	A	Fire-fighting equipment and firemen's outfits
9	A	Electrical diagram of the fixed gas fire-extinguishing systems, fixed fire detection systems, fire alarm and emergency lighting
10	A	Electrical diagram of the sprinkler systems
11	A	Electrical diagram of power control and position indication circuits for fire devices
12	I	General arrangement plan
13	I	Safety zone plan
14	A	Fire control plan

(1) A = to be submitted for approval
I = to be submitted for information.

(2) Plans are to be schematic and functional and to contain all information necessary for their correct understanding and verification such as:

- service pressures
- capacity and head of pumps and compressors, if any
- materials and dimensions of piping and associated fittings
- volumes of protected spaces, for gas and foam fire-extinguishing systems
- surface areas of protected zones for sprinkler and pressure water-spraying, low expansion foam and powder fire-extinguishing systems
- capacity, in volume and/or in mass, of vessels or bottles containing the extinguishing media or propelling gases, for gas, sprinkler, foam and powder fire-extinguishing systems
- type, number and location of nozzles of extinguishing media for gas, sprinkler, pressure water-spraying, foam and powder fire-extinguishing systems.

All or part of the information may be provided, instead of on the above plans, in suitable operation manuals or in specifications of the systems.

2 General requirements

2.1 Ship subdivisions

2.1.1 The ship shall be divided in at least two safety zones.

Note 1: If the part of the ship located forward the collision bulkhead forms one main vertical zone, this main vertical zone need not to comply with the requirements of Pt C, Ch 4, Sec 5, [6.3.7] item d) and Pt C, Ch 4, Sec 6, [1.3.2].

2.1.2 The bulkheads forming the boundaries of the safety zones shall be in line with the main vertical zone bulkheads.

2.1.3 When vulnerability zones are specified according to Pt C, Ch 4, Sec 1, [2.40], the bulkheads forming the boundaries of the vulnerability zones are to be in line with the safety zone bulkheads. A vulnerability zone may however include several safety zones.

2.1.4 The bulkheads forming the boundaries of the safety zones shall be at least A-60 fire class divisions or equivalent. Where a category (5), (9) or (10) space defined in item b) of Pt C, Ch 4, Sec 5, [1.2.3] is on one side or where fuel or diesel oil or JP 5 NATO (F44) tanks or water capacity are on both sides of the division, the standard can be reduced to A-0.

2.1.5 One damage control station is to be provided in each safety zone and equipped in such a way that the functionalities of the damage control station are also operable from an other one.

Note 1: The loss of one damage control station need not be considered for application of above requirement.

CHAPTER 2
AIRCRAFT CARRIER

Section 1 General

Section 2 Hull and Stability

Section 3 Machinery and Systems

Section 4 Electrical Installations

Section 5 Fire Protection

Section 1 General

1 General

1.1 Application

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **aircraft carrier**, as defined in Pt A, Ch 1, Sec 2, [4.3].

1.1.2 Ships dealt with in this Chapter are to comply with:

- Part A
- NR216 Materials and Welding
- applicable requirements according to Tab 1.

Table 1 : Applicable requirements

Item	Reference
Ship arrangement	• Part B
Hull	• Part B • Ch 2, Sec 2
Stability	• Part B • Ch 2, Sec 2
Machinery and systems	• Part C • Ch 2, Sec 3
Electrical installations	• Part C • Ch 2, Sec 4
Automation	• Part C • Ch 2, Sec 4
Fire protection, detection and extinction	• Part C • Ch 2, Sec 5

2 Definitions

2.1 General

2.1.1 Aircraft

In this Chapter aircraft include airplanes, helicopters or unmanned aerial vehicles (UAV).

2.1.2 Aircraft facilities

Aircraft facilities are systems and equipment which have the purpose of facilitating the launch, recovery, handling, supply, maintenance and repair of the aircraft on board the aircraft carrier.

2.1.3 Flight deck

The flight deck is the uppermost continuous deck used for aircraft operations.

2.1.4 Sponsons

Sponsons are external projections from the basic hull form at the level of or below the flight deck. They are typically used to support overhanging decks, to provide locations for mounting of equipment or to provide access for personnel.

3 Subdivision arrangement

3.1 Doors

3.1.1 Doors in cargo spaces

The doors accessible during the voyage, are to be fitted with a device which prevents unauthorized opening.

Additionally, indicators are required on the safety control station to show automatically when each door is closed and all door fastenings are secured.

3.1.2 Doors or ramps in large cargo spaces

Such doors are to be closed before the voyage commences and are to be kept closed during navigation. Should any of the doors or ramps be accessible during the voyage, they are to be fitted with a device which prevents unauthorized opening.

Section 2 Hull and Stability

1 Stability

1.1 Application

1.1.1 General

Intact stability and damage stability are to be assessed according to Pt B, Ch 3, Sec 2 and Pt B, Ch 3, Sec 3 respectively, taking into consideration the following sub-articles.

1.2 Intact stability

1.2.1 Calculation of the GZ curves

For the purpose of calculating the righting lever (GZ) curve, watertight sponsons and other watertight volumes attached to the sides of the hull may be considered as buoyant spaces provided that their design complies with the scantling requirements for all applicable design loads.

2 Structure design principles

2.1 General information

2.1.1 Aircraft

The types of aircraft for which the aircraft carrier is designed are to be formally given as a list.

In particular, this list must clearly indicate:

- the types of aircraft allowed to land and take-off (for structural design of flight deck)
- the types of aircraft for which maintenance on board is considered (for structural design of aircraft elevators and hangar deck).

For each aircraft, data pertaining to mass distribution per wheel is to be specified as per Pt B, Ch 5, Sec 6, [4] for each operating and non-operating condition. Such conditions may include:

- normal landing, hard landing, emergency landing, catapulting and parked conditions for airplanes and UAVs
- heavy landing, emergency landing and parked conditions for helicopters.

Where helicopters are considered, the requirements of Pt B, Ch 8, Sec 11 are also to be complied with.

2.1.2 Design data for vehicles and wheeled equipment

The types of vehicles and wheeled equipment intended to be used on the flight deck, elevators, hangar deck, in ammunition magazines or in other spaces are to be formally specified as per Pt B, Ch 5, Sec 6, [4].

2.2 Flight deck

2.2.1 Description of zones

The partitioning of the flight deck into various zones considered for design is to be formally documented with respect to their functional use at sea (e.g. parking / launch / recovery / emergency landing). This information is also to include the type, number and arrangement of aircraft that may be present in each zone at any time.

The description of zones is to facilitate the identification of the loads that are applicable in each zone for each functional use. Where one area of the flight deck is concerned by several functional uses, the scantlings are to be checked for all possible loads.

2.2.2 Emergency landing zone

The flight deck emergency landing zone is to be clearly specified. The design criteria to be applied are to be agreed with the Society.

2.2.3 Structure in way of catapults and arresters

The locations of catapults and arresters along with the details of their integration into the flight deck structure are to be indicated on relevant drawings.

2.2.4 Flight deck openings

The various openings in flight deck are to be clearly defined with respect to their location and size (Ammunition elevators, jet blast deflectors, aviation cabins for flight officer, etc.).

Particularly, the transverse and longitudinal extent of the flight deck recesses are to be clearly marked on relevant structure drawings.

2.2.5 Aircraft lashing devices

Lashing devices fitted in the flight deck are to be clearly shown on structural drawings and are to comply with the requirements of Pt B, Ch 8, Sec 11, [6].

2.3 Hangar

2.3.1 General

Information about the design of the hangar is to be submitted, including indication of sea pressure loads, taking into consideration any openings in the sideshell

2.3.2 Description of zones

The various zones of the hangar deck considered during design are to be documented, with respect to their functional use at sea (maintenance of aircraft, cargo area, etc.).

In particular, the design loads on the various structural mezzanines in the hangar are to be specified.

2.3.3 Doors in side shell in way of aircraft elevators

Doors in the side shell in way of aircraft elevators are to be weathertight.

They are to comply with Pt B, Ch 8, Sec 6.

2.3.4 Fire doors partitioning the hangar

As a rule, the fire doors partitioning the hangar, if any, are considered as non-structural items, except if otherwise mentioned.

2.3.5 Hangar deck openings

Openings in the hangar deck are to be clearly defined with respect to their location and size.

In particular, any deck recess in way of hangar fire doors is to be detailed, if relevant.

2.3.6 Aircraft lashing devices

Lashing devices fitted in the hangar deck are to be clearly shown on structural drawings and are to comply with the requirements of Pt B, Ch 8, Sec 11, [6].

2.4 Sponsons

2.4.1 Undersides

The underside of sponsons is the lowest boundary surface, with transverse and longitudinal limits as follows:

- inboard limit: vessel side shell
- outboard limit: lowest hard chine of sponson, if any, or the point where the tangent to the lowest boundary surface makes a 60° angle with respect to the horizontal plane, in case of a rounded transition
- Fore and aft limits: as per outboard limit.

Sponsons of unusual design are to be treated on a case-by-case basis.

2.5 Cranes and other lifting appliances

2.5.1 Permanently fitted cranes and lifting applicances are to be clearly specified, with respect to their operational use and Safe Working Loads. Detailed information concerning the loads transmitted to the ship structure and fixed parts of lifting appliances considered as an integral part of the hull are to be specified and taken into account.

2.6 Aircraft and ammunition elevators

2.6.1 General

The arrangement of aircraft and ammunition elevator systems is to be specified. Detailed information concerning the loads transmitted to the ship structure and fixed parts of lifting appliances considered as an integral part of the hull are to be specified and taken into account.

The possibility of wave loads acting on the underside of deck edge aircraft elevator platforms is to be indicated. The specific loads to be considered are to be agreed with the Society.

3 Design loads

3.1 Local loads on flight deck

3.1.1 General

Loads to be considered on the flight deck are sea pressure and wheeled loads, including those due to aircraft. These loads are to be considered separately.

Table 1 : Airplane and UAV launching and landing loads

Operation	Maximum mass (t)	Main undercarriage load per wheel in z direction			Fore under carriage load per wheel in z direction		
		Maximum vertical force (kN)	Still water force F_S (kN)	Inertial force F_W (kN)	Maximum vertical force (kN)	Still water force F_S (kN)	Inertial force F_W (kN)
Landing - Normal	M_1	F_{MN}	0	F_{MN}	F_{FN}	0	F_{FN}
Landing - Hard	M_1	F_{MH}	0	F_{MH}	F_{FH}	0	F_{FH}
Landing - Exceptional	M_1	F_{ME}	0	F_{ME}	F_{FE}	0	F_{FE}
Launching - Catapulting	M_2	F_{MC}	M.g	F_{MC} – M.g	Not applicable	Not applicable	Not applicable

M_1 : maximum mass for landing, in t
M_2 : maximum mass for launching, in t
M : mass per wheel, in t, to be calculated as follows:
$M = Q_A / n_w$
where Q_A is the axle load, in t, corresponding to mass M_2 and n_w is the number of wheels for the axle considered.
F_{MN}, F_{MH}, F_{ME}: maximum force per wheel of the main undercarriage in the z direction, in kN, for normal, hard and emergency landings respectively, corresponding to mass M_1 and to be specified by the aircraft manufacturer
F_{FN}, F_{FH}, F_{FE}: maximum force per wheel of the fore undercarriage in the z direction, in kN, for normal, hard and emergency landings respectively, corresponding to mass M_1 and to be specified by the aircraft manufacturer
F_{MC} : maximum force per wheel of the main undercarriage in the z direction, in kN, during catapulting, corresponding to mass M_2 and to be specified by the aircraft manufacturer
g : acceleration due to gravity to be taken equal to 9,81 m/s².

3.1.2 Sea pressure

Sea pressure is to be taken according to Pt B, Ch 5, Sec 5, [3].

As a rule, the flight deck is to be considered as the top of the lowest tier.

3.1.3 Wheeled loads

Still water and inertial loads for aircraft and wheeled equipment operating or parked on the flight deck are to be taken according to Pt B, Ch 5, Sec 6, [4].

The still water and inertial loads for launch and recovery of airplanes and UAVs are to be determined as per Tab 1, for each aircraft type.

Helicopter landing and garage loads are to be considered as per Pt B, Ch 8, Sec 11.

3.2 Local loads on hangar deck and mezzanines

3.2.1 Cargo loads

The design cargo loads on the hangar deck and structural mezzanines in the hangar are to be taken in accordance with Pt B, Ch 5, Sec 6, [2] and Pt B, Ch 5, Sec 6, [3].

For mezzanines used only as companionway, the minimum still water pressure p_S may be reduced to 5 kN/m².

3.2.2 Wheeled loads

Still water and inertial loads on the hangar deck are to be considered for aircraft in the parked condition and for other wheeled equipment in the parked and operational conditions as applicable. These loads are to be taken as per Pt B, Ch 5, Sec 6, [4] considering [2.1.1] and [2.1.2].

3.2.3 Sea loads

When sea pressure loads are expected on the hangar deck, the design pressures are to be defined to the satisfaction of the Society.

3.3 Local loads on island and bridge

3.3.1 Loads on front, aft and side bulkheads and on decks of islands and bridges are to be determined according to Pt B, Ch 8, Sec 4.

The lowest tier of islands and bridges is to be considered as the second tier.

3.4 Local loads on sponsons

3.4.1 Side shell of sponsons

Design pressures on the sides of sponsons are to be taken equal to the wave pressures given in Pt B, Ch 5, Sec 5, Tab 5 for upright ship conditions and Pt B, Ch 5, Sec 5, Tab 3 for inclined ship conditions.

For inclined ship conditions, the roll amplitude A_R is to be calculated according to Pt B, Ch 5, Sec 3, without consideration of any ship motion damping system

3.4.2 Front and aft surfaces of sponsons

Design pressures on the front and aft surfaces of sponsons are to be taken equal to the wave pressures given in Pt B, Ch 5, Sec 5, Tab 5 for upright ship conditions and Pt B, Ch 5, Sec 5, Tab 3 for inclined ship conditions.

For inclined ship conditions, the roll amplitude A_R is to be calculated according to Pt B, Ch 5, Sec 3, without consideration of any ship motion damping system.

3.4.3 Underside of sponsons

For transverse sections located longitudinally such than x/L is less than 0,7, the sea pressure to be considered on the underside of sponsons is the normal sea pressure acting on side shell.

For transverse sections located longitudinally such than x/L is greater than or equal to 0,7, the sea impact pressure on the underside of sponsons p_{FI} is to be obtained, in kN/m^2, from the following formula:

$$p_{FI} = C_S C_Z (0,22 + 0,15 \tan\alpha)(0,4V \sin\beta + 0,6\sqrt{L})^2$$

where:

C_S : Coefficient depending on the type of structures on which the impact pressure is considered to be acting:

- $C_S = 1,8$ for plating and ordinary stiffeners
- $C_S = 0,5$ for primary supporting members

C_Z : Coefficient depending on the distance between the full load waterline and the calculation point:

- for $z \geq 2\,C + T - 11$: $C_Z = C - 0,5\,(z - T)$
- for $z < 2\,C + T - 11$: $C_Z = 5,5$

C : Wave parameter:

$$C = 10,75 - \left(\frac{300 - L}{100}\right)^{1,5} \quad \text{for } 90 \text{ m} \leq L < 300 \text{ m}$$

$$C = 10,75 \quad \text{for } 300 \text{ m} \leq L \leq 350 \text{ m}$$

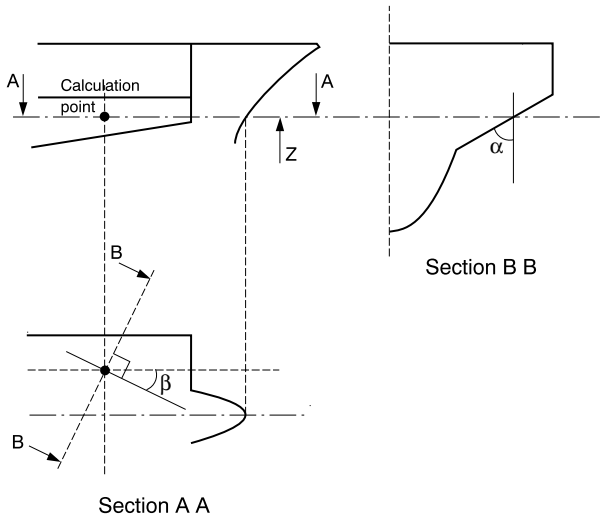
$$C = 10,75 - \left(\frac{L - 350}{150}\right)^{1,5} \quad \text{for } L > 350 \text{ m}$$

α : Flare angle at the calculation point, defined as the angle between a vertical line and the tangent to the underside plating, measured in a vertical plane normal to the horizontal tangent to the shell plating (see Fig 1) and not to be taken greater than 80°

β : Entry angle at the calculation point, defined as the angle between a longitudinal line parallel to the centreline and the tangent to the shell plating in a horizontal plane (see Fig 1)

V : Maximum service speed, in knots.

Figure 1 : Definition of angles α and β



4 Hull girder strength

4.1 Strength characteristics of the hull girder transverse sections

4.1.1 Contribution of flight deck

The flight deck is generally to be considered as the strength deck.

The actual contribution of the flight deck in way of sponsons to the hull girder strength is to be confirmed by finite element analysis.

Openings in the flight deck (e.g. elevators, jet blast deflectors, catapult recesses, aviation cabins for flight officers, etc.) are to be taken into consideration in accordance with relevant requirements of Pt B, Ch 4, Sec 6, [6] and Pt B, Ch 6, Sec 1, [2].

4.1.2 Contribution of sponsons

The actual contribution of the flight deck sponsons to the hull girder strength is to be confirmed by finite element analysis.

All other sponsons are to be considered as not contributing to the hull girder strength.

4.1.3 Openings in side shell and sponsons

Openings in side shell and in flight deck sponsons (e.g. hangar doors) are to be taken into consideration in accordance with relevant requirements of Pt B, Ch 6, Sec 1, [2].

4.2 Yielding check

4.2.1 Torque wave bending moment

Wave torque as specified in Pt B, Ch 6, Sec 2 is to be considered.

4.2.2 Structural model for the calculation of shear stresses

Finite element analysis or thin walled beam models representing members which constitute the hull girder transverse sections may be used for calculation of the vertical shear stress distribution.

5 Hull scantlings of flight deck

5.1 General

5.1.1 Structural singularities

The scantlings of flight deck local reinforcement in way of structural singularities (arresters, catapults, deflector hinges etc.) are to be assessed to the satisfaction of the Society.

Design forces (amplitudes, directions) and associated safety coefficients are to be agreed upon on a case-by-case basis.

5.2 Plating

5.2.1 The scantlings of the plating of the flight deck under wheeled loads and sea pressure are to be in compliance with the requirements of Pt B, Ch 7, Sec 1 with partial safety factors taken according to Tab 2.

5.3 Ordinary stiffeners

5.3.1 The scantlings of the ordinary stiffeners of the flight deck under wheeled loads and sea pressure are to be in compliance with the requirements of Pt B, Ch 7, Sec 2, with partial safety factors taken according to Tab 3.

Table 2 : Plating of flight deck - Partial safety factors

Partial safety factors covering uncertainties regarding	Symbol	Sea pressure	Landing Normal	Landing Hard	Landing Emergency	Launching catapulting	Parking
Still water hull girder loads	γ_{S1}	1,00	0	0	0	0	1,00
Wave hull girder loads	γ_{W1}	1,15	0	0	0	0	1,15
Still water pressure	γ_{S2}	1,00	1,00	1,00	1,00	1,00	1,00
Wave pressure	γ_{W2}	1,20	1,20	1,20	1,05	1,20	1,20
Material	γ_m	1,02	1,02	1,02	1,02	1,02	1,02
Resistance	γ_R	1,20	1,20	1,20	1,20	1,20	1,20

Table 3 : Stiffeners of flight deck - Partial safety factors

Partial safety factors covering uncertainties regarding	Symbol	Sea pressure	Landing Normal	Landing Hard	Landing Emergency	Launching catapulting	Parking
Still water hull girder loads	γ_{S1}	1,00	0	0	0	0	1,00
Wave hull girder loads	γ_{W1}	1,15	0	0	0	0	1,15
Still water pressure	γ_{S2}	1,00	1,00	1,00	1,00	1,00	1,00
Wave pressure	γ_{W2}	1,20	1,20	1,20	1,05	1,20	1,20
Material	γ_m	1,02	1,02	1,02	1,02	1,02	1,02
Resistance	γ_R	1,20	1,02	1,02	1,02	1,02	1,02

5.4 Primary supporting structure

5.4.1 The scantlings of the primary structure of the flight deck under wheeled loads and sea pressure are to be in compliance with the requirements of Pt B, Ch 7, Sec 3, with partial safety factors taken according to Tab 3.

6 Sponsons

6.1 Side shell

6.1.1 Plating, ordinary stiffeners and primary structure

The scantlings of the side shell of sponsons are to be in accordance with Part B, Chapter 7, with loads according to [3.4].

For sponsons not contributing to hull girder strength, the scantlings are to checked according to Part B, Chapter 7, with loads according to [3.4] and with longitudinal stress σ_1 equal to 0.

6.2 Front and aft surfaces

6.2.1 Plating, ordinary stiffeners and primary structure

The scantlings of front and aft surfaces of sponsons are to be in accordance with Part B, Chapter 7, with loads according to [3.4], and with longitudinal stress σ_1 equal to 0.

6.3 Underside

6.3.1 Partial safety factors

For transverse sections located longitudinally such than x/L is less than 0,7, the partial safety factors to be considered are given in Pt B, Ch 7, Sec 1, Pt B, Ch 7, Sec 2 or Pt B, Ch 7, Sec 3, as applicable.

For transverse sections located longitudinally such than x/L is greater than or equal to 0,7, the partial safety factors to be considered are to be taken as follows:

- Tab 4 for plating and ordinary stiffeners of the underside of sponsons
- Pt B, Ch 7, Sec 3 for primary structure of the underside of sponsons.

Table 4 : Reinforcements of the underside of sponsons Partial safety factors

Partial safety factors covering uncertainties regarding:	Partial safety factors		
	Symbol	Plating	Ordinary stiffeners
Still water pressure	γ_{S2}	1,00	1,00
Wave pressure	γ_{W2}	1,10	1,10
Material	γ_m	1,02	1,02
Resistance	γ_R	1,30	1,02

6.3.2 Plating and ordinary stiffeners

For transverse sections located longitudinally such than x/L is less than 0,7, the net scantlings of plating and ordinary stiffeners of the underside of sponsons are to be checked according to Pt B, Ch 7, Sec 1 or Pt B, Ch 7, Sec 2, as applicable, for the loads in [3.4.3]. However, the net scantlings of plating and ordinary stiffeners are to be not less than the minimum values given in Tab 5.

For transverse sections located longitudinally such than x/L is greater than or equal to 0,7, the net scantlings of plating and ordinary stiffeners of the underside of sponsons are to be not less than the values obtained from the formulae in Tab 5, considering the loads in [3.4.3], and the minimum values in the same Table.

Table 5 : Reinforcements of plating and ordinary stiffeners of the underside of sponsons

Element	Formula	Minimum value
Plating	Net thickness, in mm: $t = 11 c_a c_r s \sqrt{\gamma_R \gamma_m \frac{\gamma_{W2} \rho_{FI}}{R_y}}$	Net minimum thickness, in mm: $t = (0,03\ L + 5,5)\ k^{1/2}$
Ordinary stiffeners	Net section modulus, in cm^3: $w = \gamma_R \gamma_m \beta_b \frac{\gamma_{W2} \rho_{FI}}{18 c_P R_y} \left(1 - \frac{s}{2\ell}\right) s \ell^2 10^3$	Web net minimum thickness, in mm, to be not less than the lesser of: • $t = 1,5\ L_2^{1/3}\ k^{1/6}$ • the thickness of the attached plating.
	Net shear sectional area, in cm^2: $A_{Sh} = 10 \gamma_R \gamma_m \beta_s \frac{\gamma_{W2} \rho_{FI}}{R_y} \left(1 - \frac{s}{2\ell}\right) s \ell$	
Note 1: c_P : Ratio of the plastic section modulus to the elastic section modulus of the ordinary stiffeners with attached shell plating, to be taken equal to 1,16 in the absence of more precise evaluation.		

6.3.3 Intercostal stiffeners

Intercostal stiffeners are to be fitted at mid-span where the angle between the stiffener web and the attached plating is less than 70°.

6.3.4 Primary supporting members

Primary supporting members are generally to be verified through direct calculations carried out according to Pt B, Ch 7, Sec 3, considering the sea impact pressures defined in [3.4.1].

6.3.5 Strengthening of sponsons in way of workboats / lifeboats

Sponsons are to be adequately strengthened in way of workboat / lifeboat launching appliances. Stiffening of the underside is to be compatible with the boat launching and recovery operations.

7 Other hull scantlings

7.1 Bottom

7.1.1 Bottom plating

The minimum net thickness of bottom plating is to be not less than the values given in Tab 6.

Table 6 : Minimum net thickness of bottom plating

Plating	Minimum net thickness (mm)
Longitudinal framing	$2,8 + 0,032\ L\ k^{1/2} + 4,5\ s$
Transverse framing	$3,8 + 0,032\ L\ k^{1/2} + 4,5\ s$

7.2 Hangar

7.2.1 Hangar deck

The scantlings of the hangar deck structure and the mezzanine decks in the hangar under wheeled loads and cargo loads are to be in compliance with the requirements of Part B, Chapter 7.

7.2.2 Transverse racking effect

The transverse partial bulkheading structure in the hangar is to be checked against transverse racking effect induced by transverse accelerations exerted on deck structure between hangar and flight deck.

The most severe conditions are to be considered for loads and transverse accelerations.

Stress criteria are given in Pt B, Ch 7, Sec 3, [2].

7.3 Island and bridge

7.3.1 The scantlings of island and bridge structure are to be in accordance with Pt B, Ch 8, Sec 4, applicable to deckhouses.

Special consideration is to be given to support of masts on islands and bridges. Strength continuity downwards through several decks may be requested.

8 Hull outfitting

8.1 Anchoring equipment

8.1.1 The anchoring equipment is to be determined according to Pt B, Ch 9, Sec 4.

The equipment number EN is to be obtained according to Pt B, Ch 9, Sec 4, [2.1], where (2 h B) is to be replaced by: (2 h B + A_{CQST} + A_{CQPS}),

with:

A_{CQST} : Frontal area of starboard flight deck sponsons projected on the vertical transverse plane outboard of B/2

A_{CQPS} : Frontal area of portside flight deck sponsons projected on the vertical transverse plane outboard of B/2.

9 Fatigue analysis

9.1 Structural details

9.1.1 The details to be checked against fatigue, according to Pt B, Ch 7, Sec 4, are to be defined jointly with the Designer, at the beginning of the Classification design review process.

Section 3 Machinery and Systems

1 General

1.1 Application

1.1.1 Ships having the service notation **aircraft carrier** are to comply with the general requirements of Part C, Chapter 1. In addition they have to comply with the provisions of this Section.

1.1.2 Documentation to be submitted

The documents to be submitted are listed in Tab 1.

Table 1 : Documentation to be submitted

N°	I/A(**1**)	Document
1	I	For electromagnetic catapults: • electromagnetic fields generated by the components of the electromagnetic catapult • electromagnetic compatibility therewith of equipment located in the impacted areas if applicable.
(**1**) I: to be submitted for information; A: to be submitted for approval.		

2 Main propulsion

2.1 Availability

2.1.1 When in flight operation and especially in aircraft recovery phase the ordered speed of the ship is to be kept to avoid variation of the relative wind on the flight deck outside of the allowed range and a special consideration will be given to the general arrangement of the main propulsion.

Therefore the main propulsion system is to comply at least with the requirements of the additional class notation **AVM-DPS** for duplicated propulsion and steering systems as defined in Pt E, Ch 3, Sec 2.

3 Steering system

3.1 Availability

3.1.1 When in flight operation and especially in aircraft recovery phase the ordered course of the ship is to be kept to avoid variation of the relative wind on the flight deck so the steering gear is to fulfil the requirements of duplicated propulsion and steering systems **AVM-DPS** as per Pt E, Ch 3, Sec 2.

Where steering gear is used as a component of the stabilization system a special attention is to be paid on the life reduction due to this use.

4 Stabilization system

4.1 General

4.1.1 Where ship movements exceed the maximum allowed for safety of the aircraft operation the ship could be equipped with systems to reduce the movements within the allowed range with the environmental conditions requested by the Naval Authority.

Where system for reducing the movements is installed, this system is to be considered as a secondary essential service in complement of Pt C, Ch 2, Sec 1, [3.11.3].

4.1.2 Stabilization equipment

Where stabilization system is based on fin type roll stabilizers, these equipment are to comply with the general requirements for steering gear as per Pt C, Ch 1, Sec 12.

5 Heel correction system

5.1 General

5.1.1 Where angle of heel due to ship evolution or to aircraft transfer on flight deck or on hanger deck exceed the maximum allowed angle for safety of the aircraft operation the ship could be equipped with systems to reduce this angle of heel within the allowed range with the environmental conditions requested by the Naval Authority.

Where system for reducing this heel is installed, this system is to be considered as a secondary essential service in complement of Pt C, Ch 2, Sec 1, [3.11.3].

6 Aircraft launching

6.1 Take off facilities

6.1.1 General

Where catapult launching is needed, take off facilities include:

- catapult installation
- jet deflector
- sling recovery device (if any).

6.1.2 Catapult

a) A steam catapult for aircraft carrier is composed with:
   - the cylinder
   - the piston
   - the piston arrester
   - the putting back in battery system
   - the inlet regulating steam valve.

   These pieces of equipment are out of the scope of Class.

b) An electromagnetic catapult is composed with:
   - a linear induction motor
   - an energy substorage system
   - a power conversion system
   - a control system.

   These pieces of equipment are out of the scope of Class.

   A particular attention is to be paid to spaces containing electrical equipment that are likely to be affected by electromagnetic interferences.

6.1.3 Catapult steam installation

The steam accumulator and the steam generator are to comply with requirements of Pt C, Ch 1, Sec 3.

A special attention is to be paid to the fatigue thermal cycling of these boilers and pressure vessel and of the associate piping.

The feed water production installation is to be design taking in account the intended consumption of water due to the catapult launching. In particular the increase of salinity of the steam generator is to be avoided.

6.1.4 Jet deflector

Jet deflector screen are installed to protect the flight deck staff from hot gazes blast during launching operation. This equipment is to comply with general requirements of Pt C, Ch 1, Sec 3 and Pt C, Ch 1, Sec 10.

7 Aircraft recovery

7.1 Landing facilities

7.1.1 General

The aircraft landing facilities may include:

- arresting gear installation
- landing path guidance:
  - landing area deck lights
  - optical landing system
- aircraft barricade.

According to Ch 2, Sec 4, [2.2.2], the arresting gear installation, the landing area deck lights and the optical landing system are to be considered as a secondary essential service in complement of Pt C, Ch 2, Sec 1, [3.11.3].

7.1.2 Arresting gear installation

Arresting gear installation may be using hydraulic energy and alternatively electromagnetic energy coupled with water turbines.

Arresting gear installation are mainly composed of 3 or 4 independent arresting cables with their own pulleys connected to the slowing devices.

When the system includes hydraulic cylinders, these are to comply with general requirement of Pt C, Ch 1, Sec 3 and Pt C, Ch 1, Sec 10.

In case of malfunction of one of these arresting cables, dispositions are to be taken in order to clear the landing area of the defective cable within a delay acceptable by the aircraft recovery operation.

8 Aircraft handling

8.1 Aircraft Elevators

8.1.1 Aircraft elevators are to be considered as a secondary essential service according to Pt C, Ch 2, Sec 1, [3.11.3].

8.1.2 Aircraft elevators are to comply with the requirements of NR526, Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units.

8.2 Aircraft cranes

8.2.1 Permanently fitted cranes for aircraft handling or maintenance are to comply with the requirements of NR526, Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units.

9 Aircraft supplying

9.1 General

9.1.1 The supply of the aircraft needs among others handling, storage or production for:

- fuel
- ammunition
- oxygen for breathing purpose
- special ingredients and fluids for aircraft
- aircraft electric power.

9.1.2 Refuelling system

Refuelling system is to comply with requirements for helicopter platform as per Pt C, Ch 1, Sec 10, [11] and Pt C, Ch 4, Sec 10, [4].

9.1.3 Oxygen production and storage

A special consideration for risk of high concentration of oxygen is to be taken into account for aircraft breathing oxygen storage and production installation. Whenever liquefied oxygen is present on board, special consideration for consequences of leakage is to be taken into account. These consequences are to include fire risk and damage to ship structures.

10 Ammunition handling

10.1 Ammunition elevators

10.1.1 Ammunition elevators are to be considered as a secondary essential service in complement of Pt C, Ch 2, Sec 1, [3.11.3].

10.1.2 Ammunition elevators are to comply with the requirements of NR526, Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units.

Section 4 Electrical Installations

1 General

1.1 Applicability

1.1.1 In addition to (or instead of) the requirements given in Part C, Chapter 2 and Part C, Chapter 3, the following requirements are applicable for aircraft carriers.

1.2 Documentation to be submitted

1.2.1 In addition to the documents requested in Pt C, Ch 2, Sec 1, the following documents are to be submitted for information:

- harmonic analysis
- study of network stability, in stabilized conditions and at nominal functioning.

2 Design of electrical installation

2.1 Harmonic distortions

2.1.1 Electric systems' harmonic distortions are to comply with the requirements of Pt C, Ch 2, Sec 2, [2.4].

2.2 Essential services

2.2.1 In complement of the requirements of Pt C, Ch 2, Sec 1, [3.11], the following services are to be considered as primary essential services:

- internal safety communication
- external communication
- navigation equipment.

2.2.2 In complement of the requirements of Pt C, Ch 2, Sec 1, [3.11], the following services are to be considered as secondary essential services, involving the operation and preparation of aircrafts, including:

- landing radars
- ammunition elevators
- aircraft elevators
- stabilisation system (includes heel correction system if any)
- davits for rescue boats
- aircraft handling system
- visual landing aids
- landing area deck lights
- arresting gear installation.

2.3 Power supply

2.3.1 Requirement Pt C, Ch 2, Sec 2, [2.1.1] is to be replaced as follows:

All electrical components are to be so designed and manufactured that they are capable of operating satisfactorily under the variations of voltage, frequency and harmonic distortion of the power supply specified from:

- STANAG 1008-10 for components designed with this standard
- [2.2] to [2.4] for the other components.

2.3.2 Power supply to weapons and sensors, and combat management systems are to be designed so as to comply with the requirements of STANAG 1008.

2.3.3 Requirement Pt C, Ch 2, Sec 3, [7.1.1] is to be replaced as follows:

Electrical installations are to be protected against accidental overcurrents including short-circuit.

The choice, arrangement and performance of the various protective devices are to provide complete and coordinated automatic protection in order to ensure as far as possible:

- continuity of service in the event of a fault, through coordinated and discriminative action of the protective devices, up and included to the level of section boards
- elimination of the effects of faults to reduce damage to the system and the hazard of fire as far as possible.

Note 1: An overcurrent is a current exceeding the nominal current.

Note 2: A short-circuit is the accidental connection by a relatively low resistance or impedance of two or more points in a circuit which are normally at different voltages.

2.4 Main switchboard

2.4.1 When the main switchboard is constituted of two separate switchboards, connected together with at least one connection bus tie, it is not necessary to divide each main busbars of each switchboard in two parts.

2.5 Emergency switchboard

2.5.1 The requirement for emergency source of electrical power given as a reference in [3.1.1] also applies to emergency switchboards.

2.6 Shore supply

2.6.1 Electrical installations' supply from a source on shore are to be in compliance with Pt C, Ch 2, Sec 3, [3.7].

2.6.2 A second shore supply is to be provided, in order to secure the ship power at quay. This shore supply is to be connected to a different switchboard from the first shore connexion.

2.6.3 Requirement Pt C, Ch 2, Sec 3, [3.7.9] is to be disregarded and replaced as follows:

Necessary arrangements are to be provided to allow coupling of the shore supply with main switchboard, so as to avoid any black out when transferring quay supply to ship supply and vice versa.

2.7 Electrical equipment located in hazardous areas

2.7.1 Cables located in hazardous areas are to be in compliance with Pt C, Ch 2, Sec 3, [10.5].

2.7.2 Electrical equipment located in hazardous areas are to be designed in accordance with IEC 60079 standard.

2.7.3 Electrical equipment located in hazardous areas as defined in Tab 1 are to be of a safe type appropriate for the zone. They are to be explosion group IIa and temperature class T3 minimum.

2.8 Electrical equipment located in special spaces

2.8.1 Following spaces are to be considered as hazardous areas and electrical equipment related to these areas are to comply with the requirements of Pt C, Ch 2, Sec 3, [10.7]:

- paint stores or tanks
- medical product storage rooms
- workshop where solvents are used.

2.8.2 Flour storage spaces are to be considered as hazardous areas and electrical equipment related to these areas are to have a degree of protection IP 65 and maximum surface temperature of 100°C.

2.8.3 Following spaces are to be considered as hazardous areas and electrical equipment related to these areas are to comply with the requirements of Pt C, Ch 2, Sec 3, [10.6]:

- hydrogen distribution dispenser
- battery rooms
- oxygen plant.

2.9 Electrical equipment related to aircrafts services

2.9.1 The requirements of Pt C, Ch 2, Sec 3, [3.12.5] are to be replaced by the following:

A red lighting is to be provided in the following locations:

- alleyways leading to outside spaces, and used for personnel on duty
- all rooms and access leading directly to outside spaces without airlock
- all airlock for external access

- in alleyways leading to landing area, briefing rooms and resting rooms for pilots and aviation personnel on duty
- the lifts leading to platforms
- the spaces for aviation switchboard
- the spaces related to catapult systems, aircraft elevators and associated machinery, and wire break system, having personnel on duty
- the JP5 distribution area.

The level of illumination is to be between 2 and 5 Lux on the floor in passageway and 5 Lux where reading is necessary.

Table 1 : Electrical equipment permitted in hazardous areas

Hazardous areas **(1)**	Spaces		Electrical equipment
	No.	Description	
Zone 1	1	Areas at less than 450 mm above the deck or platforms for vehicles/aircraft, if fitted, without openings of sufficient size permitting penetration of petrol gases downward	Electrical equipment complying with one of the following types of protection may be considered: a) any type that may be considered for zone 0 b) certified intrinsically safe apparatus Ex(ib) c) simple electrical apparatus and components (e.g. thermocouples, photocells, strain gauges, junction boxes, switching devices), included in intrinsically-safe circuits of category "ib" not capable of storing or generating electrical power or energy in excess of limits stated in the relevant rules, and acceptable to the appropriate authority d) certified flameproof Ex(d) e) certified pressurized Ex(p) f) certified increased safety Ex(e) g) certified encapsulated Ex(m) h) certified sand filled Ex(q) i) certified specially Ex(s) j) cables sheathed with at least one of the following: • a non-metallic impervious sheath in combination with braiding or other metallic covering • copper or stainless steel sheath (for mineral insulated cables only)
Zone 1	2	Exhaust ventilation ducts from hangars	As stated under item 1
Zone 1	3	• aircraft engine test area • loading and unloading area of fuel oil • aircraft spaces (zone around distribution of JP5 and petrol)	As stated under item 1
Zone 2	4	• areas above a height of 450 mm from the deck • areas above a height of 450 mm from each platform for vehicles/ aircraft, if fitted, without openings of sufficient size permitting penetration of petrol gases downward • areas above platforms for vehicles/ aircrafts, if fitted, with openings of sufficient size permitting penetration of petrol gases downward	Electrical equipment complying with one of the following types of protection may be considered: a) any type that may be considered for zone 1 b) tested specially for zone 2 (e.g. type "n" protection) c) pressurized, and acceptable to the appropriate authority d) encapsulated, and acceptable to the appropriate authority e) the type which ensures the absence of sparks and arcs and of "hot spots" during its normal operation (minimum class of protection IP55) f) cables sheathed with at least a non-metallic external impervious sheath
(1) Alternatively, area classification according to IEC 60079-10-1:2020 may be applied with special consideration by the Society.			

3 Emergency source of electrical power and emergency installations

3.1 General

3.1.1 Requirement of Pt C, Ch 2, Sec 3, [2.3.1] on the emergency source of electrical power is to be disregarded for aircraft carrier. The requirements of Pt C, Ch 2, Sec 3, [2.3] are to be replaced with the following provisions [3.1.2] to [3.1.15].

3.1.2 A self-contained emergency source of electrical power shall be provided.

3.1.3 Provided that suitable measures are taken for safeguarding independent emergency operation under all circumstances, the emergency generator may be used, exceptionally, and for short periods, to supply non-emergency circuits.

The term “exceptionally”, whilst the vessel is at sea, is understood to mean conditions such as:

a) blackout situation

b) dead ship situation

c) routine use for testing

d) short-term parallel operation with the main source of electrical power for the purpose of load transfer.

Unless instructed otherwise by the Society, the emergency generator may be used during lay time in port for the supply of the ship mains, provided the requirements of Pt C, Ch 2, Sec 3, [2.4] are complied with.

3.1.4 The electrical power available shall be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously.

3.1.5 The emergency source of electrical power shall be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the services stated in [3.2.3] for the period specified, if they depend upon an electrical source for their operation.

3.1.6 The transitional source of emergency electrical power, where required, is to be of sufficient capacity to supply at least the services stated in [3.2.6] for the periods specified therein, if they depend upon an electrical source for their operation.

3.1.7 An indicator shall be mounted in a suitable place on the main switchboard or in the machinery control room to indicate when the batteries constituting either the emergency source of electrical power or the transitional source of emergency electrical power referred to in Pt C, Ch 2, Sec 3, [2.3.13] and Pt C, Ch 2, Sec 3, [2.3.15] are being discharged.

3.1.8 If the services which are to be supplied by the transitional source receive power from an accumulator battery by means of semiconductor converters, means are to be provided for supplying such services also in the event of failure of the converter (e.g. providing a bypass feeder or a duplication of converter).

3.1.9 Where electrical power is necessary to restore propulsion, the capacity of the emergency source shall be sufficient to restore propulsion to the ship in conjunction to other machinery as appropriate, from a dead ship condition within 30 min. after blackout.

For the purpose of this requirement only, the dead ship condition and blackout are both understood to mean a condition under which the main propulsion plant, boilers and auxiliaries are not in operation and in restoring the propulsion, no stored energy for starting the propulsion plant, the main source of electrical power and other essential auxiliaries is to be assumed available. It is assumed that means are available to start the emergency generator at all times.

The emergency generator and other means needed to restore the propulsion are to have a capacity such that the necessary propulsion starting energy is available within 30 minutes of blackout/dead ship condition as defined above. Emergency generator stored starting energy is not to be directly used for starting the propulsion plant, the main source of electrical power and/or other essential auxiliaries (emergency generator excluded).

For steam ships, the 30 minute time limit given in SOLAS can be interpreted as the time from blackout/dead ship condition defined above to light-off of the first boiler.

3.1.10 Provision shall be made for the periodical testing of the complete emergency system and shall include the testing of automatic starting arrangements.

3.1.11 For starting arrangements of emergency generating sets, see Pt C, Ch 1, Sec 2, [3.1].

3.1.12 The emergency source of electrical power may be either a generator or an accumulator battery, which shall comply with the provisions of [3.1.13] or [3.1.14], respectively.

3.1.13 Where the emergency source of electrical power is a generator, it shall be:

a) driven by a suitable prime mover with an independent supply of fuel having a flashpoint (closed cup test) of not less than 43°C;

b) started automatically upon failure of the electrical supply to the emergency switchboard from the main source of electrical power and shall be automatically connected to the emergency switchboard; those services referred to in [3.2.6] shall then be transferred automatically to the emergency generating set. The automatic starting system and the characteristic of the prime mover shall be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable, subject to a maximum of 45 s; and

c) provided with a transitional source of emergency electrical power according to [3.1.15].

3.1.14 Where the emergency source of electrical power is an accumulator battery, it shall be capable of:

a) 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;

b) automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power; and

c) immediately supplying at least those services specified in [3.2.6].

3.1.15 The transitional source of emergency electrical power required by [3.1.13] shall consist of an accumulator battery which shall operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage and be so arranged as to supply automatically in the event of failure of either the main or emergency source of electrical power at least the services in [3.2.6] if they depend upon an electrical source for their operation.

3.2 Distribution of electrical power

3.2.1 The emergency switch board shall be supplied during normal operation from the main switchboard by an interconnector feeder which shall be adequately protected at the main switchboard against overload and short-circuit and which is to be disconnected automatically at the emergency switchboard upon failure of the main source of electrical power.

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

3.2.2 In order to ensure ready availability of the emergency source of electrical power, arrangements shall be made where necessary to disconnect automatically non-emergency circuits from the emergency switchboard to ensure that power shall be available to the emergency circuits.

3.2.3 The emergency source of electrical power shall be capable of supplying simultaneously at least the following services for the periods specified hereafter, if they depend upon an electrical source for their operation:

a) for a period of 36 hours, emergency lighting:
   1) at every muster and embarkation station and over the sides;
   2) in alleyways, stairways and exits giving access to the muster and embarkation stations;
   3) in all service and accommodation alleyways, stairways and exits, personnel lift cars;
   4) in the machinery spaces and main generating stations including their control positions;
   5) in all control stations, machinery control rooms, and at each main and emergency switchboard;
   6) at all stowage positions for firemen's outfits;
   7) at the steering gear; and
   8) at the fire pump, the sprinkler pump and the emergency bilge pump referred to in (d) below and at the starting position of their motors;

b) for a period of 36 hours:
   1) the navigation lights and other lights required by the International Regulations for Preventing Collisions at Sea in force; and
   2) the VHF radio installation required by Regulation IV/7.1.1 and IV/7.1.2 of SOLAS 1974 as amended, and, if applicable:
      - the MF radio installation required by Regulations IV/9.1.1, IV/9.1.2, IV/10.1.2 and IV/10.1.3;
      - the ship earth station required by Regulation IV/10.1.1; and
      - the MF/HF radio installation required by Regulations IV/11.1.1 and IV/11.1.2;

c) for a period of 36 hours:
   1) all internal communication equipment required in an emergency (see [3.2.4];
   2) the shipborne navigational equipment as required by Regulation V/12; where such provision is unreasonable or impracticable the Head Office may waive this requirement for ships of less than 5,000 gross tonnage;
   3) the fire detection and fire alarm system, the fire door holding and release system; and
   4) intermittent operation of the daylight signalling lamp, the ship's whistle, the manually operated call points and all internal signals (see [3.2.5]) that are required in an emergency, unless such services have an independent supply for the period of 36 hours from an accumulator battery suitably located for use in an emergency;

d) for a period of 36 hours:
   1) one of the fire pumps required by the relevant provisions of Part C, Chapter 4;
   2) the automatic sprinkler pump, if any; and
   3) the emergency bilge pump and all the equipment essential for the operation of electrically powered remote controlled bilge valves;

e) for the period of time required in Pt C, Ch 1, Sec 12, [2], the steering gear if required to be so supplied;

f) for a period of half an hour:

1) any watertight doors required by Regulation II-1/15 to be power operated together with their indicators and warning signals;

2) the emergency arrangements to bring the lift cars to deck level for the escape of persons. The lift cars may be brought to deck level sequentially in an emergency.

3.2.4 Internal communication equipment required in an emergency generally includes:

a) the means of communication between the navigating bridge and the steering gear compartment

b) the means of communication between the navigating bridge and the position in the machinery space or control room from which the engines are normally controlled

c) the means of communication which is provided between the officer of the watch and the person responsible for closing any watertight door which is not capable of being closed from a damage control station

d) the public address system or other effective means of communication throughout the accommodation, public and service spaces

e) the means of communication between the navigating bridge and the main fire control station.

3.2.5 Internal signals required in an emergency generally include:

a) general alarm

b) watertight door indication

c) fire door indication.

3.2.6 The transitional source of emergency electrical power required is to supply at least the following services if they depend upon an electrical source for their operation:

a) for half an hour:

1) the lighting required by item b) [3.2.3] and Pt C, Ch 2, Sec 3, [3.6.6];

2) all services required by [3.2.3] items c) 1), c) 3) and c) 4) unless such services have an independent supply for the period specified from an accumulator battery suitably located for use in an emergency.

b) It is also to supply power to close the watertight doors as required by Regulation II-1/15.7.3.3, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided. Power to the control, indication and alarm circuits as required by Regulation II-1/15.7.2, for half an hour.

3.3 Low-location lighting

3.3.1 Aircraft carriers are to be provided with a low-location lighting (LLL) system in accordance with Pt C, Ch 4, Sec 8, [2.3.2].

Where LLL is satisfied by electric illumination, it is to comply with the following requirements.

3.3.2 The LLL system is to be connected to the emergency switchboard and is to be capable of being powered either by the main source of electrical power, or by the emergency source of electrical power for a minimum period of 60 minutes after energizing in an emergency.

3.3.3 The power supply arrangements to the LLL are to be arranged so that a single fault or a fire in any one fire zone or deck does not result in loss of the lighting in any other zone or deck. This requirement may be satisfied by the power supply circuit configuration, use of cables of a fire-resistant type complying with Pt C, Ch 2, Sec 9, [2.1.11], and/or the provision of suitably located power supply units having integral batteries adequately rated to supply the connected LLL for a minimum period of 60 minutes.

3.3.4 Single lights and lighting assemblies are to be designed or arranged so that any single fault or failure in a light or lighting assembly, other than a short-circuit, will not result in a break in visible delineation exceeding 1 metre.

3.3.5 Light and lighting assemblies are to be flame-retardant as a minimum, to have an ingress protection of at least IP55 and to meet the type test requirements as specified in Pt C, Ch 3, Sec 6, Tab 1.

3.3.6 The LLL system is to be capable of being manually activated by a single action from the continuously manned damage control station. It may, additionally, be continuously operating or be switched on automatically, e.g. by the presence of smoke within the space(s) being served.

3.3.7 When powered, the systems are to achieve the following minimum luminance:

- for any planar source: 10 cd/m^2 from the active parts in a continuous line of 15 mm minimum width

- for any point source: 35 mcd in the typical track directions of approach and viewing which is to be considered:
  - for sources which are required to be viewed from a horizontal position, i.e. deck mounted or horizontally bulkhead mounted fittings, within a 60° cone having its centre located 30° from the horizontal mounting surface of the point source and in line with the track direction; see Fig 1
  - for sources which are required to be viewed vertically, i.e. the vertical LLL marking up to the door handles, within a 60° cone having its centre located perpendicular to the mounting service of the point source; see Fig 2.

Spacing between sources is not to exceed 300 mm.

Figure 1 : Minimum luminance for LLL point sources mounted on horizontal surfaces

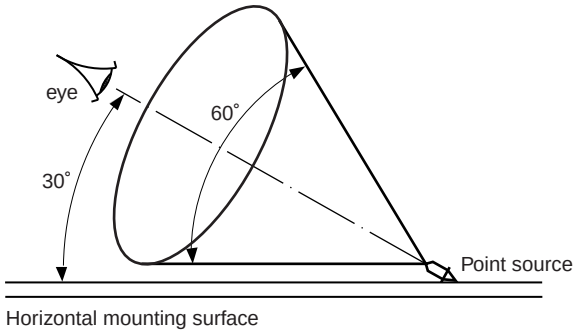
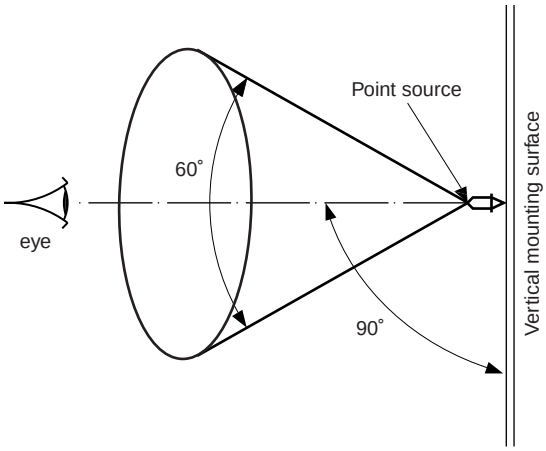


Figure 2 : Minimum luminance for LLL point sources mounted on vertical surfaces



3.3.8 The lights or lighting assemblies are to be continuous except as interrupted by constructional constraints, such as corridors or cabin doors etc., are to provide a visible delineation along the escape route and, where applicable, are to lead to the exit door handles. Interruption of the LLL system due to constructional constraints is not to exceed 2 metres.

3.3.9 The lighting is to be provided on at least one side of the corridor or stairway. In corridors and stairways in excess of 2 metres width, lighting is to be provided on both sides.

3.3.10 In corridors the lighting is to be installed either on the bulkhead within 300 mm of the deck or, alternatively, on the deck within 150 mm of the bulkhead.

3.3.11 In stairways the lighting is to be installed within 300 mm above the steps such that each step may be readily identified from either above or below that step. The top and bottom steps are to be further identified to show that there are no further steps.

4 General emergency alarm and public address systems

4.1 General emergency alarm system

4.1.1 An electrically operated bell or klaxon or other equivalent warning system installed in addition to the ship's whistle or siren for sounding the general emergency alarm signal is to comply with the requirements of Pt C, Ch 2, Sec 3, [3.14] and, in addition, with the requirements of the present sub-article.

4.1.2 The alarm system is to be audible throughout all the accommodation and normal crew working spaces and on all open decks.

4.1.3 The minimum sound pressure level for the emergency alarm tone in interior and exterior spaces is to be 80 dB (A) and at least 10 dB (A) above ambient noise levels existing during normal equipment operation with the ship underway in moderate weather.

4.1.4 In cabins without a loudspeaker installation, an electronic alarm transducer, e.g. a buzzer or similar, is to be installed.

4.1.5 The sound pressure level at the sleeping position in cabins and in cabin bathrooms is to be at least 75 dB (A) and at least 10 dB (A) above ambient noise levels.

4.1.6 For cables used for the general emergency alarm system, see Pt C, Ch 2, Sec 3, [9.6]; Pt C, Ch 2, Sec 11, [5.2.1] and Pt C, Ch 2, Sec 11, [5.2.4].

4.1.7 Electrical cables and apparatus for the general emergency alarm system and their power supply are to be arranged so that the loss of the system in any one area due to localized fire is minimized.

4.1.8 Where the fire alarm to summon the crew operated from the navigating bridge or fire control station is part of the ship's general alarm system, it is to be capable of being sounded independently of the alarm in the public spaces.

4.2 Public address system

4.2.1 The requirements of Pt C, Ch 2, Sec 3, [3.15] are to be replaced with the following provisions [4.2.2] to [4.2.16].

4.2.2 The public address system is to be one complete system consisting of a loudspeaker installation which enables simultaneous broadcast of messages from the navigation bridge, and at least one other location on-board for use when the navigation bridge has been rendered unavailable due to the emergency, to all spaces where crew members are normally present (accommodation and service spaces, control stations and open decks), and to assembly stations (i.e. muster stations).

In spaces such as under deck passageways, bosun’s locker, hospital and pump room, the public address system may not be required.

4.2.3 The public address system is to be arranged to operate on the main source of electrical power, the emergency source of electrical power and transitional sources of electrical power as required by Pt C, Ch 2, Sec 3, [2.3] and Pt C, Ch 2, Sec 3, [3.6].

4.2.4 The controls of the system on the navigation bridge are to be capable of interrupting any broadcast on the system from any other location on board.

4.2.5 Where an individual loudspeaker has a device for local silencing, an override arrangement from the control station(s), including the navigating bridge, is to be in place.

4.2.6 The system is not to require any action by the addressee.

4.2.7 It is to be possible to address crew accommodation and work spaces separately from public spaces.

4.2.8 In addition to any function provided for routine use aboard the ship, the system is to have an emergency function control at each control station which:

a) is clearly indicated as the emergency function

b) is protected against unauthorized use

c) automatically overrides any other input system or program, and

d) automatically overrides all volume controls and on/off controls so that the required volume for the emergency mode is achieved in all spaces.

4.2.9 The system is to be installed with regard to acoustically marginal conditions, so that emergency announcements are clearly audible above ambient noise in all spaces where crew members are normally present (accommodation and service spaces, control stations and open decks), and at assembly stations (i.e. muster stations).

4.2.10 With the ship underway in normal conditions, the minimum sound pressure level for broadcasting emergency announcements is to be:

a) in interior spaces 75 dB (A) and at least 20 dB (A) above the speech interference level, and

b) in exterior spaces 80 dB (A) and at least 15 dB (A) above the speech interference level.

Evidence of this level is to be shown with test result in open sea or equivalent quay measurement with appropriate correction factor.

4.2.11 The system is to be arranged to prevent feed-back or other interference.

4.2.12 The system is to be arranged to minimize the effect of a single failure so that the emergency messages are still audible (above ambient noise levels) also in the event of failure of any one circuit or component.

4.2.13 Each loudspeaker is to be individually protected against short-circuits.

4.2.14 For cables used for the public address system, see Pt C, Ch 2, Sec 3, [9.6]; Pt C, Ch 2, Sec 11, [5.2.1] and Pt C, Ch 2, Sec 11, [5.2.4].

4.2.15 All areas of each fire zone are to be served by at least two dedicated loops of flame-retardant cables which are to be sufficiently separated throughout their length and supplied by two separate and independent amplifiers.

4.2.16 A temperature alarm is to be provided in the public address cabinets in case of forced air cooling.

4.3 Combined general emergency alarm - Public address system

4.3.1 The requirements of Pt C, Ch 2, Sec 3, [3.16] are to be replaced with the following provisions [4.3.2].

4.3.2 Where the public address system is the only means for sounding the general emergency alarm signal and the fire alarm, in addition to the requirements of [4.1] and [4.2], the following are to be satisfied:

- the system automatically overrides any other input system when an emergency alarm is required
- the system automatically overrides any volume control provided to give the required output for the emergency mode when an emergency alarm is required
- the system is arranged to minimize the effect of a single failure so that the alarm signal is still audible (above ambient noise levels) also in the event of failure of any one circuit or component, by means of the use of more than one device for generating an electronic sound signal.

5 Automation

5.1 Alarms and safeties related to steam generation for catapults

5.1.1 Alarm and safeties related to steam production required for catapult operation, if any, are given in Pt C, Ch 1, Sec 3 and Part E, Chapter 3, where an additional automation notation is granted.

5.2 Data transmission link

5.2.1 The data transmission link are to be designed so as to comply to the rules given in Pt C, Ch 3, Sec 3, [7.2]. In addition, the hardware and software related to the data transmission link used for essential services are to be found in compliance with IEC 60945 and 61162. Appropriate test report and evidences, in line with these standards, are to be submitted to the Society.

5.3 Wheelhouse arrangement

5.3.1 The visibility from the wheelhouse is to be in accordance with Pt E, Ch 11, Sec 4, [6.2.1]. Where there is blind sectors larger than 5°, due to the asymmetrical location of the wheelhouse, cameras or equivalent vision systems are to be provided in appropriate location so as to cover the blind area.

5.3.2 No blind space of the landing area is to be found from the wheelhouse. If this is not achievable, cameras are to be provided in appropriate location so as to cover the blind area.

5.3.3 A status panel is to be provided in wheelhouse console to indicate the positions of the hangar doors and the positions of the aircraft elevators.

5.3.4 Due to asymmetric location of the wheelhouse, port bridge wing may be omitted.

5.3.5 Microphone and loudspeaker required in Pt E, Ch 11, Sec 4 are to be provided with a dimmer, when aircraft are operated.

Section 5 Fire Protection

1 General

1.1 Application

1.1.1 Unless otherwise specified, the provisions of this Section apply to the ships assigned the service notation **aircraft carrier**

1.1.2 Unless otherwise specified, the requirements of this section apply in addition to those of Part C, Chapter 4. Some of the requirements of Part C, Chapter 4 are however replaced by those of this section, as detailed in the concerned requirements.

1.1.3 The installations or equipment used for specific military operations which are not permanently fixed to the hull of the ship, such as mobile containers used to occasionally accommodate a mobile hospital or a mobile headquarters, are not required to comply with the requirements of this section. All other installations and equipment, including portable equipment required in this section, are to comply with the relevant requirements outlined in this section.

1.1.4 Damage control stations

The list of the references for requirements concerning controls and indicators required to be centralized in the damage control stations as defined in Pt C, Ch 4, Sec 1, [2.14.1] is indicated in Tab 1.

Table 1 : Controls and/or indicators required in damage control stations

Requirement reference	Related systems
Pt C, Ch 4, Sec 2, [2.1.1]	Controls and indicators of ventilation systems and fire and smoke damper controls and monitoring
Pt C, Ch 4, Sec 3, [7.2.1]	Fire detection alarms (see also Pt C, Ch 4, Sec 3, [2.2.1]) and monitoring, position of fire doors, control and monitoring of ventilation fans
Pt C, Ch 4, Sec 4, [2.1.3]	Controls for smoke release
[4.2.1], items c), d) and f)	Remote release of fire doors and status of the fire doors as appropriate
Pt C, Ch 4, Sec 5, [5.1.1]	Position of fire doors leading to or from vehicle or ro-ro space
Pt C, Ch 4, Sec 6, [3.2.1]	Controls for closing of ventilation openings and associated monitoring for spaces protected by fixed gas fire-extinguishing systems
Pt C, Ch 4, Sec 6, [4.6.3]	Alarm of activation of any fixed water-based local application fire-extinguishing system
Pt C, Ch 4, Sec 13, [2.1.2]	Controls of power ventilation systems for closed vehicle spaces and ro-ro spaces
Pt C, Ch 4, Sec 13, [2.1.3]	Indication of any loss of capacity of the ventilation systems of close vehicle or ro-ro spaces
Pt C, Ch 1, Sec 10, [8.4.2]	Position of discharge valves for scuppers in vehicle and ro-ro spaces when protected by water-based fire-extinguishing systems. Visual and audible alarm if fire-extinguishing system operating while the valves are closed
Pt C, Ch 4, Sec 14, [5.1.4]	Visual and audible alarm in case of activation of local carbon dioxide systems
Pt C, Ch 4, Sec 14, [6.1.2], items b)4) and b)5)	Controls and alarm for activation of high expansion foam fire-extinguishing system
Pt C, Ch 4, Sec 14, [7.3.1], items l) and o)	Controls and alarms for equivalent water-based fire-extinguishing systems
Pt C, Ch 4, Sec 14, [7.4.2], item e)	Means of control and monitoring of fixed thick water fire-extinguishing systems
Pt C, Ch 4, Sec 14, [7.4.2], item i)	Indication of foam concentrate level for thick water systems
Pt C, Ch 4, Sec 14, [8.2.1], item a)	Means of control of the valves connecting the sprinkler system to the fire main
Pt C, Ch 4, Sec 14, [8.2.1], items h) and i) Pt C, Ch 4, Sec 14, [8.3.5], item b)1)	Visual and audible alarm in case of activation of any manual or automatic sprinkler section valve
Pt C, Ch 4, Sec 14, [9.2.5], item a)2)	Control panel for fire detection and fire alarm system
Pt E, Ch 1, Sec 4, [2.1.2] item b)3) and d), Pt E, Ch 1, Sec 4, [2.3.4], item c), Pt E, Ch 1, Sec 4, [2.4.3]	For ships assigned the additional class notation **FFS**, position indicator for isolating valves, if provided and overboard discharge valves.
Pt E, Ch 8, Sec 3, [6]and Pt E, Ch 8, Sec 3, Tab 2	For ships assigned the additional class notation **CBRN** or **CBRN-AIRBLAST RESISTANCE**, monitoring and control for the CBRN protection systems

1.2 Documents to be submitted

1.2.1 The interested party is to submit to the Society the documents listed in Tab 2.

Table 2 : Documentation to be submitted

No	I/A **(1)**	Document **(2)**
1	A	Structural fire protection showing the purpose of the various spaces of the ships, the fire rating of bulkheads and decks, means of closings of openings in A and B class divisions, draught stops, and completed with the indication of material of other bulkhead and of ceilings and lining
2	A	Natural and mechanical ventilation systems showing the penetrations on A class divisions, location of dampers, means of closing, arrangements of air conditioning rooms
3	A	Means of escape and access to spaces
4	A	Automatic fire detection systems and manually operated call points
5	A	Fire pumps and fire main including pumps head and capacity, hydrant and hose locations **(2)**
6	A	Arrangement of fixed fire-extinguishing systems **(2)**
7	A	Arrangement of sprinkler or sprinkler equivalent systems **(2)**
8	A	Fire-fighting equipment and firemen's outfits
9	A	Electrical diagram of the fixed gas fire-extinguishing systems, fixed fire detection systems, fire alarm and emergency lighting
10	A	Electrical diagram of the sprinkler systems
11	A	Electrical diagram of power control and position indication circuits for fire devices
12	I	General arrangement plan
13	I	Safety zone plan
14	A	Fire control plan

(1) A = to be submitted for approval, I = to be submitted for information.

(2) Plans are to be schematic and functional and to contain all information necessary for their correct understanding and verification such as:

- service pressures
- capacity and head of pumps and compressors, if any
- materials and dimensions of piping and associated fittings
- volumes of protected spaces, for gas and foam fire-extinguishing systems
- surface areas of protected zones for sprinkler and pressure water-spraying, low expansion foam and powder fire-extinguishing systems
- capacity, in volume and/or in mass, of vessels or bottles containing the extinguishing media or propelling gases, for gas, sprinkler, foam and powder fire-extinguishing systems
- type, number and location of nozzles of extinguishing media for gas, sprinkler, pressure water-spraying, foam and powder fire-extinguishing systems.

All or part of the information may be provided, instead of on the above plans, in suitable operation manuals or in specifications of the systems.

2 General requirements

2.1 Vertical subdivisions

2.1.1 For ships fitted with a takeoff aircraft catapult equipment, the railway of the catapult is to be excluded from the subdivision into main vertical zones and vertical safety zones.

2.1.2 The interior of the ship shall be subdivided into vertical safety zones by A-60 class divisions. Steps and recesses shall be kept to a minimum, but where they are necessary they shall also be A-60 class divisions. Where a category (5), (9) or (10) space defined in item b) of Pt C, Ch 4, Sec 5, [1.2.3] is on one side or where fuel or diesel oil or JP 5 NATO (F44) tanks or water capacity are on both sides of the division, the standard can be reduced to A-0.

2.1.3 The subdivisions into main vertical zones and vertical safety zones are to fall into line between each others. That means that a main vertical zone is not to be astride on two vertical safety zones.

2.1.4 When vulnerability zones are specified according to Pt C, Ch 4, Sec 1, [2.40], the bulkheads forming the boundaries of the vulnerability zones are to be in line with the safety zone bulkheads. A vulnerability zone may however include several safety zones.

2.1.5 The length of the vertical safety zones is not to exceed 80 m but may be extended to a maximum of 100 m in order to bring the furthermost ends of the ship such as its bow or corbelled parts of the ship. If the length of the vertical safety zone exceed 80 m, the total area of the vertical safety zone is not to be more than 3400 m² on any deck. The maximum length of a vertical safety zone is the maximum distance between the furthermost points of the bulkheads bounding it.

2.1.6 If the part of the ship located forward of the collision bulkhead forms one vertical safety zone, or if the aircraft hangar forms one horizontal safety zone, this safety zone is to contain only one main vertical zone. This vertical safety zone and main vertical zone need not to comply with [6.2.12] for the assembly and embarkation stations, but the provision of [4.3.1] on ventilation still applies. As for the provisions for the fire pump, the requirements of Pt C, Ch 4, Sec 6, [1.3.2] need not to be applied for these zones.

2.2 Horizontal subdivisions

2.2.1 The ship may accommodate some additional horizontal safety zones to enclose any large ro-ro or vehicles spaces. In this case, the horizontal safety zone may contain only one main horizontal zone.

2.2.2 These horizontal safety zones may extend on more than one deck provided that the total overall clear height for vehicles does not exceed 10 m.

2.2.3 The requirements of ventilation systems and ducts, openings in A class divisions and penetrations in A class divisions for maintaining the integrity of vertical safety zone in this Chapter shall be applied equally to decks and bulkheads forming the boundaries separating horizontal safety zones from each other and from the remainder of the ship. That means that the requirements for A-30 class steel ducts and A-30 class divisions of Pt C, Ch 4, Sec 5, [1.2.1] item a) are to be replaced by requirements for A-60 class steel ducts and A-60 class divisions.

2.3 Control stations

2.3.1 One damage control station is to be provided in each safety zone and so equipped in such a way that one damage control station can be replaced by an other one.

2.3.2 Aircraft facilities fire control stations

At least two fire control stations are to be arranged in the aircraft hangars area and at least one fire control station is to be arranged close to the flight deck, at a location allowing fire-fighters to watch over aircraft operations. It is to be possible to park a fire-fighting truck (VLIP) in the vicinity of the flight deck fire control station.

3 Detection and alarm

3.1 Fixed fire detection and fire alarm system

3.1.1 The fixed fire detection and fire alarm system is to be capable of remotely and individually identifying each detector and manually operated call point. Fire detectors fitted in cabins, when activated, are also to be capable of emitting, or cause to be emitted, an audible alarm within the space where they are located.

3.1.2 A section of detectors and manually operated call points is not to be situated in more than one main vertical zone.

4 Containment of fire

4.1 Fire integrity of bulkheads and decks

4.1.1 The fire integrity of all bulkheads and decks prescribed in Pt C, Ch 4, Sec 5, Tab 1 and Pt C, Ch 4, Sec 5, Tab 2 is to be replaced by the requirements of the following Tab 3 and Tab 4.

4.1.2 Fire integrity of the flight decks

Except when a space of category (5), (9) or (10) is located below the flight decks, the flight decks are to have A-30 rating.

Note 1: When accepted by the Naval Authority, the above requested A-30 standard may locally be reduced to A-0.

In addition, the standard is to be A-60 in the following areas:

a) the helideck landing areas, and

b) for ships provided with a catapult equipment, A-60 integrity is required between the catapult space and the other internal parts of the ship and the insulation is to continue on the flight deck for a distance of at least 450 mm.

4.2 Protection of openings in fire-resistant divisions

4.2.1 The requirements of item d) of Pt C, Ch 4, Sec 5, [3.1.1] are to be replaced by the following requirements applicable to fire doors in main vertical zone bulkheads, galley boundaries and stairway enclosures other than watertight doors and those which are normally locked:

a) The doors are to be self-closing and be capable of closing with an angle of inclination of up to 3,5° opening closure.

b) The approximate time of closure for hinged fire doors is to be not more than 40 s and not less than 10 s from the beginning of their movement with the ship in upright position. The approximate uniform rate of closure for sliding doors is to be not more than 0,2 m/s and not less than 0,1 m/s with the ship in upright position.

c) The doors, except those for emergency escape trunks, are to be capable of remote release from the continuously manned damage control station, either simultaneously or in groups, and are to be capable of release also individually from a position at both sides of the door. Release switches are to have an on-off function to prevent automatic resetting of the system.

d) Hold-back hooks not subject to remote release from the continuously manned damage control station are prohibited.

e) A door closed remotely from a damage control station is to be capable of being re-opened from both sides of the door by local control. After such local opening, the door is to close again automatically.

f) Indication is to be provided at the fire door indicator panel in the continuously manned damage control station whether each door is closed.

g) The release mechanism is to be so designed that the door is to close automatically in the event of disruption of the control system or central power supply.

h) Local power accumulators for power-operated doors are to be provided in the immediate vicinity of the doors to enable the doors to be operated at least ten times (fully opened and closed) after disruption of the control system or central power supply using the local controls.

i) Disruption of the control system or central power supply at one door is not to impair the safe functioning of the other doors.

j) Remote-release sliding or power-operated doors are to be equipped with an alarm that sounds at least 5 s but not more than 10 s after the door begins to move, and continues sounding until the door is completely closed.

k) A door designed to re-open upon contracting an object in its path is to re-open not more than 1 m from the point of contact.

l) Double-leaf doors equipped with a latch necessary for their fire integrity are to have a latch that is automatically activated by the operation of the doors when released by the system.

m) Doors giving direct access to ro-ro spaces which are power-operated and automatically closed need not be equipped with the alarms and remote-release mechanisms required in items 3) and j).

n) The components of the local control system are to be accessible for maintenance and adjusting.

o) Power-operated doors are to be provided with a control system of an approved type which is to be able to operate in case of fire and be in accordance with the Fire Test Procedure Code. This system is to satisfy the following requirements:

- the control system is to be able to operate the door at the temperature of at least 200°C for at least 60 min., served by the power supply
- the power supply for all other doors not subject to fire is not to be impaired, and
- at temperatures exceeding 200°C, the control system is to be automatically isolated from the power supply and is to be capable of keeping the door closed up to at least 945°C.

4.2.2 Hose ports

With reference to the provision of Pt C, Ch 4, Sec 5, [3.1.1], as far as practicable, self-closing hose ports are to be provided on all A class doors except watertight doors, weathertight doors (semi-watertight doors), doors leading to the open decks and doors required to be gas-tight.

As far as practicable, where a watertight or weathertight or gas-tight door is fitted in a respective internal watertight or weathertight or gas-tight bulkhead, a respective watertight or weathertight or gas-tight opening capable of being opened from both sides of the bulkhead is to be provided on this bulkhead close to the door for permitting the passage of a fire hose through this bulkhead when the door is closed. Suitable measures are to be taken to ensure that this opening is closed at sea.

4.2.3 Stairway enclosures

a) With reference to the provision of Pt C, Ch 4, Sec 5, [1.2.4], stairways not enclosed within enclosures formed of A class divisions in compliance with Tab 3 and Tab 4 are not to be permitted.

b) Nevertheless, stairways which are fitted in accordance with [6.2.3] may not be enclosed within A class divisions, provided that the stairway penetrates a single deck and is protected, at a minimum, at one level by at least B class divisions and self-closing doors.

4.2.4 Openings in B class divisions

Notwithstanding the provisions of Pt C, Ch 4, Sec 5, [3.1.2], item a), ventilation openings in B class divisions with an area of more than 0,05m² may be permitted within accommodation areas provided they are fitted in the lower part of the division and are provided with a grill made of non-combustible material which is fitted with a means of closing, operable from the passageway.

Such arrangement is to be to the satisfaction of the Society.

Table 3 : Bulkheads not bounding neither vertical zones nor horizontal zones nor safety zones

SPACES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Control stations and equivalent spaces (1)	A-0 [a] [g]	A-0	A-0	A-0	A-0	A-60 A-15 [f]	A-60 A-30 [f]	A-60 A-30 [f]	A-0	A-0	A-60	A-60	A-60	A-60	A-30
Stairways (2)		A-0 [a]	A-0	A-0	A-0	A-0	A-15 A-0 [f]	A-15 A-0 [f]	A-0	A-0	A-15	A-30	A-15	A-30	A-30
Corridors (3)			B-15 C [f]	A-60	A-0	B-15 B-0 [f]	B-15 B-0 [f]	B-15 B-0 [f]	B-15 B-0 [f]	A-0	A-15	A-30	A-0	A-30	A-30
Evacuation stations and external escape routes (4)				*	A-0	A-60 [b] [d]	A-60 [b] [d]	A-60 [b] [d]	A-0 [d]	A-0	A-60 [b]	A-60 [b]	A-60 [b]	A-60 [b]	A-30
Open deck spaces (5)					*	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30 [e]
Accommodation spaces of minor fire risk (6)						B-0 C [f]	B-0 C [f]	B-0 C [f]	C	A-0	A-0	A-30	A-0	A-30 A-15 [f]	A-30
Service spaces and accommodation spaces of moderate fire risk (7)							B-0 C [f]	B-0 C [f]	C	A-0	A-15	A-60	A-15	A-60 A-30 [f]	A-30
Accommodation spaces of greater fire risk (8)								B-0 C [f]	C	A-0	A-30	A-60	A-15	A-60	A-30
Sanitary and similar spaces (9)									C	A-0	A-0	A-0	A-0	A-0	A-30

Note 1: (to be applied to Tab 3 and Tab 4, as appropriate)

[a] : Where adjacent spaces are in the same numerical category and letter [a] appears, a bulkhead of the rating shown in the tables is only required when the adjacent spaces are for a different purpose. For example, in category (13) a bulkhead need not be required between a galley and its annexed pantries provided the pantry bulkheads and decks maintain the integrity of the galley boundaries. A bulkhead is, however, required between a galley and a workshop even though both spaces are in category (13).

[b] : The ship's side to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to liferafts and evacuation slides may be reduced to A-30.

[c] : Where public toilets are installed completely within the stairway enclosure, the public toilet bulkhead within the stairway enclosure can be of B class integrity.

[d] : Where spaces of category (6), (7), (8) and (9) are located completely within the perimeter of the evacuation station, the bulkheads of these spaces are allowed to be of B-0 class integrity. Control positions for audio, video and light installations may be considered as part of the evacuation station.

[e] : When an ammunition space is adjacent or above a water tank, or adjacent to the shell of the ship below the lowest possible waterline, only “A-0” standard is required.

[f] : Where the spaces on both sides of the bulkhead are protected by an automatic sprinkler system or equivalent, the fire integrity can be the lower class standard. Where, on one side of the bulkhead, the space is protected by an automatic sprinkler system or equivalent and, on the other side, the space is of category (9) and not protected by the sprinkler system, the fire integrity can also be the lower class standard. Where the space below the deck is protected by an automatic sprinkler system or equivalent, the fire integrity of the deck can be the lower class standard.

[g] : Bulkheads separating the wheelhouse, chartroom and radio room from each other can have only a B-0 rating.

[h] : If the adjacent space of category (11) is a fuel oil or JP5 NATO (F44) tank, the standard can be reduced to A-0.

[i] : Where the ammunition space is fitted above a water tank, the deck can have only A-0 rating.

* : Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material but is not required to be of A class standard. However, where a deck, except an open deck, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke.

[j] : A fire division of at least A-30 standard is required between spaces containing a section of main switchboards and spaces of categories (13) or (14).

[k] : The boundaries between battery rooms containing Li-ion-type batteries and machinery spaces of category A are to have A-60 fire integrity.

SPACES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Tanks, voids and auxiliary machinery spaces having little or no fire risk (10)										A-0 [a]	A-0	A-0	A-0	A-0	A-30 [e]
Auxiliary machinery spaces and other similar spaces of moderate fire risk (11)											A-0 [a]	A-30 [h]	A-0 [j]	A-15 A-0 [f] [j]	A-30
Machinery spaces of category A and equivalent spaces of high fire risk (12)												A-30 [k]	A-0	A-60	A-60
Service spaces of high fire risk (13)													A-0	A-0	A-30
Special purpose spaces (14)														A-30 [a]	A-30
Ammunition spaces and other equivalent spaces (15)															A-30

Note 1: (to be applied to Tab 3 and Tab 4, as appropriate)

[a] : Where adjacent spaces are in the same numerical category and letter [a] appears, a bulkhead of the rating shown in the tables is only required when the adjacent spaces are for a different purpose. For example, in category (13) a bulkhead need not be required between a galley and its annexed pantries provided the pantry bulkheads and decks maintain the integrity of the galley boundaries. A bulkhead is, however, required between a galley and a workshop even though both spaces are in category (13).

[b] : The ship's side to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to liferafts and evacuation slides may be reduced to A-30.

[c] : Where public toilets are installed completely within the stairway enclosure, the public toilet bulkhead within the stairway enclosure can be of B class integrity.

[d] : Where spaces of category (6), (7), (8) and (9) are located completely within the perimeter of the evacuation station, the bulkheads of these spaces are allowed to be of B-0 class integrity. Control positions for audio, video and light installations may be considered as part of the evacuation station.

[e] : When an ammunition space is adjacent or above a water tank, or adjacent to the shell of the ship below the lowest possible waterline, only “A-0” standard is required.

[f] : Where the spaces on both sides of the bulkhead are protected by an automatic sprinkler system or equivalent, the fire integrity can be the lower class standard. Where, on one side of the bulkhead, the space is protected by an automatic sprinkler system or equivalent and, on the other side, the space is of category (9) and not protected by the sprinkler system, the fire integrity can also be the lower class standard. Where the space below the deck is protected by an automatic sprinkler system or equivalent, the fire integrity of the deck can be the lower class standard.

[g] : Bulkheads separating the wheelhouse, chartroom and radio room from each other can have only a B-0 rating.

[h] : If the adjacent space of category (11) is a fuel oil or JP5 NATO (F44) tank, the standard can be reduced to A-0.

[i] : Where the ammunition space is fitted above a water tank, the deck can have only A-0 rating.

* : Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material but is not required to be of A class standard. However, where a deck, except an open deck, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke.

[j] : A fire division of at least A-30 standard is required between spaces containing a section of main switchboards and spaces of categories (13) or (14).

[k] : The boundaries between battery rooms containing Li-ion-type batteries and machinery spaces of category A are to have A-60 fire integrity.

Table 4 : Decks not forming steps in main vertical zones nor bounding horizontal zones nor safety zones

SPACE below	SPACE above														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Control stations and equivalent spaces (1)	A-30 A-0 [f]	A-30 A-0 [f]	A-15 A-0 [f]	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-60	A-0	A-60 A-30 [f]	A-30
Stairways (2)	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30	A-0	A-30 A-0 [f]	A-30
Corridors (3)	A-15 A-0 [f]	A-0	A-0 [a]	A-60	A-0	A-0	A-15 A-0 [f]	A-15 A-0 [f]	A-0	A-0	A-0	A-30	A-0	A-30 A-0 [f]	A-30
Evacuation stations and external escape routes (4)	A-0	A-0	A-0	A-0	*	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Open deck spaces (5)	A-0	A-0	A-0	A-0	*	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30 [e]
Accommodation spaces of minor fire risk (6)	A-60 A-0 [f]	A-15 A-0 [f]	A-0	A-60	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Service spaces and accommodation spaces of moderate fire risk (7)	A-60 A-30 [f]	A-15 A-0 [f]	A-15 A-0 [f]	A-60	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Accommodation spaces of greater fire risk (8)	A-60 A-30 [f]	A-15	A-15 A-0 [f]	A-60	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Sanitary and similar spaces (9)	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Tanks, voids and auxiliary machinery spaces having little or no fire risk (10)	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0 [a]	A-0	A-0	A-0	A-0	A-30 [i] [e]
Auxiliary machinery spa-ces and other similar spa-ces of moderate fire risk (11)	A-60	A-60 A-15 [f]	A-60 A-15 [f]	A-60	A-0	A-0	A-0	A-0	A-0	A-0	A-0 [a]	A-30 [h]	A-0 [j]	A-30 A-0 [f] [j]	A-30
Machinery spaces of category A and equivalent spaces of high fire risk (12)	A-60	A-60	A-60	A-60	A-0	A-60	A-60	A-60	A-0	A-0	A-30 [h]	A-30 [k]	A-0	A-60	A-60
Service spaces of high fire risk (13)	A-60	A-30	A-15	A-60	A-0	A-15	A-30	A-30	A-0	A-0	A-0 [j]	A-0	A-0 [a]	A-0	A-30
Special purpose spaces (14)	A-60	A-60	A-60	A-60	A-0	A-30	A-60	A-60	A-0	A-0	A-0 [j]	A-0	A-0	A-0	A-30
Ammunition spaces and other equivalent spaces (15)	A-30	A-30	A-30	A-30	A-30 [e]	A-30	A-30	A-30	A-30	A-30 [e]	A-30	A-60	A-30	A-30	A-30
Note 1: The notes of Tab 3 apply to Tab 4, as appropriate.															

4.3 Ventilation systems

4.3.1 For the application of this Chapter, the requirement of Pt C, Ch 4, Sec 5, [6.3.7] is to be replaced by:

"The ventilation fans shall be so disposed that the ducts reaching the various spaces remain within the main vertical zones.

The air conditioning units shall not serve more than one main vertical zone. However the air inlets and outlets of the ventilation system serving one main vertical zone may be located outside the main vertical zone provided that they are located inside the same vertical safety zone. In this case, the requirement of Pt C, Ch 4, Sec 5, [6.3.9] will apply for the dedicated ventilation duct passing through the main vertical zone boundary.

If the part of the ship located forward the collision bulkhead forms one vertical safety zone containing one single main vertical zone, the dedicated air conditioning units serving this main vertical zone can be located outside this main vertical zone provided that they are located inside the immediately adjacent aftward main vertical zone. In the same way, the air inlets and outlets of the ventilation system serving this vertical safety zone can be located outside this vertical safety zone provided that they are located inside the immediately adjacent aftward safety zone. In these two cases, the requirement of Pt C, Ch 4, Sec 5, [6.3.9] will apply for the dedicated duct passing through the main vertical zone boundary or vertical safety zone boundary.

Except for the particular cases mentionned above, a ventilation duct is to pass neither through a main vertical zone boundary nor through a vertical safety zone boundary."

5 Fire-extinguishing

5.1 Fire pump capacity

5.1.1 The capacity of each large capacity fire pump required by Pt C, Ch 4, Sec 6, [1.3.2] is to be not less than 100 m^3/h.

5.2 Sprinkler installation

5.2.1 A sprinkler system of an approved type and complying with the requirements of Pt C, Ch 4, Sec 14 is to be fitted in all control stations, accommodation and service spaces.

Alternatively, control stations, where water may cause damage to essential equipment, may be fitted with an approved fixed fire-extinguishing system of another type.

Spaces having little or no fire risk such as voids, public toilets, carbon dioxide rooms and similar spaces need not be fitted with a sprinkler system

5.3 Flight decks

5.3.1 The flight decks are to be protected by a fire protection system for flight decks complying with the provisions of Pt C, Ch 4, Sec 14, [10].

6 Evacuation

6.1 General

6.1.1 The requirements of Pt C, Ch 4, Sec 8 are to be replaced by the applicable requirements of SOLAS, Chapter II-2, Part D, Regulations 12 and 13 as applicable, for passenger ships carrying more than 36 passengers, and the applicable requirements of the Fire Safety System Code, Chapter 13, and other relevant IMO Resolutions, Circulars, Guidelines and other standards referred therein, except that:

a) regulations 13.3.2.1, 13.3.2.2 and 13.3.2.4.1 are replaced by the following [6.2.1] to [6.2.5]

b) regulation 13.3.2.3 is replaced by the following [6.2.6]

c) regulation 13.3.4 is replaced by Pt C, Ch 4, Sec 8, [3]

d) requirement 2.1.1 of FSS Code, Ch 13, is replaced by the following [6.2.9]

e) requirement 2.2.3 of FSS Code, Ch 13, is replaced by the following [6.2.10]

f) requirement 2.3.1 of FSS Code, Ch 13, is replaced by the following [6.2.11].

6.1.2 Where means are required to prevent smoke from impeding escape, the following means may be accepted:

- escape route enclosed within A-class divisios, or
- mechanical ventilation providing overpressure in the escape rout, or
- alternative solutions preventing smoke from filling the escape route may also be considered on a case-by-case basis.

6.1.3 Where means are required to prevent smoke from impeding escape, the following means may be accepted:

- escape route enclosed within A-class divisions
- mechanical ventilation providing overpressure in the escape route
- alternative solutions preventing smoke from filling the escape route may also be considered on a case-by-case basis.

6.1.4 All the persons onboard are to be assimilated to the crew.

6.1.5 When it is not practical to apply one requirement of the present Article, the arrangement is to be at the satisfaction of the Society with the agreement of the Naval Authority.

6.2 Means of escape

6.2.1 Escape from spaces below damage control deck

a) Below the damage control deck, two means of escape are to be provided from each watertight compartment or similarly restricted space or group of spaces.

b) The Society may dispense with one of the means of escape for service or machinery spaces which are entered only occasionally and for service and machinery spaces where the maximum travel distance to the door is 11m or less.

c) At least one of the means of escape required in item a) above is to consist of a readily accessible enclosed stairway, where means are provided to prevent smoke from impeding escape.

d) When external escape routes are provided, they are to be provided with emergency lighting in accordance with SOLAS Ch III regulation 11 and slip-free surfaces underfoot. Boundaries facing external open stairways and passage-ways forming part of an escape route and boundaries in such a position that their failure during a fire would impede escape to the embarkation deck are to have fire integrity, including insulation values, in accordance with Tab 3 and Tab 4, as appropriate, for category [4] spaces.

e) The stairway arrangement required by item c) for compartments below damage control deck within one main vertical zone may be arranged as follows:

   1) one enclosed stairway up to the embarkation deck in one watertight compartment, and

   2) each of the other watertight compartments of the main vertical zone has an enclosed stairway up to the damage control deck, and

   3) Where needed, an horizontal escape route allows transiting from the stairways referred to in item 2) to the stairways referred to in item 1). In general, such horizontal escape route is to be protected as a category (2) space. Other categorizations may however be accepted provided means are provided to prevent smoke from impeding escape.

6.2.2 Escape from spaces above the damage control deck: fire scenario

Above the damage control deck there is to be at least two means of escape from each main vertical zone or similarly restricted space or group of spaces. At least one of these means of escape is to give access to a stairway forming a vertical escape to the embarkation deck. This stairway is to comply with [4.2.3].

6.2.3 Escape from spaces between damage control deck and bulkhead deck: flooding scenario

a) Between damage control deck and bulkhead deck, at least one means of escape independent from watertight doors and giving access to embarkation deck is to be provided at each deck level from each watertight compartment or similarly restricted space or group of spaces.

b) The means of escape required in item a) above are to be, as far as practicable, a stairway, but where the purpose and forms of the ship make it impracticable, the means of escape may be a ladder or ladders (depending on the number of persons to be evacuated), to the satisfaction of the Society.

6.2.4 Dead-end corridors

Dead-end corridors with a length up to 9 m may be accepted in areas separated from cabin areas and provided conspicuous marking is installed outlining the dead-end.

6.2.5 Additional requirements

a) When it is not possible to cross from one side to the other of the ship, the requirements [6.2.1] to [6.2.3] are applicable to each side of the ship.

b) The stairways referred to in [6.2.1] and [6.2.2] (fire scenario) are to be sized considering that the total number of persons to be evacuated use those stairways. Other stairways which may be added for compliance with requirement [6.2.3] but do not comply with [6.2.1] are not to be considered as main escape routes for fire scenario evacuation analysis.

6.2.6 Direct access to stairway enclosures

Stairway enclosures in accommodation and service spaces are to have direct access from the corridors and be of a sufficient area to prevent congestion, having in view the number of persons likely to use them in an emergency.

Within the perimeter of such stairway enclosures, only public toilets, lockers of non-combustible material providing storage for non-hazardous safety equipment and open information counters are permitted. Only public spaces, accommodation spaces of minor fire risk as defined in Pt C, Ch 4, Sec 5, [1.2.3], item b), corridors, lifts, public toilets, pantries containing no cooking appliances, ro-ro and vehicle spaces, other escape stairways required by regulation 13.3.2.4.1 or escape stairways from machinery spaces other that category A machinery spaces and external areas are permitted to have direct access to these stairway enclosures. Small corridors or “lobbies” used to separate an enclosed stairway from galleys or main laundries may have direct access to the stairway provided they have a minimum deck area of 4,5 m^2, a width of not less than 900 mm and contain a fire hose station.

6.2.7 Evacuation analysis

Escape routes are to be evaluated by an evacuation analysis early in the design process.

The analysis is to be used to identify and eliminate, as far as practicable, congestion which may develop during an abandonment, due to normal movement of crew along escape routes. In addition, the analysis is to be used to demonstrate that escape arrangements are sufficiently flexible to provide for the possibility that certain escape routes, assembly stations, embarkation stations or survival craft may not be available as a result of a casualty.

Note 1: For the application of the IMO Circular MSC.1/Circ.1533, the scenarios and given values such as Response duration (R), Total travel duration (T), Embarkation and launching duration (E+L), counterflow factor, walking speed, etc. may be replaced by more effective scenarios and values given by the Naval Authority.

6.2.8 Around the flight decks, corridors on open deck, giving access to a safe route to the assembly stations, are to be provided. The persons evacuating by these external corridors are to be protected from the liquids falling from the flight decks by a suitable gutter arrangement.

6.2.9 Basic requirements for stairway widths

a) Stairways are not to be less than 700 mm in clear width.

b) The clear width of the stairways is not to be inferior to the width calculated as per the Fire Safety Systems Code, Ch 13, [2.1.2], considering the distribution of persons given in [6.3] hereafter.

6.2.10 Vertical rise and inclination of stairways

Stairways are not to exceed 4 m in vertical rise without the provision of a landing and are to have an angle of inclination not greater than 62°. In machinery spaces however, stairways with an angle of inclination up to 70° may be permitted.

Where the hospital and the flight deck are not on the same deck, the stairway intended for medical evacuation is to have an angle of inclination not exceeding 45°.

6.2.11 Width of doors, hatches and corridors included in the means of escape

a) Corridors and intermediate landings included in means of escape are to be sized in the same manner as stairways.

b) The clear width of doors and hatches included in means of escape may be smaller than that of the passageways they serve, provided their clear width remains above the minimum clear width required for the associated passageway.

6.2.12 Assembly stations and embarkation stations

The assembly stations are to have sufficient clear deck space to accommodate all persons assigned to muster at that station but at least 0,35 m^2 per person.

The assembly stations and embarkation stations may include spaces such as corridors, landings of stairway enclosures, accommodation and service spaces but an assembly station is not to include a control station, a machinery space or an ammunition space. In any case, a space which requires a key for access may not be included in an assembly station or an embarkation station unless the key is enclosed in a break-glass type enclosure conspicuously located an indicated near the normally locked access door.

6.3 Distribution of persons

6.3.1 For the application of the provision of the Fire Safety System Code, Chapter 13 [2.1.2.2.2.1], cases 1 and 2 are to be replaced by:

a) Case 1 (night-time)
- All crew not operating by watch in their cabins and berthing spaces
- 3/4 of the crew operating by watch in their cabins and berthing spaces, and
- Accommodation, service spaces and control stations occupied by 1/4 of the crew operating by watch, according to their operating position.

b) Case 2 (daytime)
- Public spaces occupied by 1/4 of the crew not operating by watch and 1/2 of the crew operating by watch
- 3/4 of the crew not operating by watch and 1/4 of the crew operating by watch distributed in accommodation, service spaces and control stations according to their operating positions.

Note 1: For the application of the provision of Fire Safety System Code, Chapter 13 [2.1.2.1.4], the number of persons to be distributed in each public space is to be proportional to the deck area of these public spaces, as per the following formula:

$n = N \cdot a / A$

where:

N : Total number of persons to be distributed in the public spaces

a : Deck area of the selected public space

A : Total deck area of the public spaces available to the total number of persons to be distributed in the public spaces.

Note 2: Other cases of distribution of persons may be considered in replacement of, or in addition to, cases 1 and 2 above by more effective scenarios given by the Naval Authority.

7 Aircraft hangars

7.1 General

7.1.1 General definition

An aircraft hangar is a closed manned space in which aircrafts can be loaded. Maintenance and other necessary services such as refuelling, defuelling, ammunition loading, oxygen loading can be handed on the aircrafts inside the aircraft hangar.

7.1.2 Application

The requirements and the general provisions for a ro-ro space as defined in Pt C, Ch 4, Sec 1, [2.32.1] are also applicable to an aircraft hangar.

Permanent openings in the side plating, the ends or deckhead of the space are to be so situated that a fire in the aircraft hangar does not endanger stowage areas and embarkation stations for survival craft and accommodation spaces, service spaces and control stations in superstructures and deckhouses above the aircraft hangar.

7.1.3 Protection of aircraft hangar access doors

Suitable means of fire-protection such as local water spraying systems are to be provided to the doors giving access to aircraft hangars from the open decks in order to withstand any projection of fired fuel oil from the flight decks.

7.1.4 Subdivided aircraft hangars

Where an aircraft hangar is internally divided into several sub-aircraft hangars by means of internal subdividing bulkheads extending across the full breadth of the aircraft hangar, the doors fitted in the subdividing bulkheads need not have A class integrity nor be made of steel and the use of combustible materials may be accepted if agreed by the Society. However, when such a door does not have A class integrity or is not of steel construction or is made of combustible materials, a water curtain capable of delivering at least 5 l/min/m^2 of water is to be provided on both sides of the door.

7.1.5 Drainage facilities

Drainage from aircraft hangars directly to the sea is to be avoided as far as possible. In addition to the requirements of Pt C, Ch 1, Sec 10, [8.10.7], drainage facilities from aircraft hangars are to comply with the requirements of Pt C, Ch 4, Sec 10, [3.2.2].

7.1.6 Aircraft refuelling facilities

a) In addition to the requirements of Pt C, Ch 1, Sec 10, [11], aircraft refuelling facilities are to comply with the requirements of Pt C, Ch 4, Sec 10, [4.1], as applicable, to helicopter facilities for fuels having a flashpoint above or equal to 60°C.

b) Facilities dedicated for fuels having a flashpoint below 60°C are to comply with requirements of Pt C, Ch 4, Sec 11, [3.8].

7.2 Operational

7.2.1 Vehicles

Where vehicles such as cars, fire-fighting trucks (VLIP), maintenance trucks using internal combustion engine for their own propulsion are running or stored inside the aircraft hangar, their fuel is not to have a flash point below 60°C. At any time of operation, the total number of such vehicles in the aircraft hangar is to be such that the total power output of these vehicles does not exceed 0,02 kW/m^3.

7.2.2 Battery charging

When some vehicle using electrical engines or other batteries are located in the aircraft hangar, the charging of such batteries will not be permitted in the aircraft hangar. The charging of such batteries is to be done in a dedicated spaces considered as a battery room.

7.2.3 Aircraft refuelling and defuelling

The aircraft refuelling and defuelling may be permitted inside the aircraft hangar if suitable safety devices are provided and safety procedures are ensured.

In case of aircraft refuelling and defuelling operation inside the hangar, the dedicated area is to be fitted with a mechanical ventilation system providing at least 10 air changes per hour during the refuelling and defuelling operations.

Ventilation fans are to be of non-sparking type.

7.3 Fire protection

7.3.1 Fire-fighting system

With regards to the risk analysis proceeded by the Naval Authority, the fire-fighting system required by Pt C, Ch 4, Sec 14, [4.1] may be replaced by a more suitable technical solution on the agreement of the Society.

7.3.2 If a fixed water-based deluge system is used for aircraft hangars, then a fire detection and fire alarm system identifiable to the same sections of the deluge system is to be arranged.

7.3.3 The fire detection and fire alarm system is to be designed with a system interface which provides logical and unambiguous presentation of the information, to allow a quick and correct understanding and decision-making. In particular, section numbering of the alarm system is to coincide with that of other systems, such as a fixed water-based fire-extinguishing system or video monitoring system, if available.

7.3.4 Video Monitoring

An effective video monitoring system is to be arranged in the aircraft hangar for continuous monitoring. The system is to be provided with immediate playback capability to allow for quick identification of fire location, as far as practicable. Cameras are to be installed to cover the whole space, high enough to see over cargo and vehicles after loading.

The videos recorded by this monitoring system are to be available for replay at a continuously manned control station or at the damage control station for at least seven days. The correspondence between any one video camera and the section of the fixed water-based fire-extinguishing system protecting the space covered by this camera are to be clearly displayed close to the video monitor. Continuous monitoring of the video image by the crew is not required.

7.4 Rooms for testing the airplane reactors

7.4.1 Rooms in which the airplane reactors are tested, are to have a sufficient opening to the exterior of the ship. This opening is to be arranged such that the fired gases can be exhausted outside without reaching any other part of the ship.

7.4.2 Rooms in which the airplane reactors are tested, are to be considered as a machinery space of category A in way of fire integrity of their boundaries, ventilation, fire detection and fire-fighting.

7.4.3 Access to the airplane reactor testing room is to be provided through a self-closing and reasonably gastight fire door provided with a self-closing hose port. Arrangements are to be provided in order to ensure that the door will remain closed while airplane reactors are under operation.

7.4.4 Airplane reactor testing control room

The airplane reactor testing control room may be included in the airplane reactor testing room for fire protection purposes provided the airplane reactor testing control room is provided with a means of escape independent from the rest of the airplane reactor testing room. In this case, all fire protection requirements applying to the airplane reactor testing room also apply to the airplane reactor testing control room, especially the fixed fire-extinguishing system required by [6.4.6] is also to cover the airplane reactor testing control room. Section valves may be provided in order to avoid unwanted water release in the airplane reactor testing control room.

Alternatively, the airplane reactor testing control room may be considered as fully separate from the airplane reactor testing room for fire-protection purposes. In this case, any door or window intended to be provided between both spaces is to fulfil the applicable fire-integrity requirements in addition to any mechanical qualification required otherwise.

7.4.5 One flame detector is to be provided in the room in which the airplane reactors are tested and this detector is to be capable of being stopped during operation of the airplane reactors. Arrangements are to be provided in order to ensure that this flame detector will be activated at all other times.

7.4.6 A fixed high expansion foam fire-extinguishing system, a fixed pressure water spraying, a thick water spraying system complying with the requirements of Pt C, Ch 4, Sec 14 or an other fixed fire-extinguishing system deemed equivalent by the Society is to be provided in the room in which the airplane reactors are tested.

7.4.7 For the system required by the provisions of [7.4.6] above, some nozzles are to be fitted at the air supply point of the tested airplane reactor.

7.4.8 A semi-fixed carbon dioxide fire-extinguishing system complying with the provision of Pt C, Ch 4, Sec 14, [5.1.5] is to be available at the access point of the room in which the airplane reactors are tested.

7.4.9 The fuel oil used for the reactors such as JP5 is to be stowed outside the room in which the airplane reactors are tested.

8 Flight deck

8.1 Drainage facilities

8.1.1 In addition to the requirements of Pt C, Ch 1, Sec 10, [8.10.7], drainage facilities of flight decks are to comply with the requirements of Pt C, Ch 4, Sec 10, [3.2], as applicable to helidecks.

8.2 Refuelling and defuelling facilities

8.2.1 Open refuelling or defuelling stations on flight decks are to comply with requirements of Pt C, Ch 4, Sec 10, [4.1.1].

9 Oxygen production

9.1 Oxygen production and storage installation

9.1.1 Where oxygen for aircraft breathing is produced aboard the ship, special consideration is to be given to the oxygen production and storage installation, with regard to fire prevention, containment of fire, ventilation, fire detection and fire fighting. Where fitted, such installation is to be to the satisfaction of the Society.

CHAPTER 3
CORVETTE

Section 1 General

Section 2 Hull

Section 3 Machinery and Systems

Section 4 Electrical Installations

Section 5 Fire Protection

Section 1 General

1 General

1.1 Application

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **corvette**, as defined in Pt A, Ch 1, Sec 2, [4.4].

1.1.2 Ships dealt with in this Chapter are to comply with:

- Part A
- NR216 Materials and Welding
- applicable requirements according to Tab 1.

Table 1 : Applicable requirements

Item	Reference
Ship arrangement	• Part B
Hull	• Part B • Ch 3, Sec 2
Stability	• Part B
Machinery and systems	• Part C • Ch 3, Sec 3
Electrical installations	• Part C • Ch 3, Sec 4
Automation	• Part C • Ch 3, Sec 4
Fire protection, detection and extinction	• Part C • Ch 3, Sec 5

Section 2 Hull

Symbols

V : Maximum ahead service speed, in knots

α_d : For hull that does not have a clearly identified deodorise angle, α_d is the angle between the horizontal and a straight line joining the keel and the chine. For hull that does not have a clearly identified chine, the chine is the hull point at which the tangent to the hull is inclined 50° to the horizontal.

1 General

1.1 Application

1.1.1 Naval ships having the service notation **corvette** are to comply with the applicable requirements of Part B.

The maximum speed, in knots, to be used in Part B, Chapter 5 is to be not greater than $7{,}16\ \Delta^{1/6}$.

1.1.2 In addition, naval ships having the service notation **corvette** and having a maximum ahead service speed V, in knots, such that:

$V \geq 7{,}16\ \Delta^{1/6}$

are to comply with the following requirements.

1.1.3 For naval ships with the service notation **corvette** and a maximum ahead service speed V lower than specified in [1.1.2], the following requirements can be disregarded and the sole compliance with Part B is required.

1.1.4 Following requirements are applicable for ships constructed in steel and/or aluminium alloys.

Ships constructed in composite or with parts constructed in composite will be considered by the Society on a case by case basis.

1.2 Gross scantling approach

1.2.1 All scantling and dimensions referred to in this Section are net, i.e. they don't include the margins for corrosion.

The gross scantling are to be calculated from the net scantling by adding the corrosion margins specified in Pt B, Ch 4, Sec 2.

1.3 Corrosion protection - Heterogeneous steel/aluminium alloy assembly

1.3.1 Connections between aluminium alloy parts, and between aluminium alloy and steel parts, if any, are to be protected against corrosion by means of coatings applied by suitable procedures agreed by the Society.

1.3.2 In any case, any direct contact between steel and aluminium alloy is to be avoided (e.g. by means of zinc or cadmium plating of the steel parts and application of a suitable coating on the corresponding light alloy parts).

1.3.3 Any heterogeneous jointing system is subject to the Society's agreement.

1.3.4 The use of transition joints made of aluminium/steel-cladded plates or profiles is subject to the Society's agreement.

1.3.5 Transition joints are to be type-approved.

1.3.6 Qualifications tests for welding procedures are to be carried out for each joint configuration.

1.3.7 A welding booklet giving preparations and various welding parameters for each type of assembly is to be submitted for review.

2 Structure design principles

2.1 Vertical acceleration at LCG

2.1.1 The vertical acceleration at LCG considered for the design, a_{CG}, in g, is the average of the one per cent highest accelerations in the most severe conditions expected within the "limit operating conditions", in addition to the gravity acceleration.

2.1.2 The vertical acceleration is the responsibility of the designer and is to be submitted to the Society.

However, at a preliminary stage where vertical acceleration at LCG is not known, a_{CG}, can be taken as follows:

$$a_{CG} = \frac{2}{3} Soc \frac{V}{\sqrt{L}}$$

Table 1 : Soc values

Sea area	Open sea	Restricted open sea	Moderate environment	Smooth sea
Soc	C_F **(1)**	0,30	0,23	0,14
(1) $C_F = 0,2 + \frac{0,6}{V/\sqrt{L}} \geq 0,32$				

2.1.3 The sea areas referred to in Tab 1 are defined with reference to significant wave heights H_s which are exceeded for an average of not more than 10 percent of the year:

- Open-sea service: $H_s \geq 4,0$ m
- Restricted open-sea service: $2,5 \text{ m} \leq H_s < 4,0$ m
- Moderate environment service: $0,5 \text{ m} < H_s < 2,5$ m
- Smooth sea service: $H_s \leq 0,5$ m.

2.1.4 The longitudinal distribution of vertical acceleration along the hull is given by:

$a_v = k_v \, a_{CG}$

where:

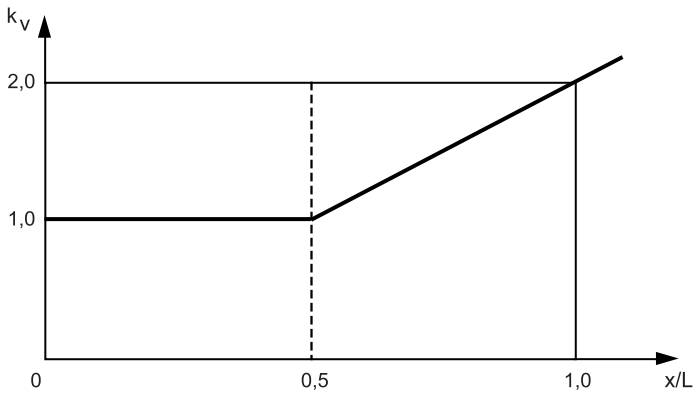
k_v : Longitudinal distribution factor, not to be less than (see Fig 1):

$k_v = 1$ for $x/L \leq 0,5$

$k_v = 2 \, x/L$ for $x/L > 0,5$

Higher values may be requested based on pitch consideration.

Figure 1 : k_v factor



2.2 Transverse acceleration

2.2.1 The transverse acceleration, a_T, is the average of the one per cent highest accelerations in the most severe conditions expected within the "limit operating conditions".

2.2.2 The transversal acceleration is the responsibility of the designer and is to be submitted to the Society.

However, at a preliminary stage where the transversal acceleration is not known, a_T, at a given calculation point, can be taken equal to:

$$a_T = 2,5 \frac{H_{sl}}{L}\left(1 + \frac{5r}{L}\left(1 + \frac{V}{6\sqrt{L}}\right)^2\right)$$

where:

H_{sl} : Permissible significant wave height at maximum service speed V

r : Distance of the considered calculation point to 0,5 D.

2.3 Operating conditions

2.3.1 Assessment of limit operating conditions

a) "Limit operating conditions" in this paragraph are to be taken to mean sea states (characterized only by their significant wave heights) compatible with the structural design parameters of the ship, i.e. the sea states in which the ship may operate depending on its actual speed.

b) Limit operating conditions are derived from the restrictions presented in [2.3.2] and [2.3.3].

c) It is the designer's responsibility to specify the format and the values of the limit operating conditions. Their format may be for example a relationship between speed and significant wave height which ascertains actual loads less than the one used for structural design.

d) Other specific design parameters influenced by sea state and speed could be also considered at the discretion of the Society.

e) The limit operating conditions are defined, at the discretion of the Society, on the basis of results of model tests and full-scale measurements or by numerical simulations.

f) The limit operating conditions, taken as a basis for classification, are indicated in the Classification Certificate.

These limit operating conditions must be put at the disposal of the crews operating the crew boat (display at the weelhouse is recommended).

2.3.2 Limitation imposed by bottom impact pressure and deck loads

a) Bottom impact pressure, given in [4.3], and deck loads, given in [4.6], depend explicitly or implicitly upon the vertical acceleration at the LCG. Therefore, the design values of these loads taken as the basis for the classification directly impose a limitation on the permissible vertical acceleration at the LCG.

b) It is the designer's responsibility to provide for a relation between the speed and the significant wave height that provides a maximum vertical acceleration less than the design value.

c) Model tests if any are to be carried out in irregular sea conditions with a significant wave height corresponding to the operating conditions of the craft and a clearly specified sea spectrum. The scale effect is to be accounted for with an appropriate margin of safety. The characteristic value of acceleration and global loads to be assumed corresponds to the average of the 1 per cent highest values obtained during tests. The duration of the test is, as far as practicable, to be sufficient to guarantee that results are stationary.

d) Where model test results or full-scale measurements are not available, the formula given in e) may be used to define maximum speeds compatible with design acceleration, depending on sea states having a significant height H_s.

e) The significant wave height is related to the ship's geometric and motion characteristics and to the vertical acceleration a_{CG} by the following formula:

$$a_{CG} = \frac{(50 - \alpha_{dCG})\left(\frac{\tau}{16} + 0,75\right)}{3555 C_B}\left(\frac{H_S}{T} + (0,084)\frac{B_{WS}}{T}\right)K_{FR}K_{HS}$$

- for units for which $V/\sqrt{L} \geq 3$ and $\Delta/(0,01L)^3 \geq 3500$:

$$K_{FR} = \left(\frac{V_X}{\sqrt{L}}\right)^2$$

$$K_{HS} = 1$$

- for units for which $V/\sqrt{L} < 3$ or $\Delta/(0,01L)^3 < 3500$:

$$K_{FR} = 0,8 + (1,6)\frac{V_X}{\sqrt{L}}$$

$$K_{HS} = \frac{H_S}{T}$$

where:

H_s : Significant wave height, in m

α_{dCG} : Deadrise angle, in degrees, at LCG, to be taken between 10° and 30°

τ : Trim angle during navigation, in degrees, to be taken not less than 4°

V : Maximum service speed, in knots

V_x : Actual ship speed, in knots.

If V_x is replaced by the maximum service speed V of the ship, the previous formula yields the significant height of the limit sea state, H_{sl}. This formula may also be used to specify the permissible speed in a sea state characterized by a significant wave height equal to or greater than H_{sl}.

f) On the basis of the formula indicated in e), the limit sea state may be defined (characterized by its significant wave height H_{sl}), i.e. the sea state in which the craft may operate at its maximum service speed. During its voyage, whenever the ship encounters waves having a significant height greater than H_{sl}, it has to reduce its speed.

g) The reduction of vertical acceleration a_{CG} induced by stabilization system if any is to be disregarded for the purpose of limit operating conditions imposed by bottom impact loads.

2.3.3 Limitation imposed by global loads

The longitudinal bending moment and shear forces as given in [3.1] depend explicitly or implicitly upon the vertical acceleration along the ship. Therefore, the design values of these loads taken as the basis for classification directly impose a limitation on the permissible vertical acceleration at the LCG. The requirements of [2.3.2], items b) to g) apply.

The reduction of vertical acceleration along the ship induced by the stabilization system, if any, is to be disregarded for the purpose of specifying the limiting operating conditions imposed by global loads.

2.3.4 Hull monitoring

The Society may require a hull monitoring system to be fitted on board in case of:

- ship with unusual hull lines
- ship for which the vertical acceleration at LCG, a_{CG}, has not been duly justified either by experience or by direct calculations.

The hull monitoring system is to display in real time the vertical acceleration and any other sensitive parameter with respect to the strength.

The information is to be available at the wheelhouse and displayed in a clear format allowing to compare with design values.

When a hull monitoring system is requested, its specification is to be submitted for review.

3 Hull girder strength

3.1 Hull girder loads

3.1.1 Still water bending moments

The still water bending moments in hogging and sagging conditions, $M_{SWM,H}$ and $M_{SWM,S}$ are to be submitted by the designer and calculated according to Pt B, Ch 5, Sec 2, [2].

3.1.2 Total bending moments

The values of the longitudinal bending moment are given, in first approximation, by the formulae in items a) and b).

The total bending moments M_{TH}, in hogging conditions, and M_{TS}, in sagging conditions, in kN.m, are to be taken as the greatest of those given by the formulae in items a) and b).

The longitudinal distribution of the total bending moments M_{TH} and M_{TS} is given in [3.1.3]

a) Bending moments due to still water loads, wave induced loads and impact loads (case with impact considered):

$M_{TH} = -M_{TS} = 0{,}55\ \Delta\ L\ (C_B + 0{,}7)\ (1 + a_{CG})$

where a_{CG} is the vertical acceleration at the LCG, defined in [2.1].

b) Bending moments due to still water loads and wave induced loads (case with no impact considered):

$M_{TH} = M_{SWM,H} + 0{,}60\ Soc\ C\ L^2\ B\ C_B$

$M_{TS} = M_{SWM,S} - 0{,}35\ Soc\ C\ L^2\ B\ (C_B + 0{,}7)$

where:

$M_{SWM,H}$: Hogging still water bending moment, in kN/m

$M_{SWM,S}$: Sagging still water bending moment, considered as negative, in kN/m

C : Coefficient to be taken equal to: $C = 6 + 0{,}02\ L$

For the purpose of this calculation, C_B may not be taken less than 0,6.

If the actual distribution of weights along the craft is known, a more accurate calculation may be carried out according to the procedure in [3.1.4]. The Society reserves the right to require calculation to be carried out according to [3.1.4] whenever it deems necessary.

3.1.3 Longitudinal distribution of total bending moment

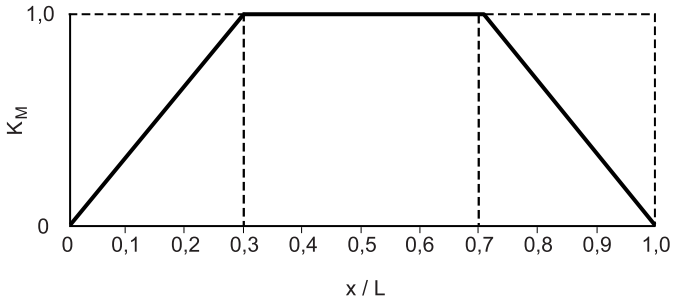
The longitudinal distribution of the total bending moments is given by:

- in hogging condition: $K_M \cdot M_{TH}$
- in sagging condition: $K_M \cdot M_{TS}$

where:

K_M : Longitudinal distribution factor as shown on Fig 2.

Figure 2 : Factor K_M



3.1.4 Bending moment and shear force taking into account the actual distribution of weights

The distribution of quasi-static bending moment and shear force, due to still water loads and wave induced loads, is to be determined from the difference in weight and buoyancy distributions in hogging and sagging for each loading or ballast condition envisaged.

For the calculation purpose, the following values are to be taken for the design wave:

- wave length, in m:

  $\lambda = L$

- wave height, in m:

$$h = \frac{L}{15 + \frac{L}{20}}$$

- wave form: sinusoidal.

In addition, the increase in bending moment and shear force, due to impact loads in the forebody area, for the sagging condition only, is to be determined as specified below. For the purpose of this calculation, the hull is considered longitudinally subdivided into a number of intervals, to be taken, in general, equal to 20. For smaller craft, this number may be reduced to 10 if justified, at the Society's discretion, on the basis of the weight distribution, the hull forms and value of the design acceleration a_{CG}.

The total impact force, in kN, is:

$$F_{SL} = \sum q_{SLi} \cdot \Delta x_i$$

where:

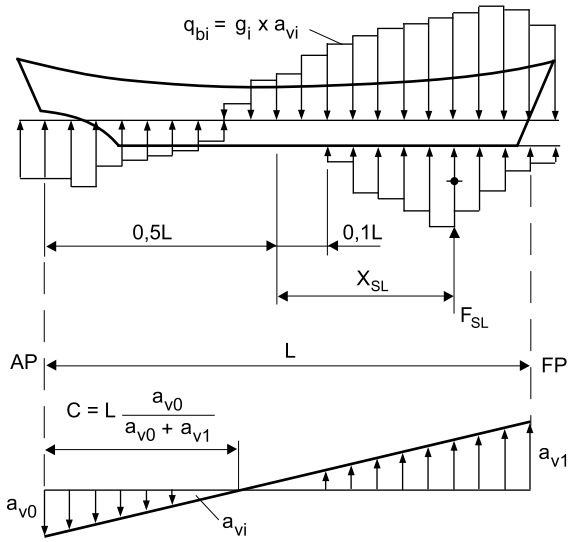
$\Delta\xi_i$: Length of interval, in m

q_{SLi} : Additional load per unit length, in kN/m, for x/L ≥ 0,6 (see also Fig 3), given by:

$$q_{SLi} = p_0 \cdot B_i \cdot \sin\left[2 \cdot \pi \cdot \left(\frac{x_i}{L} - 0,6\right)\right]$$

x_i : Distance, in m, from the aft perpendicular, to be measured at the centre of interval i

Figure 3 : Load due to impact on fore body



B_i : Craft breadth, in m, at the uppermost continuous deck (i.e. generally B_i is to be evaluated at the bulkhead deck), to be measured at the centre of interval i

p_0 : Maximum hydrodynamic pressure, in kN/m², equal to:

$$p_0 = \frac{a_{v1} \cdot G \cdot (r_0^2 - x_W^2)}{f_{SL} \cdot [r_0^2 + 0,5 \cdot L \cdot (x_{SL} - x_W) - x_{SL} \cdot x_W]}$$

a_{v1} : Vertical design acceleration at the forward perpendicular, as defined in [2.1.4]

G : Weight force, in kN, equal to:

$$G = \sum g_i \cdot \Delta x_i$$

g_i : Weight per unit length, in kN/m, of interval i

x_W : Distance, in m, of LCG from the midship perpendicular, equal to:

$$x_W = \frac{\sum (g_i \cdot \Delta x_i \cdot x_i)}{\sum (g_i \cdot \Delta x_i)} - 0,5 \cdot L$$

r_0 : Radius of gyration, in m, of weight distribution, equal to:

$$r_0 = \left(\frac{\sum g_i \cdot \Delta x_i \cdot (x_i - 0,5L)^2}{\sum g_i \cdot \Delta x_i} \right)^{0,5}$$

Normally: $0,2\ L < r_0 < 0,25\ L$ (guidance value)

x_{SL} : Distance, in m, of centre of surface F_{SL} from the midship perpendicular, given by:

$$x_{SL} = \frac{1}{f_{SL}} \sum \Delta x_i \cdot x_i \cdot B_i \cdot \sin\left[2\pi \cdot \left(\frac{x_i}{L} - 0,6\right)\right] - 0,5L$$

f_{SL} : Surface, in m², equal to:

$$f_{SL} = \sum \Delta x_i \cdot B_i \cdot \sin\left[2\pi \cdot \left(\frac{x_i}{L} - 0,6\right)\right]$$

with $x_i / L \geq 0,6$

The resulting load distribution q_{si}, in kN/m, for the calculation of the impact induced sagging bending moment and shear force is:

- For $x/L < 0,6$:

  $q_{si} = q_{bi} = g_i \cdot a_{vi}$

  where:

  a_{vi} : Total dimensionless vertical acceleration at interval i, equal to:

  $a_{vi} = a_h + a_p\ (x_i - 0,5\ L)$

  a_h : Acceleration due to heaving motion, equal to:

  $$a_h = \frac{F_{SL}}{G} \cdot \left(\frac{r_0^2 - x_{SL} \cdot x_W}{r_0^2 - x_W^2}\right)$$

  a_p : Acceleration due to pitching motion, in m^{-1}, equal to:

  $$a_p = \frac{F_{SL}}{G} \cdot \left(\frac{x_{SL} - x_W}{r_0^2 - x_W^2}\right)$$

  a_h and a_p are relative to g

- For $x/L \geq 0,6$:

  $q_{si} = q_{bi} - q_{SLi}$

  The impact induced sagging bending moment and shear force are obtained by integration of the load distribution q_{si} along the hull. They are to be added to the respective values calculated according to design wave in order to obtain the total bending moment M_T and shear force Q_T due to still water loads, wave induced loads and impact loads.

3.1.5 Total shear force

The total shear force, in kN, is to be taken equal to:

$$Q_T = \frac{3,2 M_T}{L}$$

where:

M_T : Greatest bending moment between M_{TH} and M_{TS} in absolute value calculated according to [3.1.2].

3.2 Yielding check

3.2.1 Section modulus

The net section modulus Z_A, in cm^3, at any point of a hull transverse section is to be calculated as specified in Pt B, Ch 6, Sec 1.

3.2.2 Hull girder stress

The normal stresses, in N/mm^2, induced by the vertical bending moments are obtained at any point of the hull transverse section from the following formula:

$$\sigma_{X1} = \frac{M_T}{Z_A} 10^3$$

3.2.3 Checking criteria

It is to be checked that the normal stress σ_{X1} and the shear stress τ induced by the vertical bending moments are not greater than:

$$\sigma_{X1} \leq \frac{165}{k}$$

$$\tau \leq \frac{100}{k}$$

4 Local loads

4.1 Introduction

4.1.1 Design loads defined in this Article are to be used for the resistance checks provided for in [5] to obtain scantlings of structural elements of hull and deckhouses.

4.1.2 Such loads may be integrated or modified on the basis of the results of model tests or full-scale measurements. Model tests are to be carried out in irregular sea conditions with significant wave heights corresponding to the operating conditions of the ship. The scale effect is to be accounted for by an appropriate margin of safety.

4.1.3 The characteristic value to be assumed is defined as the average of the 1 per cent highest values obtained during testing. The length of the test is, as far as practicable, to be sufficient to guarantee that statistical results are stationary.

4.2 Loads

4.2.1 General

The following loads are to be considered in determining scantlings of hull structures:

- impact pressures due to slamming, if expected to occur
- sea pressures due to hydrostatic heads and wave loads
- internal loads.

External pressure generally determines scantlings of side and bottom structures; internal loads generally determine scantlings of deck structures.

Where internal loads are caused by concentrated masses of significant magnitude (e.g. tanks, machinery), the capacity of the side and bottom structures to withstand such loads is to be verified according to criteria stipulated by the Society. In such cases, the inertial effects due to acceleration of the ship are to be taken into account.

Such verification is to disregard the simultaneous presence of any external wave loads acting in the opposite direction to internal loads.

4.2.2 Load points

Pressure on panels and strength members may be considered uniform and equal to the pressure at the following load points:

- for panels:
  - lower edge of the plate, for pressure due to hydrostatic head and wave load
  - geometrical centre of the panel, for impact pressure
- for strength members:
  - centre of the area supported by the element.

Where the pressure diagram shows cusps or discontinuities along the span of a strength member, a uniform value is to be taken on the basis of the weighted mean value of pressure calculated along the length.

4.3 Impact pressure on the bottom

4.3.1 Except otherwise justified by the designer, it is generally considered that slamming is expected to occur on bottom. The impact pressure, in kN/m², considered as acting on the bottom is not less than:

$$p_{sl} = 70\frac{\Delta}{S_r}K_1K_2K_3a_{CG}$$

where:

Δ : Moulded full load displacement, end of life, in tonnes

S_r : Reference area, in m², equal to:

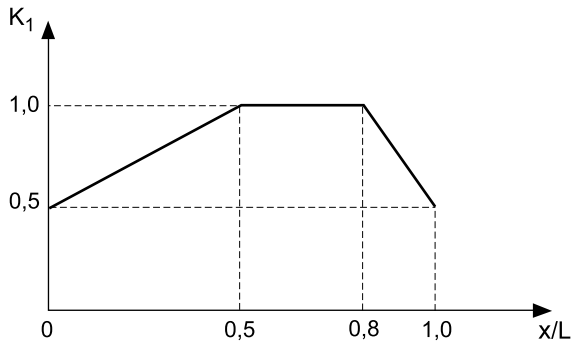
$$S_r = 0,7\frac{\Delta}{T}$$

K_1 : Longitudinal bottom impact pressure distribution factor (see Fig 4):

- for $x/L < 0,5$: $K_1 = 0,5 + x/L$
- for $0,5 \le x/L \le 0,8$: $K_1 = 1,0$
- for $x/L > 0,8$: $K_1 = 3,0 - 2,5 \cdot x/L$

where x is the distance, in m, from the aft end to the load point

Figure 4 : Impact area factor K_1



K_2 : Factor accounting for impact area, equal to:

$$K_2 = 0,455 - 0,35\frac{u^{0,75} - 1,7}{u^{0,75} + 1,7}$$

with:

- $K_2 \ge 0,50$ for plating
- $K_2 \ge 0,45$ for stiffeners
- $K_2 \ge 0,35$ for girders and floors

$$u = 100\frac{s}{S_r}$$

where s is the area, in m², supported by the element (plating, stiffener, floor or girder). For plating, the supported area is the spacing between the stiffeners multiplied by their span, without taking for the latter more than three times the spacing between the stiffeners

K_3 : Factor accounting for shape and deadrise of the hull, equal to:

$K_3 = (70 - \alpha_d) / (70 - \alpha_{dCG})$

where:

α_{dCG} : Deadrise angle, in degrees, measured at LCG

α_d : Deadrise angle, in degrees, between horizontal line and straight line joining the edges of respective area measured at the longitudinal position of the load point

values of α_d and α_{dCG} are to be taken between 10° and 30°

a_{CG} : Design vertical acceleration at LCG, defined in [2.1].

4.4 Sea pressures

4.4.1 Sea pressure on bottom and side shell

a) The sea pressure, in kN/m^2, considered as acting on the bottom and side shell is not less than p_{smin}, defined in Tab 2, nor less than:

- for $z \leq T$:

$$p_s = 10\left[T + 0,75S - \left(1 - 0,25\frac{S}{T}\right)z\right]$$

- for $z > T$:

$$p_s = 10\,(T + S - z)$$

where:

z : Vertical distance, in m, from the moulded base line to load point. z is to be taken positively upwards

S : As given, in m, in Tab 2 with C_B taken not greater than 0,5.

b) Between midship area and fore end ($0,5 < x/L < 0,9$), p_s varies in a linear way as follows:

$$p_s = p_{sFP} - (2,25 - 2,5\,x/L)\,(p_{sFP} - p_{sM})$$

where p_{sFP} is the sea pressure at fore end and p_{sM} the sea pressure in midship area.

Table 2 : Values of S and p_{smin}

x/L	S	p_{smin}
$x/L \geq 0,9$	$T \leq 0,36\,a_{CG}\frac{\sqrt{L}}{C_B} \leq 3,5T$	$20 \leq \frac{L + 75}{5} \leq 35$
$x/L \leq 0,5$	$T \leq 0,60\,a_{CG}\sqrt{L} \leq 2,5T$	$10 \leq \frac{L + 75}{10} \leq 20$

4.5 Sea pressures on deckhouses

4.5.1 The pressure, kN/m^2, considered as acting on walls of deckhouses is not less than:

$$p_{su} = K_{su}\left[1 + \frac{x_1}{2L(C_B + 0,1)}\right](1 + 0,045L - 0,38z_1)$$

where:

K_{su} : Coefficient equal to:

- for front walls of a deckhouse located directly on the main watertight deck not at the fore end:
  $K_{su} = 6,0$
- for unprotected front walls of the second tier, not located at the fore end:
  $K_{su} = 5,0$
- for sides of deckhouses, b being the breadth, in m, of the considered deckhouse:
  $K_{su} = 1,5 + 3,5\,b/B$ (with $3 \leq K < 5$)
- for the other walls:
  $K_{su} = 3,0$

x_1 : Distance, in m, from front walls or from wall elements to the midship perpendicular (for front walls or side walls aft of the midship perpendicular, x_1 is equal to 0)

z_1 : Distance, in m, from load point to waterline at draught T.

4.5.2 The minimum values of p_{su}, in kN/m^2, to be considered are:

- for the front wall of the lower tier:
  $p_{su} = 6,5 + 0,06\,L$
- for the sides and aft walls of the lower tier:
  $p_{su} = 4,0$
- for the other walls or sides:
  $p_{su} = 3,0$

4.5.3 For unprotected front walls located at the fore end, the pressure p_{su} will be individually considered by the Society.

4.6 Deck loads

4.6.1 General

The pressure, in kN/m^2, considered as acting on decks is given by the formula:

$p_d = p\ (1 + 0{,}4\ a_v)$

where:

p : Uniform pressure due to the load carried, in kN/m^2. Minimum values are given in [4.6.2] and [4.6.3]

a_v : Design vertical acceleration, defined in [2.1.4].

Where decks are intended to carry masses of significant magnitude, including vehicles, the concentrated loads transmitted to structures are given by the formula:

$F_d = F\ (1 + 0{,}4\ a_v)$

where:

F : Static force due to the load carried, in kN. Minimum values are given in [4.6.2]

a_v : Design vertical acceleration, defined in [2.1.4].

4.6.2 Exposed decks

a) For exposed decks without deck cargo:

- if $z_d \leq 2$:

  $p = 6{,}0$ kN/m^2
- if $2 < z_d < 3$:

  $p = (12 - 3\ z_d)$ kN/m^2
- if $z_d \geq 3$:

  $p = 3{,}0$ kN/m^2

where z_d is the vertical distance, in m, from deck to waterline at draught T.

p can be reduced by 20% for primary supporting members and pillars under decks located at least 4 m above the waterline at draught T, excluding embarkation areas.

b) For exposed decks with deck cargo:

- if $z_d \leq 2$:

  $p = (p_c + 2)$ kN/m^2, with $p_c \geq 4{,}0$ kN/m^2
- if $2 < z_d < 3$:

  $p = (p_c + 4 - z_d)$ kN/m^2, with $p_c \geq (8{,}0 - 2\ z_d)$ kN/m^2
- if $z_d \geq 3$:

  $p = (p_c + 1)$ kN/m^2, with $p_c \geq 2{,}0$ kN/m^2

where:

z_d : Distance defined in item a) above

p_c : Uniform pressure due to deck cargo load, in kN/m^2, to be defined by the designer with the limitations indicated above.

4.6.3 Protected decks

They are decks which are protected by enclosed accommodation, and which are therefore not exposed to green-seas effect.

a) For protected deck supporting uniform pressure, the value of still water pressure p is to be taken equal to the value of p_s defined in Pt B, Ch 5, Sec 6, Tab 3, Pt B, Ch 5, Sec 6, Tab 7 and Pt B, Ch 5, Sec 6, Tab 8.

b) For protected deck supporting dry unit cargo, the value of still water force F is to be taken equal to the value of F_s defined in Pt B, Ch 5, Sec 6, Tab 4 and Pt B, Ch 5, Sec 6, Tab 5.

c) For protected deck supporting vehicles and helicopters, the value of still water force P is to be taken as defined in [5.1.3].

4.7 Pressures on tank structures

4.7.1 The pressure, in kN/m^2, considered as acting on structures which constitute boundaries of compartments intended to carry liquids is to be taken not less than:

$p_{t1} = 9{,}81\ h_1\ \rho\ (1 + 0{,}4\ a_v) + 100\ p_v$

where:

h_1 : Distance, in m, from load point to tank top

ρ : Liquid density, in t/m^3 (1,0 t/m^3 for water)

p_v : Setting pressure, in bars, of pressure relief valve, when fitted.

5 Hull scantlings

5.1 Plating

5.1.1 General

The requirements of this sub-article apply for the strength check of plating subjected to lateral pressure, wheeled loads and hull girder normal stress.

The static and inertial pressures induced by the sea and the various type of cargoes and loads are to be considered depending on the location of the plating under consideration.

5.1.2 Plating subjected to lateral pressure

The net thickness of plate panels subjected to lateral pressure, in mm, is to be not less than the value obtained from the following formula:

$$t = 22,4 \mu s \sqrt{\frac{p}{f \sigma_{am}}}$$

where:

μ : Aspect ratio of the plate panel equal to:

$$\mu = \sqrt{1,1 - 0,5 \left(\frac{s}{\ell}\right)^2}$$

to be taken not greater than 1

s : Length, in m, of the shorter side of the plate panel

ℓ : Length, in m, of the longer side of the plate panel

p : Lateral pressure, in kN/m^2, to be evaluated from the requirements in [4]

f : Coefficient equal to:

- 1,00 for steel structure
- 2,35 for aluminium alloy structures

σ_{am} : Admissible stress values, in N/mm^2, given in Tab 3 for the various hull components.

Table 3 : Admissible stress values, in N/mm^2

	Steel	Aluminium alloy
Bottom and bilge under impact loads	235 / k	95 / k
Bottom and bilge under sea loads	200 / k	85 / k
Other hull components	200 / k	85 / k

5.1.3 Plating subjected to wheeled loads

The thickness of plate panels subjected to wheeled loads is not to be less than the value given by formulae defined in Pt B, Ch 7, Sec 1, [4.3.1], provided that the wheeled force, P_0, is taken equal to:

$$P_0 = P (1 + 0,4\, a_v)$$

where:

Π : Static load, in kN, on one tyre print

α_V : Vertical acceleration defined in [2.1.4].

5.1.4 Buckling

For plate panel subjected to compression and bending on one side, the critical buckling stress is to comply with the following criteria:

$$|\sigma_{X1} + \sigma_{X2}| \leq \sigma_c$$

where:

σ_{X1} : Hull girder compression normal stress, in N/mm^2, to be calculated as specified in Tab 4

σ_{X2} : Compressive normal stress, in N/mm^2, induced by the local bending of the primary supporting members

σ_c : Critical buckling stress, in N/mm^2, to be calculated as specified in Pt B, Ch 7, Sec 1, [5.3.1].

When the buckling criteria is exceeded, the scantlings may still be considered as acceptable, provided that the stiffeners located on the plate panel satisfy the buckling and the ultimate strength checks as specified in Pt B, Ch 7, Sec 2, [4] and Pt B, Ch 7, Sec 2, [5].

Table 4 : σ_{x1} for buckling

Condition	σ_{x1} in N/mm^2
$z \geq N$	$\sigma_{X1} = \frac{M_{ts}(z-N)10^{-3}}{I_Y}$
$z < N$	$\sigma_{X1} = \frac{M_{th}(z-N)10^{-3}}{I_Y}$
Note 1: N is defined in Part B, Chapter 7	

5.2 Ordinary stiffeners

5.2.1 General

The requirements of this sub-article apply for the strength check of ordinary stiffeners subjected to lateral pressure, wheeled loads and hull girder normal stress.

The static and inertial pressure induced by the sea and the various type of cargoes and loads are to be considered depending on the location of the stiffener under consideration.

5.2.2 The section modulus Z, in cm^3, and the shear area A_t, in cm^2, required for the purpose of supporting the design pressure transmitted by the plating, are given by the following formulae:

- case of uniform pressure

$$Z = 1000\frac{\ell^2 sp}{mfC\sigma_{am}}$$

$$A_t = 5\frac{\ell sp}{f\tau_{am}}$$

- case of wheeled loads

$$Z = 1000\frac{\ell P_0}{6fC\sigma_{am}}$$

$$A_t = 10\frac{P_0}{f\tau_{am}}$$

where:

s, ℓ, p, f : As defined in [5.1.2]

P_0 : As defined in [5.1.3]

m : Coefficient specified in Tab 5 and depending on the stiffener type and on whether there are rule brackets at the end of each individual span

C : Coefficient equal to:

- for steel stiffeners:

$$C = C_S = 1,4 - \frac{k\sigma_{X1}}{165f}$$

- for aluminium alloy stiffeners:

$$C = C_A = 1,3 - \frac{k\sigma_{X1}}{165f}$$

- for steel or aluminium stiffeners under impact pressure:

  C = 1

- for steel or aluminium stiffeners not contributing to hull girder strength:

  C = 1

without being taken greater than 1

σ_{am} : Maximum normal stress, in N/mm^2, to be taken equal to:

- 165 / k for steel stiffeners
- 70 / k for aluminium alloy stiffeners

τ_{am} : Maximum shear stress, in N/mm^2, to be taken equal to:

- 100 / k for steel stiffeners
- 45 / k for aluminium alloy stiffeners.

Table 5 : Coefficient m

Type of stiffener	m
Continuous longitudinal stiffeners without rule brackets at the ends of span	12
Longitudinal and transverse stiffeners with rule brackets at the ends of span	19
Longitudinal and transverse stiffeners with rule brackets at one end of span	15
Non-continuous longitudinal stiffeners and transverse stiffeners without rule brackets at the ends of span	8
Note 1: A rule bracket is to have a arm equal to $\ell/8$, where ℓ is the greater span of the connected stiffeners.	

5.2.3 Buckling

For ordinary stiffeners subjected to compression and bending on one side, the critical buckling stress is to comply with the following criteria:

$$|\sigma_{X1} + \sigma_{X2}| \leq \frac{\sigma_C}{S_F}$$

where:

σ_{X1} : Hull girder compression normal stress, in N/mm^2, to be calculated as specified in Tab 4

σ_{X2} : Compressive normal stress, in N/mm^2, induced by the local bending of the primary supporting members

σ_c : Critical buckling stress, in N/mm^2, to be calculated as specified in Pt B, Ch 7, Sec 2, [4.3]

S_F : Safety factor to be taken equal to 1,33 for stiffeners contributing to the longitudinal strength and to 1,00 otherwise.

5.3 Primary members

5.3.1 General

As a general rule, primary members of a corvette are to be analyzed through direct calculation in accordance with the criteria defined in [5.4].

However, primary members not interacting with the surrounding structure can be analyzed through isolated beam model. In such case, the modulus and the section of the primary members is not to be less than specified in [5.2.2] provided that:

- m is taken equal to 12 for side stringer and equal to 10 for floors, bottom girders, side frames, deck beam, deck girder and vertical web of superstructures
- the maximum normal stress σ_{am} for side and front walls is to be taken equal to:

$$\sigma_{am} = \frac{165}{fk} - \sigma_a$$

where:

f : Coefficient equal to:
  - 1,00 for steel structure
  - 2,35 for aluminium alloy structures

σ_a : Stress induced by the normal force in side transverse due to deck loads transmitted by deck beam.

5.4 Direct calculation

5.4.1 General

As a rule, the primary members of a corvette are to be analyzed through direct calculation based on a three-dimensional analysis.

5.4.2 impact loads

The impact pressure is to be calculated as stipulated in [4.3]. For each floor, the K_2-factor which appears in the formula for the impact pressure is to be calculated as a function of the area supported by the floor itself.

In the case of three-dimensional analyses, the longitudinal distribution of impact pressure is to be considered individually, in the opinion of the Society. In general, the impact pressure is to be considered as acting separately on each transverse section of the model, the remaining sections being subject to the hydrostatic pressure.

5.4.3 Load cases

As a rule the following loading conditions are to be considered for the direct calculation of the primary members:

a) Loading condition in still water
  - forces caused by weights which are expected to be carried in the full load condition, distributed according to the weight booklet of the craft
  - outer hydrostatic load in still water.

b) Combined loading condition 1

- forces caused by weights which are expected to be carried in the full load condition, distributed according to the weight booklet of the craft
- forces of inertia due to the vertical acceleration a_v of the craft, considered in a downward direction.

c) Combined loading condition 2

- forces caused by weights which are expected to be carried in the full load condition, distributed according to the weight booklet of the craft
- forces of inertia due to the vertical acceleration a_v of the craft, considered in a downward direction
- impact pressure acting on the bottom of the craft (2 cases):
  - case 1: symmetrically and according to [4.3]
  - case 2: asymmetrically and acting on one side of a complete compartment between transverse bulkheads, the other side being subject to hydrostatic load in still water.

5.4.4 Structural model

Primary structures of a corvette may usually be modelled with beam elements. When, however, grounds for the admissibility of this model are lacking, or when the geometry of the structures gives reason to suspect the presence of high stress concentrations, finite element analyses are necessary.

The extent of the model is to be such as to allow analysis of the behaviour of the main structural elements and their mutual effects.

The requirements defined in Pt B, Ch 7, App 1 are applicable to establish the three dimensional model of the primary structure.

5.4.5 Checking criteria

The stresses given by the above calculations are to be not greater than the following allowable values, in N/mm^2:

- bending stress:

$$\sigma_{am} = \frac{165}{k \cdot f_s}$$

- shear stress:

$$\tau_{am} = \frac{100}{k \cdot f_s}$$

- Von Mises equivalent bending stress:

$$\sigma_{eq,am} = \frac{210}{k \cdot f_s}$$

where:

k : Material factor defined in Pt B, Ch 4, Sec 1

f_s : Safety coefficient, to be assumed equal to:

- 1,00 for combined loading conditions
- 1,25 for loading condition in still water.

6 Hull outfitting

6.1 Anchoring equipment

6.1.1 Anchoring equipment of a corvette are to be designed in accordance with the applicable requirements of Pt B, Ch 9, Sec 4.

However, for corvettes, one of the two anchors required by above requirements may be not retractable. Which means that the anchor is designed to be lowered just once and released from the ship after a single operation.

In such a case the non retractable anchoring line needs not to be associated to a windlass and a chain stopper. In addition, the mooring force exerted by the chain cable on its connection to the ships will be considered on a case by case basis.

6.2 Rudders

6.2.1 Rudders are to comply with applicable requirements of Pt B, Ch 9, Sec 1, considering a maximum speed V_{max}, in knots, not greater than 7,16 $\Delta^{1/6}$.

In addition the designer is to justify that the operational conditions of the rudder at high speed will not induce loads on the rudder higher than specified in Pt B, Ch 9, Sec 1.

6.3 Waterjets

6.3.1 The supporting structures of waterjets are to be able to withstand the loads thereby generated in the following conditions:

- maximum ahead thrust
- maximum thrust at maximum lateral inclination
- maximum reversed thrust (going astern).

Information on the above loads is to be given by the waterjet manufacturer and supported by documents.

6.3.2 For each waterjet, following loading cases are to be investigated:

LDC 1 : Internal hydrodynamic pressure p_h in the built-in nozzle

LDC 2 : Horizontal longitudinal force F_{x1} in normal service (ahead)

LDC 3 : Horizontal transverse force F_y and associated moment M_z during steering operation

LDC 4 : Horizontal longitudinal force F_{x2} , vertical force F_z and overturning moment M_y in crash-stop situation.

6.3.3 The actual location of the thrust bearing is to be adequately considered (either located aft of the stem in the stator bowl or inside the waterjet compartment).

6.3.4 The scantlings are to be checked by direct calculations.

6.3.5 Tab 6 indicates the loading cases to be considered for the various components of the waterjet system. Other loading cases could be considered for specific or new design.

6.3.6 The stress criteria for static analysis may be taken as the following one, in N/mm^2:

- bending stress:

$$\sigma_{am} = \frac{165}{k}$$

- shear stress:

$$\tau_{am} = \frac{100}{k}$$

- Von Mises equivalent bending stress:

$$\sigma_{eq,am} = \frac{210}{k}$$

where:

k : Material factor defined in Pt B, Ch 4, Sec 1.

6.3.7 The stress criteria for fatigue analysis are to be specified by the designer.

6.3.8 The shell thickness in way of nozzles as well as the shell thickness of the tunnel are to be individually considered. In general, such thicknesses are to be not less than 1,5 times the thickness of the adjacent bottom plating.

Table 6 : Load cases

Component	LDC 1	LDC 2	LDC 3	LDC 4
Built-in nozzle: - plating - bending behaviour	X **(1)**	X **(2)**		X **(3)**
Ship stem		X **(2)**	X	X **(4)**
Bolting on stem			X **(5)**	X **(5)**

(1) To be checked under lateral pressure and against fatigue behaviour
(2) Buckling to be checked (100% of F_x transferred by built-in nozzle in case of thrust bearing aft of the stem)
(3) Ratio of M_y directly sustained by the built-in nozzle to be estimated on basis of relative stiffnesses
(4) Ratio of M_y directly sustained by the transom structure to be estimated on basis of relative stiffnesses
(5) Bolting calculation taking account of the actual pre-tension in bolts.

6.3.9 General principles to be followed for such structures subject to cyclic loadings are listed hereafter:

- continuous welding
- shear connections between stiffeners and transverse frames
- soft toe brackets
- no sniped ends
- no termination on plate fields
- no scallops in critical areas
- no start and stop of welding in corners or at ends of stiffeners and brackets
- possibly grinding of toes of critical welds.

Note 1: As a guidance, the following criteria may be considered:

The bending natural frequency of plates and strength members of the hull in the area of waterjets should not be less than 2,3 times the blade frequency for structures below the design waterline and between transom and aft engine room bulkhead. Structural components (such as the casing of waterjet and accessory parts and the immersed shell area) which may transfer pressure fluctuations into the ship structure have to fulfill the requirements of the waterjet manufacturer. Especially with regard the grids installed in the inlet duct, the hydrodynamic design should assure an unproblematic operation with respect to cavitation phenomenon.

This checking is left to the manufacturers.

6.4 Hull appendages - Propeller shaft brackets

6.4.1 Propeller shaft bracket are to be designed in accordance with applicable requirements of Pt B, Ch 9, Sec 3, where RPM is taken equal to the revolution per minute of the propeller for the maximum speed V, in Kn, of the ship.

7 Fatigue

7.1

7.1.1 The fatigue strength of structural details is to be checked, when deemed necessary by the Society. In this case, the criteria defined in Pt B, Ch 7, Sec 4 are to be applied.

Section 3 Machinery and Systems

1 General

1.1 Application

1.1.1 Ships having the service notation **corvette** are to comply with the general requirements of Part C, Chapter 1. In addition they are to comply with the provisions of this Section.

2 Gearing

2.1 General

2.1.1 The general requirements of Pt C, Ch 1, Sec 6 apply with the following changes of the safety factors.

2.1.2 Safety factors for contact stress

The safety factors for contact stress as per Pt C, Ch 1, Sec 6, Tab 18 are to be replaced by the values given in Tab 1.

Table 1 : Safety factor S_H for contact stress

Type of installation		S_H
Main gears (propulsion)	single machinery	1,25
	duplicate machinery	1,20
Auxiliary gears		1,15

2.1.3 Safety factors for bending stress

The safety factors for tooth root bending stress as per Pt C, Ch 1, Sec 6, Tab 24 are to be replaced by the values given in Tab 2.

Table 2 : Values of safety factor S_F for tooth root bending stress

Type of installation		S_F
Main gears (propulsion)	single machinery	1,60
	duplicate machinery	1,55
Auxiliary gears	single machinery	1,45
	duplicate machinery	1,40

Section 4 Electrical Installations

1 General

1.1 Application

1.1.1 The requirements of this Section are applicable to ships granted with the service notation **corvette**. These requirements are additional to those of Part C, Chapter 2.

1.1.2 The text “at every muster station” in Pt C, Ch 2, Sec 3, [3.6.3], item a) is to be replaced by “at main and emergency evacuation stations, as defined in Ch 3, Sec 5, [1.2.1] and Ch 3, Sec 5, [1.2.2]”.

Section 5 Fire Protection

1 General

1.1 Application

1.1.1 Unless otherwise specified, the provisions of this Section apply to the ships having the service notation **corvette**.

1.1.2 Applicable Rules

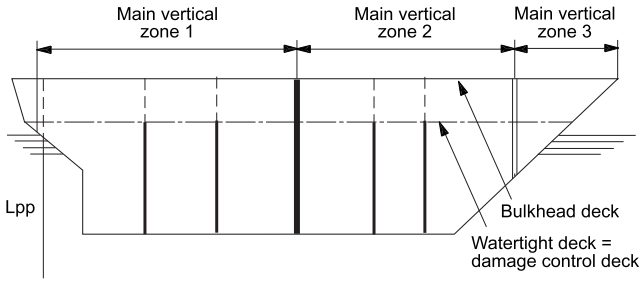
Unless otherwise specified in this Section, requirements of Part C, Chapter 4 shall apply.

Non-applicable requirements of Part C, Chapter 4 are summarized in Tab 1.

1.1.3 Ship arrangement

The ship arrangement represented by Pt C, Ch 4, Sec 1, Fig 1 is replaced by Fig 1.

Figure 1 : Ship's vertical subdivision arrangement



1.2 Definitions

1.2.1 Main evacuation stations

The main evacuation stations are the areas from which the persons to be evacuated have access to the liferafts when launched at sea.

Note 1: The evacuation stations may include spaces such as corridors, landings of stairway enclosures, accommodation and service spaces but an evacuation station is not to include a control station, a machinery space, an ammunition space or a vehicle or ro-ro space. In any case, a space which requires a key for access can not be included in an evacuation station unless the key is enclosed in a beak-glass type enclosure conspicuously located an indicated near the normally locked access door.

1.2.2 Emergency evacuation stations

The emergency evacuation stations are the areas from which the persons to be evacuated have access to the liferafts when main evacuation stations are unusable.

Table 1 : Summary of requirements of Part C, Chapter 4 to be replaced by requirements of Pt D, Ch 3, Sec 5

Concerned Sections of Part C, Chapter 4	Applicable requirements for service notation **corvette**
Pt C, Ch 4, Sec 1	Pt C, Ch 4, Sec 1, [1.1.2] replaced by [1.1.3]
Pt C, Ch 4, Sec 5	Pt C, Ch 4, Sec 5, [1.2.1] item a) replaced by [2.2.2]
	Pt C, Ch 4, Sec 5, [1.2.3] item b) corrected by [2.2.3]
	Pt C, Ch 4, Sec 5, [6.3.8] replaced by [2.3.1]
	Pt C, Ch 4, Sec 5, [6.4.1] corrected by [2.3.2]
Pt C, Ch 4, Sec 6	Pt C, Ch 4, Sec 6, [1.2.4] item a) replaced by [3.1.1]
	Pt C, Ch 4, Sec 6, [1.3.2] replaced by [3.1.2]
	Pt C, Ch 4, Sec 6, [1.3.3] replaced by [3.1.3]
	Pt C, Ch 4, Sec 6, [8.2] replaced by [3.2.1]
Pt C, Ch 4, Sec 8	Pt C, Ch 4, Sec 8, [2.1.1] replaced by [4.1.1]
	Pt C, Ch 4, Sec 8, [2.3.2] replaced by [4.1.2]
	Pt C, Ch 4, Sec 8, [4.4] replaced by [4.2.2] and [4.2.3]
	Pt C, Ch 4, Sec 8, [4.2.1] and Pt C, Ch 4, Sec 8, [4.2.2] replaced by [4.3.2] and [4.3.3]
Pt C, Ch 4, Sec 13	Pt C, Ch 4, Sec 13, [2.1.4] item b) replaced by [5.1.1]

2 Suppression of fire and explosion: Containment of fire

2.1 Damage control stations

2.1.1 Two damage control stations as defined in Pt C, Ch 4, Sec 1, [2.14] are to be provided and equipped in such a way that the functionalities of each damage control station are also operable from the other station.

Note 1: The loss of one damage control station need not be considered for application of above requirement.

2.1.2 Those damage control stations may be located in the same main vertical zone provided direct access to the damage control station which is not permanently manned at sea is provided from the other main vertical zone.

Note 1: Access to this damage control station by a single corridor may be accepted, to the satisfaction of the Society.

Note 2: If the part of the ship located forward of the collision bulkhead forms one main vertical zone, this main vertical zone need not have direct access to the damage control stations and should not be taken into account for the purpose of this requirement.

2.2 Ship subdivision

2.2.1 Safety zone

For the provisions of this Section and applicable requirements of Part C, Chapter 4, the entire ship is to be considered as one safety zone.

2.2.2 Main vertical zones

The requirements of Pt C, Ch 4, Sec 5, [1.2.1] item a) are to be replaced by:

a) The interior of the hull, superstructure and deckhouses shall be divided (see Fig 1) into at least two main vertical zones by A-60 class divisions. Steps and recesses shall be kept to a minimum, but where they are necessary, they shall have the fire integrity of the vertical limits of the main vertical zones. Where a category (5), (9) or (10) space defined in item b) of Pt C, Ch 4, Sec 5, [1.2.3] is on one side or where fuel or diesel oil or JP 5 NATO (F44) tanks or water capacities are on both sides of the division, the standard can be reduced to A-0.

Note 1: If the part of the ship located forward of the collision bulkhead forms one main vertical zone, this main vertical zone need not to comply with the requirements of [3.2.1], [4.2.3] Pt C, Ch 4, Sec 4, [4.3.1] item a)1) and Pt C, Ch 4, Sec 5, [6.3.7].

2.2.3 Fire integrity of bulkheads and decks

a) The definition of category (4) of Pt C, Ch 4, Sec 5, [1.2.3], item b) 2) is to be replaced by:

- (4) Evacuation stations and external escape routes

  Survival craft stowage area.

  Open deck spaces and passageways forming lifeboat and liferaft embarkation and lowering stations.

  External stairs and open decks used for escape routes.

  The ship's side to the waterline in the lightest condition including superstructures and deckhouse sides situated below the evacuation areas.

  Internal and external main evacuation stations.

  Note 3 and Note 4 of category (5) of Pt C, Ch 4, Sec 5, [1.2.3] item b) 2) are also applicable for this category (4).

2.3 Ventilation systems

2.3.1 Stairway enclosure ventilation system

The requirements of Pt C, Ch 4, Sec 5, [6.3.8] are to be replaced by:

"Ventilation systems serving stairway enclosures which penetrate more than a single deck shall be so arranged as to reduce the likelihood of smoke and hot gases passing from one 'tween deck space to another through the system."

Note 1: A ventilation system fitted at each penetration of the stairway enclosure with a fire or smoke damper is considered to meet this requirement. See also Pt C, Ch 4, Sec 5, [6.4.2] Pt C, Ch 4, Sec 5, [6.4.3].

2.3.2 Main vertical zone boundary penetration

The last paragraph of Pt C, Ch 4, Sec 5, [6.3.9] is to be replaced by:

"The duct is to be insulated to "A-60" class standard throughout the main vertical zone which is not served by the ventilation duct."

3 Suppression of fire and explosion: Fire-fighting

3.1 Fire pumps

3.1.1 Isolating valves and relief valve

The requirements of Pt C, Ch 4, Sec 6, [1.2.4] item a) 2) are to be replaced by:

"At least one isolating valve is to be fitted at each main vertical zone bulkhead penetrated. It shall be possible to operate the isolating valve from both sides of the main vertical zone bulkhead unless isolating valves are fitted on both sides of the division."

Note 1: If the part of the ship located forward of the collision bulkhead forms one main vertical zone, this main vertical zone need not to comply with item a) 3) of Pt C, Ch 4, Sec 6, [1.2.4].

3.1.2 Number of fire pumps

The requirements of Pt C, Ch 4, Sec 6, [1.3.2] are to be replaced by:

"The ship is to be equipped with at least two independently driven fire pumps.

The arrangement of the fire pumps shall be such that, in the event of a fire in any one compartment, the remaining fire pumps are capable of supplying the quantity of water required in [3.1.3]."

3.1.3 Capacity of fire pumps

The requirements of Pt C, Ch 4, Sec 6, [1.3.3] are to be replaced by:

"The fire pumps required by [3.1.2] shall be capable of supplying, at the pressure stated in Pt C, Ch 4, Sec 6, [1.2.6], four hydrants and the ship most demanding fire-fighting system using the fire main as the main supply of sea water, including bilge pumping if bilge ejectors are used as mentioned in Pt C, Ch 1, Sec 10, [6].

Note 1: The expression "the ship most demanding systems" means the most demanding room associated with its adjacent ammunition stores.

The fire-fighting system plan shall indicate the water systems to be in operation at the same time and the relevant water demand."

3.2 Firefighter's outfits

3.2.1 Number of firefighter's outfits

The requirements of Pt C, Ch 4, Sec 6, [8.2] are to be replaced by the following requirement [3.2.2].

3.2.2 Each main vertical zone is to be provided with at least 4 firefighter's outfits.

Note 1: If the part of the ship located forward of the collision bulkhead forms one main vertical zone, this main vertical zone need not to comply with this requirement.

4 Escape and circulation

4.1 Means of escape

4.1.1 Purpose

The requirement Pt C, Ch 4, Sec 8, [2.1.1] is to be replaced by:

"The purpose of the following requirements of this section is to provide means of escape so that persons on board can safely and swiftly escape to the evacuation stations or adjacent main vertical zone. For this purpose, the following functional requirements shall be met:

- escape routes shall be maintained in a safe condition, clear of obstacles, and
- additional aids for escape shall be provided as necessary to ensure accessibility, clear marking and adequate design for emergency situations.

Note 1: Means of escape are all the available means to exit from any space continuously or occasionally manned at sea.

Note 2: Evacuation routes or escape routes are all the main and secondary ways to escape from any space to evacuation stations or to adjacent main vertical zones."

4.1.2 Means of escape from accommodation spaces, service spaces and control station

The requirements of Pt C, Ch 4, Sec 8, [2.3.2] item a) are to be replaced by:

a) General

Stairways and ladders shall be so arranged as to provide ready means of escape to the main and emergency evacuation stations as defined in [1.2.1] and [1.2.2] from all the accommodation and service spaces and control stations in which the crew is normally employed.

4.2 Evacuation stations

4.2.1 Application

The requirements of Pt C, Ch 4, Sec 8, [4.4] are to be replaced by the following requirements [4.2.2] and [4.2.3].

4.2.2 Main evacuation stations arrangement

At least one main evacuation station as defined in [1.2.1] is to be provided for the ship.

The main evacuation station(s) shall be arranged in compliance with the prescriptions of items a) to c) below:

a) Access to liferaft launched at sea from the evacuation station shall be possible from each side of the ship

b) If a main vertical zone is not provided with a main evacuation station, access to the main evacuation station from this main vertical zone is to be provided through a main passageway as defined in [1.2.1], which have fire integrity and insulation values for stairway enclosures as determined by Pt C, Ch 4, Sec 5, Tab 1 and Pt C, Ch 4, Sec 5, Tab 2.

Note 1: If the part of the ship located forward of the collision bulkhead forms one main vertical zone, this main vertical zone need not to comply with this requirement.

c) The number of crew and special persons onboard shall be distributed in the main evacuation stations. Each main evacuation station shall have sufficient clear deck area to accommodate all the crew and special persons assigned to evacuate from that evacuation station, but at least 0,35 m² per person.

4.2.3 Emergency evacuation station

a) At least one emergency evacuation station as defined in [1.2.2] is to be provided for the ship, which shall allow the persons to be evacuated to reach the liferaft when launched at sea, in case it is not possible to use the main evacuation station.

Note 1: Access to the emergency evacuation station may be provided through adjacent spaces such as the helicopter hangar provided passage is maintained clear of obstacles at all times, with appropriate marking.

b) This evacuation station should be located as far as possible from the main evacuation station and in another main vertical zone. In no case shall this emergency evacuation station be contiguous to the main evacuation station.

c) This emergency evacuation station is not needed when one main evacuation station is provided for each main vertical zone or when the main evacuation station is provided on the open deck.

Note 2: If the part of the ship located forward of the collision bulkhead forms one main vertical zone, this main vertical zone is not to be considered for the application of item c).

4.3 Width of escape routes

4.3.1 Application

The requirements of Pt C, Ch 4, Sec 8, [4.2.1] and Pt C, Ch 4, Sec 8, [4.2.2] are to be replaced by the following [4.3.2] and [4.3.3].

4.3.2 The Main passageways and doors within, including exit door leading to the evacuation station, shall not be less than 800mm clear width. In addition, the clear width is not to be inferior to the width calculated as per the Fire Safety Systems Code, Ch 13, 2.1.2, considering the distribution of persons as per Pt C, Ch 4, Sec 8, [4.5].

4.3.3 Other passageways used as escape route and doors within, shall not be less than 600 mm clear width. In addition, the clear width is not to be inferior to the width calculated as per the Fire Safety Systems Code, Ch 13, 2.1.2, considering the distribution of persons as per Pt C, Ch 4, Sec 8, [4.5].

Doors, stairways and hatches along these passageways are to be sized in a same manner as the passageways.

5 Protection of vehicle and ro-ro spaces

5.1 Precaution against ignition of flammable vapours in closed vehicle and ro-ro spaces

5.1.1 Closing appliances and ducts in ventilation systems of vehicle and ro-ro spaces

The requirements of Pt C, Ch 4, Sec 13, [2.1.4] item b) are to be replaced by:

b) Ventilation ducts, including dampers, within a common

horizontal zone shall be made of steel. Ventilation ducts that pass through other horizontal zones or machinery spaces shall be “A” class steel ducts constructed in accordance with Pt C, Ch 4, Sec 5, [6.3.1].

CHAPTER 4
AUXILIARY NAVAL VESSEL

Section 1 General

Section 2 Ship Arrangement

Section 3 Hull and Stability

Section 4 Machinery and Systems

Section 5 Electrical Installations

Section 6 Fire Protection

Section 7 Replenishment at Sea

Section 8 Carriage of Limited Quantities of Flammable Products with Flashpoint ≤ 60°C

Section 1 General

1 General

1.1 Application

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **auxiliary naval vessel**, as defined in Pt A, Ch 1, Sec 2, [4.5].

1.1.2 The requirements of this Chapter apply to ships intended for the carriage and underway replenishment of oil products:

- having a flash point above 60°C, and
- at a temperature below and not within 15°C of their flash point.

Limited quantities of flammable products with flashpoint ≤ 60°C may be carried subject to the requirements of Ch 4, Sec 8.

The auxiliary naval vessels may also be intended to carry and transfer at sea ammunition and dry stores.

1.1.3 Number of persons on board

The requirements of this Chapter apply to ships carrying not more than 240 persons on board.

Note 1: Ships carrying more than 240 persons on board are subject to special examination of the Society.

1.1.4 Ships dealt with in this Chapter are to comply with:

- Part A
- NR216 Materials and Welding
- applicable requirements according to Tab 1.

Table 1 : Applicable requirements

Item	Reference
Ship arrangement	• Ch 4, Sec 2
Hull	• NR467, Part B • NR467, Pt D, Ch 7, Sec 3, [3] to [13] as applicable for **oil tanker** • Ch 4, Sec 3
Stability	• NR467, Part B, Chapter 3 • Ch 4, Sec 3
Machinery and systems	• NR467, Part C, Chapter 1 • NR467, Pt D, Ch 11, Sec 4 • Ch 4, Sec 4
Electrical installations	• NR467, Part C, Chapter 2 • NR467, Pt D, Ch 11, Sec 5 • Ch 4, Sec 5
Automation	• NR467, Part C, Chapter 3
Fire protection, detection and extinction	• NR467, Part C, Chapter 4 as applicable for passenger ships carrying less than 36 passengers **(1)** • Ch 4, Sec 6
Replenishment at sea	• Ch 4, Sec 7
Carriage of limited quantities of flammable products with flashpoint < 60°C	• Ch 4, Sec 8
(1) Except that Helicopter Facilities are to comply with the requirements of Pt C, Ch 4, Sec 10.	

1.2 Definitions

1.2.1 Cargo area

The cargo area is that part of the ship that contains cargo tanks, slop tanks, cargo pump rooms as well as deck areas throughout the entire length and breadth of the part of the ship above these spaces.

1.2.2 Cargo pump room

Cargo pump room is a space containing pumps and their accessories for the handling of products covered by the service notation granted to the ship.

1.2.3 Cargo service spaces

Cargo service spaces are spaces within the cargo area used for workshops, lockers and storerooms of more than 2 m^2 in area, intended for cargo handling equipment.

1.2.4 Cofferdam

For the purpose of Ch 4, Sec 2, a cofferdam is an isolating space between two adjacent steel bulkheads or decks. It is to meet the following criteria:

a) The minimum distance between the two bulkheads or decks is to be sufficient for safe access and inspection

b) In order to meet the single failure principle, in the particular case when a corner-to-corner situation occurs, this principle may be met by welding a diagonal plate across the corner.

1.2.5 Expansion bends

Expansion bends means expansion loops such as an omega bend (' Ω ') in piping system to counteract excessive stresses or displacement caused by thermal expansion or hull deformation which could be fabricated from straight lengths of pipe.

1.2.6 Fuel oil

Fuel oil means any oil used as fuel in connection with the propulsion and auxiliary machinery of the ship on which such oil is carried.

1.2.7 Hazardous areas

Hazardous areas are defined in Pt C, Ch 2, Sec 1, [3.13]. The identified hazardous zones for auxiliary naval vessels are defined in NR467, Pt D, Ch 7, Sec 5, Tab 1.

1.2.8 Heavy flanges joints

Heavy flanges joints means welded flange joints rated at least PN10 or one pressure rating higher than required design pressure, whichever is greater.

1.2.9 Hold space

Hold space is the space enclosed by the ship's structure in which an independent cargo tank is fitted.

1.2.10 Open superstructure

An open superstructure is a superstructure which is:

- open at both ends, or
- open at one end and provided with adequate natural ventilation effective over the entire length through permanent openings to outside of at least 10% of the total area of the space sides, or
- provided with adequate natural ventilation effective over the entire length though permanent openings to outside of at least 30% of the total area of the space sides.

Note 1: the total area of the space sides excludes the deck area of the space.

1.2.11 Segregated ballast

Segregated ballast means the ballast water introduced into a tank which is completely separated from the cargo oil and fuel oil system and which is permanently allocated to the carriage of ballast

1.2.12 Slop tank

Slop tank means a tank specifically designated for the collection of tank draining, tank washings and other oily mixtures.

Section 2 Ship Arrangement

1 General

1.1 Documentation to be submitted

1.1.1 The documentation listed in Tab 1 is to be submitted for approval.

Table 1 : Documentation to be submitted

No.	Documentation
1	General arrangement drawing with indication of: • access and openings • capacity and size of the cargo tanks, slop tanks and ballast tanks • dry stores and ammunition transfer routes • extent of the cargo area
2	Diagram of the mechanical and natural ventilation with indication of the ventilation inlets and outlets

2 Definitions

2.1 Deadweight

2.1.1 For the application of this Section and of Ch 4, Sec 4, “Deadweight” is to be understood as the mass, in tons, of the maximum cargo oil capacity of the ship, corresponding to the highest cargo density.

3 Ship arrangement

3.1 Double bottom arrangement outside of cargo area

3.1.1 Except for the cargo area where requirements of [5] apply, a double bottom is to be fitted extending from the collision bulkhead to the after peak bulkhead, as far as this is practicable and compatible with the design and proper working of the ship.

3.1.2 Where a double bottom is required to be fitted, the inner bottom is to be continued out to the ship's sides in such a manner as to protect the bottom to the turn of the bilge. Such protection is to be deemed satisfactory if the inner bottom is not lower at any part than a plane parallel with the keel line and which is located not less than a vertical distance h measured from the keel line, as calculated by the formula: h = B/20

However, in no case is the value of h to be less than 760 mm, and need not to be taken as more than 2 m.

3.1.3 Small wells constructed in the double bottom, in connection with the drainage arrangements of holds, are not to extend downward more than necessary. A well extending to the outer bottom, is, however, permitted at the after end of the shaft tunnel of the ship. Other wells may be permitted by the Society if it is satisfied that the arrangements give protection equivalent to that afforded by a double bottom complying with [3.1]. In no case, the vertical distance from the bottom of such a well to a plane coinciding with the keel line is to be less than 500 mm.

3.1.4 A double bottom need not be fitted in way of watertight tanks, including dry tanks of moderate size, provided the safety of the ship is not impaired in the event of bottom or side damage as defined in Ch 4, Sec 3, [1.2].

3.1.5 In the case of unusual bottom arrangements, it is to be demonstrated that the ship is capable of withstanding bottom damages, as specified in Ch 4, Sec 3, [1.2]

3.2 Openings in watertight bulkheads below the bulkhead deck

3.2.1 The number of openings in watertight bulkheads shall be reduced to the minimum compatible with the design and proper working of the ship; satisfactory means shall be provided for closing these openings.

3.2.2

a) Where pipes, scuppers, electric cables, etc.;, are carried through watertight bulkheads, arrangements shall be made to ensure the watertight integrity of the bulkheads.

b) Valves not forming part of a piping system shall not be permitted in watertight bulkheads.

c) Heat sensitive materials shall not be used in systems which penetrate watertight bulkheads, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads.

3.2.3 Openings in machinery spaces

Not more than one door apart from the doors to shaft tunnels may be fitted in each watertight bulkhead within spaces containing the main and auxiliary propulsion machinery including boilers serving the needs of propulsion. Where two or more shafts are fitted the tunnels are to be connected by an inter-communicating passage. Only one door is to be provided between the machinery space and the tunnel spaces where two shafts are fitted and only two doors where there are more than two shafts. All these doors are to be of the sliding type and are to be so located as to have their sills as high as practicable. The hand gear for operating these doors from above the bulkhead deck is to be situated outside the spaces containing the machinery.

Portable plates on bulkheads are not permitted except in machinery spaces. The Society may permit not more than one power-operated sliding watertight door in each watertight bulkhead larger than 1,20 m to be substituted for these portable plates, provided these doors are intended to remain closed during navigation except in the case of urgent necessity at the discretion of the Master. These doors need not meet the requirements of complete closure by hand-operated gear in 90 seconds (see [3.2.7] e).

3.2.4 Openings in cargo spaces

Watertight doors complying with the requirements of [3.2.7] may be fitted in watertight bulkheads dividing cargo between deck spaces. Such doors may be hinged, rolling or sliding doors but are not to be remotely controlled. They are to be fitted at the highest level and as far from the shell plating as practicable, but in no case are the outboard vertical edges to be situated at a distance from the shell plating which is less than one fifth of the breadth of the ship, such distance being measured at right angles to the centreline at the level of the deepest subdivision load line.

The doors accessible during the voyage are to be fitted with a device which prevents unauthorised opening. When it is proposed to fit such doors, the number and arrangements are to receive the special consideration of the Society.

3.2.5 Trunks and tunnels

Where trunkways or tunnels for access from crew accommodation to the stokehold, for piping, or for any other purpose are carried through watertight bulkheads, they are to be watertight and in accordance with the requirements of NR467, Pt B, Ch 4, Sec 7, [1.3]. The access to at least one end of each such tunnel or trunkway, if used as a passage at sea, is to be through a trunk extending watertight to a height sufficient to permit access above the bulkhead deck. The access to the other end of the trunkway or tunnel may be through a watertight door of the type required by its location in the ship. Such trunkways or tunnels are not to extend through the first subdivision bulkhead abaft the collision bulkhead.

Where trunkways in connection with refrigerated cargo and ventilation or forced draught trunks are carried through more than one watertight bulkhead, the means of closure at such openings are to be operated by power and be capable of being closed from a central position situated above the bulkhead deck.

3.2.6 Requirements for doors

The requirements relevant to the degree of tightness, as well as the operating systems, for doors complying with the prescriptions in [3.2.7] are specified in Tab 2.

3.2.7 Doors in watertight bulkheads below the bulkhead deck

a) Watertight doors, except as provided in [3.2.4] paragraph 1, are to be capable of being closed simultaneously from the central operating console at the navigation bridge in not more than 60 s with the ship in the upright position.

b) The means of operation whether by power or by hand of any power-operated sliding watertight door are to be capable of closing the door with the ship listed to 15° either way. Consideration is to also be given to the forces which may act on either side of the door as may be experienced when water is flowing through the opening applying a static head equivalent to a water height of at least 1 m above the sill on the centreline of the door.

c) Watertight door controls, including hydraulic piping and electrical cables, are to be kept as close as practicable to the bulkhead in which the doors are fitted, in order to minimise the likelihood of them being involved in any damage which the ship may sustain. The positioning of watertight doors and their controls are to be such that if the ship sustains damage within one fifth of the breadth of the ship, such distance being measured at right angles to the centreline at the level of the deepest subdivision load line, the operation of the watertight doors clear of the damaged portion of the ship is not impaired.

d) All power-operated sliding watertight doors are to be provided with means of indication which show at all remote operating positions whether the doors are open or closed. Remote operating positions are only to be located at the navigating bridge and at the location where hand operation above the bulkhead deck is required by e).

e) Each power-operated sliding watertight door:

- is to move vertically or horizontally;
- is to be normally limited to a maximum clear opening width of 1,20 m. The Society may permit larger doors only to the extent considered necessary for the effective operation of the ship provided that other safety measures, including the following, are taken into consideration:
  - special consideration is to be given to the strength of the door and its closing appliances in order to prevent leakages;
  - the door is to be located outside the damage zone B/5.
- is to be fitted with the necessary equipment to open and close the door using electrical power, hydraulic power, or any other form of power that is acceptable to the Society;
- is to be provided with an individual hand-operated mechanism. It is to be possible to open and close the door by hand at the door itself from either side and, in addition, close the door from an accessible position above the bulkhead deck with an all round crank motion or some other movement providing the same degree of safety acceptable to the Society. Direction of rotation or other movement is to be clearly indicated at all operating positions. The time necessary for the complete closure of the door, when operating by hand gear, may not exceed 90 s with the ship in the upright position;
- is to be provided with controls for opening and closing the door by power from both sides of the door and also for closing the door by power from the central operating console at the navigation bridge;
- is to be provided with an audible alarm, distinct from any other alarm in the area, which is to sound whenever the door is closed remotely by power and which is to sound for at least 5 s but no more than 10 s before the door begins to move and is to continue sounding until the door is completely closed. In the case of remote hand operation it is sufficient for the audible alarm to sound only when the door is moving. Additionally, in passenger areas and areas of high ambient noise, the Society may require the audible alarm to be supplemented by an intermittent visual signal at the door;
- is to have an approximately uniform rate of closure under power. The closure time, from the time the door begins to move to the time it reaches the completely closed position, is to in no case be less than 20 s or more than 40 s with the ship in the upright position.

f) The electrical power required for power-operated sliding watertight doors is to be supplied from the emergency switchboard either directly or by a dedicated distribution board situated above the bulkhead deck. The associated control, indication and alarm circuits are to be supplied from the emergency switchboard either directly or by a dedicated distribution board situated above the bulkhead deck and be capable of being automatically supplied by a transitional source of emergency electrical power in the event of failure of either the main or emergency source of electrical power.

The transitional source of emergency electrical power is to consist of an accumulator battery suitably located for use in an emergency which is to operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage and be of sufficient capacity and so arranged as to supply power automatically, in the event of failure of either the main or emergency source of electrical power, to control, indication and alarm circuits at least for half an hour.

g) Power-operated sliding watertight doors are to have either:

- a centralised hydraulic system with two independent power sources each consisting of a motor and pump capable of simultaneously closing all doors. In addition, there are to be for the whole installation hydraulic accumulators of sufficient capacity to operate all the doors at least three times, i.e. closed-open-closed, against an adverse list of 15°. This operating cycle is to be capable of being carried out when the accumulator is at the pump cut-in pressure. The fluid used is to be chosen considering the temperatures liable to be encountered by the installation during its service. The power operating system is to be designed to minimise the possibility of having a single failure in the hydraulic piping adversely affect the operation of more than one door. The hydraulic system is to be provided with a low-level alarm for hydraulic fluid reservoirs serving the power-operated system and a low gas pressure group alarm or other effective means of monitoring loss of stored energy in hydraulic accumulators. These alarms are to be audible and visual and are to be situated on the central operating console at the navigating bridge; or
- an independent hydraulic system for each door with each power source consisting of a motor or pump capable of opening and closing the door. In addition, there is to be a hydraulic accumulator of sufficient capacity to operate the door at least three times, i.e. closed-open-closed, against an adverse list of 15°. This operating cycle is to be capable of being carried out when the accumulator is at the pump cut-in pressure. The fluid used is to be chosen considering the temperatures liable to be encountered by the installation during its service. A low gas pressure group alarm or other effective means of monitoring loss of stored energy in hydraulic accumulators is to be provided at the central operating console on the navigation bridge. Loss of stored energy indication at each local operating position is to also be provided; or
- an independent electrical system and motor for each door with each power source consisting of a motor capable of opening and closing the door. The power source is to be capable of being automatically supplied by the transitional source of emergency electrical power in the event of failure of either the main or emergency source of electrical power and with sufficient capacity to operate the door at least three times, i.e. closed-open-closed, against an adverse list of 15°.

  The transitional source of emergency electrical power is to consist of an accumulator battery suitably located for use in an emergency which is to operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage and be of sufficient capacity and so arranged as to supply power automatically, in the event of failure of either the main or emergency source of electrical power, to watertight doors, but not necessarily all of them simultaneously, unless an independent source of stored energy is provided.

For the systems specified above, provision is to be made as follows:

Power systems for power-operated watertight sliding doors are to be separate from any other power system. A single failure in the electrical or hydraulic power-operated systems excluding the hydraulic actuator is not to prevent the hand operation of any door.

h) Control handles are to be provided at each side of the bulkhead at a minimum height of 1,6 m above the floor and are to be so arranged as to enable persons passing through the doorway to hold both handles in the open position without being able to set the power closing mechanism in operation accidentally. The direction of movement of the handles in opening and closing the door is to be in the direction of door movement and is to be clearly indicated.

i) As far as practicable, electrical equipment and components for watertight doors are to be situated above the bulkhead deck and outside hazardous areas and spaces.

j) The enclosures of electrical components necessarily situated below the bulkhead deck are to provide suitable protection against the ingress of water.

k) Electric power, control, indication and alarm circuits are to be protected against faults in such a way that a failure in one door circuit is not to cause a failure in any other door circuit. Short-circuits or other faults in the alarm or indicator circuits of a door are not to result in a loss of power operation of that door. Arrangements are to be such that leakage of water into the electrical equipment located below the bulkhead deck is not to cause the door to open.

l) A single electrical failure in the power operating or control system of a power-operated sliding watertight door is not to result in a closed door opening. Availability of the power supply is to be continuously monitored at a point in the electric circuit as near as practicable to each of the motors required in g). Loss of any such power supply is to activate an audible and visual alarm at the central operating console at the navigation bridge.

m) The central operating console at the navigation bridge is to have a “master mode” switch with two modes of control:

- a “local control” mode which is to allow any door to be locally opened and locally closed after use without automatic closure, and
- a “doors closed” mode which is to automatically close any door that is open. The “doors closed” mode is to permit doors to be opened locally and is to automatically reclose the doors upon release of the local control mechanism.

The “master mode” switch is to normally be in the “local control” mode. The “doors closed” mode is to only be used in an emergency or for testing purposes. Special consideration is to be given to the reliability of the “master mode” switch.

n) The central operating console at the navigation bridge is to be provided with a diagram showing the location of each door, with visual indicators to show whether each door is open or closed. A red light is to indicate a door is fully open and a green light is to indicate a door is fully closed. When the door is closed remotely the red light is to indicate the intermediate position by flashing. The indicating circuit is to be independent of the control circuit for each door.

o) It is not to be possible to remotely open any door from the central operating console.

Table 2 : Doors

			Sliding type			Hinged type			Rolling type (cargo between deck spaces)
			Remote operation indication on the bridge	Indicator on the bridge	Local operation only	Remote operation indication on the bridge	Indicator on the bridge	Local operation only	
Watertight	below the bulkhead deck	open at sea	X						
		normally closed**(4)**	X						
		remain closed **(4)**					X **(1)**		X **(1) (3)**
Weathertight / semi-watertight **(2)**	above the bulkhead deck	open at sea	X			X			
		normally closed**(4)**		X			X		
		remain closed **(4)**						X	

(1) The door is to be closed before the voyage commences.

(2) Semi-watertight doors are required when they are located below the waterline at the equilibrium of the intermediate stages of flooding.

(3) If the door is accessible during the voyage, a device which prevents unauthorised opening is to be fitted.

(4) Notice to be affixed on both sides of the door: “to be kept closed at sea”.

4 General arrangement of the ship with regard to fire prevention and crew safety

4.1 Location and separation of spaces

4.1.1 Tanks containing cargo or cargo residues are to be segregated from accommodation, service and machinery spaces, tanks containing drinking water and stores for human consumption by means of a cofferdam or similar space.

4.1.2 Double bottom tanks adjacent to cargo tanks are not to be used as fuel oil tanks.

4.1.3 Protection of accommodations

Exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation, is to be constructed of steel and insulated to A-60 standard for the whole of the portions which face the cargo area and on the outward sides for a distance of 3 m from the end boundary facing the cargo area. The distance of 3 m is to be measured horizontally and parallel to the middle line of the ship from the boundary which faces the cargo area at each deck level. In the case of the sides of those superstructures and deckhouses, such insulation is to be carried up to the underside of the deck of the navigation bridge.

Note 1: For the portions which face the cargo area, the A-60 standard insulation should be provided up to the underside of the deck of the navigation bridge.

4.2 Access and openings

4.2.1 Access and openings to accommodation spaces, service spaces, control stations and machinery spaces

Access doors, air inlets and openings to accommodation spaces, service spaces and control stations are not to face the cargo area.

4.2.2 Access to spaces in the cargo area

a) Safe access to cofferdams, ballast tanks, cargo tanks and other compartments in the cargo area is to be direct from the open deck and such as to ensure their complete inspection. Safe access to double bottom compartments or to forward ballast tanks may be from a pump-room, deep cofferdam, pipe tunnel, double hull compartment or similar compartment not intended for the carriage of oil or hazardous cargoes.

Note 1: Unless other additional arrangements provided to facilitate their access are considered satisfactory by the Society, the double bottom tanks are to be provided with at least two separate means of access complying with a) above.

b) For access through horizontal openings, hatches or manholes, the dimensions are to be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also provide a clear opening to facilitate the hoisting of an injured person from the bottom of the compartment. The minimum clear opening is to be not less than 600 mm x 600 mm.

c) For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the compartment, the minimum opening is to be not less than 600 mm x 800 mm at a height of not more than 600 mm from the bottom shell plating unless gratings or other foot holds are provided.

d) Access ladders of cargo tanks are to be fitted with handrails and to be securely attached to the tank structure. They are not to be fitted vertically, unless justified by the size of the tanks. Rest platforms are to be provided at suitable intervals of not more than 10 m.

4.2.3 Access to the pipe tunnels

a) The pipe tunnels in the double bottom are to comply with the following requirements:

   1) they are not to communicate with the engine room,

   2) provision is to be made for at least two exits to the open deck arranged at a maximum distance from each other. One of these exits fitted with a watertight closure may lead to the cargo pump room.

b) Where there is permanent access from a pipe tunnel to the main pump room, a watertight door is to be fitted complying with the requirements of NR467, Pt B, Ch 2, Sec 1, [5] and in addition with the following:

   1) in addition to the bridge operation, the watertight door is to be capable of being manually closed from outside the main pump room entrance,

   2) the watertight door is to be kept closed during normal operations of the ship except when access to the pipe tunnel is required.

Note 1: A notice is to be affixed to the door to the effect that it may not be left open.

4.3 Ventilation

4.3.1 General

Spaces located within the cargo area are to be efficiently ventilated. Portable means of ventilation are permitted.

4.3.2 Ventilation of cargo pump rooms

The ventilation of the cargo pump room is to comply with requirements of Ch 4, Sec 4, [4.5.1].

5 General arrangement of the ship with regard to pollution prevention

5.1 Protection of the cargo tank length in the event of grounding or collision

5.1.1 General

a) The design and construction of auxiliary naval vessels is to pay due regard to the general safety aspects including the need for maintenance and inspections of wing and double bottom tanks or spaces.

b) Oil is not to be carried in any space extending forward of a collision bulkhead located in accordance with NR467, Pt B, Ch 2, Sec 1, [2]. An oil tanker that is not required to have a collision bulkhead in accordance with that regulation is not to carry oil in any space extending forward of the transverse plane perpendicular to the centreline that is located as if it were a collision bulkhead located in accordance with that regulation.

5.1.2 Case of ships of 5000 tons deadweight and above

On auxiliary naval vessels of 5000 tons deadweight and above, the entire cargo tank length is to be protected by ballast tanks or spaces other than cargo and fuel oil tanks as follows:

a) Wing tanks or spaces

Wing tanks or spaces are to extend either for the full depth of the ship's side or from the top of the double bottom to the uppermost deck, disregarding a rounded gunwale where fitted. They are to be arranged such that the cargo tanks are located inboard of the moulded line of the side shell plating, nowhere less than the distance w which, as shown in Fig 1 is measured at any cross-section at right angles to the side shell, as specified below:

$$w = 0,5 + \frac{DW}{20000}(m)$$

or w = 2,0 m, whichever is the lesser.

The minimum value of w = 1,0 m.

b) Double bottom tanks or spaces

At any cross-section, the depth of each double bottom tank or compartment is to be such that the distance h between the bottom of the cargo tanks and the moulded line of the bottom shell plating measured at right angles to the bottom shell plating, as shown in Fig 1 is not less than specified below:

- B/15 (m), or
- 2,0 m, whichever is the lesser.

The minimum value of h = 1,0 m.

Note 1: Double bottom tanks or spaces as required by the above paragraph may be dispensed with, provided that the design of the tanker is such that the cargo and vapour pressure exerted on the bottom shell plating forming a single boundary between the cargo and the sea does not exceed the external hydrostatic water pressure, as expressed by the following formula:

$$f \times h_c \times \rho_c \times g + 100\Delta_p \leq d_n \times \rho_s \times g$$

where:

h_c : Height of cargo in contact with the bottom shell plating, in metres

ρ_c : Maximum cargo density, in t/m^3

d_n : Minimum operating draught under any expected loading conditions, in metres

ρ_s : Density of seawater, in t/m^3

Δ_p : Maximum set pressure of pressure/vacuum valve provided for the cargo tanks, in bars

f : Safety factor = 1,1

g : Standard acceleration of gravity (9,81 m/s^2).

Any horizontal partition necessary to fulfil the above requirements are to be located at a height of not less than B/6 or 6 m, whichever is the lesser, but not more than 0,6D, above the baseline where D is the moulded depth amidships.

The location of wing tanks or spaces is to be as defined in item a) above except that, below a level 1,5 h above the baseline where h is as defined above, the cargo tank boundary line may be vertical down to the bottom plating, as shown in Fig 2.

Figure 1 : Cargo tank boundary lines

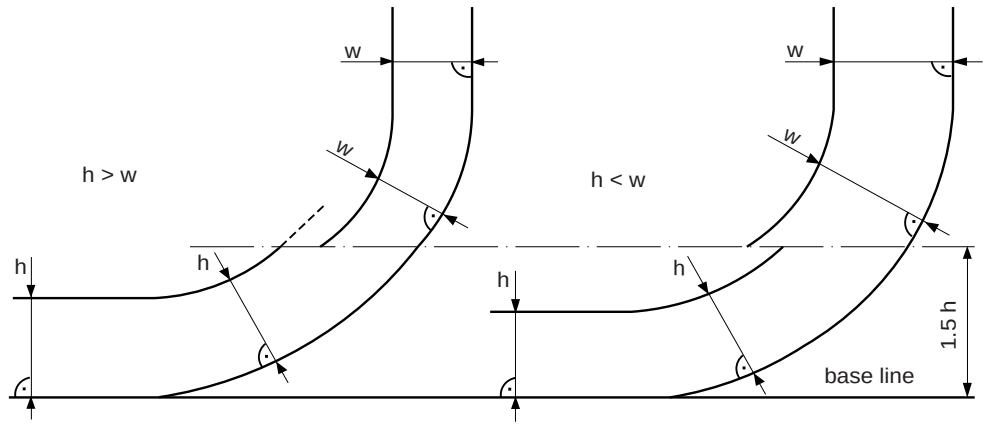
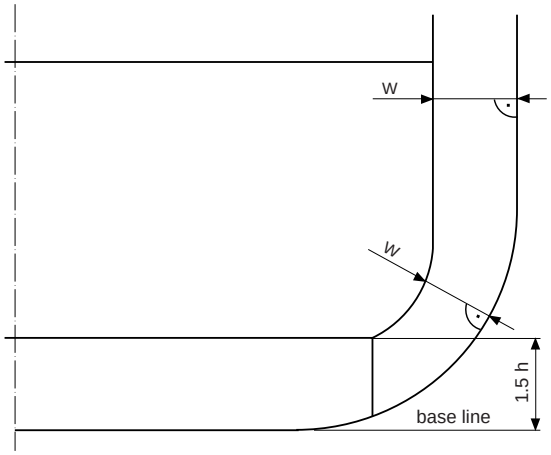


Figure 2 : Cargo tank boundary lines



c) Turn of the bilge area or at locations without a clearly defined turn of the bilge

Where the distance h and w are different, the distance w is to have preference at levels exceeding 1,5 h above baseline as shown in Fig 1.

d) Suction wells in cargo tanks may protube into the double bottom below the boundary line defined by the distance h provided that such wells are as small as practicable and the distance between the well bottom and bottom shell plating is not less than 0,5 h.

e) Ballast and cargo piping is to comply with the provisions of Ch 4, Sec 4, [3.3.1] and Ch 4, Sec 4, [4.4.1].

Note 2: Other methods of design and construction of auxiliary naval vessels may also be accepted as alternatives to the requirements prescribed in items a) to e), provided that such methods ensure at least the same level of protection against oil pollution in the event of collision or stranding and are approved in principle by the Society.

The Society will accept the methods of design and construction described in IMO Resolution MEPC.110(49) and its corrigenda.

5.1.3 Case of ships of less than 5000 tons deadweight

Auxiliary naval vessels of less than 5000 tons deadweight are to:

a) at least be fitted with double bottom tanks or spaces having such a depth that the distance h specified in [5.1.2] b) complies with the following:

h = B/15 (m)

with a minimum value of h = 0,76 m;

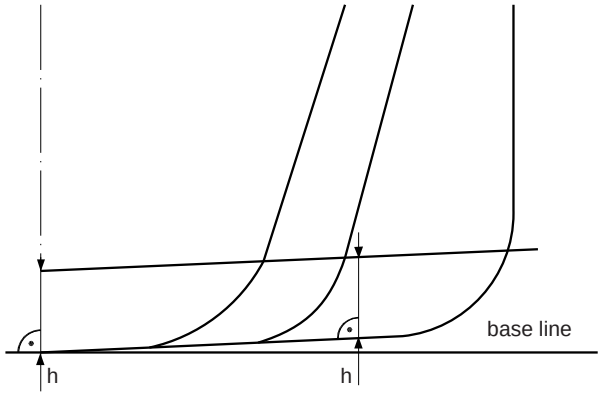
in the turn of the bilge area and at locations without a clearly defined turn of bilge, the cargo tank boundary line is to run parallel to the line of the midship flat bottom as shown in Fig 3; and

b) be provided with cargo tanks so arranged that the capacity of each cargo tank does not exceed 700 m^3 unless wing tanks or spaces are arranged in accordance with [5.1.2] a) complying with the following:

$$w = 0,4 + \frac{2,4DW}{20000}(m)$$

with a minimum value of w = 0,76 m.

Figure 3 : Cargo tank boundary lines



5.2 Segregation of oil and water ballast

5.2.1 No ballast water is to be carried in any oil fuel tank.

5.3 Accidental oil outflow performance

5.3.1 Auxiliary naval vessels are to comply with the requirements of the Regulation 23 of Annex I to Marpol Convention, as amended.

5.4 Retention of oil on board - Slop tanks

5.4.1 General

a) Auxiliary naval vessels shall be provided with slop tank arrangements in accordance with items a) and b) below, [5.4.2] and [5.4.3].

b) Adequate means are to be provided for transferring the dirty ballast residue and tank washings from the cargo tanks into a slop tank approved by the Society.

c) Arrangements are to be provided to transfer the oily waste into a slop tank or combination of slop tanks.

5.4.2 Capacity of slop tanks

The arrangement of the slop tank or combination of slop tanks is to have a capacity necessary to retain the slop generated by tank washings, oil residues and dirty ballast residues. The total capacity of the slop tank or tanks is not to be less than 3% of the oil carrying capacity of the ship, except that the Society may accept:

a) 2% for auxiliary naval vessels where the tank washing arrangements are such that once the slop tank or tanks are charged with washing water, this water is sufficient for tank washing and, where applicable, for providing the driving fluid for eductors, without the introduction of additional water into the system

b) 2% where segregated ballast tanks are provided in accordance with [5.2]. This capacity may be further reduced to 1,5% where the tank washing arrangements are such that once the slop tank or tanks are charged with washing water, this water is sufficient for tank washing and, where applicable, for providing the driving fluid for eductors, without introduction of additional water into the system.

Auxiliary naval vessels of 70 000 tons deadweight and above are to be fitted with at least two slop tanks.

5.4.3 Design of slop tanks

Slop tanks are to be so designed particularly in respect of the position of inlets, outlets, baffles or weirs where fitted, so as to avoid excessive turbulence and entrainment of oil or emulsion with the water.

5.5 Deck spills

5.5.1

a) Means are to be provided to keep deck spills away from accommodation and service areas. This may be accomplished by provision of a permanent continuous coaming of a height of at least 300 mm, extending from side to side. Special consideration shall be given to the arrangements associated with stern loading.

Note 1: The provisions of paragraph a) above also apply to bow and stern cargo loading stations.

b) Where gutter bars are installed on the weather decks of oil tankers in way of cargo manifolds and are extended aft as far as the aft bulkhead of superstructures for the purpose of containing cargo spills on deck during loading and discharge operations, the free surface effects caused by containment of a cargo spill during liquid transfer operations or of boarding seas while underway are to be considered with respect to the vessel's available margin of positive initial stability (GMo).

c) Where the gutter bars installed are higher than 300 mm, they are to be treated as bulwarks with freeing ports arranged in accordance with NR467, Pt B, Ch 9, Sec 9, [5] and provided with effective closures for use during loading and discharge operations. Attached closures are to be arranged in such a way that jamming is prevented while at sea, enabling the freeing ports to remain effective.

d) On ships without deck camber, or where the height of the installed gutter bars exceeds the camber, and for oil tankers having cargo tanks exceeding 60% of the vessel's maximum beam amidships regardless of gutter bar height, gutter bars may not be accepted without an assessment of the initial stability (GMo) for compliance with the relevant intact stability requirements taking into account the free surface effect caused by liquids contained by the gutter bars.

5.6 Pump-room bottom protection

5.6.1 General

This Article is applicable to auxiliary naval vessels of 5000 tons deadweight and above.

5.6.2 The pump-room is to be provided with a double bottom such that at any cross-section the depth of each double bottom tank or space is to be such that the distance h between the bottom of the pump-room and the ship's base line measured at right angles to the ship's base line is to be not less than the lesser of:

- h= B/15 m
- h=2m

without being taken less than 1 m.

5.6.3 In case of pump rooms whose bottom plate is located above the base line by at least the minimum height required in [5.6.2] (e.g. gondola stern designs), there is no need for a double bottom construction in way of the pump-room.

5.6.4 Ballast pumps are to be provided with suitable arrangements to ensure efficient suction from double bottom tanks.

5.6.5 Notwithstanding the provisions of [5.6.2] and [5.6.3], where the flooding of the pump-room would not render the ballast or cargo pumping system inoperative, a double bottom need not be fitted.

Section 3 Hull and Stability

Symbols

L_{LL} : Load line length, in m, defined in NR467, Pt B, Ch 1, Sec 2, [3.2]

R_y : Minimum yield stress, in N/mm^2, of the material, to be taken equal to 235/k N/mm^2, unless otherwise specified

k : Material factor for steel, defined in NR467, Pt B, Ch 4, Sec 1, [2.3]

E : Young's modulus, in N/mm^2, to be taken equal to:

- E = 2,06·10^5 N/mm^2 for steels in general
- E = 1,95·10^5 N/mm^2 for stainless steels.

1 Stability

1.1 Intact stability

1.1.1 General

The stability of the ship for the loading conditions specified in NR467, Pt B, Ch 3, App 2, [1.2.6] is to be in compliance with the requirements of NR467, Pt B, Ch 3, Sec 2. In addition, the requirements in [1.1.2] are to be complied with.

1.1.2 Liquid transfer operations

Ships with certain internal subdivision may be subjected to lolling during liquid transfer operations such as loading, unloading or ballasting. In order to prevent the effect of lolling, the design of ships having the service notation **auxiliary naval vessel** is to be such that the following criteria are complied with:

a) The intact stability criteria reported in b) is to be complied with for the worst possible condition of loading and ballasting as defined in c), consistent with good operational practice, including the intermediate stages of liquid transfer operations. Under all conditions the ballast tanks are to be assumed slack.

b) The initial metacentric height GMo, in m, corrected for free surface measured at 0° heel, is to be not less than 0,15. For the purpose of calculating GMo, liquid surface corrections are to be based on the appropriate upright free surface inertia moment.

c) The vessel is to be loaded with:

- all cargo tanks filled to a level corresponding to the maximum combined total of vertical moment of volume plus free surface inertia moment at 0° heel, for each individual tank
- cargo density corresponding to the available cargo deadweight at the displacement at which transverse KM reaches a minimum value
- full departure consumable
- 1% of the total water ballast capacity.The maximum free surface moment is to be assumed in all ballast tanks.

1.2 Damage stability

1.2.1 General

The Ship is to comply with the subdivision and damage stability criteria as specified in [1.2.8], after the assumed side or bottom damage as specified in [1.2.2], for the standard of damage described in [1.2.3], and for any operating draught reflecting actual partial or full load conditions consistent with trim and strength of the ship as well as specific gravities of the cargo.

The actual partial or full load conditions to be considered are those specified in NR467, Pt B, Ch 3, App 2, [1.2.6].

1.2.2 Damage dimensions

The assumed extent of damage is to be as defined in Tab 1.

The transverse extent of damage is measured inboard the ship side at right angles to the centreline at the level of the summer load line.

For the purpose of determining the extent of assumed damage, suction wells may be neglected, provided such wells are not excessive in areas and extend below the tank for a minimum distance and in no case more than half the height of the double bottom.

The vertical extent of damage is measured from the moulded line of the bottom shell plating at centreline.

If any damage of a lesser extent than the maximum extent of damage specified in Tab 1 would result in a more severe condition, such damage is to be considered.

1.2.3 Standard of damage

The damage in [1.2.2] is to be applied to all conceivable locations along the length of the ship, according to Tab 2.

1.2.4 Calculation method

The metacentric heights (GM), the stability levers (GZ) and the centre of gravity positions (KG) for judging the final survival conditions are to be calculated by the constant displacement method (lost buoyancy).

1.2.5 Flooding assumptions

The requirements of [1.2.8] are to be confirmed by calculations which take into consideration the design characteristics of the ship, the arrangements, configuration and contents of the damaged compartments and the distribution, specific gravities and free surface effect of liquids.

Where the damage involving transverse bulkheads is envisaged as specified in [1.2.3], transverse watertight bulkheads are to be spaced at least at a distance equal to the longitudinal extent of assumed damage specified in [1.2.2] in order to be considered effective. Where transverse bulkheads are spaced at a lesser distance, one or more of these bulkheads within such extent of damage is to be assumed as non-existent for the purpose of determining flooded compartments.

1.2.6 Progressive flooding

If pipes, ducts or tunnels are situated within the assumed extent of damage penetration as defined in [1.2.2], arrangements are to be made so that progressive flooding cannot thereby extend to compartments other than those assumed to be floodable in the calculation for each case of damage.

1.2.7 Permeabilities

The specific gravity of cargoes carried, as well as any outflow of liquid from damaged compartments, are to be taken into account for any empty or partially filled tank.

The permeability of compartments assumed to be damaged are to be as indicated in Tab 3.

1.2.8 Survival requirements

Ships having the service notation **auxiliary naval vessel** are to be regarded as complying with the damage stability criteria if the requirements of [1.2.9] and [1.2.10] are met.

Table 1 : Extent of damage

Damage		Longitudinal extent	Transverse extent	Vertical extent
Side		l_C = 1/3 $L_{LL}^{2/3}$ or 14,5 m **(1)**	t_C = B/5 or 11,5 m **(1)**	v_C = without limit
Bottom	For 0,3 L_{LL} from the forward perpendicular	l_S = 1/3 $L_{LL}^{2/3}$ or 14,5 m **(1)**	t_S = B/6 or 10,0 m **(1)**	v_S = B/15 or 6,0 m **(1)**
	any other part	l_S = 1/3 $L_{LL}^{2/3}$ or 5,0 m **(1)**	t_S = B/6 or 5,0 m **(1)**	v_S = B/15 or 6,0 m **(1)**
(1) Whichever is the lesser				

Table 2 : Standard of damage

Ship's length, in m	Damage anywhere in ship's length	Machinery space flooded
$L_{LL} \leq 225$	Yes	Yes, alone
$L_{LL} > 225$	Yes	Yes

Table 3 : Permeability

Compartments	Permeability
Appropriate for stores	0,60
Intended for ammunition storage	0,80
Occupied by accommodation	0,95
Occupied by machinery	0,85
Void compartments	0,95
Intended for consumable liquids	0 to 0,95 **(1)**
Intended for other liquids	0 to 0,95 **(1)**
(1) The permeability of partially filled compartments is to be consistent with the amount of liquid carried in the compartment. Whenever damage penetrates a tank containing liquids, it shall be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.	

1.2.9 Final stage of flooding

a) The final waterline, taking into account sinkage, heel and trim, shall not immerse:

1) the lower edge of any opening through which progressive flooding may take place. Such openings shall include air-pipes and those which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by

means of watertight manhole covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, and sidescuttles of the non-opening type

2) any part of the bulkhead deck considered an horizontal evacuation route for compliance with the requirements of Ch 4, Sec 6, [8]

3) The progressive flooding is to be considered in accordance with NR467, Pt B, Ch 3, Sec 3, [3.3].

b) Furthermore, the waterline after damage in any intermediate stage of flooding, or in the final stage of flooding shall not immerse:

1) any vertical escape hatch in the bulkhead deck intended for compliance with the requirements of Ch 4, Sec 6, [8]

2) any controls intended for operation of watertight doors, equalization devices, valves on piping or on ventilation ducts intended to maintain the integrity of watertight bulkheads from above the bulkhead deck. In addition, these controls shall remain accessible and operable

3) any part of piping or ventilation ducts carried out through a watertight boundary if not fitted with watertight means of closure at each boundary.

c) The maximum angle of heel after flooding but before equalization shall not exceed 20°. Where cross flooding fittings are required, the time for equalization shall not exceed 15 minutes. The controls are to be operable with a maximum heel angle of 20°.

The equalization system is to be independent without need of any power supply, and sufficient residual stability is to be maintained during all stages where equalisation is used.

In the final stage of flooding after equalization, the angle of heel shall not exceed 15°.

d) The stability is to be investigated and may be regarded as sufficient if the righting lever curve has at least a range of 20° beyond the position of equilibrium in association with a maximum residual righting lever, in m, of at least 0,1 within the 20° range; the area, in m·rad, under the curve within this range is to be not less than 0,0175.

1.2.10 Intermediate stage of flooding

The Society is to be satisfied that the stability is sufficient during the intermediate stages of flooding. To this end the Society applies the same criteria relevant to the final stage of flooding also during the intermediate stages of flooding.

1.2.11 Bottom raking damage

This requirement applies to auxiliary naval vessels of 20000 t deadweight and above.

The damage assumptions relative to the bottom damage prescribed in [1.2.2] are to be supplemented by the assumed bottom raking damage of Tab 4.

The requirements of [1.2.8] are to be complied with for the assumed bottom raking damage.

Table 4 : Bottom damage extent

Deadweight	Longitudinal extent	Transverse extent	Vertical extent
< 75000 t	0,4 L_{LL} **(1)**	B/3	**(2)**
≥ 75000 t	0,6 L_{LL} **(1)**	B/3	**(2)**
(1) Measured from the forward perpendicular. **(2)** Breach of the outer hull.			

1.2.12 Information to the Master

The Master of every ship having the service notation **auxiliary naval vessel** is to be supplied in an approved form with:

- information relative to loading and distribution of cargo necessary to ensure compliance with the requirements relative to stability, and
- data on the ability of the ship to comply with damage stability criteria as determined in [1.2.8].

1.2.13 Loading instrument

Ships having the service notation **auxiliary naval vessel** are to be provided with an approved loading instrument of a type to the satisfaction of the Society.

A simple and straightforward instruction manual is to be provided.

In order to validate the proper functioning of the computer hardware and software, pre-defined loading conditions are to be run in the loading instrument periodically, at least at every periodical class survey, and the print-out is to be maintained on board as check conditions for future reference in addition to the approved test conditions booklet.

The procedure to be followed, as well as the list of technical details to be sent in order to obtain loading instrument approval, are given in NR467, Pt B, Ch 11, Sec 2, [4].

2 Loading conditions

2.1 Propeller immersion

2.1.1 For all loading cases of the ship, including ballast conditions and ballast water exchange sequences, the draught at the after perpendicular is to be not less than that which is necessary to obtain full immersion of the propeller(s).

3 Structure

3.1 Application

3.1.1 The requirements of this article come in addition to those of NR467, Part B and NR467, Pt D, Ch 7, Sec 3, [2] to NR467, Pt D, Ch 7, Sec 3, [9].

3.2 Hull scantlings

3.2.1 Dry stores and ammunition transfer routes

All dry stores and ammunition transfer routes are to be checked with regards to wheeled load as defined in NR467, Pt B, Ch 5, Sec 6, [6] and strength criteria given in NR467, Part B, Chapter 7.

3.2.2 Height of door sills along transfer routes

Where sills are required on doors located along the dry stores or ammunition transfer routes, the fitting of alternative arrangements to enable their transfer by way of wheeled vehicles will be considered by the Society on a case by case basis.

3.3 Ammunition and dry stores elevators

3.3.1 Lifting operations

Lifting operations are to be described, with detailed information about Safe Working load of elevators, type of loads carried out and operating procedures with corresponding load dynamic amplification factors.

Dynamic amplification factors include combined effects of:

a) vertical acceleration induced by start and stop of lifting process

b) accelerations induced by behaviour of ship at sea.

When a ship motion damping system is fitted, it may be accepted, on a case by case basis, to reduce the accelerations mentioned in b) above. The reduction level, if any, will be defined after an analysis of operating procedures in normal conditions and in degraded conditions.

3.3.2 Loads on elevators

The design pressure exerted on the platform of the ammunition and dry stores elevators are to be taken in accordance with Pt B, Ch 5, Sec 6, [2], Pt B, Ch 5, Sec 6, [3] and Pt B, Ch 5, Sec 6, [4], as appropriate.

3.3.3 Plating

The scantlings of the plating of ammunition and dry stores elevators loads are to be in compliance with requirements of NR467, Pt B, Ch 7, Sec 1.

3.3.4 Ordinary stiffeners

The scantlings of the ordinary stiffeners of ammunition and dry stores elevators are to be in compliance with requirements of NR467, Pt B, Ch 7, Sec 2.

3.3.5 Primary structure

The scantlings of the primary structure of ammunition and dry stores elevators are generally to be checked on basis of three dimensional structural model, according to the requirements of NR467, Pt B, Ch 7, Sec 3, [3] and NR467, Pt B, Ch 7, Sec 3, [6].

3.3.6 Locking and lifting devices

The scantlings of locking and lifting devices and the surrounding reinforcements are to be assessed on first principle basis.

Design forces (amplitudes, directions) and associated safety coefficients are to be agreed upon on a case by case basis.

Section 4 Machinery and Systems

1 General

1.1 Documents to be submitted

1.1.1 The documents listed in Tab 1 are to be submitted for approval.

Table 1 : Documents to be submitted

No.	Description of the document **(1)**
1	General layout of cargo pump room with details of: • bulkhead penetrations • gas detection system • other alarms and safety arrangements
2	Diagram of cargo piping system
3	Diagram of the cargo tank venting system with: • indication of the outlet position • details of the pressure/vacuum valves and flame arrestors • details of the draining arrangements, if any
4	Diagram of the cargo tank level gauging system with overfill safety arrangements
5	Diagram of the cargo tank cleaning system
6	Diagram of the bilge and ballast systems serving the spaces located in the cargo area
(1)	Diagrams are also to include, where applicable, the (local and remote) control and monitoring systems and automation systems

2 Propulsion and steering capability

2.1 Propulsion availability

2.1.1 The ship propulsion system is to comply at least with the requirements of the additional class notation **AVM-APS** for alternative propulsion mode as defined in Part E, Chapter 3.

In addition, the control system for propulsion is to be such that ship speed and propeller speed can be changed by small steps of not more than 0,2 knots for ship speed or 2 rpm for propeller speed.

2.2 Steering

2.2.1 The steering system is to comply with the requirements given in Ch 4, Sec 7, [2.2].

3 Piping systems other than cargo piping system

3.1 General

3.1.1 Materials

a) Materials are to comply with the provisions of NR467, Pt C, Ch 1, Sec 10.

b) Spheroidal graphite cast iron may be accepted for bilge and ballast piping within double bottom or cargo tanks.

c) Grey cast iron may be accepted for ballast lines within cargo tanks, except for ballast lines to forward tanks through cargo tanks.

3.1.2 Independence of piping systems

a) Bilge system serving the cargo pump room and spaces located within the cargo area are to be independent from any piping system serving spaces located outside the cargo area.

b) Fuel oil and JP5-NATO (F44) systems referred in [3.5] are to:

- be independent from the cargo piping system
- have no connections with pipelines serving cargo or slop tanks, except as permitted by [3.5].

3.1.3 Passage through cargo tanks and slop tanks

a) Unless otherwise specified, bilge, ballast and fuel oil systems serving spaces located outside the cargo area are not to pass through cargo tanks or slop tanks.

b) Where expressly permitted, ballast pipes passing through cargo tanks are to fulfil the following provisions:
- they are to have welded or heavy flanged joints the number of which is kept to a minimum. Expansion bends only are permitted in these lines within cargo tanks for serving the ballast tanks and within the ballast tanks for serving the cargo tanks.
- they are to be of extra-reinforced wall thickness as per Tab 2
- they are to be adequately supported and protected against mechanical damage.

c) Where required in order to meet the requirements of Ch 4, Sec 3, [1.2.6], lines of piping which run through cargo tanks are to be fitted with closing devices.

Table 2 : Minimum wall thickness for carbon steel pipes

Nominal diameter (mm)	Mnimum wall thickness (mm)
50	6,3
100	8,6
125	9,5
150	11
200 and above	12,5

3.2 Bilge system

3.2.1 Bilge pumps

a) At least one bilge pump is to be provided for draining the spaces located within the cargo area. Cargo pumps or stripping pumps may be used for this purpose.

b) Bilge pumps serving spaces located within the cargo area are to be located in the cargo pump room or in another suitable space within the cargo area.

3.2.2 Draining of spaces located outside the cargo area

The bilge system for spaces located outside the cargo area are to comply with the requirements of NR467, Pt D, Ch 11, Sec [4].

3.2.3 Draining of pump rooms

a) Arrangements are to be provided to drain the pump rooms by means of power pumps or bilge ejectors.

b) Cargo pumps or stripping pumps may be used for draining cargo pump rooms provided that:
- a screw-down non-return valve is fitted on the bilge suctions, and
- a remote control valve is fitted between the pump suction and the bilge distribution box.

c) Bilge pipe diameter is not to be less than 50 mm.

d) The bilge system of cargo pump rooms is to be capable of being controlled from outside.

3.3 Ballast system

3.3.1 Ballast pipes passing through tanks

a) Ballast piping is not to pass through cargo tanks except in the case of short lengths of piping complying with [3.1.3], item b).

b) Sliding type couplings are not to be used for expansion purposes where ballast lines pass through cargo tanks. Expansion bends only are permitted.

3.3.2 The ballast pump is to be located in the cargo pump room, or a similar space within the cargo area not containing any source of ignition.

3.3.3 Emergency discharge of segregated ballast

Provisions may be made for emergency discharge of the segregated ballast by means of a connection to a cargo pump through a detachable spool piece provided that:

- non-return valves are fitted on the segregated ballast connections to prevent the passage of oil to the ballast tank, and
- shut-off valves are fitted to shut off the cargo and ballast lines before the spool piece is removed.

The detachable spool piece is to be placed in a conspicuous position in the pump room and a permanent warning notice restricting its use is to be permanently displayed adjacent to it.

3.4 Scupper pipes

3.4.1 Scupper pipes are not to pass through cargo tanks except, where this is impracticable, in the case of short lengths of piping complying with the following provisions:

- they are of steel
- they have only welded or heavy flanged joints the number of which is kept to a minimum
- they are of substantial wall thickness as per NR467, Pt C, Ch 1, Sec 10, Tab 25, column 1.

3.5 Arrangement for JP5-NATO (F44) and Fuel oil systems

3.5.1 General

In addition to specific requirements given in this Chapter, JP5-NATO (F44) systems are to comply with the general requirements of NR467 Pt C, Ch 1 applicable to fuel oil systems.

3.5.2 Dedicated tanks and piping are to be provided for the storage and distribution of JP5-NATO (F44) intended for the helicopters carried on board the vessel.

3.5.3 Tanks for JP5-NATO mentioned in [3.5.2] above are not to be located adjacent to a machinery space of category A.

3.5.4 The piping system referred in [3.5.2] and the ship fuel oil piping may be connected to the cargo piping system provided it complies with the following:

a) they comply with the requirements of [3.1.3], item b).

b) the piping outside of the cargo area is to be fitted at least 760 mm inboard.

c) Such piping is to be clearly identified and fitted with a shutoff valve at its connection to the cargo piping system within the cargo area. At this location, it shall also be capable of being separated by means of a removable spool-piece and blank flanges when not in use.

d) Arrangements are to be made to allow the piping outside the cargo area to be efficiently drained and purged.

3.5.5 Treatment systems

For JP5 NATO (F44), one means of treatment may be accepted.

3.5.6 Construction of JP5-NATO (F44) piping systems

JP5-NATO (F44) pipes and valves located on the refuelling line (i.e. downstream the treatment equipment) are to be of stainless steel.

3.5.7 Passage of JP5-NATO (F44) pipes through tanks

JP5-NATO (F44) pipes are not allowed to pass through tanks containing other fluids.

3.5.8 Passage of pipes through fuel oil or JP5-NATO (F44) tanks

JP5-NATO (F44) tanks are not to be passed through by any other piping system.

3.6 Heating systems

3.6.1 Thermal oil systems

Thermal oil systems are not accepted on board auxiliary naval vessels.

3.7 Heating systems intended for cargo

3.7.1 General

a) Heating systems intended for cargo are to comply with the relevant requirements of NR467, Pt C, Ch 1, Sec 10.

b) No part of the heating system is normally to exceed 220°C.

c) Blind flanges or similar devices are to be provided on the heating circuits fitted to tanks carrying cargoes which are not to be heated.

d) Heating systems are to be so designed that the pressure maintained in the heating circuits is higher than that exerted by the cargo oil. This need not be applied to heating circuits which are not in service provided they are drained and blanked-off.

e) Isolating valves are to be provided at the inlet and outlet connections of the tank heating circuits. Arrangements are to be made to allow manual adjustment of the flow.

f) Heating pipes and coils inside tanks are to be built of a material suitable for the heated fluid and of reinforced thickness as per NR467, Pt C, Ch 1, Sec 10, Tab 6. They are to have welded connections only.

3.7.2 Steam heating

To reduce the risk of liquid or gaseous cargo returns inside the engine or boiler rooms, steam heating systems of cargo tanks are to satisfy either of the following provisions:

- they are to be independent of other ship services, except cargo heating or cooling systems, and are not to enter machinery spaces, or
- they are to be provided with an observation tank on the water return system located within the cargo area. However, this tank may be placed inside the engine room in a well-ventilated position remote from boilers and other sources of ignition. Its air pipe is to be led to the open and fitted with a flame arrester.

3.7.3 Hot water heating

Hot water systems serving cargo tanks are to be independent of other systems. They are not to enter machinery spaces unless the expansion tank is fitted with:

- means for detection of flammable vapours
- a vent pipe led to the open and provided with a flame arrester.

4 Cargo pumping and piping systems

4.1 General

4.1.1 A complete system of pumps and piping is to be fitted for handling the cargo oil (including JP5-NATO (F44) carried as cargo). Except where expressly permitted, these systems are to be independent of any other piping system on board.

4.2 Cargo pumping system

4.2.1 Number and location of cargo pumps

a) Each cargo tank is to be served by at least two separate fixed means of discharging and stripping. However, for tanks fitted with an individual submerged pump, the second means may be portable.

b) Cargo pumps are to be located:
   - in a dedicated pump room, or
   - on deck, or
   - when designed for this purpose, within the cargo tanks.

4.2.2 Use of cargo pumps

a) Except where expressly permitted in [3.2], cargo pumps are to be used exclusively for handling the liquid cargo and are not to have any connections to compartments other than cargo tanks.

b) Subject to their performance, cargo pumps may be used for tank stripping.

c) Cargo pumps may be used, where necessary, for the washing of cargo tanks.

4.2.3 Cargo pumps drive

a) Prime movers of cargo pumps are not to be located in the cargo area, except in the following cases:
   - steam driven machine supplied with steam having a temperature not exceeding 220°C
   - hydraulic motors
   - electric motors in accordance with Ch 4, Sec 5.

b) Pumps with a submerged electric motor are not permitted in cargo tanks.

4.2.4 Design of cargo pumps

a) Materials of cargo pumps are to be suitable for the products carried.

b) The delivery side of cargo pumps is to be fitted with relief valves discharging back to the suction side of the pumps (bypass) in closed circuit. Such relief valves may be omitted in the case of centrifugal pumps with a maximum delivery pressure not exceeding the design pressure of the piping, with the delivery valve closed.

4.2.5 Monitoring of cargo pumps

Cargo pumps are to be monitored as required in Tab 3.

Table 3 : Monitoring of cargo pumps

Equipment, parameter	Alarm **(1)**	Indication	Comments
Pump, discharge pressure	L	Local	• on the pump **(2)**, or • next to the unloading control station
(1) L = Low **(2)** and next to the driving machine if located in a separate compartment			

4.2.6 Control of cargo pumps

Cargo pumps are to be capable of being stopped from:

- a position outside the pump room, and
- a position next to the pumps.

4.3 Cargo piping design

4.3.1 General

a) Unless otherwise specified, cargo piping is to be designed and constructed according to the requirements of NR467, Pt C, Ch 1, Sec 10.

b) Piping for JP5-NATO (F44) is to comply with requirements of [3.5], except [3.5.2]

c) For tests, refer to Article [7].

4.3.2 Materials

a) Materials readily rendered ineffective by heat are not to be used for valves, fittings, cargo vent piping and cargo piping so as to prevent the spread of fire to the cargo.

b) Cargo piping is, in general, to be made of steel or cast iron.

c) Valves, couplings and other end fittings of cargo pipe lines for connection to hoses are to be of steel or other suitable ductile material.

d) Spheroidal graphite cast iron may be used for cargo oil piping within the double bottom or cargo tanks.

e) Grey cast iron may be accepted for cargo oil lines:

- within cargo tanks, and
- on the weather deck for pressure up to 1,6 Mpa.

It is not to be used for manifolds and their valves of fittings connected to cargo handling hoses.

f) Plastic pipes may be used in the conditions specified in NR467, Pt C, Ch 1, App 3. Arrangements are to be made to avoid the generation of static electricity.

4.3.3 Connection of cargo pipe lengths

Cargo pipe lengths may be connected either by means of welded joints or, unless otherwise specified, by means of flange connections.

4.3.4 Expansion joints

a) Where necessary, cargo piping is to be fitted with expansion joints or bends.

b) Expansion joints including bellows are to be of a type approved by the Society.

c) Expansion joints made of non-metallic material may be accepted only inside tanks and provided they are:

- of an approved type
- designed to withstand the maximum internal and external pressure
- electrically conductive.

4.3.5 Valves with remote control

a) Valves with remote control are to comply with NR467, Pt C, Ch 1, Sec 10, [2.7.3].

b) Submerged valves are to be remote controlled. In the case of a hydraulic remote control system, control boxes are to be provided outside the tank, in order to permit the emergency control of valves.

c) Valve actuators located inside cargo tanks are not to be operated by means of compressed air.

4.4 Cargo piping arrangement and installation

4.4.1 Cargo pipes passing through tanks or compartments

a) Cargo piping is not to pass through tanks or compartments located outside the cargo area except where permitted in [4.4.3].

b) Cargo piping and similar piping to cargo tanks is not to pass through ballast tanks except in the case of short lengths of piping complying with [3.1.3], item b).

c) Cargo piping may pass through vertical fuel oil tanks adjacent to cargo tanks on condition that the provisions of [3.1.3], item b) are complied with.

d) Cargo piping passing through cargo tanks is to comply with the provisions of Ch 4, Sec 3, [1.2.6].

e) Cargo piping may pass through open superstructure

4.4.2 Cargo piping passing through bulkheads

Cargo piping passing through bulkheads is to be so arranged as to preclude excessive stresses at the bulkhead. Bolted flanges are not to be used in the bulkhead.

4.4.3 Cargo loading and unloading arrangement

Where the cargo transfer stations are located outside the cargo area, the following provisions are to be complied with:

a) the piping outside the cargo area is to be fitted with an isolating valve at its connection with the piping system within the cargo area

b) pipe connections outside the cargo area are to be of welded type only

c) arrangements are to be made to allow the piping outside the cargo area to be efficiently drained and purged

d) the piping outside of the cargo area may pass through low fire risk spaces provided the requirements of [3.1.3], item b) are complied with.

4.4.4 Valves

a) Stop valves are to be provided to isolate each tank.

b) A stop valve is to be fitted at each end of the cargo manifold.

c) When a cargo pump in the cargo pump room serves more than one cargo tank, a stop valve is to be fitted in the cargo pump room on the line leading to each tank.

d) Main cargo oil valves located in the cargo pump room below the floor gratings are to be remote controlled from a position above the floor.

e) Where required in order to meet the requirements of Ch 4, Sec 3, [1.2.6], lines of piping which run through cargo tanks are to be fitted with closing devices.

4.4.5 Prevention of the generation of static electricity

a) In order to avoid the generation of static electricity, the loading pipes are to be led as low as practicable in the tank.

b) Cargo pipe sections and their accessories are to be electrically bonded together and to the ship's hull.

4.4.6 Draining of cargo pumps and oil lines

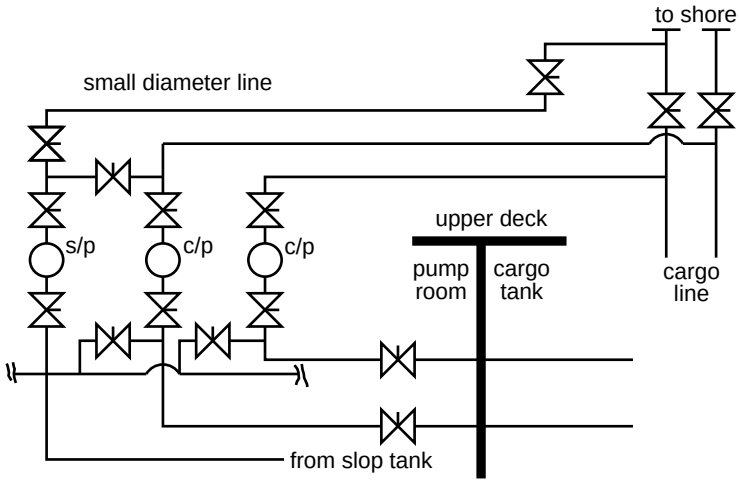
a) Oil piping is to be so designed and installed that oil retention in the lines is minimised, and

b) Means are to be provided to drain all cargo pumps and all oil lines at the completion of cargo discharge, where necessary by connection to a stripping device. The line and pump drainings are to be capable of being discharged both ashore and to a cargo tank or slop tank. For discharge ashore, a special small diameter line having a cross-sectional area not exceeding 10% of the main cargo discharge line is to be provided and is to be connected on the downstream side of the ship's deck manifold valves, both port and starboard, when the cargo is being discharged; see Fig 1.

4.4.7 Cleaning and gas-freeing

a) The cargo piping system is to be so designed and arranged as to permit its efficient cleaning and gas-freeing.

Figure 1 : Connection of small diameter line to the manifold valve



4.5 Arrangement of cargo pump rooms

4.5.1 Pump room ventilation

The ventilation of the cargo pump room is to comply with the following provisions:

a) Cargo pump rooms are to be mechanically ventilated and discharges from exhaust fans are to be led to a safe place on the open deck. The ventilation of these rooms is to have sufficient capacity to minimize the possibility of accumulation of flammable vapours. The number of changes of air is to be at least 20 per hour, based upon the gross volume of the space. The air ducts are to be arranged so that all of the space is effectively ventilated. The ventilation is to be of the suction type using fans of the non-sparking type.

b) The ventilation ducts are to be so arranged that their suction is just above the transverse floor plates or bottom longitudinals in the vicinity of bilges.

c) An emergency intake located about 2,20 m above the pump room lower grating is to be provided. It is to be fitted with a damper capable of being opened or closed from the exposed deck and lower grating level.

Ventilation through the emergency intake is to be effective when the lower intakes are sealed off due to flooding in the bilges.

d) The foregoing exhaust system is in association with open grating floor plates to allow the free flow of air.

e) Arrangements involving a specific ratio of areas of upper emergency and lower main ventilator openings, which can be shown to result in at least the required 20 air changes per hour through the lower inlets, can be adopted without the use of dampers. When the lower access inlets are closed then at least 15 air changes per hour should be obtained through the upper inlets.

f) Ventilation exhaust ducts are to discharge upwards in locations at least 3 m from any ventilation intake and opening to gas safe spaces.

g) Ventilation intakes are to be so arranged as to minimize the possibility of recycling hazardous vapours from ventilation discharge openings.

h) The ventilation ducts are not to be led through gas safe spaces, cargo tanks or slop tanks.

5 Cargo tanks and fittings

5.1 Application

5.1.1 The provisions of Article [5] apply to cargo tanks and slop tanks.

5.2 Cargo tank venting

5.2.1 The relevant provisions of NR467, Pt C, Ch 1, Sec 10, [9] and NR467, Pt C, Ch 1, Sec 10, [11] are to be complied with.

5.2.2 Tank venting systems are to open to the atmosphere at a height of at least 760 mm above the weather deck.

5.2.3 Tanks may be fitted with venting systems of the open type provided with a flame screen.

5.2.4 Additional provisions for ships fitted with an inert gas system

a) On ships fitted with an inert gas system, one or more pressure/vacuum-breaking devices are to be provided to prevent the cargo tanks from being subject to:

1) a positive pressure in excess of the test pressure of the cargo tank if the cargo were to be loaded at the maximum rated capacity and all other outlets are left shut, and

2) a negative pressure in excess of 700 mm water gauge if cargo were to be discharged at the maximum rated capacity of the cargo pumps and the inert gas blowers were to fail.

Such devices are to be installed on the inert gas main unless they are installed in the venting system or on individual cargo tanks.

b) The location and design of the devices referred to in paragraph a) above are to be in accordance with requirements of NR467, Pt D, Ch 7, Sec 4, [4.2].

5.3 Cargo tank inerting, purging and/or gas-freeing

5.3.1 General

a) Arrangements are to be made for purging and/or gas-freeing of cargo tanks. The arrangements are to be such as to minimise the hazards due to the dispersal of flammable vapours in the atmosphere and to flammable mixtures in a cargo tank.

b) Ventilation/gas-freeing lines between fans and cargo tanks are to be fitted with means, such as detachable spool pieces, to prevent any back-flow of hydrocarbon gases through the fans when they are not used.

5.3.2 Ships provided with an inert gas system

The following provisions apply to ships provided with an inert gas system:

a) On individual cargo tanks the gas outlet pipe, if fitted, is to be positioned as far as practicable from the inert gas / air inlet and in accordance with [5.2]. The inlet of such outlet pipes may be located either at the deck level or at not more than 1 m above the bottom of the tank.

b) The arrangement of inert gas and cargo piping systems is to comply with the provisions of NR467, Pt C, Ch 4, Sec 15 [13].

5.4 Cargo tank level gauging systems

5.4.1 The relevant provisions of NR467, Pt C, Ch 1, Sec 10, [9] and NR467, Pt C, Ch 1, Sec 10, [11] are to be complied with.

5.4.2 Tanks may be fitted with gauging systems of the open type, such as a hand sounding pipe or other portable gauging device.

5.4.3 Ships provided with an inert gas system

a) On ships provided with an inert gas system, the gauging devices are to be of the closed type.

b) Use of indirect gauging devices will be given special consideration.

5.5 Protection against tank overfilling

5.5.1 General

a) Provisions are to be made to guard against liquid rising in the venting system of cargo or slop tanks to a height which would exceed the design head of the tanks. This is to be accomplished by high level alarms or overflow control systems or other equivalent means, together with gauging devices and cargo tank filling procedures.

b) Sufficient ullage is to be left at the end of tank filling to permit free expansion of liquid during carriage.

c) High level alarms, overflow control systems and other means referred to in a) are to be independent of the gauging systems referred to in [5.4].

5.5.2 High level alarms

a) High level alarms are to be type approved.

b) High level alarms are to give an audible and visual signal at the control station, where provided.

5.5.3 Other protection systems

a) Where the tank level gauging systems, cargo and ballast pump control systems and valve control systems are centralised in a single location, the provisions of [5.5.1] may be complied with by the fitting of a level gauge for the indication of the end of loading, in addition to that required for each tank under [5.4]. The readings of both gauges for each tank are to be as near as possible to each other and so arranged that any discrepancy between them can be easily detected.

b) Where a tank can be filled only from other tanks, the provisions of [5.5.1] are considered as complied with.

5.6 Tank washing systems

5.6.1 General

Adequate means are to be provided for cleaning the cargo tanks.

Note 1: Portable equipment may be used for cleaning the cargo tanks.

5.6.2 Washing machines

a) Tank washing machines are to be of a type approved by the Society.

b) Washing machines are to be made of steel or other electricity conducting materials with a limited propensity to produce sparks on contact.

5.6.3 Washing pipes

a) Washing pipes are to be built, fitted, inspected and tested in accordance with the applicable requirements of NR467, Pt C, Ch 1, Sec 10.

5.6.4 Installation of washing systems

a) Tank cleaning openings are not to be arranged in enclosed spaces.

b) The complete installation is to be permanently earthed to the hull.

6 Prevention of pollution by cargo oil

6.1 General

6.1.1 The provisions of Ch 4, Sec 2, [5.4] are to be complied with.

6.2 Oil discharge monitoring and control system

6.2.1 General

a) An oil discharge monitoring and control system is to be fitted.

b) A manually operated alternative method is to be provided.

6.2.2 Design of the discharge monitoring and control system

a) The discharge monitoring and control system is to be of a type approved in compliance with the provisions of IMO MEPC.108(49).

b) The discharge monitoring and control system is to be fitted with a recording device to provide a continuous record of the discharge in litres per nautical mile and total quantity discharged, or the oil content and rate of discharge. This record is to be identifiable as regards time and date.

c) The oil discharge monitoring and control system is to come into operation when there is any discharge of effluent into the sea and is to be such as will ensure that any discharge of oily mixture is automatically stopped when the instantaneous rate of discharge of oil content exceeds 30 litres per nautical mile.

d) Any failure of the monitoring and control system is to stop the discharge.

6.2.3 Oil/water interface detectors

Effective oil/water interface detectors approved by the Society are to be provided for a rapid and accurate determination of the oil/water interface in slop tanks and are to be available for use in other tanks where the separation of oil and water is effected and from which it is intended to discharge effluent directly to the sea.

6.3 Pumping, piping and discharge arrangements

6.3.1 Discharge manifold

a) A discharge manifold for connection to reception facilities for the discharge of oil contaminated water is to be located on the open deck on both sides of the ship.

b) A fixed container or enclosed deck area should be fitted around each oil loading manifold and each oil transfer connection point with a minimum capacity, in all conditions of list or trim encountered during loading according to Tab 4, depending on the size of hose(s) or loading arm(s) it serves.

Each container is to be equipped with means of draining or removing oil, without discharging it into the water, and with a mechanical means of closing each drain and scupper.

Table 4 : Minimum capacity of drip trays in way of manifolds

Inside diameter (inches)	less than 2	less than 4	less than 6	less than 12	12 or more
Capacity (barrels)	1/2	1	2	3	4

6.3.2 Discharge pipelines

In every oil tanker, pipelines for the discharge of oil contaminated water from cargo tank areas to the sea, where permitted, are to be led to the open deck or to the ship side above the waterline in the deepest ballast condition.

6.3.3 Discharge stopping

Means are to be provided for stopping the discharge into the sea of oil contaminated water from cargo tank areas, other than those discharges below the waterline permitted under [6.3.2], from a position on the upper deck or above located so that the manifold in use referred to in [6.3.1] and the discharge to the sea from the pipelines referred to in [6.3.2] may be visually observed. Means for stopping the discharge need not be provided at the observation position if a positive communication system such as a telephone or radio system is provided between the observation position and the discharge control position.

7 Certification, inspection and testing

7.1 Application

7.1.1 The provisions of this Article are related to cargo piping and other equipment fitted in the cargo area. They supplement those given in NR467, Pt C, Ch 1, Sec 10, [20] for piping systems.

7.2 Workshop tests

7.2.1 Tests for materials

Where required in Tab 5, materials used for pipes, valves and fittings are to be subjected to the tests specified in NR467, Pt C, Ch 1, Sec 10, [20.4.2].

7.2.2 Inspection of welded joints

Where required in Tab 5, welded joints are to be subjected to the examinations specified in NR467, Pt C, Ch 1, Sec 10, [3.6] for class II pipes.

7.2.3 Hydrostatic testing

a) Where required in Tab 5, cargo pipes, valves, fittings and pump casings are to be submitted to hydrostatic tests in accordance with the relevant provisions of NR467, Pt C, Ch 1, Sec 10, [20.5].

b) Expansion joints and cargo hoses are to be submitted to hydrostatic tests in accordance with the relevant provisions of NR467, Pt C, Ch 1, Sec 10, [20.5].

c) Where fitted, bellow pieces of gas-tight penetration glands are to be pressure tested.

7.2.4 Tightness tests

Tightness of the following devices is to be checked:

- gas-tight penetration glands
- cargo tank P/V and high velocity valves.

Note 1: These tests may be carried out in the workshops or on board.

7.2.5 Summarising table

Inspections and tests required for cargo piping and other equipment fitted in the cargo area are summarised in Tab 5.

7.3 Shipboard tests

7.3.1 Pressure test

a) After installation on board, the cargo piping system is to be checked for leakage under operational conditions.

7.3.2 Survey of pollution prevention equipment

The ship is to be subjected to an initial survey before the ship is put in service, to ensure that the equipment, systems, fittings, arrangements and materials fully comply with the relevant provisions of [5.6] and [6].

Table 5 : Inspection and testing at works

No.	Item	Tests for materials		Inspections and tests for the products			References to the Rules
		Y/N **(1)**	Type of material certificate **(2)**	during manufacturing **(1)**	after completion **(1) (3)**	Type of product certificate **(2)**	
1	pipes, valves and fittings of class II (see [3.3.1])	Y	• C where ND > 100mm • W where ND ≤ 100mm	Y **(4)**	Y	C	[7.2.1] [7.2.1] [7.2.2] [7.2.3]
2	expansion joints and cargo hoses	Y **(5)**	W	N	Y	C	[7.2.1] [7.2.3]
3	cargo pumps	Y	• C for cast body • W for welded construction	Y **(6)**	Y	C	see **(6)** [7.2.3]
4	gas-tight penetration glands	N		N	Y	C	[7.2.3], [7.2.4]
5	cargo tank P/V and high velocity valves	Y	W	Y	Y	C	[7.2.2] [7.2.3], [7.2.4]
6	flame arresters	N		N	Y	C	see **(3)**
7	Oil discharge, monitoring and control system	N			Y **(7)**	C	see **(3)**
8	Oil/water interface detector	N			Y **(7)**	C	see **(3)**

(1) Y = required, N = not required.
(2) C = indicates that a Society certificate is required.
W = indicates that a manufacturer's document is required.
(3) includes the checking of the rule characteristics according to the approved drawings.
(4) only in the case of welded construction.
(5) if metallic.
(6) inspection during manufacturing is to be carried out according to a program approved by the Society.
(7) may also be carried out on board.

8 Dry stores and ammunition handling

8.1 Internal movements

8.1.1 General

The movements of the dry stores and ammunition between their storage deck and the weather deck are operated by elevators.

The ammunition and dry stores elevators are to be considered as a secondary essential service in complement of NR46,7 Pt C, Ch 2, Sec 1, [3.4.1].

8.1.2 Ammunition and dry stores elevators

With regards to strength matters, ammunition and dry stores elevators are to comply with general requirements of Ch 4, Sec 3, [3.3], NR467, Pt B, Ch 9, Sec 8, and with requirements of NR526 Rules for lifting appliances, as far as they are applicable to unmanned platform elevator.

The following requirements are also to be complied with:

- a mechanical locking of the platform at the storage level deck and weather deck is to be provided
- disposition are to be taken to avoid any change in the level of the platform when removing the locking whatever load change occurred
- platforms are to be equipped to avoid any contact of staff or load with fixed parts of ship during movements of the platforms
- Storage level deck and weather deck are to be equipped with disposal to avoid any fall of staff or load when platform is not locked at the deck level.

In addition, the ammunition and dry stores elevators are to be in compliance with ISO 8383 standard.

Section 5 Electrical Installations

1 General

1.1 Application

1.1.1 The design is to be in accordance with IEC publication 60092-502.

1.2 Essential services

1.2.1 With regards to electrical distribution, the following services are considered as secondary essential services, in addition to those listed in NR467, Pt C, Ch 2, Sec 1, [3.4.1]:

a) Cargo offloading system

b) Lifting appliances and hoses handling equipment.

1.3 Documentation to be submitted

1.3.1 In addition to the documentation requested in NR467, Pt C, Ch 2, Sec 1, Tab 1, the following are to be submitted for approval:

a) plan of hazardous areas

b) document giving details of types of cables and safety characteristics of the equipment installed in hazardous areas

c) diagrams of tank level indicator systems, high level alarm systems and overflow control systems where requested.

1.3.2 The documentation dealing with the electrical system for watertight door and fire door systems as requested in:

- NR467, Pt C, Ch 2, Sec 1, Tab 1,
- NR467, Pt B, Ch 1, Sec 4, Tab 1 and
- NR467, Pt C, Ch 4, Sec 1, Tab 1,

is to be submitted for approval.

1.4 System of supply

1.4.1 The following systems of generation and distribution of electrical energy are acceptable:

a) direct current:
   - two-wire insulated

b) alternating current:
   - single-phase, two-wire insulated
   - three-phase, three-wire insulated.

1.4.2 Earthed systems with hull return are not permitted, with the following exceptions to the satisfaction of the Society:

a) impressed current cathodic protective systems

b) limited and locally earthed systems, such as starting and ignition systems of internal combustion engines, provided that any possible resulting current does not flow directly through any hazardous area

c) insulation level monitoring devices, provided that the circulation current of the device does not exceed 30 mA under the most unfavourable conditions.

1.4.3 Earthed systems without hull return are not permitted, with the following exceptions:

a) earthed intrinsically safe circuits and the following other systems to the satisfaction of the Society

b) power supplies, control circuits and instrumentation circuits in non-hazardous areas where technical or safety reasons preclude the use of a system with no connection to earth, provided the current in the hull is limited to not more than 5 A in both normal and fault conditions, or

c) limited and locally earthed systems, such as power distribution systems in galleys and laundries to be fed through isolating transformers with the secondary windings earthed, provided that any possible resulting hull current does not flow directly through any hazardous area, or

d) alternating current power networks of 1,000 V root mean square (line to line) and over, provided that any possible resulting current does not flow directly through any hazardous area; to this end, if the distribution system is extended to areas remote from the machinery space, isolating transformers or other adequate means are to be provided.

1.4.4 In insulated distribution systems, no current carrying part is to be earthed, other than:

a) through an insulation level monitoring device

b) through components used for the suppression of interference in radio circuits.

1.5 Electrical distribution and protection

1.5.1 Distribution systems shall be so arranged that fire in any main vertical zone as defined in NR467, Part C, Chapter 4 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 is practicable.

1.5.2 The main switchboard is to be divided in two parts.

1.5.3 It is to be possible to split the main switchboard into at least two independent sections, by means of at least one circuit breaker or other suitable disconnecting devices, each supplied by at least one generator. If two separate switchboards are provided and interconnected with cables, a circuit breaker is to be provided at each end of the cable.

Where essential services as defined in [1.2.1] have duplicated equipment, their power supplies are to be divided between the sections.

1.6 Earth detection

1.6.1 The devices intended to continuously monitor the insulation level of all distribution systems are also to monitor all circuits, other than intrinsically safe circuits, connected to apparatus in hazardous areas or passing through such areas. An audible and visual alarm is to be given, at a manned position, in the event of an abnormally low level of insulation.

1.7 Mechanical ventilation of hazardous spaces

1.7.1 Electric motors driving fans of the ventilating systems of hazardous spaces are to be located outside the ventilation ducting.

1.7.2 At the discretion of the Society, motors driving ventilating fans may be located within the ducting provided that they are of a certified safe type and are arranged with an additional enclosure (having a degree of protection of at least IP 44) which prevents the impingement of the ducted air stream upon the motor casing.

1.7.3 The materials used for the fans and their housing are to be in compliance with the requirements of non-sparking fans in Pt C, Ch 4, Sec 1, [2.33].

1.7.4 Cargo pump-rooms and other enclosed spaces which contain cargo-handling equipment and similar spaces in which work is performed on the cargo should be fitted with mechanical ventilation systems, capable of being controlled from outside such spaces.

1.7.5 Provisions are to be made to ventilate the spaces defined in [1.7.4] prior to entering the compartment and operating the equipment, in compliance with Ch 4, Sec 4, [4.5.1].

1.8 Electrical installation precautions

1.8.1 Precautions against inlet of gases or vapours

Suitable arrangements are to be provided, to the satisfaction of the Society, so as to prevent the possibility of gases or vapours passing from a hazardous space to another space through runs of cables or their conduits.

2 Hazardous locations and types of equipment

2.1

2.1.1 Cargo tanks, slop tanks, cargo pump rooms, any pipe work of pressure-relief or other venting systems for cargo and slop tanks, pipes and equipment containing the cargo are to be classified as zone 2.

3 Emergency distribution of electrical power and emergency installations

3.1 Distribution of electrical power

3.1.1 The emergency source of electrical power is to be capable of supplying simultaneously at least the following services for the periods specified hereafter, if they depend upon an electrical source for their operation:

a) for a period of 36 hours, emergency lighting:

   1) at every muster and embarkation station and over the sides

   2) in alleyways, stairways and exits giving access to the muster and embarkation stations

3) in all service and accommodation alleyways, stairways and exits, personnel lift cars
4) in the machinery spaces and main generating stations including their control positions
5) in all control stations, machinery control rooms, and at each main and emergency switchboard
6) at all stowage positions for firemen's outfits
7) at the steering gear, and
8) at the fire pump, the sprinkler pump and the emergency bilge pump referred to in item d) below and at the starting position of their motors

b) for a period of 36 hours:
1) the navigation lights and other lights required by the International Regulations for Preventing Collisions at Sea in force, and
2) the VHF radio installation required by Regulation IV/7.1.1 and IV/7.1.2 of SOLAS 1974 as amended, and, if applicable:
- the MF radio installation required by Regulations IV/9.1.1, IV/9.1.2, IV/10.1.2 and IV/10.1.3
- the ship earth station required by Regulation IV/10.1.1, and
- the MF/HF radio installation required by Regulations IV/11.1.1 and IV/11.1.2.

c) for a period of 36 hours:
1) all internal communication equipment required in an emergency (see [4.1.1])
2) the shipborne navigational equipment as required by Regulation V/12; where such provision is unreasonable or impracticable the Head Office may waive this requirement for ships of less than 5,000 gross tonnage
3) the fire detection and fire alarm system, the fire door holding and release system, and
4) intermittent operation of the daylight signalling lamp, the ship's whistle, the manually operated call points and all internal signals (see [4.1.2]) that are required in an emergency, unless such services have an independent supply for the period of 36 hours from an accumulator battery suitably located for use in an emergency

d) for a period of 36 hours:
1) one of the fire pumps required by the relevant provisions of NR467, Part C, Chapter 4
2) the automatic sprinkler pump, if any, and
3) the emergency bilge pump and all the equipment essential for the operation of electrically powered remote controlled bilge valves

e) for the period of time required in NR467, Pt C, Ch 1, Sec 14, [2], the steering gear if required to be so supplied

f) for a period of half an hour:
1) any watertight doors required by Regulation II-1/15 to be power operated together with their indicators and warning signals
2) the emergency arrangements to bring the lift cars to deck level for the escape of persons. The lift cars may be brought to deck level sequentially in an emergency

g) for a period of one hour
1) Installations of cargo offloading, necessary for safety and cargo preservation
(list of corresponding cargo offloading systems to be defined).

3.1.2 The transitional source of emergency electrical power required is to supply at least the following services if they depend upon an electrical source for their operation:

a) for half an hour:
1) the lighting required by [3.1.1] b) 1) and NR467, Pt C, Ch 2, Sec 3, [3.6.7], item (a)
2) all services required by [3.1.1], items c) 1), c) 3) and c) 4) unless such services have an independent supply for the period specified from an accumulator battery suitably located for use in an emergency

b) it is also to supply power to close the watertight doors as required by Regulation II-1/15.7.3.3, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided. Power to the control, indication and alarm circuits as required by Regulation II-1/15.7.2, for half an hour.

3.2 Low-location lighting

3.2.1 Auxiliary naval vessels are to be provided with a low-location lighting (LLL) system in accordance with NR467, Pt C, Ch 4, Sec 8, [2.2.3].

Where LLL is satisfied by electric illumination, it is to comply with the following requirements.

3.2.2 The LLL system is to be connected to the emergency switchboard and is to be capable of being powered either by the main source of electrical power, or by the emergency source of electrical power for a minimum period of 60 minutes after energising in an emergency.

3.2.3 The power supply arrangements to the LLL are to be arranged so that a single fault or a fire in any one fire zone or deck does not result in loss of the lighting in any other zone or deck. This requirement may be satisfied by the power supply circuit

configuration, use of cables of a fire-resistant type complying with Pt C, Ch 2, Sec 9, [2.1.11], and/or the provision of suitably located power supply units having integral batteries adequately rated to supply the connected LLL for a minimum period of 60 minutes.

3.2.4 Single lights and lighting assemblies are to be designed or arranged so that any single fault or failure in a light or lighting assembly, other than a short-circuit, will not result in a break in visible delineation exceeding 1 metre.

3.2.5 Light and lighting assemblies are to be flame-retardant as a minimum, to have an ingress protection of at least IP55 and to meet the type test requirements as specified in NR467, Pt C, Ch 3, Sec 6, Tab 1.

3.2.6 The LLL system is to be capable of being manually activated by a single action from the CMCS. It may, additionally, be continuously operating or be switched on automatically, e.g. by the presence of smoke within the space(s) being served.

3.2.7 When powered, the systems are to achieve the following minimum luminance:

- for any planar source: 10 cd/m^2 from the active parts in a continuous line of 15 mm minimum width
- for any point source: 35 mcd in the typical track directions of approach and viewing which is to be considered:
  - for sources which are required to be viewed from a horizontal position, i.e. deck mounted or horizontally bulkhead mounted fittings, within a 60° cone having its centre located 30° from the horizontal mounting surface of the point source and in line with the track direction, see Fig 1.
  - for sources which are required to be viewed vertically, i.e. the vertical LLL marking up to the door handles, within a 60° cone having its centre located perpendicular to the mounting service of the point source, see Fig 2.

Spacing between sources is not to exceed 300 mm.

Figure 1 : Minimum luminance for LLL point sources mounted on horizontal surfaces

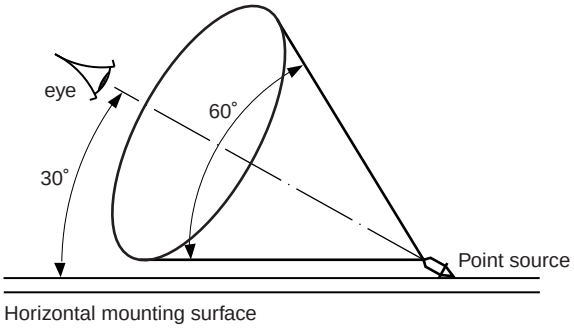
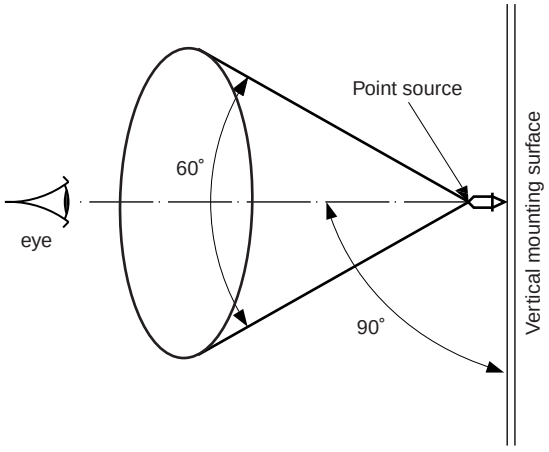


Figure 2 : Minimum luminance for LLL point sources mounted on vertical surfaces



3.2.8 The lights or lighting assemblies are to be continuous except as interrupted by constructional constraints, such as corridors or cabin doors etc., are to provide a visible delineation along the escape route and, where applicable, are to lead to the exit door handles. Interruption of the LLL system due to constructional constraints is not to exceed 2 metres.

3.2.9 The lighting is to be provided on at least one side of the corridor or stairway. In corridors and stairways in excess of 2 metres width, lighting is to be provided on both sides.

3.2.10 In corridors the lighting is to be installed either on the bulkhead within 300 mm of the deck or, alternatively, on the deck within 150 mm of the bulkhead.

3.2.11 In stairways the lighting is to be installed within 300 mm above the steps such that each step may be readily identified from either above or below that step. The top and bottom steps are to be further identified to show that there are no further steps.

4 Internal communications

4.1 General

4.1.1 Internal communication equipment required in an emergency generally includes:

a) the means of communication between the navigating bridge and the steering gear compartment

b) the means of communication between the navigating bridge and the position in the machinery space or control room from which the engines are normally controlled.

c) the means of communication which is provided between the officer of the watch and the person responsible for closing any watertight door which is not capable of being closed from a CMCS.

d) External boundaries which are required in NR467, Pt C , Ch 4, Sec 7, [2.1.1] to be of steel or other equivalent material may be pierced for the fitting of windows and sidescuttles provided that there is no requirement for such boundaries of auxiliary naval vessels to have A class integrity.

e) the means of communication between the navigating bridge and the main fire control station.

4.1.2 Internal signals required in an emergency generally include:

a) general alarm

b) watertight door indication

c) fire door indication.

4.2 General emergency alarm system

4.2.1 An electrically operated bell or klaxon or other equivalent warning system installed in addition to the ship's whistle or siren for sounding the general emergency alarm signal is to comply with the following requirements.

4.2.2 The general emergency alarm system is to be supplemented by either a public address system complying with the requirements in Ch 2, Sec 4, [4.2] or other suitable means of communication.

4.2.3 The entertainment sound system is to be automatically turned off when the general alarm system is activated.

4.2.4 The system is to be continuously powered and is to have an automatic change-over to a standby power supply in case of loss of the normal power supply.

An alarm is to be given in the event of failure of the normal power supply.

4.2.5 The system is to be powered by means of two circuits, one from the ship's main supply and the other from the emergency source of electrical power required by Ch 2, Sec 4, [3.1] and Ch 2, Sec 4, [3.2].

4.2.6 The system is to be capable of operation from the navigation bridge and, except for the ship’s whistle, also from other strategic points.

Note 1: Other strategic points are taken to mean those locations, other than the navigation bridge, from where emergency situations are intended to be controlled and the general alarm system can be activated. A fire control station or a cargo control station is normally to be regarded as strategic points.

4.2.7 The alarm is to continue to function after it has been triggered until it is manually turned off or is temporarily interrupted by a message on the public address system.

4.2.8 The alarm system is to be audible throughout all the accommodation and normal crew working spaces and on all open decks.

4.2.9 The minimum sound pressure level for the emergency alarm tone in interior and exterior spaces is to be 80 dB (A) and at least 10 dB (A) above ambient noise levels existing during normal equipment operation with the ship underway in moderate weather.

4.2.10 In cabins without a loudspeaker installation, an electronic alarm transducer, e.g. a buzzer or similar, is to be installed.

4.2.11 The sound pressure level at the sleeping position in cabins and in cabin bathrooms is to be at least 75 dB (A) and at least 10 dB (A) above ambient noise levels.

4.2.12 For cables used for the general emergency alarm system, see NR467, Pt C, Ch 2, Sec 3, [9.6.1], NR467, Pt C, Ch 2, Sec 11, [5.2.1] and NR467, Pt C, Ch 2, Sec 11, [5.2.4].

4.2.13 Electrical cables and apparatus for the general emergency alarm system and their power supply are to be arranged so that the loss of the system in any one area due to localised fire is minimised.

4.2.14 Where the fire alarm to summon the crew operated from the navigating bridge or fire control station is part of the ship's general alarm system, it is to be capable of being sounded independently of the alarm in the public spaces.

4.3 Public address system

4.3.1 The public address system is to be one complete system consisting of a loudspeaker installation which enables simultaneous broadcast of messages from the navigation bridge, and at least one other location on board for use when the navigation bridge has been rendered unavailable due to the emergency, to all spaces where crew members or special personnels, or both, are normally present (accommodation and service spaces and control stations and open decks), and to assembly stations (i.e. muster stations).

In spaces such as under deck passageways, bosun's locker, hospital and pump room, the public address system may not be required.

4.3.2 The public address system is to be arranged to operate on the main source of electrical power, the emergency source of electrical power and transitional sources of electrical power as required by NR467, Pt C, Ch 2, Sec 3, [2.3] and NR467, Pt C, Ch 2, Sec 3, [3.6].

4.3.3 The controls of the system on the navigation bridge are to be capable of interrupting any broadcast on the system from any other location on board.

4.3.4 Where an individual loudspeaker has a device for local silencing, an override arrangement from the control station(s), including the navigating bridge, is to be in place.

4.3.5 The system is not to require any action by the addressee.

4.3.6 It is to be possible to address crew accommodation and work spaces separately from public spaces.

4.3.7 In addition to any function provided for routine use aboard the ship, the system is to have an emergency function control at each control station which:

a) is clearly indicated as the emergency function

b) is protected against unauthorised use

c) automatically overrides any other input system or program, and

d) automatically overrides all volume controls and on/off controls so that the required volume for the emergency mode is achieved in all spaces.

4.3.8 The system is to be installed with regard to acoustically marginal conditions, so that emergency announcements are clearly audible above ambient noise in all spaces where crew members or special personnels, or both, are normally present (accommodation and service spaces and control stations and open decks), and at assembly stations (i.e. muster stations).

4.3.9 With the ship underway in normal conditions, the minimum sound pressure level for broadcasting emergency announcements is to be:

a) in interior spaces 75 dB (A) and at least 20 dB (A) above the speech interference level, and

b) in exterior spaces 80 dB (A) and at least 15 dB (A) above the speech interference level.

Evidence of this level is to be shown with test result in open sea or equivalent quay measurement with appropriate correction factor.

4.3.10 The system is to be arranged to prevent feed-back or other interference.

4.3.11 The system is to be arranged to minimise the effect of a single failure so that the emergency messages are still audible (above ambient noise levels) also in the event of failure of any one circuit or component.

4.3.12 Each loudspeaker is to be individually protected against short-circuits.

4.3.13 For cables used for the public address system, see NR467, Pt C, Ch 2, Sec 3, [9.6.1], NR467, Pt C, Ch 2, Sec 11, [5.2.1] and NR467, Pt C, Ch 2, Sec 11, [5.2.4].

4.3.14 All areas of each fire zone are to be served by at least two dedicated loops of flame-retardant cables which are to be sufficiently separated throughout their length and supplied by two separate and independent amplifiers.

4.3.15 A temperature alarm is to be provided in the public address cabinets in case of forced air cooling.

4.4 Combined general emergency alarm - public address system

4.4.1 Where the public address system is the only means for sounding the general emergency alarm signal and the fire alarm, in addition to the requirements of Ch 2, Sec 4, [4.1] and Ch 2, Sec 4, [4.2], the following are to be satisfied:

- the system automatically overrides any other input system when an emergency alarm is required.
- the system automatically overrides any volume control provided to give the required output for the emergency mode when an emergency alarm is required.
- the system is arranged to minimise the effect of a single failure so that the alarm signal is still audible (above ambient noise levels) also in the event of failure of any one circuit or component, by means of the use of more than one device for generating an electronic sound signal.

5 Installation

5.1 Section and distribution boards

5.1.1 Cubicles and cupboards in areas which are accessible to any personnel are to be lockable.

6 Type approved components

6.1

6.1.1 Components for Low-Location Lighting systems (LLL) in auxiliary naval vessels escape routes are to be type approved or in accordance with [6.1.2].

6.1.2 Case-by-case approval based on submission of adequate documentation and execution of tests may also be granted at the discretion of the Society.

Section 6 Fire Protection

1 General

1.1 Documents to be submitted

1.1.1 In addition to the documentation requested in Ch 4, Sec 2, Tab 1, the documents listed in Tab 1 are to be submitted for approval.

Table 1 : Documents to be submitted

No.	Description of the document **(1)**
1	General arrangement drawing
2	Specification of the fire integrity of bulkheads and decks
3	Specification of the instruments for measuring oxygen and flammable vapour concentrations
4	Diagram of the pressure water system within the cargo area
5	For the foam extinguishing system within the cargo area: • diagrammatic arrangement drawing • calculation note • foam agent specification • characteristics of foam monitors and hoses
6	For the fire-extinguishing system in cargo pump rooms: • general arrangement drawing • calculation note
(1)	Diagrams are also to include, where applicable, the (local and remote) control and monitoring systems and automation systems.

2 General requirements

2.1 Sources of ignition

2.1.1 Hazardous areas, defined in Pt C, Ch 2, Sec 1, [3.13], are not to contain:

- internal combustion engines
- steam turbines and steam piping with a steam temperature in excess of 220°C
- other piping systems and heat exchangers with a fluid temperature in excess of 220°C
- any other source of ignition.

2.1.2 Electrical equipment

For the installation of electrical equipment, refer to Ch 4, Sec 5.

3 Detection and alarm

3.1 Protection of machinery spaces

3.1.1 Installation

A fixed fire detection system and fire alarm system complying with the relevant provisions given in Pt C, Ch 4, Sec 13 is to be installed in any machinery space, as defined in Pt C, Ch 4, Sec 1, [2.23].

Fire detecting system for unattended machinery spaces are to comply with Part E, Chapter 4.

3.1.2 Design

The fire detection system required in [3.1.1] shall be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in recesses and in spaces of restricted height and where their use is specially appropriate, detection systems using only thermal detectors are not permitted.

The detection system shall initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places to ensure that the alarms are heard and observed on the navigating bridge.

3.2 Protection of accommodation and service spaces and control stations

3.2.1 The requirements of NR467, Pt C, Ch 4, Sec 3, [4.4] are to be replaced by the following:

- A fixed fire detection and fire alarm system complying with the provisions given in NR467, Pt C, Ch 4, Sec 3, [4.3] is to be installed in accommodation and service spaces and control stations.

3.3 Protection of ammunition spaces

3.3.1 Application and general requirements

Ammunition spaces are to be provided with a fixed fire detection and alarm system complying with the requirements of Pt C, Ch 4, Sec 13 and with the following additional requirements:

- The detection system is to include smoke, temperature and temperature gradient detection.
- Information concerning the surveillance and monitoring thresholds for temperature and temperature gradient is to be clearly indicated on the outside of main access points to these spaces and is to be available at a continuously manned control position.
- Smoke detectors are to be fitted in ammunition lifts trunks.

3.3.2 Installation requirements

In general, a section of fire detectors which covers a control station, a service space or an accommodation space is not to include ammunition spaces.

Note 1: Where few ammunition spaces are concerned, a section of fire detectors which covers a control station, a service space or an accommodation space may include ammunition spaces, to the satisfaction of the Society.

4 Containment of fire

4.1 Thermal and structural subdivision

4.1.1 Fire integrity of bulkheads and decks

The requirements of NR467, Pt C, Ch 4, Sec 5, [1.3.4] are to be replaced by the following:

a) In addition to complying with the specific provisions for fire integrity of bulkheads and decks mentioned in NR467, Pt C, Ch 4, Sec 5, [1.3.1] and NR467, Pt C, Ch 4, Sec 5, [1.3.2], the minimum fire integrity of bulkheads and decks shall be as prescribed in Tab 2 and Tab 3.

b) The following requirements govern application of the tables:

1) Tab 2 and Tab 3 shall apply, respectively, to the bulkheads and decks separating adjacent spaces.

2) For determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in categories (1) to (13) below. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of the present Section, or where it is possible to assign two or more classifications to a space, it shall be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30 % communicating openings to that space are considered separate spaces. The fire integrity of the boundary bulkheads and decks of such smaller rooms shall be as prescribed in Pt C, Ch 4, Sec 5, Tab 1 and Pt C, Ch 4, Sec 5, Tab 2. The title of each category is intended to be typical rather than restrictive. The number in parentheses preceding each category refers to the applicable column or row in the tables.

- (1) Control stations

  Spaces containing emergency sources of power and lighting

  Wheelhouse and chartroom

  Spaces containing the ship's radio equipment for safety or ship navigation communication

  Fire control stations

  Control room for propulsion machinery when located outside the machinery space

  Spaces containing centralized fire alarm equipment

  Spaces containing network cabinets for computer and control centers, electronic cabinet systems or control computers managing data related to the control of the ship

  Spaces containing centralized emergency public address system stations and equipment.

  For the purpose of this Article, the space containing naval systems for detection, command, defence, offence, communication, combat (e.g. COC) or weapon control/operation; bridge for command, defence, operation or planning rooms and spaces containing centralised ship's operation equipment (e.g. COP) are assimilated as a control station.
- (2) Corridors

  Corridors and lobbies.
- (3) Accommodation spaces

  Spaces as defined in NR467, Pt C, Ch 4, Sec 1, [3.2] excluding corridors.
- (4) Stairways

Interior stairways, lifts, totally enclosed emergency escape trunks, and escalators (other than those wholly contained within the machinery spaces) and enclosures thereto.

In this connection, a stairway which is enclosed only at one level shall be regarded as part of the space from which it is not separated by a fire door.

- (5) Service spaces (low risk)

  Lockers and store-rooms not having provisions for the storage of flammable liquids and having areas less than 4 m^2 and drying rooms and laundries.

- (6) Machinery spaces of category A and equivalent spaces of high fire risk

  Spaces as defined in NR467, Pt C, Ch 4, Sec 1, [3.29].

  Aircraft refuelling stations, JP5 pump rooms and other pump rooms used for the refuelling of vehicles carried onboard

  Battery rooms containing li-ion batteries

- (7) Other machinery spaces and oil fuel tanks

  Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces)

  Spaces containing network cabinets for computer and control centers, electronic cabinet systems or control computers not managing data related to the control of the ship

  Spaces containing radio equipment not intended for safety or ship navigation communication

  Spaces as defined in NR467, Pt C, Ch 4, Sec 1, [3.28], excluding machinery spaces of category A

  Oil fuel tanks (where installed in a separate space with no machinery).

- (8) Cargo pump-rooms

  Spaces containing cargo pumps and entrances and trunks to such spaces.

- (9) Service spaces (high risk)

  Galleys, pantries containing cooking appliances, paint lockers, lockers and store-rooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids, saunas and workshops other than those forming part of the machinery spaces

  Spaces and routes used for solid cargo transfer except ammunition.

- (10) Open decks

  Open deck spaces and enclosed promenades having little or no fire risk. Enclosed promenades shall have no significant fire risk, meaning that furnishing shall be restricted to deck furniture. In addition, such spaces shall be naturally ventilated by permanent openings

  Air spaces (the space outside superstructures and deckhouses).

- (11) Special purpose spaces

  Special category and ro-ro spaces as defined in NR467, Pt C, Ch 4, Sec 1, [3.40] and NR467, Pt C, Ch 4, Sec 1, [3.46]

  Vehicle spaces as defined in NR467, Pt C, Ch 4, Sec 1, [3.51]

  Helicopter hangars (when segregated from refuelling facilities)

  Helicopter decks.

- (12) Evacuation stations and external escape routes

  Survival craft stowage area

  Open deck spaces and enclosed promenades forming lifeboat and liferaft embarkation and lowering stations

  Assembly stations, internal and external

  External stairs and open decks used for escape routes

  The ship's side to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to the liferaft and evacuation slide embarkation areas.

- (13) Ammunition spaces and other equivalent spaces

  Ammunition spaces as defined in Pt C, Ch 4, Sec 1, [2.4]and lifts to such spaces

  Ammunition transfer spaces and routes.

c) Continuous B class ceilings or linings, in association with the relevant decks or bulkheads, may be accepted as contributing, wholly or in part, to the required insulation and integrity of a division.

d) External boundaries which are required in NR467, Pt C, Ch 4, Sec 7, [2.1.1] to be of steel or other equivalent material may be pierced for the fitting of windows and sidescuttles provided that there is no requirement for such boundaries of auxiliary naval vessels to have A class integrity. Similarly, in such boundaries which are not required to have A class integrity, doors may be constructed of materials which are to the satisfaction of the Society.

e) Exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation shall be constructed of steel and insulated to A-60 standard for the whole of the portions which face the cargo area and on the outward sides for a distance of 3 m from the end boundary facing the cargo area. The distance of 3 m shall be measured horizontally and parallel to the middle line of the ship from the boundary which faces the

cargo area at each deck level. In the case of the sides of those superstructures and deckhouses, such insulation shall be carried up to the underside of the deck of the navigation bridge.

Windows and side scuttles within these limits are to be of the fixed type and constructed to the A-60 standard.

f) Skylights to cargo pump-rooms shall be of steel, shall not contain any glass and shall be capable of being closed from outside the pump-room.

g) In approving structural fire protection details, the Society shall have regard to the risk of heat transmission at intersections and terminal points of required thermal barriers.

Table 2 : Fire integrity of bulkheads separating adjacent spaces

SPACES		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Control stations	(1)	A-0 [c]	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	*	A-60	A-0	A-30
Corridors	(2)		C [e]	B-0 [e]	A-0 [a] B-0 [e]	B-0 [e]	A-60	A-0	A-60	A-0	*	A-15	A-0	A-30
Accommodation spaces	(3)			C [e]	A-0 [a] B-0 [e]	B-0 [e]	A-60	A-0	A-60	A-0	*	A-0	A-60	A-30
Stairways	(4)				A-0 [a] B-0 [e]	A-0 [a] B-0 [e]	A-60	A-0	A-60	A-0	*	A-15	A-0	A-30
Service spaces (low risk)	(5)					C [e]	A-60	A-0	A-60	A-0	*	A-0	A-15	A-30
Machinery spaces of category A and equivalent spaces of high fire risk	(6)						* [h]	A-0 [g]	A-0	A-60	*	A-60	A-60	A-60
Other machinery spaces and oil fuel tanks	(7)							A-0 [b]	A-0	A-0 [g]	*	A-0 [g]	A-15	A-30
Cargo pump room	(8)								*	A-60	*	A-60	A-60	-
Service spaces (high risk)	(9)									A-0 [b]	*	A-30	A-60	A-30
Open decks	(10)										–	A-0	*	A-30 [d]
Special purpose spaces	(11)											A-0	A-60	A-30
Evacuation stations and external escape routes	(12)												A-0	A-30
Ammunition spaces and other equivalent spaces	(13)													A-30

Note 1: (to be applied to Tab 2 and Tab 3, as appropriate)

[a] : For clarification as to which applies, see NR467, Pt C, Ch 4, Sec 5, [1.3.2] and NR467, Pt C, Ch 4, Sec 5, [1.3.5].

[b] : Where spaces are of the same numerical category and letter "b" appears, a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose, e.g. in category (9). A galley next to a galley does not require a bulkhead, but a galley next to a paint room requires an A-0 bulkhead.

[c] : Bulkheads separating the wheelhouse and chartroom from each other may have a B-0 rating.

[d] : When an ammunition space is adjacent or above a water tank, or adjacent to the shell of the ship below the lowest possible waterline, only "A-0" standard is required.

[e] : For the application of item b) of NR467, Pt C, Ch 4, Sec 5, [1.3.1], B-0 and C, where appearing in Tab 2, are to be read as A-0.

[f] : Fire insulation need not be fitted if the machinery space in category (7), in the opinion of the Society, has little or no fire risk.

[g] : A fire division of at least A-30 standard is required between spaces containing a section of main switchboards and spaces of categories (6), (9) or (11).

[h] : The boundaries between battery rooms containing Li-ion-type batteries and machinery spaces of category A are to have A-60 fire integrity.

Table 3 : Fire integrity of decks separating adjacent spaces

SPACE below		SPACE above												
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Control stations	(1)	A-0	A-0	A-0	A-0	A-0	A-60	A-0	A-0	A-0	*	A-30	A-0	A-30
Corridors	(2)	A-0	*	*	A-0	*	A-60	A-0	A-0	A-0	*	A-0	A-0	A-30
Accommodation spaces	(3)	A-60	A-0	*	A-0	*	A-60	A-0	A-0	A-0	*	A-0	A-60	A-30
Stairways	(4)	A-0	A-0	A-0	*	A-0	A-60	A-0	A-0	A-0	*	A-0	A-0	A-30
Service spaces (low risk)	(5)	A-15	A-0	A-0	A-0	*	A-60	A-0	A-0	A-0	*	A-0	A-15	A-30
Machinery spaces of category A and equivalent spaces of high fire risk	(6)	A-60	A-60	A-60	A-60	A-60	* [h]	A-60 [f] [g]	A-30	A-60	*	A-60	A-60	A-60
Other machinery spaces and oil fuel tanks	(7)	A-15	A-0	A-0	A-0	A-0	A-0 [g]	*	A-0	A-0 [g]	*	A-0 [g]	A-15	A-30
Cargo pump room	(8)	A-60	A-0	A-0	A-0	A-0	A-0	A-0	*	A-0	*	A-0	A-60	A-30
Service spaces (high risk)	(9)	A-60	A-0	A-0	A-0	A-0	A-60	A-0 [g]	A-0	A-0	*	A-30	A-60	A-30
Open decks	(10)	*	*	*	*	*	*	*	*	*	–	A-0	*	A-30 [d]
Special purpose spaces	(11)	A-60	A-15	A-0	A-15	A-0	A-30	A-0 [g]	A-0	A-30	A-0	A-0	A-60	A-30
Evacuation stations and external escape routes	(12)	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	*	A-0	A-0	A-30
Ammunition spaces and other equivalent spaces	(13)	A-30	A-30	A-30	A-30	A-30	A-60	A-30	A-30	A-30	A-30 [d]	A-30	A-30	A-30
Note 1: The notes to Tab 2 apply to this Table as appropriate.														

4.1.2 Exhaust ducts from galley ranges

The provisions of NR467, Pt C, Ch 4, Sec 5, [6.6.2] are to be replaced by the following:

In addition to the requirements in NR467, Pt C, Ch 4, Sec 5, [6.2], [6.3] and [6.4], exhaust ducts from galley ranges shall be constructed in accordance with NR467, Pt C, Ch 4, Sec 5, [6.3.4], item b) 1) and NR467, Pt C, Ch 4, Sec 5, [6.3.4], item b) 2). They shall also be fitted with:

a) a grease trap readily removable for cleaning unless an alternative approved grease removal system is fitted;

b) a fire damper located in the lower end of the duct at the junction between the duct and the galley range hood which is automatically and remotely operated and, in addition, a remotely operated fire damper located in the upper end of the duct close to the outlet of the duct;

c) a fixed means for extinguishing a fire within the duct;

d) remote-control arrangements for shutting off the exhaust fans and supply fans, for operating the fire dampers mentioned in item b) and for operating the fire-extinguishing system, which shall be placed in a position outside the galley close to the entrance to the galley. Where a multi-branch system is installed, a remote means located with the above controls shall be provided to close all branches exhausting through the same main duct before an extinguishing medium is released into the system; and

e) suitably located hatches for inspection and cleaning, including one provided close to the exhaust fan and one fitted in the lower end where grease accumulates.

The requirements given in item a) to item e) apply to all exhaust ducts from galley ranges in which grease or fat is likely to accumulate from galley ranges.

4.1.3 Ventilation ducts for ammunition spaces

The ventilation systems serving ammunition spaces shall be separated from the ventilation systems serving other types of space. No ventilation duct shall pass through any ammunition space except the ducts provided for the ventilation of this ammunition space. Torpedo magazines shall be provided with a dedicated ventilation system capable of being stopped locally.

Note 1: If a common duct serves several ammunition spaces, this common duct is to be located outside the served spaces.

Ducts provided for the ventilation of ammunition spaces shall not pass through other spaces unless:

a) the ducts comply with NR467 Pt C, Ch 4, Sec 5 [6.3.4] item a) 1) and item a) 2); and

b) the ducts are either:

   1) fitted with automatic fire dampers close to the boundaries of the ammunition space penetrated, and insulated as the penetrated division from the ammunition spaces to a point at least 5 m beyond each fire damper; or

   2) insulated as required in Tab 2 throughout the spaces penetrated; and

c) penetrations of main vertical zone divisions, if any, comply with NR467 Pt C, Ch 4, Sec 5 [6.3.6]

4.2 Ventilation systems

4.2.1 Application

a) Ventilation systems intended to be used during normal operation are to comply with the requirements of NR467 Pt C, Ch 4, Sec 5, [6] and with the present sub-article.

   These requirements are not intended to apply to alternative configurations used solely in casualty situations. In any case, arrangements intended for use solely in casualty situations are not to impair compliance of the ventilation systems intended for normal operation with the requirements of NR467 Pt C, Ch 4, Sec 5, [6] and with those of the present sub-article.

b) For ships provided with CBRN protection, parts of the ventilation system not fully complying with the requirements of NR467 Pt C, Ch 4, Sec 5 [6] and with those of the present sub-article may be accepted provided that:

   - they are used solely during CBRN operation, and suitably marked to this end, and
   - they are separated from parts of the ventilation system that will be used during normal operation, to the satisfaction of the Society, and
   - the ventilation system in use during normal operation is fully compliant with the requirements of the present Article, and
   - suitable arrangements are provided to prevent the fire extinguishing medium, especially CO_2, from leaving the protected space in case of release during CBRN operation or normal operation.

Attention is drawn to the provisions of Pt E, Ch 8, Sec 3, [2] for ships to be assigned the **CBRN** additional class notation.

4.2.2 Ammunition space

Ammunition spaces are to be fitted with a mechanical ventilation system in order to avoid the formation of condensation inside the space. The ventilation system is to be such as to provide at least 0,5 air change per hour.

4.2.3 Spaces for the storage of gas fire-extinguishing medium

Spaces dedicated to the storage of bottles or vessels containing the gas fire-extinguishing medium as mentioned in Tab 4, are to be fitted with a mechanical ventilation system designed to exhaust air from the bottom of the space and capable of providing at least 6 air changes per hour unless access to the space is provided from the open deck.

4.2.4 Battery room

Spaces for the storage of batteries are to be fitted with a mechanical ventilation system complying with the requirements of NR467 Pt C, Ch 2, Sec 3, [10.4] and NR467 Pt C, Ch 2, Sec 11, [6.5]. When the formula of NR467 Pt C, Ch 2, Sec 11, [6.5.2] has not been applied, the ventilation system is to be capable of providing at least 15 air changes per hour.

4.2.5 Spaces dedicated to the storage of flammable liquids

Spaces dedicated to the storage of flammable liquids in closed containers are to be fitted with a mechanical ventilation system complying with the requirements of NR467, Pt C, Ch 2, Sec 3, [10.5] and capable of providing at least 6 air changes per hour.

4.2.6 Workshops for the handling of flammable liquid

Workshops which can be used for the handling of flammable liquids are to be fitted with a mechanical ventilation system capable of providing at least 10 air changes per hour.

4.2.7 Spaces containing welding gas (acetylene) bottle

In addition to the requirements of NR467, Pt C, Ch 1, Sec 10, [19.4.1] applicable to the spaces for the storage of welding gas (acetylene), spaces for the storage of welding gas bottles, including the workshops where welding operations are performed, are to be fitted with a mechanical ventilation system complying with the requirements of NR467, Pt C, Ch 2, Sec 3, [10.6] and capable of providing at least 6 air changes per hour.

4.2.8 Workshops for the maintenance of internal combustion machinery

Workshops for the maintenance of any internal combustion machinery using fuel having a flash-point below 60°C are to be fitted with a mechanical ventilation system capable of providing at least 15 air changes per hour.

Table 4 : Summary of the fixed fire-extinguishing systems

Type of protected space	Applicable requirements	Type of fixed fire-extinguishing system
Machinery spaces of category A	NR467, Pt C, Ch 4, Sec 6, [4] NR467, Pt C, Ch 4, Sec 15 Pt C, Ch 4, Sec 14, [7.4]	• fixed gas fire-extinguishing system, or • fixed high-expansion foam fire-extinguishing system, or • fixed pressure water-spraying fire-extinguishing system **(2)**
JP5 pump rooms	[5.7] NR467, Pt C, Ch 4, Sec 15 Pt C, Ch 4, Sec 14, [7.4]	• fixed pressure water-spraying fire-extinguishing system **(2)**
Cargo pump rooms	[5.3] NR467, Pt C, Ch 4, Sec 15	• fixed CO2 system, or • fixed high-expansion foam fire-extinguishing system, or • fixed pressure water-spraying fire-extinguishing system
Ammunition spaces	[5.4] NR467, Pt C, Ch 4, Sec 15	Fixed pressure water-spraying fire-extinguishing system (drencher system)
Dry stores and ammunition transfer routes	[5.5]	Fixed pressure water-spraying fire-extinguishing system (drencher system)
Control stations, accommodation and service spaces	[5.6] NR467, Pt C, Ch 4, Sec 15	Automatic sprinkler system
Helicopter hangar	NR467, Pt C, Ch 4, Sec 13 NR467, Pt C, Ch 4, Sec 15 Pt C, Ch 4, Sec 14, [7.4]	Fixed pressure water-spraying fire-extinguishing system (drencher system) **(2)**
Flight deck	Pt C, Ch 4, Sec 10	Dry powder and foam system **(1)**
Cargo area and RAS station	[6]	Deck foam system
(1) Dry powder systems may consist of portable powder extinguishers with the same total capacity **(2)** Thick water systems complying with Pt C, Ch 4, Sec 14, [7.4] may also be used.		

5 Fire fighting

5.1 Fire mains and hydrants

5.1.1 Arrangement of fire pumps and fire mains

a) The fire pumps required in NR467, Pt C, Ch 4, Sec 6, [1.3] are to be so arranged that when the isolating valves referred to in [5.1.3] are shut, all the hydrants on the ship, except those in the cargo area between the isolating valves, and other fire fighting systems using the fire main as the main supply of sea water can be supplied with water by one or several of the fire pumps at the required pressure.

b) Attention is drawn to the provisions of item c) of [6.2.1].

5.1.2 Capacity of fire pumps

a) Total capacity of required fire pumps

The required fire pumps are to be capable of supplying, at the pressure stated in NR467, Pt C, Ch 4, Sec 6, [1.2.6], two hydrants and the ship most demanding fire-fighting system using the fire main as the main supply of sea water.

Note 1: The expression “the ship most demanding systems” means the most demanding room associated with its adjacent ammunition stores.

b) Capacity of each fire pump

Each of the required fire pumps shall have a capacity not less than 80% of the total required capacity divided by the minimum number of required fire pumps, but in any case not less than 25 m^3/hour, and each such pump shall in any event be capable of delivering at least the two required jets of water. These fire pumps shall be capable of supplying the fire main system under the required conditions. Where more pumps than the minimum of required pumps are installed, such additional pumps shall have a capacity of at least 25 m^3/h and shall be capable of delivering at least the two jets of water required in NR467, Pt C, Ch 4, Sec 6, [1.2.5] a).

5.1.3 Fire main isolating valves

In addition to the valves required in NR467, Pt C, Ch 4, Sec 6, [1.2.4], isolation valves are to be fitted in the fire main aft and forward of the cargo area in a protected position and on the tank deck at intervals of not more than 40 m to preserve the integrity of the fire main system in the event of fire or explosion.

5.2 Type of fixed fire-extinguishing systems

5.2.1 The different types of fixed fire-extinguishing systems required for auxiliary naval vessels are summarized in Tab 4.

5.3 Fire-extinguishing systems for cargo pump rooms

5.3.1 Cargo pump rooms of auxiliary naval vessels are to be provided with a fixed fire-extinguishing system complying with [5.3.2].

5.3.2 Design and arrangement of the fire-extinguishing system

a) Each cargo pump-room is to be provided with one of the following fixed fire-extinguishing systems operated from a readily accessible position outside the pump-room. Cargo pump-rooms are to be provided with a system suitable for machinery spaces of category A.

   1) Either a carbon dioxide system complying with the provisions of NR467, Pt C, Ch 4, Sec 15, [4] and with the following:
      - the alarms giving audible warning of the release of fire-extinguishing medium are to be safe for use in a flammable cargo vapour/air mixture,
      - a notice is to be exhibited at the controls stating that due to the electrostatic ignition hazard, the system is to be used only for fire extinguishing and not for inerting purposes.

   2) A high-expansion foam system complying with the provisions of NR467, Pt C, Ch 4, Sec 15, [5.2], provided that the foam concentrate supply is suitable for extinguishing fires involving the cargoes carried.

   3) A fixed pressure water-spraying system complying with the provisions of NR467, Pt C, Ch 4, Sec 15, [6.1.1].

b) Where the extinguishing medium used in the cargo pump-room system is also used in systems serving other spaces, the quantity of medium provided or its delivery rate need not be more than the maximum required for the largest compartment.

5.4 Fire-extinguishing systems for ammunition spaces

5.4.1 Ammunition spaces are to be provided with a fixed fire-extinguishing system complying with the requirements of Pt C, Ch 4, Sec 6, [6.1]. This system is to be fed by the fire main.

5.5 Fire-extinguishing systems for ammunition and dry stores transfer routes

5.5.1 Spaces forming part of the dry stores or ammunition transfer routes are to be provided with a fixed water-based fire-fighting system complying with the provisions of NR467, Pt C, Ch 4, Sec 15, [6.1.4]. The system is to be of the deluge type with manual release and is to be sized according to the prescriptive-based requirements.

The system may be supplied by the fire main provided that the requirements of [5.1] are complied with.

5.6 Fire-extinguishing arrangements in control stations, accommodation and service spaces

5.6.1 An automatic sprinkler, fire detection and fire alarm system of an approved type complying with the requirements of NR467, Pt C, Ch 4, Sec 15 is to be fitted in all control stations, accommodation and service spaces, including corridors and stairways.

Alternatively, control stations, where water may cause damage to essential equipment, may be fitted with an approved fixed fire-extinguishing system of another type.

Spaces having little or no fire risk such as voids, public toilets, carbon dioxide rooms and similar spaces need not be fitted with an automatic sprinkler system

5.6.2 Protection of Navy operational spaces

Operational spaces containing systems where water may cause damage to essential equipment may be protected by a section of the sprinkler system required in [5.6.1] and fitted with a stop valve provided the following requirements are complied with:

a) These stop valve are readily accessible in a location outside of the protected spaces

b) These stop valves is normally to be kept opened at sea

c) An indication is to be provided in a CMCS to indicate wether those valves are opened or closed, and visual and audible warning is to be provided when those valves are closed.

d) The valve's locations are to be clearly and permanently indicated. Means should be provided to prevent the operation of the stop-valves by an unauthorized person.

5.7 Protection of JP5 pump rooms

5.7.1 Fixed fire-extinguishing system

Each JP5-NATO (F44) pump room shall be provided with a fixed pressure water-spraying system or an equivalent fixed water based fire-extinguishing system complying with the provisions of the NR467 Pt C, Ch 4, Sec 15.

5.7.2 In addition of the system required above, and with consideration of the floor arrangement of the JP5-NATO (F44) pump room, a low expansion foam system, a thick water system, or any other approved system, is to be provided for the protection of bilge spaces under the machinery floors.

5.7.3 Quantity of fire-extinguishing medium

Where the extinguishing medium used in the fuel pump room system is also used in systems serving other spaces, the quantity of medium provided or its delivery rate need not be more than the maximum required for the largest compartment.

6 Fixed deck foam system

6.1 Application

6.1.1 Ships having the service notation **auxiliary naval vessel** are to be provided with a fixed deck foam system complying with the provisions of [6.2] and [6.3] or with an equivalent fixed installation.

Note 1: To be considered equivalent, the system proposed in lieu of the deck foam system is to:

- be capable of extinguishing spill fires and also preclude ignition of spilled oil not yet ignited, and
- be capable of combating fires in ruptured tanks.

6.2 System design

6.2.1 Principles

a) The arrangements for providing foam are to be capable of delivering foam to the entire cargo tank deck area as well as into any cargo tank the deck of which has been ruptured.

b) The deck foam system is to be capable of simple and rapid operation.

c) Operation of a deck foam system at its required output is to permit the simultaneous use of the minimum required number of jets of water at the required pressure from the fire main.

Note 1: A common line for fire main and deck foam line can only be accepted if it can be demonstrated that the hose nozzles can be effectively controlled by one person when supplied from the common line at a pressure needed for operation of the monitors. Additional foam concentrate is to be provided for operation of two nozzles for the same period of time required for the foam system.

The simultaneous use of the minimum required jets of water is to be possible on deck over the full length of the ship, in the accommodation spaces, service spaces, control stations and machinery spaces.

d) Foam from the fixed foam system is to be supplied by means of monitors and foam applicators.

Note 2: On auxiliary naval vessels of less than 4000 tons deadweight, the Society may not require installation of monitors but only applicators.

e) Applicators are to be provided to ensure flexibility of action during fire-fighting operations and to cover areas screened from the monitors.

6.2.2 Foam solution - Foam concentrate

a) The rate of supply of foam solution is not to be less than the greatest of the following:

1) 0,6 l/min per square metre of cargo tanks deck area, where cargo tanks deck area means the maximum breadth of the ship multiplied by the total longitudinal extent of the cargo tank spaces,

2) 6 l/min per square metre of the horizontal sectional area of the single tank having the largest such area, or

3) 3 l/min per square metre of the area protected by the largest monitor, such area being entirely forward of the monitor, but not less than 1250 l/min.

b) Sufficient foam concentrate is to be supplied to ensure at least 20 minutes of foam generation in ships fitted with an inert gas installation or 30 minutes of foam generation in ships not fitted with an inert gas installation when using solution rates stipulated in item 1 above, whichever is the greatest. The foam expansion ratio (i.e. the ratio of the volume of foam produced to the volume of the mixture of water and foam-making concentrate supplied) is not generally to exceed 12 to 1. Where systems essentially produce low expansion foam but at an expansion ratio slightly in excess of 12 to 1 the quantity of foam solution available is to be calculated as for 12 to 1 expansion ratio systems. When medium expansion ratio foam (between 50 to 1 and 150 to 1 expansion ratio) is employed, the application rate of the foam and the capacity of a monitor installation is to be to the satisfaction of the Society.

6.2.3 Monitors and foam applicators

a) At least 50 per cent of the foam solution supply rate required in items a) 1) and a) 2) of [6.2.2] is to be delivered from each monitor.

b) The capacity of any monitor is to be at least 3 l/minute of foam solution per square metre of deck area protected by that monitor, such area being entirely forward of the monitor. Such capacity is to be not less than 1250 l/minute.

c) The capacity of any applicator is to be not less than 400 l/min and the applicator throw in still air conditions is to be not less than 15 m.

Note 1: Where, in pursuance of [6.2.1], the installation of monitors is not required on auxiliary naval vessels of less 4000 tons deadweight, the capacity of each applicator is to be at least 25 per cent of the foam solution supply rate required in items a) 1) and a) 2) of [6.2.2].

6.3 Arrangement and installation

6.3.1 Monitors

a) The number and position of monitors are to be such as to comply with item a) of [6.2.1].

b) The distance from the monitor to the farthest extremity of the protected area forward of that monitor is not to be more than 75 per cent of the monitor throw in still air conditions.

c) A monitor and hose connection for a foam applicator are to be situated both port and starboard at the front of accommodation spaces facing the cargo tank deck.

6.3.2 Applicators

a) The number of foam applicators provided is to be not less than four. The number and disposition of foam main outlets are to be such that foam from at least two applicators can be directed on to any part of the cargo tank deck area.

b) The deck foam system is to be so arranged as to permit the protection of the loading or unloading arrangements by at least two foam applicators.

6.3.3 Isolation valves

Valves are be provided in the foam main, and in the fire main when this is an integral part of the deck foam system, downstream of any monitor position to isolate damaged sections of those mains.

6.3.4 Main control station

The main control station for the system is to be suitably located outside the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected.

7 Equipment for measuring oxygen and flammable vapours concentration

7.1 Provisions applicable to all ships

7.1.1 All ships are to be provided with at least two portable gas detectors capable of measuring flammable vapour concentrations in air (%LEL) and at least two portable oxygen analysers. Alternatively, at least two gas detectors, each capable of measuring both oxygen and flammable vapour concentrations in air (%LEL), are to be provided.

Note 1: The number of portable detection instruments required above is considered equivalent to one portable instrument for measuring flammable vapour concentration, one portable instrument for measuring oxygen and sufficient spares.

7.1.2 The gas detectors required in [7.1.1] are to be of a type approved by the Society.

7.2 Additional provisions for ships fitted with an inert gas system

7.2.1 In addition to the provisions of [7.1], for ships fitted with inert gas systems, at least two portable gas detectors are to be capable of measuring concentrations of flammable vapours in inerted atmosphere. Gas detectors are to be capable of measuring any gas content from 0 to 100% in volume.

8 Means of escape

8.1 Means of escape from control stations, accommodation spaces and service spaces

8.1.1 The requirements of NR467, Pt C, Ch 4, Sec 8, [2.2.3], items a) and b) are to be replaced by:

a) Escape from spaces below the bulkhead deck

1) Below the bulkhead deck, two means of escape, at least one of which shall be independent of watertight doors, shall be provided from each watertight compartment or similarly restricted space or group of spaces. Exceptionally, the Society may dispense with one of the means of escape for crew spaces that are entered only occasionally, if the required escape route is independent of watertight doors.

2) Where the Society has granted dispensation under the provisions of 1) above, this sole means of escape shall provide safe escape. However, stairways shall not be less than 700 mm in clear width with handrail at least on one side.

b) Escape from spaces above the bulkhead deck

Above the bulkhead deck there shall be at least two means of escape from each main vertical zone or similarly restricted space or group of spaces, at least one of which shall give access to a stairway forming a vertical escape.

8.1.2 Direct access to stairway enclosures

The requirements of NR467, Pt C, Ch 4, Sec 8, [2.2.3], item c) are to be replaced by:

Stairway enclosures in accommodation and service spaces are to have direct access from the corridors and be of a sufficient area to prevent congestion, having in view the number of persons likely to use them in an emergency.

Within the perimeter of such stairway enclosures, only public toilets, lockers of non-combustible material providing storage for non-hazardous safety equipment and open information counters are permitted. Only public spaces, corridors, lifts, public toilets,

pantries containing no cooking appliances, ro-ro and vehicle spaces, other escape stairways required by [8.1.3] or escape stairways from machinery spaces other that category A machinery spaces and external areas are permitted to have direct access to these stairway enclosures. Small corridors or "lobbies" used to separate an enclosed stairway from galleys or main laundries may have direct access to the stairway provided they have a minimum deck area of 4,5 m^2, a width of not less than 900 mm and contain a fire hose station.

8.1.3 Details of means of escape

The requirements of NR467, Pt C, Ch 4, Sec 8, [2.2.3], item d) are to be replaced by:

1) At least one of the means of escape required by [8.1.1] items a) and b) shall consist of a readily accessible enclosed stairway, which shall provide continuous fire shelter from the level of its origin to the appropriate lifeboat and liferaft embarkation decks, or to the uppermost weather deck if the embarkation deck does not extend to the main vertical zone being considered. In the latter case, direct access to the embarkation deck by way of external open stairways and passageways shall be provided and shall have emergency lighting in accordance with NR467, Pt C, Ch 2, Sec 3 and slip-free surfaces underfoot. Boundaries facing external open stairways and passageways forming part of an escape route and boundaries in such a position that their failure during a fire would impede escape to the embarkation deck shall have fire integrity, including insulation values, in accordance with Tab 2 and Tab 3, as appropriate.

2) Protection of access from the stairway enclosures to the lifeboat and liferaft embarkation areas shall be provided either directly or through protected internal routes which have fire integrity and insulation values for stairway enclosures as determined by Tab 2 and Tab 3, as appropriate.

3) The widths, number and continuity of escapes shall be in accordance with the requirements in NR467, Pt C, Ch 4, Sec 15, except that the requirements of NR467, Pt C, Ch 4, Sec 15, [12.1.1] and NR467, Pt C, Ch 4, Sec 15, [12.1.2] item c) are replaced by [8.1.4] and [8.1.6] respectively.

8.1.4 Width of stairways

The requirements of NR467, Pt C, Ch 4, Sec 15, [12.1.1] are to be replaced by:

a) Stairways are not to be less than 700 mm in clear width. The minimum clear width of stairways is to increase by 10 mm for every person provided in excess of 70 persons. The total number of persons to be evacuated by such stairways is assumed to be two thirds of the total number of the crew and special persons in the areas served by such stairways.

b) The clear width of the stairways is not to be inferior to the width calculated as per the Fire Safety Systems Code, Ch 13, 2.1.2, considering the distribution of persons given in [8.1.5].

8.1.5 Distribution of persons

For the application of the provision of the Fire Safety System Code, Chapter 13, 2.1.2.2.2.1, cases 1 and 2 are to be replaced by:

a) Case 1 (night-time)
- the total number of the members of crew not operating by watch in its cabins and berthing
- 2/3 of the members of the crew operating by watch in its cabins and berthing spaces, and
- 1/3 of the crew operating by watch in its service spaces.

b) Case 2 (daytime)
- 1/4 of the members of crew not operating by watch in its public spaces
- 3/4 of the members of crew not operating by watch in its service spaces
- 1/3 of the crew operating by watch in its cabins and berthing spaces
- 1/3 of the crew operating by watch in its service spaces, and
- 1/3 of the crew operating by watch in its public spaces.

Note 1: For the application of the provision of Fire Safety System Code, Chapter 13 [2.1.2.1.4], the number of persons to be distributed in each public space is to be proportional to the deck area of these public spaces, as per the following formula:

$n = N \ a / A$

where:

N : Total number of persons to be distributed in the public spaces

a : Deck area of the selected public space

A : Total deck area of the public spaces available to the total number of persons to be distributed in the public spaces.

Note 2: Other cases of distribution of persons may be considered in replacement of, or in addition to, cases 1 and 2 above by more effective scenarios given by the Naval Authority.

8.1.6 Vertical rise and inclination of stairways

The requirements of NR467, Pt C, Ch 4, Sec 15, [12.1.2] item c) is to be replaced by:

Stairways are not to exceed 3,5 m in vertical rise without the provision of a landing. Their angle of inclination is to be in general 45°, but not greater than 50°, and, in machinery spaces and small spaces, not greater than 60°.

8.1.7 Evacuation analysis

Escape routes are to be evaluated by an evacuation analysis early in the design process.

The analysis is to be used to identify and eliminate, as far as practicable, congestion which may develop during an abandonment, due to normal movement of crew along escape routes. In addition, the analysis is to be used to demonstrate that escape arrangements are sufficiently flexible to provide for the possibility that certain escape routes, assembly stations, embarkation stations or survival craft may not be available as a result of a casualty.

Note 1: For the application of the IMO Circular MSC.1/Circ.1533 , the scenarios and given values such as Response duration (R), Total travel duration (T), Embarkation and launching duration (E+L), counterflow factor, walking speed, etc. may be replaced by more effective scenarios and values given by the Naval Authority.

Section 7 Replenishment at Sea

1 General

1.1 Application

1.1.1 The requirements of this Section are applicable to auxiliary naval vessel installations for underway Replenishment At Sea (RAS) of liquid and solid supplies.

1.2 Documents to be submitted

1.2.1 The plans and documents to be submitted to the Society are listed in Tab 1.

1.3 Definitions

1.3.1 Replenishment at sea (RAS)

RAS means refuelling at sea or underway replenishment at sea of solid and liquid supplies.

1.3.2 Vertical Replenishment (VERTREP)

Vertical Replenishment (VERTREP) means transfer of unitized cargo by means of helicopter.

1.3.3 RAS station

A Replenishment at Sea (RAS) station is the deck area fitted with RAS equipment providing the capability to carry out underway replenishment of liquid and/or solid cargo.

Table 1 : Documentation to be submitted

No.	A / I **(1)**	Description of document
1	I	Description and operation manuals of the ship's RAS systems and equipment
2	A	Plans showing each proposed combination of equipment, fully rigged
3	I	Details of solid cargo to be transferred: maximum weight and dimensions
4	A	Details of liquid cargo to be transferred and diagram of the fluid transfer system
5	I	Details of maximum sea state and environmental conditions under which RAS operations are permitted
6	I	General arrangement showing: • relative disposition of RAS stations and associated clearances • location of RAS control stations • arrangement of solid cargo and ammunition transfer routes
7	A	Lifting appliances: plans and construction drawings of all lifting appliances, masts, derricks, rigs
8	A	Details of equipment identified for RAS operations. Design and installation loads on the equipment together with details of securing and holding down arrangements. Details of the access required for maintenance and to operate the equipment
9	I	Description of safety devices (emergency breakaway, antislack devices, alarms, limit switches…)
10	A	Drawings of the foundations of lifting appliances and winches, including footprint and reaction forces
11	I	National or international regulations, standards or specifications used for type testing of equipment requiring type testing according to Tab 4
12	I	SWL of all components of RAS installation
13	A	Test and inspection programme for the test onboard: static load test, checking verifications, dynamic overload tests
14	A	Details of structural reinforcement under RAS stations dump areas
15	A	Diagram of internal ship communication system
16	I	Diagram of ship to ship communication system
17	I	Standards used for ship to ship and ship to helicopter communication systems
18	I	Arrangement plan of low intensity lightning of RAS stations and transfer routes
(1) I = to be submitted for information; A = to be submitted for approval		

1.3.4 VERTREP area

Deck area where VERTREP operations are carried out. It includes the clear deck space for helicopter rotor, fuselage and landing gear, and VERTREP load clearances (including dump areas).

1.3.5 RAS control station

A RAS control station is a station from which it is possible to operate RAS equipment and observe the RAS operations performed at RAS station(s).

1.3.6 RADHAZ

A hazard caused by a transmitter/antenna installation that generates electromagnetic radiation in the vicinity of personnel or fueling operations in excess of established safe levels or increases the existing levels to a hazardous level.

1.4 Standardization

1.4.1 RAS operations are to be conducted in accordance with ATP-16 or equivalent National Standard.

2 Design and construction

2.1 RAS equipment

2.1.1 Typical arrangement

Fig 1 shows a tensioned liquid replenishment installation which may be used as reference.

Fig 2 shows a tensioned solid replenishment installation also for reference purpose.

Other types of RAS installations may be used and are to be submitted to the Society for special examination.

Figure 1 : Tensioned liquid replenishment installation

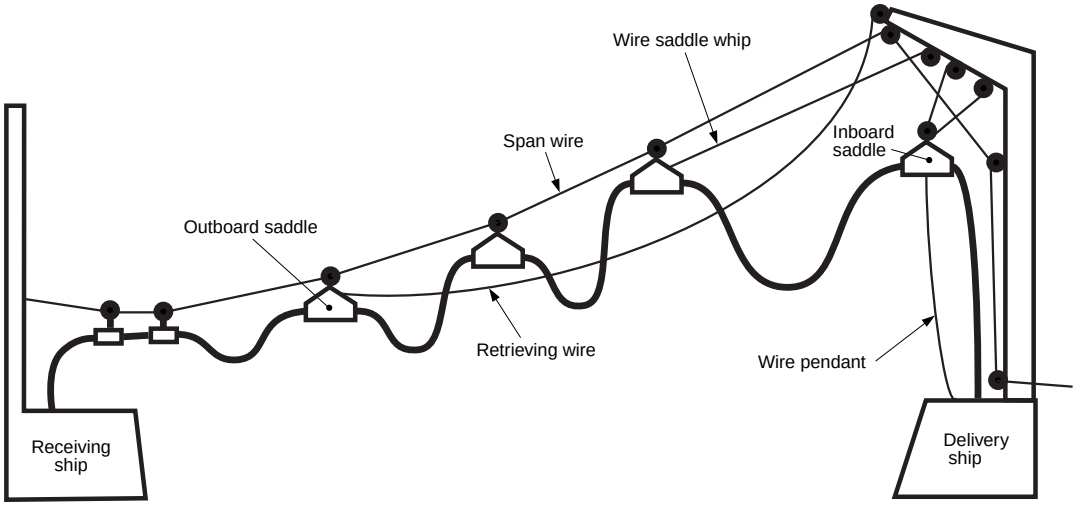
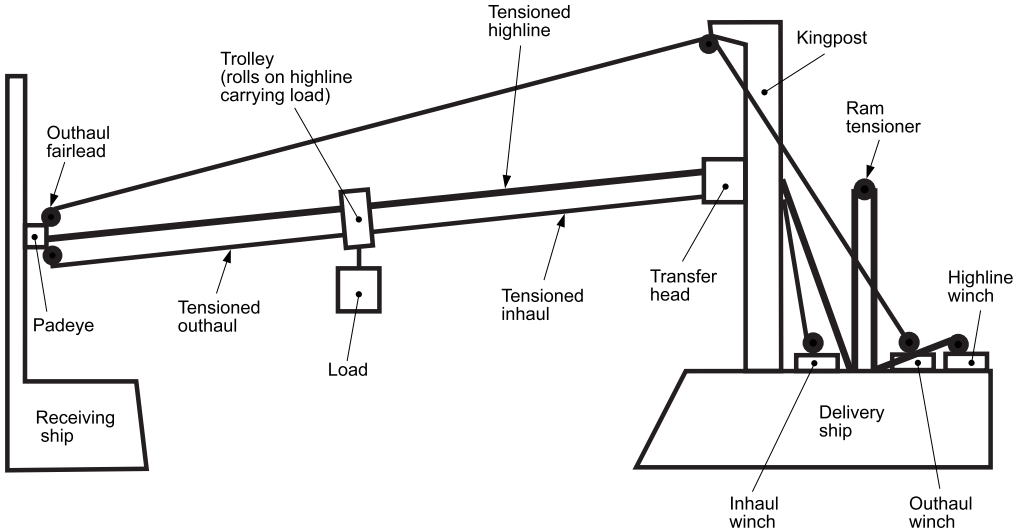


Figure 2 : Tensioned solid replenishment installation



2.1.2 General

RAS pieces of equipment onboard ships having the service notation **auxiliary naval vessel** are to comply with the following requirements:

- they are to be type approved according to the requirements in [4.1]
- certificates of inspection of materials and equipment are to be provided as indicated in [4.2]
- fitting onboard of the RAS equipment is to be witnessed by a Surveyor of the Society and the relevant certificate is to be issued
- demonstration of the strength, structural integrity and good working of RAS equipment is to be effected for each ship through shipboard testing as mentioned in [4.4] and this is to be reported in the above certificate.

2.1.3 Emergency breakaway

All RAS equipment and facilities are to be designed to permit the application of emergency breakaway procedures that should normally be complete within one minute of the commencement of initiation. Use may be made of quick release couplings and/or breakable couplings. Attention is to be given to the attachment of wires and ropes to winch drums and the selection of emergency breakaway equipment (wire cutters, axes, etc.).

2.1.4 Protection

All deck mounted electrical equipment and enclosures have to be designed with IP56 ingress protection rating.

2.1.5 Survey of elements within the scope of ship classification

The fixed parts of the RAS equipment and connections to ship structure (masts, winches and equipment foundations, local reinforcements under the dump area and transfer lanes) are to be surveyed at the yard by a Surveyor of the Society within the scope of ship classification.

2.1.6 Safe Working Load (SWL) of RAS equipment

The safe working load of RAS components is to be sufficient to withstand the maximum load to which such component may be subjected during the RAS operation. The safe working load is to be indicated by the designer.

For tensioned spanwire or highline systems, the SWL of the rigging components is the maximum design tension of the spanwire or highline given by the designer.

As a rule, the SWL of the components which are not part of the tensioned line is not to be less than the values from Tab 2.

Table 2 : Safe working loads of non-tensioned components

RAS system component	SWL, in kN
Riding and retrieving lines	35
Inhaul and outhaul rigging and saddle whips	25

2.1.7 Winches

Winches are to incorporate safety features that permit safe RAS operations and cater for the unique loading conditions that may arise during RAS operations. The following functions are to be fulfilled:

a) quick and efficient engagement and disengagement of the service brake by both automatic and manual means

b) long term locking of the winch drum having manual engagement and disengagement

c) for highline, spanwire and inhaul winches, an overload protection preventing the wire/rope being overstressed during RAS operations (e.g. when ships move or roll apart)

d) proper spooling of the wire onto the drum

e) for highline, spanwire and outhaul winches, slack rope prevention that maintains tension in the wire when the winch is operating under no load.

Combined stress resulting from application in the most unfavourable conditions of a tension in the cable equal the breaking load of this cable should not be higher than 80% of the comparison elastic limit of the material of which strength elements such as frame, drum, drum axles, assembly welds, etc. are made.

Minimum braking force of service brakes is not to be less than 1,5 times the safe working force on the brake.

2.1.8 Steel wire ropes

Steel wire ropes used for RAS operations are to be in compliance with requirements of NR216 Materials and Welding, Ch 4, Sec 1, [4].

The ratio of the specified breaking load of the cable to its SWL is not to be taken less than 3,5.

2.1.9 Hoses and fittings

Hoses for transferring liquids are to be in accordance with standards applicable to the intended application.

Where probe fuelling systems are part of the design, the following features are to be incorporated:

a) automatic latching mechanism with sleeve valve that opens on proper engagement and automatically closes on disengagement

b) disengagement on application of a specified load

c) swivel arm that keeps probe receiver aligned with the spanwire

d) manual release lever

e) quick release hook

f) indication of incorrect probe engagement.

2.1.10 Masts

Masts, cranes, derricks and rigs intended for RAS operations are to comply with the relevant requirements of NR526 Rules for lifting appliances, considering the most unfavourable combination of all safe working loads applied to the mast.

2.2 Steering capability

2.2.1 General

The steering gear system is to fulfil the requirements defined in NR467, Pt C, Ch 1, Sec 14.

2.2.2 Electrical Power supply

An alternative power supply either from the emergency source of electrical power or from an independent source of power located in the steering gear compartment is to be provided, sufficient at least to supply the steering gear power unit such that the latter is able to perform the duties of auxiliary steering gear.

This power source is to be activated automatically, within 45 seconds, in the event of failure of the main source(s) of electrical power.

The independent source is to be used only for this purpose.

The alternative power source is also to supply the steering gear control system, the remote control of the power unit and the rudder angle indicator.

2.2.3 Steering control systems

Any single failure in the steering control system including its interfaces to the navigation system is not to impair the steering capability which is to be continuously maintained.

Such single failure may affect any active component as defined in NR467, Pt F, Ch 2, Sec 1, [1.2.5] from interfaces to the navigation system to interfaces to the mechanical steering actuators.

Compliance with the above requirements of [2.2.3] is to be demonstrated by a risk analysis performed in compliance with NR467, Pt F, Ch 2, App 1, Procedures for Failure Modes and Effect Analysis.

3 Arrangement and installation

3.1 General

3.1.1 RAS systems are to be designed and installed such that degradation or failure of any RAS system will not render another ship system inoperable.

3.2 Arrangement of RAS stations

3.2.1 Location of RAS stations

The distance separating two alongside RAS stations is recommended not to be less than 20 m and not to exceed 40 m.

As far as practicable, one side RAS station is to be located amidships to maximise crew protection during RAS operations during heavy weather conditions.

3.2.2 Clearance requirements

A clearance of at least 30° aft and forward of each side RAS station is to be provided.

For the stern station, if any, sufficient clearance is to be provided for safe deployment of refuelling equipment with regards to deck and stern equipment.

3.3 Communication

3.3.1 Bridge conning position

A conning position for the officer in charge of RAS operations is to be provided on the navigating bridge with a duplicated position on both bridge wings.

From this conning position, it is to be possible to observe the ship's heading and relative movement of the ships conducting RAS operations. In addition, a gyro compass readout and rudder angle indicator are to be readily visible from the conning position.

3.3.2 Ship internal communication systems

Means of communication are to be provided between each RAS Station and the RAS control station.

Such communication system is to be such that communication between RAS Stations and RAS control station can be maintained in case of equipment single failure.

As a minimum, means of effective ship internal communications are to be provided in accordance with Tab 3.

3.3.3 Ship to ship communications

a) Means are to be provided to allow continuous ship to ship distance measurement during side by side replenishment at sea operations.

b) Visual and aural means of communication are to be provided between the ships conducting RAS operations.

c) If some equipment such as distance line is to be transferred from one ship to another in order to conduct the RAS operations, the following is to be complied with:

- the distance line securing points are to be clear of all RAS stations and arranged so that the distance line is visible from the bridge conning position.

Table 3 : Internal communications

Position	Conning position	RAS station	RAS control station	Remarks
Conning position		X	X	
RAS station (including Helideck deck control station for VERTREP operations)	X		X	Each RAS station is to be able to communicate with the conning position and RAS control station
RAS control station	X	X		

3.4 RAS station arrangement

3.4.1 Protection of personnel

a) Bulwarks, guard rails or other equivalent arrangement are to be provided in exposed upper deck positions with regards to personnel protection, in accordance with NR467, Pt B, Ch 12, Sec 2.

b) In general, RAS operations are to be carried out with guard rails in position. Where, for operational reasons, this is not practicable, alternative equivalent arrangements are to be provided.

c) Slip-free surfaces are to be provided in the areas where RAS operations are conducted, and tripping hazards are to be minimized.

d) A minimum distance of at least 3 m between any RAS station superstructure and the edge of the weather deck is to be provided.

e) The arrangements and operational procedures are to be such that the personnel involved in RAS operations will not be exposed to RADHAZ.

3.4.2 Access

The rigging securing points are to be arranged so that safe access is provided to them, including ladders and walkways on the masts.

3.4.3 RAS equipment stores

RAS equipment and fittings are to be stored in dedicated stores, readily accessible from their RAS station. The stores are to have direct access to the weather deck.

3.4.4 Sources of high intensity noise

RAS stations are to be arranged so that exposure to high intensity noise (above 85 db) is as low as practicable during RAS operations.

3.5 RAS control station arrangement

3.5.1

a) A RAS control station is to be provided for control and monitoring of each RAS station equipment.

b) The controls for RAS equipment are to be situated at one control position or grouped in as few positions as possible to the satisfaction of the Society.

c) The RAS control station is to be located so it provides a clear view of all RAS stations and associated equipment.

3.6 Fluid transfer

3.6.1 General

a) The filling connections for liquid transfer operations are to be located within the RAS station and are to be fitted with a shut-off valve operable from the weather deck.

b) As far as practicable, separate filling connections are to be provided for each type of fluid that may be taken on board. To reduce the risk of inadvertent incorrect hose connection, the filling connections are to be of different types and separated as far as possible from each other for each type of liquid to be transferred.

c) Each filling connection is to be provided with means of sampling and a filter capable of being cleaned.

d) Each filling connection is to be provided with a permanently attached notice identifying the fluid storage system(s) connected to the filling connection.

e) Filling connections are to be designed to allow an emergency breakaway as per [2.1.4].

f) Fluid transfer piping is to be in compliance with Ch 4, Sec 4.

g) Emergency stop of the cargo pumps is to be provided at the RAS control station.

3.7 Solid transfer

3.7.1 General

To prevent ingress of water into the ship, sills or alternative equivalent arrangements are to be provided at the entrances to the interior of the ship from each RAS station.

3.7.2 Ship’s structure

a) Each RAS station intended for solid transfer operations is to be provided with a designated dump area.

The dump area is to be suitably reinforced to withstand the impact loads that may arise due to landing of stores and equipment on board during RAS operations.

b) The dump area is to extend for at least 1m outside of the largest expected solid cargo foot print. A factor of safety of not less than four times the maximum load to be transferred is to be used in the design of the structure.

3.8 VERTREP

3.8.1 VERTREP stations are to be provided with facilities and equipment to permit the discharge of static electricity from the helicopter or cargo whilst airborne.

3.9 Night RAS operation

3.9.1 Night operation

The following requirements are to be complied in order to carry out RAS operation at night:

- low intensity red lighting is to be provided at each RAS station, along the transfer routes to and from the RAS station to the stores and within the stores
- provision is also to be made for suitable low intensity lighting inside the RAS control station for control and monitoring of RAS equipment.

4 Certification, inspection and testing

4.1 Type approval procedure

4.1.1 RAS components are to be type approved according to the following procedure:

- the design is to comply with the requirements of this section and either national or international standards, or recognized codes or specifications, which are to be indicated
- each component of the RAS equipment is to be tested and its manufacturing is to be witnessed and certified by a Surveyor according to [4.2]
- types tests are to be carried out as specified under [4.3].

Table 4 : Materials and equipment certification

Item	Material certification	Product certification					Remarks
		Design assessment / approval	Examinations and tests			Certification	
			During fabrication	After completion	Running tests		
Lifting appliances: masts, cranes, derricks	C (1)	DA	X (2)	X (2)	X (3)	C	(1) As per NR216 (2) As per relevant provisions of NR526 (3) Shop tests and running tests onboard as per [4.4]
Winches, anti-slack devices, Ram tensioner	C (1)	TA (2)	X	X	X (3)	C	(1) As per NR216 (2) As a rule, no individual design assessment of winches and RAS equipment (3) Onboard tests as per [4.4]
Electric motors and electrical equipment used for RAS operations (1)	W	DA or TA		X (2)	X (2)	W	(1) Considered as intended for secondary essential services (2) Testing of electric motors includes type tests and routine tests as per NR467, Pt C, Ch 2, Sec 4, [3]
Hydraulic cylinders, piping of class I and equipment essential for RAS operation (winches, Ram tensioner)	C		X s	X h		C	
Control systems of winches and essential systems for RAS operation (Ram tensioner)		DA			X (1)	C	(1) According to an agreed programme for onboard tests as per [4.4]
Cargo transfer hoses and pipes couplings, including breakaway couplings	C (1)	TA		X s h (2)	X (3)	C	(1) Only for metallic pieces and couplings (2) Non-destructive and hydraulic tests as per recognized standards or specification to be specified by the manufacturer (3) Emergency breakaway capabilities to be demonstrated onboard
Loose gear and accessories, including blocks, hooks, shackles, swivels …	W	DA (1)		X (2)		C	(1) Only for elements not complying with a national or international standard (2) Proof load as per [4.3]
Steel wire ropes	W			X (1)		C	(1) As per requirement of NR216 or in compliance with a national or international standard (ISO 3178 for instance)

Note 1:
"C" indicates that a Society certificate is required.
"W" indicates that a manufacturer's certificate is required.
Index "h" means that an hydraulic pressure test is required.
Index "s" means that non destructive tests are required, as per Rules, standard or specification.
"TA" means a type approval is required.
"DA" means a design approval of the product is required, either for the specific unit produced, or using the type approval procedure.
Note 2: Where nothing is mentioned in the design index assessment column, a design assessment of the specific unit is not required.

4.2 Inspection at works of the RAS equipment

4.2.1 The materials and equipment are to be inspected and certified as specified in Tab 4.

4.3 Prototype tests

4.3.1 Prototype tests are to be witnessed by a Surveyor from the Society and to include load test of the RAS equipment under a proof load at least equal to 2 times the safe working load defined in [2.1.7].

4.4 Tests on board

4.4.1 General

The RAS arrangements are to undergo the following tests and inspections after their installation on board:

- static load test demonstrating the strength of the complete rigging of RAS equipment under a load condition larger than the operational one
- after static load test, a visual inspection and functional test to demonstrate that the system is operational and has not suffered damages from the static load tests
- overload tests to demonstrate proper functioning of the equipment on overload.

These tests are to be carried out according to a test programme submitted to the Society.

Testing and marking of the RAS equipment is to be in accordance with the relevant requirements of NR526 Rules for lifting appliances, Ch 4, Sec 1.

4.4.2 Static load tests

Static load tests are to be performed using dedicated test wire rope, different from the ship's wire rope used onboard.

The test loads should be greater than twice the rated SWL of the rigging to be tested. In addition, for tensioned spanwire or highline systems, the test load should not be less than 20% of the breaking strength of the spanwire or highline.

4.4.3 Overload tests

Repeated load cycles specific to each type of equipment are to be performed according to a test programme submitted to the Society. As a rule, the test load is to be 1,5 times the rated operating load corresponding to the SWL.

On winches with adjustable clutches, the clutch need temporary readjustment in order to perform the overload tests. After completion of the test, the clutch or limiting devices are to be readjusted to the normal value and retested.

Section 8 Carriage of Limited Quantities of Flammable Products with Flashpoint less or equal to 60°C

1 General

1.1 Application

1.1.1 Ships having the service notation **auxiliary naval vessel** and complying with the requirements of this Section may carry flammable liquids with flashpoint ≤ 60°C in limited amounts not exceeding the maximum specified in [1.2.1].

1.2 Maximum capacity of flammable liquid with flashpoint ≤ 60°C

1.2.1 The total capacity of cargo tanks designed to carry oil product having a flashpoint ≤ 60°C is to be less than 1000 m^3.

1.3 Definitions

1.3.1 Integral tank

Integral tank means a cargo containment envelope which forms part of the ship's hull and which may be stressed in the same manner and by the same loads which stress the contiguous hull structure and which is normally essential to the structural completeness of the ship's hull.

1.3.2 Independent tank

Independent tank means a cargo-containment envelope which is not contiguous with, or part of, the hull structure. An independent tank is built and installed so as to eliminate whenever possible (or in any event to minimize) its stressing as a result of stressing or motion of the adjacent hull structure. An independent tank is not essential to the structural completeness of the ship's hull.

1.3.3 Cargo area

With regards to the carriage of flammable liquids with flashpoint ≤ 60°C and corresponding requirements of this Section, the cargo area is that part of the ship where cargo and cargo vapours are likely to be present and includes cargo tanks, cargo pump rooms, hold spaces in which independent tanks are located, cofferdams, ballast or void spaces surrounding integral tanks and the following deck areas:

- within 3 m of a cargo tank installed on deck
- within 3 m of a cargo tank outlet in case of independent tanks installed below deck
- within 3 m of a cargo tank outlet in case of integral tanks installed below deck and separated from the weather deck by a cofferdam
- the deck area above an integral tank without an overlaying cofferdam plus the deck area extending transversely and longitudinally for a distance of 3 m beyond each side of the tank
- within 3 m of any cargo liquid or vapour pipe, flange, cargo valve, gas or vapour outlet, or entrance or ventilation opening to a cargo pump-room.

2 General arrangement

2.1 Compartment arrangement

2.1.1 Cargo tank capacity

The total capacity of cargo tanks designed to carry flammable liquids with flashpoint ≤ 60°C is to comply with the requirements stipulated in [1.2.1].

2.1.2 Length of cargo tanks

The length of each cargo tank is not to exceed 10 metres or the applicable value in Tab 1, whichever is greater.

Table 1 : Length of cargo tanks

Longitudinal bulkhead	Type of cargo tank	b_i/B **(1)**	Centreline bulkhead	Length (m)
No bulkhead	–	–	–	(0,5 b_i/B + 0,1) L **(2)**
Centreline bulkhead	–	–	–	(0,25 b_i/B + 0,15) L
Two or more bulkheads	Wing cargo tank	–	–	0,2 L
	Centre cargo tank	• if $b_i/B \geq 1/5$	–	0,2 L
		• if $b_i/B < 1/5$	no	(0,50 b_i/B + 0,10) L
			yes	(0,25 b_i/B + 0,15) L

(1) b_i : Minimum distance from the ship side to the outer longitudinal bulkhead of the tank in question measured inboard at right angles to the centreline at the level corresponding to the assigned summer freeboard.

(2) The cargo tank length is not to exceed 0,2 L.

2.1.3 Cargo segregation

Cargo tanks designed to carry flammable liquids with flashpoint ≤ 60°C are to:

a) be segregated from other cargoes or fuel oils by means of a cofferdam, void space, cargo pump room, pump room or empty tank

b) have separate pumping and piping systems which may not pass through other cargo tanks, unless encased in a tunnel, and

c) have separate tank venting systems.

2.2 Access arrangements

2.2.1 Access to spaces within the cargo area

The access to spaces within the cargo area is to meet the requirements of Ch 4, Sec 2, [4.2.2].

2.2.2 Access to the gas-safe spaces

Gas-safe spaces such as accommodation, service, machinery and other similar spaces are not to have any direct communication with hazardous areas.

Nevertheless, access openings to gas-safe spaces below the weather deck, which are located less than 10 metres but not less than 3 metres from the outlets of gas vents in cargo tanks and cargo storage vessels, may be permitted where they are intended as emergency means of escape from normally attended spaces or as access to normally unattended spaces, provided that the relevant doors are kept permanently closed when the ship is not gas-freed.

Suitable warning plates are to be fixed in the proximity of such openings.

3 Machinery systems

3.1 Bilge system

3.1.1 Cargo pump rooms, duct keels below cargo tanks, hold spaces in which independent cargo tanks are installed and all hazardous areas, dry cofferdams are to be served by an independent bilge pumping system entirely situated within the cargo area as defined in [1.3.3] and fitted with pumps or ejectors. No connection is permitted with the bilge system serving gas-safe spaces of the ship.

3.2 Other piping systems not intended for cargo

3.2.1 Piping systems serving ballast tanks

Pumps, ballast lines, vent lines and other similar equipment serving permanent ballast tanks are to be independent of similar equipment serving cargo tanks.

3.2.2 Air pipes and sounding pipes of cofferdams considered as hazardous areas

Cofferdams considered as hazardous areas are to be provided with air pipes led to the open and, where not accessible, also with sounding pipes.

4 Cargo systems

4.1 Cargo segregation

4.1.1 For cargo handling, a pumping and piping system entirely separate from other pumping and piping systems on board is to be provided. Such systems are not to pass through any accommodation, service or machinery space other than cargo pump rooms.

4.2 Materials

4.2.1 Materials for construction of tanks, piping, fittings and pumps are to be in accordance with Ch 4, Sec 4, [4.3.2].

4.3 Installation of independent portable tanks

4.3.1 Independent portable tanks, to be fitted on the weather deck, may be used as cargo storage vessels subject to the following conditions:

- the portable tanks are to be securely fastened to the hull structure
- in the zone on the weather deck where the portable tanks are arranged, a suitable possibly removable containment coaming is to be fitted such as to prevent any spillage and/or leakages from flowing to gas-safe areas
- a space is to be left between tanks and ship sides sufficient to allow easy passage of ship personnel and transfer of fire-fighting arrangements
- the cargo handling system serving portable tanks is to be such that liquid heads higher than those allowable for cargo tanks, if any, served by the same system cannot occur.

Provisions are to be made such that any portable tank is easily identifiable by means of markings or suitable plates.

4.4 Cargo pumping system, piping system and pump rooms

4.4.1 Cargo pump room

a) The cargo pump room is to comply with the applicable requirements for oil tankers. Refer to NR467, Pt D, Ch 7, Sec 4.

b) For the construction, installation and operation of cargo pumps, the applicable requirements for oil tankers are to be complied with. Refer to NR467, Pt D, Ch 7, Sec 4.

4.4.2 Piping system

a) The cargo piping system is to be installed, except as stipulated in [4.4.3], within the cargo tank and cargo storage vessel area and is not to run through tanks, fuel oil tanks and other compartments not belonging to the cargo system.

b) Where necessary, cargo piping is to be provided with joints or expansion bends.

c) Pipe lengths serving tanks are to be provided with shut-off valves operable from the weather deck.

d) In order to prevent any generation of static electricity, the outlets of filling lines are to be led as low as possible in the tanks.

4.4.3 Loading and unloading connections

a) Pipe ends, valves and other fittings to which hoses for cargo loading and unloading are connected are to be of steel or other ductile material and are to be of solid construction and effectively secured.

b) Connecting couplings for cargo hoses are to be fitted with devices which automatically shut off the cargo piping when the hose is disconnected and with means for quick-release of the hose, to be provided by the installation either of a coupling hydraulically controlled from outside the cargo area or of a weak link assembly which will break when subjected to a pre-determined pull.

c) Where a pipe end to which hoses for cargo loading and unloading are connected is arranged outside the cargo tank area, the connection piping to such end is to be provided, in way of its connection to the manifold in the cargo tank area, with a blank spectacle flange or a spool piece, irrespective of the number and type of valves fitted in way of such connection. The space within a range of 3 metres from the above pipe end is to be considered gas-dangerous as far as electrical installations or other sources of ignition are concerned.

4.5 Cargo tanks and cargo storage vessels

4.5.1 Design and construction of portable tanks

a) The cargo handling system serving portable tanks is to be such that liquid heads higher than those allowable for cargo tanks, if any, served by the same system cannot occur.

b) The scantlings of independent tanks are to be in compliance with the provisions of Pt B, Ch 5, Sec 6 and Part B, Chapter 7, except that the net thickness is not to be less than 5 m.

c) Provisions are to be made such that any portable tank is easily identifiable by means of markings or suitable plates.

d) Portable tanks are to be provided with appropriate access hatches allowing the use of portable gas-freeing equipment.

4.5.2 Level gauging systems

a) Each cargo tank or cargo storage vessel is to be fitted with at least one level gauging device of the closed type as defined in NR467, Pt D, Ch 7, Sec 4, [4.4.2].

b) Sounding pipes may be accepted provided that they are so constructed and installed as to minimise the quantity of gas released during sounding operations. Such sounding pipes are not to be arranged within enclosed spaces.

4.5.3 Venting systems

Cargo tanks and cargo storage vessels are to be provided with gas venting systems entirely separate from any vent pipes serving other compartments. Such systems are to comply with the requirements of NR467, Pt D, Ch 7, Sec 4, [4.2] for gas venting systems of cargo tanks of oil tankers.

4.5.4 Cargo tank inerting, purging and/or gas-freeing

In addition to the requirements given in Ch 4, Sec 4, [5.3], the following is to be complied with:

a) Discharge outlets are to be located at least 10 m measured horizontally from the nearest air intake and openings to enclosed spaces with a source of ignition and from deck machinery equipment which may constitute an ignition hazard.

b) The cargo tanks designed to carry oil product having a flashpoint ≤ 60°C are to be fitted with an inert gas system complying with the provisions of NR467 Pt C, Ch 4, Sec 15 [13] or with an equivalent system.

This system is to be entirely separate from another inert gas system serving other cargo tanks, if fitted.

Note 1: To be considered equivalent, the system proposed in lieu of the fixed inert gas system is to:

- be capable of preventing dangerous accumulation of explosive mixtures in intact cargo tanks during normal service throughout the ballast voyage and necessary in-tank operations, and
- be so designed as to minimize the risk of ignition from the generation of static electricity by the system itself.

c) On individual cargo tanks the gas outlet pipe, if fitted, is to be positioned as far as practicable from the inert gas / air inlet and in accordance with Ch 4, Sec 4, [5.2]. The inlet of such outlet pipes may be located either at the deck level or at not more than 1 m above the bottom of the tank.

d) The cross-sectional area of such gas outlet pipe referred to in a) above is to be such that an exit velocity of at least 20 m/s can be maintained when any three tanks are being simultaneously supplied with inert gas. Their outlets are to extend not less than 2 m above deck level.

e) Each gas outlet referred to in d) above is to be fitted with suitable blanking arrangements.

f) The arrangement of inert gas and cargo piping systems is to comply with the provisions of NR467 Pt C, Ch 4, Sec 15 [13.2.3], item b) 7).

g) The cargo tanks are first to be purged in accordance with the provisions of a) to d) above until the concentration of hydrocarbon vapours in the cargo tanks has been reduced to less than 2% by volume. Thereafter, gas-freeing may take place at the cargo tank deck level.

5 Electrical installations

5.1 Hazardous locations and types of equipment

5.1.1 In addition to the general requirements of Ch 4, Sec 5, electrical equipment and hazardous areas definitions are to comply with requirements of NR467, Pt D, Ch 7, Sec 5, [2].

CHAPTER 5
AMPHIBIOUS VESSEL

Section 1 General

Section 2 Ship Arrangement

Section 3 Hull and Stability

Section 4 Machinery and Systems

Section 5 Electrical Installations

Section 6 Fire Protection

Section 7 Facilities for Flammable Products with Flashpoint less or equal to 60 °C

Section 1 General

1 General

1.1 Application

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **amphibious vessel**, as defined in Pt A, Ch 1, Sec 2, [4.6].

1.1.2 The requirements of this Chapter apply to ships intended for amphibious power projection and possibly for airborne power projection.

In addition with aircrafts and vehicles, flammable products with flashpoint ≤ 60°C may be carried subject to the requirements of Ch 5, Sec 7.

1.1.3 As a rule, the requirements of this Chapter apply to ships carrying 240 persons or more.

However, ships carrying less than 240 persons could be considered on a case by case basis.

1.1.4 Ships dealt with in this Chapter are to comply with:

- Part A
- NR216 Materials and Welding
- applicable requirements according to Tab 1.

1.1.5 As an alternative, recognised Naval Standards may be used instead of requirements of the present Chapter.

These Standards must be specified at the beginning of the design process and formally accepted by the Society.

Table 1 : Applicable requirements

Item	Reference
Ship arrangement	• Part B, Chapter 2 • Ch 5, Sec 2
Hull	• Part B • Ch 5, Sec 3
Stability	• Part B, Chapter 3 • Ch 5, Sec 3
Machinery and systems	• Part C, Chapter 1 • Ch 5, Sec 4
Electrical installations	• Part C, Chapter 2 • Ch 5, Sec 5
Automation	• Part C, Chapter 3
Fire protection, detection and extinction	• Part C, Chapter 4 • Ch 5, Sec 6
Carriage of flammable products	• Ch 5, Sec 7

1.2 Definitions

1.2.1 Aircrafts

Aircrafts for this chapter are to be understood as aircrafts (VTOL or STOL), helicopters or Unmanned Combat Airplane Vehicle (UCAV).

1.2.2 Cargo area

The cargo area is the part of the ship that contains the hangar space, the Ro-Ro cargo spaces and the well dock.

1.2.3 Cargo service spaces

Cargo service spaces are spaces within the cargo area used for workshops, lockers and storerooms of more than 2 m^2 in area, intended for cargo handling equipment.

1.2.4 Cofferdam

For the purpose of Ch 5, Sec 2, a cofferdam is an isolating space between two adjacent steel bulkheads or decks. It is to meet the following criteria:

a) The minimum distance between the two bulkheads or decks is to be sufficient for safe access and inspection.

b) In order to meet the single failure principle, in the particular case when a corner-to-corner situation occurs, this principle may be met by welding a diagonal plate across the corner.

1.2.5 Embarked troops

The embarked troops are the persons on board that are not considered as crew members.

The embarked troops are considered in the present Rules as well trained, organized and healthy persons.

1.2.6 Flight deck

If existing, the flight deck is the uppermost platform deck used for aircraft operations.

1.2.7 Fuel oil

Fuel oil means any oil used as fuel in connection with the propulsion and auxiliary machinery of the ship on which such oil is carried.

1.2.8 Hangar space

The hangar space is the enclosed shelter structure surrounding the platform deck used for storage and maintenance of the aircrafts.

The hangar space may be connected to the flight deck by means of one or several aircraft elevators.

1.2.9 Open superstructure

An open superstructure is a superstructure which is:

- open at both ends, or
- open at one end and provided with adequate natural ventilation effective over the entire length through permanent openings to outside of at least 10% of the total area of the space sides, or
- provided with adequate natural ventilation effective over the entire length though permanent openings to outside of at least 30% of the total area of the space sides.

Note 1: the total area of the space sides excludes the deck area of the space.

1.2.10 Ro-Ro cargo spaces

Ro-Ro cargo spaces are spaces not normally subdivided in any way and normally extending to either a substantial length or the entire length of the ship, in which motor infantry vehicles with fuel in their tanks for their own propulsion and/or goods can be loaded and unloaded normally in horizontal direction.

The various Ro-Ro cargo decks are served by internal ramps or elevators and by side or aft external door ramps.

The lower Ro-Ro cargo deck may be in direct connection with the fore part of the well dock.

1.2.11 Well dock

The well dock is the floodable part of the ship that is used to launch and recover landing crafts or other utilities vessels.

The well dock may be fitted with a weathertight aft door so designed as to be operated at sea to flood the well dock and that could be operated in harbour as a loading ramp.

The well dock is to be flooded at sea under controlled favourable weather conditions, to be specified by the designer. These conditions are to be not more than sea state 3 according to Stanag 4154. On the contrary, a consequence assessment will have to be performed on a case by case basis.

Section 2 Ship Arrangement

1 Ship arrangement

1.1 Well dock arrangement

1.1.1 The well dock being exposed to high risk of shocks, its sides and bottom are to be protected by wooden defences and sheating or equivalent, providing adequate protection of the ship structure for all intended operational situation.

Appropriate means are to be fitted to read the water depth at any time.

Adequate bollards, or equivalent system, are to be fitted to secure the landing crafts when afloat. Appropriate passageways are to be fitted eitherside of the well dock for easy access to the bollard system.

1.2 Well dock watertight/weathertight boundaries

1.2.1 The watertight boundaries of the well dock are made of:

- well dock bottom
- well dock sides (port and starboard)
- first full breadth transverse bulkhead limiting the forward end of the sloped part

The aft ramp constitutes a weathertight boundary.

1.3 Number and disposition of transverse watertight bulkheads

1.3.1 Where the distance between transverse bulkheads is considered excessive by the Society, ships are to be fitted with a system of partial bulkheads, side transverse frames and deck transverses such as to provide equivalent transverse strength.

Section 3 Hull and Stability

1 Intact and damage stability in transit

1.1 General

1.1.1 For the transit condition, the requirements of Pt B, Ch 3, Sec 2, Pt B, Ch 3, Sec 3, Pt B, Ch 3, App 1, Pt B, Ch 3, App 2 and Pt B, Ch 3, App 3 are to be complied with for the loading conditions of Pt B, Ch 1, Sec 2, [5.2], Pt B, Ch 1, Sec 2, [5.3] and Pt B, Ch 1, Sec 2, [5.4].

2 Intact stability requirements for the well dock into operation

2.1 General intact stability criteria

2.1.1 The intact stability criteria of Pt B, Ch 3, Sec 2, [2.1.8] are to be complied with for the loading conditions of Pt B, Ch 1, Sec 2, [5.2], Pt B, Ch 1, Sec 2, [5.3] and Pt B, Ch 1, Sec 2, [5.4] when the well dock is into operation (ie the door of the well dock is open) except for the angle of the GZmax which can be less than 30° but in no case less than 15° subject to the compliance with the following additional criteria defined in [2.1.2].

2.1.2 The area under the curve of the righting levers (GZ curve) should not be less than 0,095 m.rd up to an angle of 15° when the maximum righting lever (GZ) occurs at 15° and 0,080 m.rd when the maximum righting lever (GZ) occurs at an angle of 30° or above. Where the maximum righting lever (GZ) occurs at angles of between 15° and 30° the corresponding area under the righting lever curve should be:

$0,080 + 0,001\ (30° - \theta\ GZmax)$

2.2 Severe wind and rolling criteria

2.2.1 The severe wind and rolling criteria of Pt B, Ch 3, Sec 2, [2.3] are to be complied with for the loading conditions of Pt B, Ch 1, Sec 2, [5.2], Pt B, Ch 1, Sec 2, [5.3] and Pt B, Ch 1, Sec 2, [5.4] when the well dock is into operation (ie door open), with a reduced wind speed of 15 knots.

2.3 Ice accretion

2.3.1 The stability criteria of Pt B, Ch 3, Sec 2, [2.4] for the ice accretion are to be complied with for the loading conditions of Pt B, Ch 1, Sec 2, [5.2], Pt B, Ch 1, Sec 2, [5.3] and Pt B, Ch 1, Sec 2, [5.4] when the well dock is into operation (ie door open) considering the following amount of ice:

- 30 kg per square meter on exposed weather decks
- 7,5 kg per square meter for projected lateral area of each side of the vessel above the waterline

2.4 Crowding of embarked troops

2.4.1 The stability criteria of Pt B, Ch 3, Sec 2, [2.7] for the crowding of embarked troops on one side are to be complied with for the loading conditions of Pt B, Ch 1, Sec 2, [5.2], Pt B, Ch 1, Sec 2, [5.3] and Pt B, Ch 1, Sec 2, [5.4] when the well dock is into operation (ie door open).

2.4.2 For the purpose of the crowding of the embarked troops, it has to be considered only the embarked troops not already in the well dock on board the crafts. The number of crafts and the maximum number of embarked troops per craft have to be also indicated.

3 Damage stability requirements for the well dock into operation

3.1 General

3.1.1 The damage stability criteria of [3.3] and [3.4] are to be complied with for the loading conditions of Pt B, Ch 1, Sec 2, [5.2], Pt B, Ch 1, Sec 2, [5.3] and Pt B, Ch 1, Sec 2, [5.4] when the well dock is on operation (ie door open) considering the damage definition and the assumptions as described in [3.2].

3.2 Damage definition

3.2.1 The damage to take into account is to be applied anywhere within the ship's length L. All positions of the damage along the ship are to be considered.

a) Longitudinal damage extension: The extension of the damage causes the flooding of two adjacent watertight compartments.

b) Vertical damage extension: The vertical extension of the damage is to be such that all the decks closures and platforms within the damaged area are destroyed.

c) Transversal damage extension: The transversal extension of the damage may reach the centerline of the ship without nevertheless including it.

For the purpose of the damage stability calculations, the following requirements are to be considered:

- Pt B, Ch 3, Sec 3, [2.1.1]
- Pt B, Ch 3, Sec 3, [2.1.2]
- Pt B, Ch 3, Sec 3, [2.2]
- Pt B, Ch 3, Sec 3, [2.3.2]
- Pt B, Ch 3, Sec 3, [2.4.3] to Pt B, Ch 3, Sec 3, [2.4.7].

3.2.2 The permeability of the well dock is to be considered equal to 0,90.

3.3 Damage stability criteria at the final stage of flooding and after equalization

3.3.1 The waterline, taking into account sinkage, heel and trim, should be below the lower edge of any opening through which progressive flooding or down flooding may take place. A complete list of the openings (air pipes, doors, hatch, scuttles,…) including their coordinates and tightness will have to be submitted into the damage stability booklet. The location and tightness of those opening will have to be confirmed on board by a surveyor of the Society.

3.3.2 The positive residual righting lever curve shall have a minimum range of 15° beyond the angle of equilibrium. This range may be reduced to a minimum of 10°, in the case where the area under the righting lever curve is that specified in [3.3.3], increased by the ratio: 15/range, where the range is expressed in degrees.

3.3.3 The area under the righting lever curve shall be at least 0,015 m.rd measured from the angle of equilibrium to the lesser of:

- The angle at which progressive flooding occurs
- 30° (from the upright).

3.3.4 A residual righting lever is to be obtained within the range of positive stability, taking into account the greatest of the following heeling moments:

- The wind effect considering a wind speed equal to 15knots
- The crowding of all embarked troops on one side:

  M = (0,075 N) (0,45 B)

  where N is the number of embarked troops not already in the well dock on board the crafts.

The righting lever GZ, in m, is to be calculated by the formula:

GZ = heeling moment / displacement + 0,04

However in no case this righting lever is to be less than 0,1 m.

3.3.5 In the case of unsymmetrical flooding, the angle of heel shall not exceed 15°.If a more restrictive angle is included in the specification or in the contract, this angle is to be considered instead of 15°.

3.4 Damage stability criteria at the intermediate stages of flooding including before equalization

3.4.1 The maximum righting lever shall be at least 0.05 m and the range of positive righting levers shall be at least of 7°.

3.4.2 The maximum angle of heel shall not exceed 20°. If a more restrictive angle is included in the specification or in the contract, this angle is to be considered instead of 20°.

4 Loading conditions

4.1 Well dock operation

4.1.1 Loading conditions corresponding to all specified well dock operations are to be submitted.

Longitudinal strength and stability have to be checked for all these loading conditions.

4.1.2 Maximum draft at aft end during all specified well dock operations are to be submitted.

5 Structure design principles

5.1 General information

5.1.1 Aircrafts

The types of aircraft as defined in Ch 5, Sec 1, [1.2.1] for which the amphibious vessel is designed, are to be formally given as a list.

Particularly, this list must clearly indicates:

- the types of aircraft allowed to land and take-off (structure design of flight deck)
- the types of aircraft for which maintenance on board is considered (structure design of aircraft elevators and hangar deck).

For helicopters, the requirements of Pt B, Ch 8, Sec 11 are also to be complied with.

For aircrafts other than helicopters, the following data are to be indicated:

- the number of axles and the relative arrangement of axles
- the number of wheels per axle and their relative arrangement
- the maximum mass of the aircraft, for each operational case (take-off, landing, parking)
- the maximum load, in kN, per wheel, and the corresponding tyre print for each operational case (parking, normal landing, hard and emergency landing, take-off). It is accepted to consider that the load per tyre and the corresponding tyre print are proportional.

5.1.2 Armoured vehicles

The types of armoured vehicles for which amphibious vessel is designed are to be formally given as a list.

Particularly, this list must clearly indicates the data:

- the number of axles and the relative arrangement of axles
- the number of wheels per axle and their relative arrangement
- the maximum mass of the vehicle

5.1.3 Landing crafts

The types of landing crafts for which amphibious vessel is designed are to be formally given as a list.

Particularly, this list must clearly indicates:

- the maximum displacement of the craft
- the contact surface when grounded

5.1.4 Tractors and mobile cranes

The types of engined tractors intended to be used on flight deck, elevators and hangar deck are to be formally specified.

The following data are to be indicated:

- the number of axles and the relative arrangement of axles
- the maximum load per axle
- the number of wheels per axle and their relative arrangement.

Any movable crane used on flight deck (for removal of crashed aircraft or other operations) is also to be formally specified, with respect to its operational use and Safe Working Load.

5.1.5 Lifting devices for maintenance

All eye plates permanently fitted in decks and used for lifting operations during maintenance are to comply with Pt B, Ch 9, Sec 5.

The SWL of each eye plate permanently fitted in decks is to be indicated on drawings.

Moreover, each lifting eye is to be fitted with information about SWL and load testing, in tons.

The strength verification is to be performed as follows:

- for all SWL: initial load test at 2 x SWL and verification of absence of deformation
- in addition, for SWL > 1.5 tons: combined stress σ_{VM} not exceeding 0.5 $Rp_{0.2}$ in lifting eye, connection weld and supporting structure

Load test are to be performed periodically, with a load test equal to 125% of SWL.

5.2 Well dock

5.2.1 Corrosion margin

The corrosion addition t_c for side and bottom structures exposed to sea water during flooding operation is to be as defined for ballast tank in Pt B, Ch 4, Sec 2, Tab 2.

5.2.2 Protection of well dock

Any possible protection against shocks and contact during operation, by wooden sheating or equivalent, is to be indicated and described.

5.2.3 Mooring fittings of landing craft

The fittings integrated in the well dock to allow mooring of the landing craft during loading/unloading operation are to be clearly shown on structure drawings.

Their design is to be submitted, with information about their Safe Working Load (SWL) and the detail of their integration into the well dock.

5.3 Flight deck

5.3.1 Description of zones

The partitioning of the flight deck into various zones considered for design is to be formally documented with respect to their functional use at sea (parking / normal landing / emergency landing / take-off). This information is also to include the type, number and arrangement of aircraft in each zone.

Where one area of the flight deck is concerned by several functional uses, the scantlings are to be checked for all specified loads.

5.3.2 Coating of flight deck

Any possible coating or sheating on flight deck is to be indicated and described. Its protective index is to be given, with respect to mechanical shocks and sea water corrosion.

5.3.3 Emergency landing zone

If any, the emergency landing zone is to be clearly specified, together with relevant design criteria.

5.3.4 Flight deck openings

The various openings in flight deck are to be clearly defined with respect to their location and size (Ammunition elevators, etc.).

Particularly, the transverse and longitudinal extent of the flight deck recesses are to be clearly marked on relevant structure drawings.

5.3.5 Aircraft lashing devices

The lashing devices fitted in the flight deck are to be clearly shown on structure drawings.

Their design is to be submitted, with information about their Safe Working Load (SWL) and the detail of their fitting into the flight deck.

The strength verification is to be performed as follows:

- for all SWL: initial load test at 2 x SWL and verification of absence of deformation
- in addition, for SWL > 1.5 tons: combined stress σ_{VM} not exceeding 0.5 $Rp_{0.2}$ in lashing eye, connection weld and supporting structure

Load test are to be performed periodically, with a load test equal to 125% of SWL.

5.3.6 Fixed crane on deck

Any fixed crane fitted on flight deck is to be clearly specified, with respect to its operational use and Safe Working Load.

5.4 Hangar

5.4.1 General

General information about hangar are to be submitted, particularly regarding the open or closed situation with respect to wave loads.

5.4.2 Description of zones

Various zones of hangar deck considered during design are to be documented, with respect to their functional use at sea (maintenance of aircraft, cargo area, etc.).

In particular, the design loads on the various structural mezzanines in the hangar are to be specified.

5.4.3 Doors in outside shell in way of aircraft elevators

The doors on transom in way of aircraft elevators are to be weathertight.

They are to comply with Pt B, Ch 8, Sec 6.

5.4.4 Hangar deck opening

The various openings in hangar deck are to be clearly defined with respect to their location and size.

In particular, any deck recess in way of hangar fire doors is to be detailed, if relevant.

5.4.5 Aircraft lashing devices

The lashing devices fitted in the hangar deck are to be clearly shown on structure drawings.

Their design is to be submitted, with information about heir Safe Working Load (SWL) and the detail of their fitting into the deck.

Strength verification and load tests are to be performed according to [5.3.5].

5.4.6 Hangar gantry crane

Any gantry crane fitted in hangar is to be clearly specified, with respect to its operational use and Safe Working Load.

5.5 Accomodation spaces

5.5.1 Description of zones

Various zones of accomodation spaces considered during design are to be documented, with respect to their functional use (cabins, kitchens, hospital, etc.).

In particular, the design loads on the various accomodation decks are to be specified.

5.5.2 Accomodation deck opening

The various openings in accomodation decks are to be clearly defined with respect to their location and size.

5.6 Aircraft elevators

5.6.1 General

General information about aircraft elevators location and type (i.e. internal or deck edge) are to be submitted.

5.6.2 Lifting operations

Lifting operations are to be described, with detailed information about Safe Working Load of elevators, type of loads carried out and operating procedures with corresponding load dynamic amplification factors.

Dynamic amplification factors include combined effects of:

a) vertical acceleration induced by start and stop of lifting process

b) accelerations induced by behaviour of ship at sea.

When a ship motion damping system is fitted, it may be accepted, on a case by case basis, to reduce the accelerations mentioned in item b) above. The reduction level, if any, will be defined after an analysis of operating procedures in normal conditions and in degraded conditions.

5.6.3 Securing devices

If any, securing devices are to be specified, with information about their design and operation.

5.7 Ammunition elevators

5.7.1 Lifting operations

Lifting operations are to be described, with detailed information about Safe Working load of elevators, type of loads carried out and operating procedures with corresponding load dynamic amplification factors.

Dynamic amplification factors include combined effects of:

a) vertical acceleration induced by start and stop of lifting process

b) accelerations induced by behaviour of ship at sea.

When a ship motion damping system is fitted, it may be accepted, on a case by case basis, to reduce the accelerations mentioned in b) above. The reduction level, if any, will be defined after an analysis of operating procedures in normal conditions and in degraded conditions.

5.7.2 Securing devices

If any, securing devices are to be specified, with information about their design and operation.

6 Design loads

6.1 Loads in well dock

6.1.1 Sea pressure

Sea pressure is to be taken as:

- static pressure p_s: according to Pt B, Ch 5, Sec 5, [1.1] with T_1 taken equal to maximum water depth in well dock during operation
- wave pressure p_w : according to Pt B, Ch 5, Sec 5, [2] with h_1 taken equal to the significant wave height of the maximum design weather conditions defined in Ch 5, Sec 1, [1.2.11].

Operating precautions are to be such as to limit transverse resonance in the well dock.

6.1.2 Impact pressure

Impact pressure is to be taken as the combination of:

- still water pressure p_s, in kN/m², from the following formulae:

  $p_S = \rho_L\, g\, (0{,}7\, H + d_{TB} - z)$ for $z < 0{,}7\, H + d_{TB}$

  $p_S = 0$ for $z \geq 0{,}7\, H + d_{TB}$

- wave pressure p_w, in kN/m², from the following formulae:

  $p_w = 0,61\ \rho_L\ g\ (0,75\ B - 8)\ b_c\ A_R$

With:

H : Height of the longitudinal bulkheads in the well dock.

d_{TB} : Vertical distance, in m, from the baseline to the tank bottom

d_F : Filling level, in m, of the well dock to be taken as the vertical distance from the bottom of the well dock to the free surface of the sea water inside the well dock.

b_c : Transverse distance, in m, between longitudinal bulkheads of the well dock.

A_R : Roll amplitude as defined Pt B, Ch 5, Sec 3, [2.4].

6.1.3 Wheeled loads

The design wheeled loads to be considered for the assessment of the well dock are to cover all types of vehicles operating on the bottom of the well dock.

The wheeled loads are to be indicated by the designer:

- for tractors and mobile cranes: according to [5.1.4]
- for armoured vehicles: according to [5.1.2].

Design pressures are to be taken according to Pt B, Ch 5, Sec 6, [4].

6.1.4 Other loads

Any other relevant loads due to operation in well dock have to be submitted.

6.2 Loads on flight deck

6.2.1 General

Loads to be considered on flight deck are sea pressure and wheeled loads. Above type of loads can be considered separately.

6.2.2 Sea pressure

Sea pressure is to be taken according to Pt B, Ch 5, Sec 5, [3].

As a Rule, φ can be considered as 0,75.

6.2.3 Wheeled loads

For helicopters, the wheeled loads are to be considering according to Pt B, Ch 8, Sec 11, [4].

For aircrafts other than helicopters, the design wheeled loads to be considered are to cover all types of tyred vehicles operating on the flight deck (aircraft, tractors, mobile cranes, etc.), in all possible operating conditions.

The wheeled loads are to be indicated by the designer:

- for aircrafts: according to [5.1.1]
- for tractors and mobile cranes: according to [5.1.4].

Design pressures for aircrafts during landing operation are to be taken according to Tab 1, for each aircraft and each possible operating mass. Maximum vertical forces are to be considered per wheel or group of wheels loading the structural member under consideration.

Design pressures for aircrafts during parking operations and for tractors and mobile cranes are to be taken according to Pt B, Ch 5, Sec 6, [4].

Table 1 : Design pressures for aircrafts

Operation	Mass of aircraft (t)	Main undercarriage			Fore under carriage		
		Maximum vertical force (kN)	Still water force F_S (kN)	Inertial force F_W (kN)	Maximum vertical force (kN)	Still water force F_S (kN)	Inertial force F_W (kN)
Landing - Normal	M_1	F_{MN}	0	F_{MN}	F_{FN}	0	F_{FN}
Landing - Hard	M_1	F_{MH}	0	F_{MH}	F_{FH}	0	F_{FH}
Landing - Exceptional	M_1	F_{ME}	0	F_{ME}	F_{FE}	0	F_{FE}

6.2.4 Loads on sponsons

- Sideshell of sponsons:

Load heights on sides of sponsons are to be taken according to Pt B, Ch 5, Sec 5, Tab 5 for upright ship conditions and Pt B, Ch 5, Sec 5, Tab 3 for inclined ship conditions.

For inclined ship conditions, the roll amplitude A_R is to be calculated according to Pt B, Ch 5, Sec 3, without any consideration given to the motion damping system, if any.

- Front wall and aft wall of sponsons:

  Load heights on front wall of sponsons are to be taken according to Pt B, Ch 5, Sec 5, Tab 5 for upright ship conditions and Pt B, Ch 5, Sec 5, Tab 3 for inclined ship conditions.

  For inclined ship conditions, the roll amplitude A_R is to be calculated according to Pt B, Ch 5, Sec 3, without any consideration given to the motion damping system, if any.

- Undersides of sponsons:

  For transverse sections located longitudinally such than x/L is less than 0,7, the sea pressure to be considered on the underside of sponsons is the normal sea pressure acting on side shell.

  For transverse sections located longitudinally such than x/L is greater than or equal to 0,7, the sea impact pressure on the underside of sponsons p_{FI} is to be obtained, in kN/m^2, from the following formula:

$$p_{FI} = C_S C_Z (0,22 + 0,15 \tan\alpha)(0,4V \sin\beta + 0,6\sqrt{L})^2$$

where:

C_S : Coefficient depending on the type of structures on which the impact pressure is considered to be acting:

- $C_S = 1,8$ for plating and ordinary stiffeners
- $C_S = 0,5$ for primary supporting members

C_Z : Coefficient depending on the distance between the full load waterline and the calculation point:

- for $z \geq 2\,C + T - 11$:

  $C_Z = C - 0,5\,(z - T)$
- for $z < 2\,C + T - 11$:

  $C_Z = 5,5$

C : Wave parameter:

$$C = 10,75 - \left(\frac{300 - L}{100}\right)^{1,5} \quad \text{for } 90 \text{ m} \leq L < 300 \text{ m}$$

$$C = 10,75 \quad \text{for } 300 \text{ m} \leq L \leq 350 \text{ m}$$

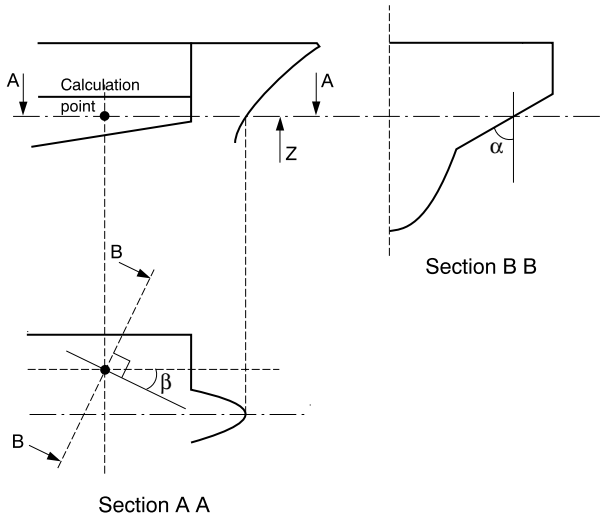
$$C = 10,75 - \left(\frac{L - 350}{150}\right)^{1,5} \quad \text{for } L > 350 \text{ m}$$

α : Flare angle at the calculation point, defined as the angle between a vertical line and the tangent to the underside plating, measured in a vertical plane normal to the horizontal tangent to the shell plating (see Fig 1) and not to be taken greater than 80°

β : Entry angle at the calculation point, defined as the angle between a longitudinal line parallel to the centreline and the tangent to the shell plating in a horizontal plane (see Fig 1)

V : Maximum service speed, in knots.

Figure 1 : Definition of angles α and β



6.3 Loads on island and bridge

6.3.1 Loads on front, aft and side walls of island and bridge are to be calculated according to Pt B, Ch 8, Sec 4. For this application, it is accepted that the lowest tier of the island be considered as a second tier.

Loads on decks of island and bridge are calculated according to Pt B, Ch 8, Sec 4.

6.4 Loads on hangar decks

6.4.1 Cargo loads

The design cargo loads on the hangar deck are to be taken in accordance with Pt B, Ch 5, Sec 6, [2] and Pt B, Ch 5, Sec 6, [3].

The design cargo loads on the various structural mezzanines in the hangar are to be taken according to Pt B, Ch 5, Sec 6, [2] and Pt B, Ch 5, Sec 6, [3]. In specific areas used only as companionway, the minimum still water pressure p_S, in kN/m^2, to be considered in Pt B, Ch 5, Sec 6, Tab 3 is to be taken equal to $p_S = 5$.

6.4.2 Wheeled loads

The design wheeled loads to be considered for the assessment of the hangar deck are to cover all types of vehicles operating on that deck.

The wheeled loads are to be indicated by the designer:

- for aircrafts: according to [5.1.1] (parking condition)
- for tractors and mobile cranes: according to [5.1.4]
- for armoured vehicles: according to [5.1.2].

Design pressures are to be taken according to Pt B, Ch 5, Sec 6, [4].

6.5 Loads in accomodation spaces

6.5.1 Accomodation loads

The design accomodation loads on the various accomodation decks are to to be taken in accordance with Pt B, Ch 5, Sec 6, [5].

6.6 Loads on aircraft elevators

6.6.1 Cargo loads

When aircraft elevators are not exposed to sea loads, the design pressure exerted on the platform of the aircraft elevators are to be taken in accordance with Pt B, Ch 5, Sec 6, [2] and Pt B, Ch 5, Sec 6, [3].

6.6.2 Wheeled loads

The wheeled loads on the aircraft elevator platform exerted by aircrafts subject to maintenance are to be taken in accordance with [5.1.1] for parking situation.

The wheeled loads on the aircraft elevator platform exerted by tractors are to be taken in accordance with [5.1.4] for parking situation.

Dynamic amplification factors according to [5.6.2] are also to be considered.

6.7 Loads on ammunition elevators

6.7.1 The design pressure exerted on the platform of the ammunition elevators are to be taken in accordance with Pt B, Ch 5, Sec 6, [2] and Pt B, Ch 5, Sec 6, [3].

7 Hull scantling

7.1 Well dock

7.1.1 Plating

The scantling of the plating of well dock bottom and sides under sea pressure as defined in [6.1.1] and well dock bottom under wheeled load as defined in [6.1.3] are to be in compliance with requirements of Pt B, Ch 7, Sec 1.

The scantling of the plating of well dock sides under impact pressure as defined in [6.1.2] are to be in compliance with requirements of Pt B, Ch 7, Sec 1 using partial safety factors of Tab 2.

7.1.2 Ordinary stiffeners

The scantling of the ordinary stiffeners of well dock bottom and sides under sea pressure as defined in [6.1.1] and well dock bottom under wheeled load as defined in [6.1.3] are to be in compliance with requirements of Pt B, Ch 7, Sec 2.

The scantling of the ordinary stiffeners of well dock sides under impact pressure as defined in [6.1.2] are to be in compliance with requirements of Pt B, Ch 7, Sec 1 using partial safety factors of Tab 2.

7.1.3 Primary supporting structure

The scantling of the primary supporting members of well dock bottom and sides under sea pressure as defined in [6.1.1] and well dock bottom under wheeled load as defined in [6.1.3] are to be in compliance with requirements of Pt B, Ch 7, Sec 3.

Table 2 : Impact pressure on well dock sides - Partial safety factors

Partial safety factors covering uncertainties regarding:	Partial safety factors		
	Symbol	Plating	Ordinary stiffeners
Still water pressure	γ_{S2}	1,00	1,00
Wave pressure	γ_{W2}	1,20	1,00
Material	γ_m	1,02	1,02
Resistance	γ_R	1,02	1,02

7.2 Flight deck

7.2.1 Plating

The scantling of the plating of flight deck under sea pressure as defined in [6.2.2]and under wheeled load as defined in [6.2.3]are to be in compliance with requirements of Pt B, Ch 7, Sec 1 with partial safety factors according to Tab 3.

7.2.2 Ordinary stiffeners

The scantling of the ordinary stiffeners of flight deck under sea pressure as defined in [6.2.2]and under wheeled load as defined in [6.2.3]are to be in compliance with requirements of Pt B, Ch 7, Sec 2 with partial safety factors according to Tab 4.

7.2.3 Primary supporting structure

The scantling of the primary supporting structure of flight deck under sea pressure as defined in [6.2.2] and under wheeled load as defined in [6.2.3] are to be in compliance with requirements of Pt B, Ch 7, Sec 2 with partial safety factors according to Tab 4.

Table 3 : Plating of flight deck - Partial safety factors

Partial safety factors covering uncertainties regarding	Symbol	Sea pressure	Landing Normal	Landing Hard	Landing Emergency	Parking
Still water hull girder loads	γ_{S1}	1,00	0	0	0	1,00
Wave hull girder loads	γ_{W1}	1,15	0	0	0	1,15
Still water pressure	γ_{S2}	1,00	1,00	1,00	1,00	1,00
Wave pressure	γ_{W2}	1,20	1,20	1,20	1,05	1,20
Material	γ_m	1,02	1,02	1,02	1,02	1,02
Resistance	γ_R	1,20	1,20	1,20	1,20	1,20

Table 4 : Stiffeners of flight deck - Partial safety factors

Partial safety factors covering uncertainties regarding	Symbol	Sea pressure	Landing Normal	Landing Hard	Landing Emergency	Parking
Still water hull girder loads	γ_{S1}	1,00	0	0	0	1,00
Wave hull girder loads	γ_{W1}	1,15	0	0	0	1,15
Still water pressure	γ_{S2}	1,00	1,00	1,00	1,00	1,00
Wave pressure	γ_{W2}	1,20	1,20	1,20	1,05	1,20
Material	γ_m	1,02	1,02	1,02	1,02	1,02
Resistance	γ_R	1,20	1,02	1,02	1,02	1,02

7.3 Sponsons

7.3.1 Side Shell

The scantlings of plating, ordinary stiffeners and primary members of side shell of sponsons are to be in accordance with Part B, Chapter 7, with loads according to [6.2.4].

When sponsons are not contributing to hull girder strength, the scantlings are to checked according to Part B, Chapter 7, with loads according to [6.2.4] and with longitudinal stress σ_1 equal to 0.

7.3.2 Front wall and aft wall

The scantlings of front wall and aft wall of sponsons are to be in accordance with Part B, Chapter 7, with loads according to [6.2.4] and with longitudinal stress σ_1 equal to 0.

7.3.3 Partial safety factors for underside

For transverse sections located longitudinally such than x/L is less than 0,7, the partial safety factors to be considered are given in Pt B, Ch 7, Sec 1, Pt B, Ch 7, Sec 2 or Pt B, Ch 7, Sec 3, as applicable.

For transverse sections located longitudinally such than x/L is greater than or equal to 0,7, the partial safety factors to be considered are to be taken as follows:

- Tab 5 for plating and ordinary stiffeners of the underside of sponsons
- Pt B, Ch 7, Sec 3 for primary structure of the underside of sponsons.

Table 5 : Reinforcements of the underside of sponsons - Partial safety factors

Partial safety factors covering uncertainties regarding:	Partial safety factors		
	Symbol	Plating	Ordinary stiffeners
Still water pressure	γ_{S2}	1,00	1,00
Wave pressure	γ_{W2}	1,10	1,10
Material	γ_m	1,02	1,02
Resistance	γ_R	1,30	1,02

7.3.4 Plating and ordinary stiffeners for underside

For transverse sections located longitudinally such than x/L is less than 0,7, the net scantlings of plating and ordinary stiffeners of the underside of cantilever quarters below flight deck are to be checked according to Pt B, Ch 7, Sec 1 or Pt B, Ch 7, Sec 2, as applicable. However, the net scantlings of plating and ordinary stiffeners are to be not less than the minimum values given in Tab 6.

For transverse sections located longitudinally such than x/L is greater than or equal to 0,7, the net scantlings of plating and ordinary stiffeners of the underside of cantilever quarters below flight deck are to be not less than the values obtained from the formulae in Tab 6 and the minimum values in the same Table.

7.3.5 Intercostal stiffeners for underside

Intercostal stiffeners are to be fitted at mid-span where the angle between the stiffener web and the attached plating is less than 70°.

7.3.6 Primary supporting members for underside

Primary supporting members are generally to be verified through direct calculations carried out according to Pt B, Ch 7, Sec 3, considering the sea impact pressures defined in [6.2.4].

7.3.7 Strengthening of sponsons underside in way of workboats / lifeboats

Stiffening of undersides of cantilever quarters in way of workboats / lifeboats is to be compatible with the launching operation. Cantilever quarters in way of launching appliances are to be adequately strengthened.

Table 6 : Reinforcements of plating and ordinary stiffeners of the underside of sponsons

Element	Formula	Minimum value
Plating	Net thickness, in mm: $t = 11 c_a c_r s \sqrt{\gamma_R \gamma_m \frac{\gamma_{W2} p_{FI}}{R_y}}$	Net minimum thickness, in mm: $t = (0{,}03\ L + 5{,}5)\ k^{1/2}$
Ordinary stiffeners	Net section modulus, in cm³: $w = \gamma_R \gamma_m \beta_b \frac{\gamma_{W2} p_{FI}}{18 c_P R_y} \left(1 - \frac{s}{2\ell}\right) s \ell^2 10^3$	Web net minimum thickness, in mm, to be not less than the lesser of: • $t = 1{,}5\ L_2^{1/3}\ k^{1/6}$ • the thickness of the attached plating.
	Net shear sectional area, in cm²: $A_{Sh} = 10 \gamma_R \gamma_m \beta_s \frac{\gamma_{W2} p_{FI}}{R_y} \left(1 - \frac{s}{2\ell}\right) s \ell$	
Note 1: c_P : Ratio of the plastic section modulus to the elastic section modulus of the ordinary stiffeners with attached shell plating, to be taken equal to 1,16 in the absence of more precise evaluation.		

7.4 Island and bridge

7.4.1 The scantlings of island and bridge are to be in accordance with Pt B, Ch 8, Sec 4, applicable to deckhouses.

Special consideration is to be given to support of masts and aerials at top of island. Strength continuity downwards through several decks may be requested.

7.5 Hangar

7.5.1 Hangar decks

The scantlings of the hangar decks structure under cargo loads as defined in [6.4.1] and under wheeled loads as defined in [6.4.2] are to be in compliance with requirements of Part B, Chapter 7.

7.5.2 Transverse racking effect

The transverse partial bulkheading structure in the hangar is to be checked against transverse racking effect induced by transverse accelerations exerted on deck structure between hangar and flight deck.

The most severe conditions are to be considered for loads and transverse accelerations.

Stress criteria are given in Pt B, Ch 7, Sec 3, [2].

7.6 Accomodation spaces

7.6.1 Accomodation decks

The scantling of the accomodation decks under accomodation loads as defined in [6.5] are to be in compliance with requirements of Part B, Chapter 7.

7.7 Aircraft elevators

7.7.1 Plating

The scantlings of the plating of aircraft elevators under wheeled loads are to be in compliance with requirements of Pt B, Ch 7, Sec 1.

7.7.2 Ordinary stiffeners

The scantlings of the ordinary stiffeners of aircraft elevators under wheeled loads are to be in compliance with requirements of Pt B, Ch 7, Sec 2.

7.7.3 Primary supporting structure

The scantlings of the primary structure of aircraft elevators under wheeled loads are generally to be checked on basis of three dimensional structural model, according to the requirements of Pt B, Ch 7, Sec 3, [2] and Pt B, Ch 7, Sec 3, [5].

7.7.4 Locking and lifting devices

The scantlings of locking and lifting devices and the surrounding reinforcements are to be assessed on first principle basis.

Design forces (amplitudes, directions) and associated safety coefficients are to be agreed upon on a case by case basis.

7.8 Ammunition elevators

7.8.1 Plating

The scantlings of the plating of ammunition elevators loads are to be in compliance with requirements of Pt B, Ch 7, Sec 1.

7.8.2 Ordinary stiffeners

The scantlings of the ordinary stiffeners of ammunition elevators are to be in compliance with requirements of Pt B, Ch 7, Sec 2.

7.8.3 Primary supporting structure

The scantlings of the primary structure of ammunition elevators are generally to be checked on basis of three dimensional structural model, according to the requirements of Pt B, Ch 7, Sec 3, [2] and Pt B, Ch 7, Sec 3, [5].

7.8.4 Locking and lifting devices

The scantlings of locking and lifting devices and the surrounding reinforcements are to be assessed on first principle basis.

Design forces (amplitudes, directions) and associated safety coefficients are to be agreed upon on a case by case basis.

7.9 Transfer routes

7.9.1 Hull scantling for dry store and ammunition transfer routes

All dry stores and ammunition transfer routes are to be checked with regards to wheeled loads as defined in Pt B, Ch 5, Sec 6, [4] and strength criteria given in Part B, Chapter 7.

7.9.2 Height of door sills along transfer routes

Where coamings are required on doors located along the dry stores or ammunition transfer routes, the fitting of alternative arrangements to enable their transfer by way of wheeled vehicles will be considered by the society on a case by case basis.

Section 4 Machinery and Systems

1 Main propulsion

1.1 Availability

1.1.1 According to the missions of this type of ships, a special consideration will be given to the general arrangement of the main propulsion.

Therefore the main propulsion system is to comply at least with the requirements of the additional class notation **AVM-APM** as defined in Pt E, Ch 3, Sec 1.

Note 1: relaxation to this requirement may be granted to ships not operating aircrafts with a limited number of persons aboard.

2 Well dock systems

2.1 Ballast system dedicated to well dock operation

2.1.1 Availability of system

Failure of one ballast pump or other active equipment used instead of pump for water transfer shall not render unable to operate transfer of water:

- between aft and fore ballasts
- between port and starboard ballasts.

2.2 Drainage of well dock

2.2.1 Communication between well dock and the sea

If any piping is installed for direct communication between well dock and sea, it should be fitted with isolating valve operable from above DC deck. These valves do not need to be installed if review of intact and damage stability is found satisfactory without them.

2.2.2 Drainage of well dock

a) General: a pumping system and/or gravity discharges shall be installed in order to dry up well dock when it is no more flooded because of amphibious operations. Drainage system capacity shall be able to evacuate water falling into well dock in case fire fighting systems of compartments drained to well dock or in communication with it are used.

b) Arrangement and dimensioning of system: the drainage system shall be sized to remove no less than 125% of the combined capacity of both the water-spraying system pumps and the required number of fire hose nozzles. The drainage system valves shall be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells shall be of sufficient holding capacity and shall be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment. IMO Circular MSC.1-Circ.1320 may be used as guidelines.

c) Number and capacity of pumps: If pumps are necessary at least two pumps shall be able to serve this system. Only one of them needs to be dimensioned with capacity related to evacuation of water used for fire fighting.

d) Segregation from source of ignition: scuppers if any should not be led to compartments where sources of ignition may be present, like machinery spaces. Pumps connected to drainage system of well dock are not to be located in compartments where sources of ignition may be present.

2.3 Control and monitoring of ballast system dedicated to well dock

2.3.1 Location of valve controls

Remote control for ballast system valves dedicated to well dock operation shall be provided and available from a control room. Position of valves shall be monitored from this control room.

Local means are to be provided in order to operate valves when remote control is not available. When valve in itself is not reachable, local means may be located at a convenient place permanently reachable by crew close to the valve.

2.3.2 Location of pump control

Remote control for ballast system pumps dedicated to well dock operation shall be provided and available from a control room.

2.3.3 Capacity of pumps

When Naval Authority requires some minimum delay for well dock operation, calculation is to be provided in order to asses capacity of pumps.

Note 1: corresponding water flow is to be taken into account regarding requirement for water velocity mentioned in Pt C, Ch 1, Sec 10, [5.8].

3 Aircraft handling

3.1 Internal movements

3.1.1 General

The movements of the aircraft between the flight deck and the hangar deck are operated by aircraft elevators.

The movements of the aircraft on a deck are operated with tractors.

Deck crane is also to be provided for handling of a crashed aircraft.

The aircraft elevators are to be considered as a secondary essential service in complement of Pt C, Ch 2, Sec 1, [3.11.3].

3.1.2 Aircraft elevators

Aircraft elevators are to comply with general requirements of Pt B, Ch 8, Sec 9, and with requirements of NR526 Rules for lifting appliances, as far as they are applicable to unmanned platform elevator. The following requirements are also to be complied with:

- a mechanical locking of the platform at the two levels hangar deck and flight deck is to be provided
- disposition are to be taken to avoid any change in the level of the platform when removing the locking whatever load change occurred
- platforms are to be equipped to ensure security of staff and load against falling
- platforms are to be equipped to avoid any contact of staff or load with fixed parts of ship during movements of the platforms
- hangar deck and flight deck are to be equipped with disposal to avoid any fall of staff or load when platform is not locked at the deck level.

4 Aircraft supplying

4.1 General

4.1.1 The supply of the aircraft needs among others handling, storage or production for:

- fuel
- ammunition
- oxygen for breathing purpose
- special ingredients and fluids for aircraft
- aircraft electric power.

4.1.2 Refuelling system

Refuelling system is to comply with requirements for helicopter platform as per Pt C, Ch 1, Sec 10, [11] and Pt C, Ch 4, Sec 10, [4].

4.1.3 Weapons elevators

With regards to strength matters, ammunition elevators are to comply with general requirements of Ch 5, Sec 3, [7.8], and with requirements of NR526 Rules for lifting appliances, as far as they are applicable to unmanned platform elevator.

The following requirements are also to be complied with:

- a mechanical locking of the platform at the two levels, hangar deck and flight deck, is to be provided
- disposition are to be taken to avoid any change in the level of the platform when removing the locking whatever load change occurred
- platforms are to be equipped to ensure security of staff and load against falling
- platforms are to be equipped to avoid any contact of staff or load with fixed parts of ship during movements of the platforms
- hangar deck and flight deck are to be equipped with disposal to avoid any fall of staff or load when platform is not locked at the deck level.

In addition, the weapons elevators are to be in compliance with ISO 8383 standard.

4.1.4 Oxygen production and storage

A special consideration for risk of high concentration of oxygen is to be taken into account for aircraft breathing oxygen storage and production installation. Whenever liquefied oxygen is present on board, special consideration for consequences of leakage is to be taken into account. These consequences are to include fire risk and damage to ship structures.

Section 5 Electrical Installations

1 General

1.1 Applicable requirements

1.1.1 In addition to the relevant requirements given in Ch 5, Sec 1, Tab 1, electrical installations in spaces intended for the carriage of motor vehicles with fuel in their tanks for their propulsion are to comply with those of Part C, Chapter 4.

1.2 Documentation to be submitted

1.2.1 In addition to the documentation requested in Pt C, Ch 2, Sec 1, Tab 1, the following are to be submitted for approval:

a) plan of hazardous areas

b) document giving details of types of cables and safety characteristics of the equipment installed in hazardous areas

c) diagrams of electrical systems of fire doors, shell doors, loading doors and similar appliances, television surveillance or water leakage detection systems as requested in NR467, Pt B, Ch 1, Sec 4, Tab 1 and Pt C, Ch 4, Sec 1, Tab 1.

d) diagrams of the supplies to the supplementary emergency lighting systems.

1.3 Electrical distribution and protection

1.3.1 In an amphibious ships, distribution systems shall be so arranged that fire in any main vertical zone as defined in Part C, Chapter 4 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 is practicable.

1.3.2 For generators arranged to operate in parallel and for individually operating generators, arrangements are to be made to disconnect automatically the excess load when the generators are overloaded in such a way as to prevent a sustained loss of speed. The operation of such device is to activate a visual and audible alarm.

2 Emergency source of electrical power and emergency installations

2.1 General

2.1.1 A self-contained emergency source of electrical power shall be provided.

2.1.2 Provided that suitable measures are taken for safeguarding independent emergency operation under all circumstances, the emergency generator may be used, exceptionally, and for short periods, to supply non-emergency circuits.

Whilst the vessel is at sea, the following can be understood as exceptional conditions:

a) blackout situation

b) dead ship situation

c) routine use for testing

d) short-term parallel operation with the main source of electrical power for the purpose of load transfer.

Unless instructed otherwise by the Society, the emergency generator may be used during lay time in port for the supply of the ship mains, provided the requirements of Pt C, Ch 2, Sec 3, [2.4] are complied with.

2.1.3 The electrical power available shall be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously.

2.1.4 The emergency source of electrical power shall be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the services stated in [2.2.3] for the period specified, if they depend upon an electrical source for their operation.

2.1.5 The transitional source of emergency electrical power, where required, is to be of sufficient capacity to supply at least the services stated in [2.2.6] for the periods specified therein, if they depend upon an electrical source for their operation.

2.1.6 An indicator shall be mounted in a suitable place on the main switchboard or in the machinery control room to indicate when the batteries constituting either the emergency source of electrical power or the transitional source of emergency electrical power referred to in Pt C, Ch 2, Sec 3, [2.3.15] and Pt C, Ch 2, Sec 3, [2.3.16] are being discharged.

2.1.7 If the services which are to be supplied by the transitional source receive power from an accumulator battery by means of semiconductor converters, means are to be provided for supplying such services also in the event of failure of the converter (e.g. providing a bypass feeder or a duplication of converter).

2.1.8 Where electrical power is necessary to restore propulsion, the capacity of the emergency source shall be sufficient to restore propulsion to the ship in conjunction to other machinery as appropriate, from a dead ship condition within 30 min. after blackout.

For the purpose of this requirement only, the dead ship condition and blackout are both understood to mean a condition under which:

- The main propulsion plant, boilers and auxiliaries are not in operation
- No stored energy for starting the propulsion plant and the main source of electrical power are available.
- Equipment of Propulsion systems, main source of electrical power and other essential auxiliaries is to be assumed available.
- means are available to start the emergency generator at all times.

The emergency generator and other means needed to restore the propulsion are to have a capacity such that the necessary propulsion starting energy is available within 30 minutes of blackout/dead ship condition as defined above. Emergency generator stored starting energy is not to be directly used for starting the propulsion plant, the main source of electrical power and/or other essential auxiliaries (emergency generator excluded).

2.1.9 Provision shall be made for the periodical testing of the complete emergency system and shall include the testing of automatic starting arrangements.

2.1.10 For starting arrangements of emergency generating sets, see Pt C, Ch 1, Sec 2, [3.1].

2.1.11 The emergency source of electrical power may be either a generator or an accumulator battery, which shall comply with the provisions of [2.1.12] or [2.1.13], respectively.

2.1.12 Where the emergency source of electrical power is a generator, it shall be:

a) driven by a suitable prime mover with an independent supply of fuel having a flashpoint (closed cup test) of not less than 43°C

b) started automatically upon failure of the electrical supply to the emergency switchboard from the main source of electrical power and shall be automatically connected to the emergency switchboard; those services referred to in [2.2.6] shall then be transferred automatically to the emergency generating set. The automatic starting system and the characteristic of the prime mover shall be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable, subject to a maximum of 45 s, and

c) provided with a transitional source of emergency electrical power according to [2.1.14].

2.1.13 Where the emergency source of electrical power is an accumulator battery, it shall be capable of:

a) 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

b) automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power, and

c) immediately supplying at least those services specified in [2.2.6].

2.1.14 The transitional source of emergency electrical power required by [2.1.12] shall consist of an accumulator battery which shall operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage and be so arranged as to supply automatically in the event of failure of either the main or emergency source of electrical power at least the services in [2.2.6] if they depend upon an electrical source for their operation.

2.1.15 Where the emergency and/or transitional source of power is an uninterruptible power system (UPS), it is to comply with the requirements of Pt C, Ch 2, Sec 6, [2].

2.2 Distribution of electrical power

2.2.1 The emergency switch board shall be supplied during normal operation from the main switchboard by an interconnector feeder which shall be adequately protected at the main switchboard against overload and short-circuit and which is to be disconnected automatically at the emergency switchboard upon failure of the main source of electrical power.

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

2.2.2 In order to ensure ready availability of the emergency source of electrical power, arrangements shall be made where necessary to disconnect automatically non-emergency circuits from the emergency switchboard to ensure that power shall be available to the emergency circuits.

2.2.3 The emergency source of electrical power shall be capable of supplying simultaneously at least the following services for the periods specified hereafter, if they depend upon an electrical source for their operation:

a) for a period of 36 hours, emergency lighting:
   1) at every muster and embarkation station and over the sides
   2) in alleyways, stairways and exits giving access to the muster and embarkation stations
   3) in all service and accommodation alleyways, stairways and exits, personnel lift cars
   4) in the machinery spaces and main generating stations including their control positions
   5) in all control stations, machinery control rooms, and at each main and emergency switchboard
   6) at all stowage positions for firemen's outfits
   7) at the steering gear, and
   8) at the fire pump, the sprinkler pump and the emergency bilge pump referred to in (d) below and at the starting position of their motors

b) for a period of 36 hours:
   1) The navigation lights and other lights required by the International Regulations for Preventing Collisions at Sea in force.
   2) the VHF radio installation required by Regulation IV/7.1.1 and IV/7.1.2 of SOLAS 1974 as amended, and, if applicable:
      - the MF radio installation required by Regulations IV/9.1.1, IV/9.1.2, IV/10.1.2 and IV/10.1.3
      - the ship earth station required by Regulation IV/10.1.1, and
      - the MF/HF radio installation required by Regulations IV/11.1.1 and IV/11.1.2.

c) for a period of 36 hours:
   1) all internal communication equipment required in an emergency (see [2.2.4])
   2) the shipborne navigational equipment as required by Regulation V/12; where such provision is unreasonable or impracticable the Head Office may waive this requirement for ships of less than 5,000 gross tonnage
   3) the fire detection and fire alarm system, the fire door holding and release system, and
   4) intermittent operation of the daylight signalling lamp, the ship's whistle, the manually operated call points and all internal signals (see [2.2.5]) that are required in an emergency, unless such services have an independent supply for the period of 36 hours from an accumulator battery suitably located for use in an emergency

d) for a period of 36 hours:
   1) one of the fire pumps required by the relevant provisions of Part C, Chapter 4
   2) the automatic sprinkler pump, if any, and
   3) the emergency bilge pump and all the equipment essential for the operation of electrically powered remote controlled bilge valves

e) for the period of time required in Pt C, Ch 1, Sec 12, [2], the steering gear if required to be so supplied

f) for a period of half an hour:
   1) any watertight doors required by Regulation II-1/15 to be power operated together with their indicators and warning signals
   2) the emergency arrangements to bring the lift cars to deck level for the escape of persons. The lift cars may be brought to deck level sequentially in an emergency.

2.2.4 Internal communication equipment required in an emergency generally includes:

a) the means of communication between the navigating bridge and the steering gear compartment, if any

b) the means of communication between the navigating bridge and the position in the machinery space or control room from which the engines are normally controlled

c) the means of communication which is provided between the officer of the watch and the person responsible for closing any watertight door which is not capable of being closed from a damage control station

d) the public address system or other effective means of communication throughout the accommodation, public and service spaces

e) the means of communication between the navigating bridge and the main fire control station.

2.2.5 Internal signals required in an emergency generally include:

a) general alarm

b) watertight door indication

c) fire door indication.

2.2.6 The transitional source of emergency electrical power required is to supply at least the following services if they depend upon an electrical source for their operation:

a) for half an hour:

1) the lighting required by [2.2.3] (b) and Pt C, Ch 2, Sec 3, [3.6.6] (a)

2) all services required by [2.2.3] (c1, 3 and 4) unless such services have an independent supply for the period specified from an accumulator battery suitably located for use in an emergency

b) it is also to supply power to close the watertight doors as required by Regulation II-1/15.7.3.3, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided. Power to the control, indication and alarm circuits as required by Regulation II-1/15.7.2, for half an hour.

2.3 Low-location lighting

2.3.1 Amphibious vessels are to be provided with a low-location lighting (LLL) system in accordance with Pt C, Ch 4, Sec 8, [2.3.2].

Where LLL is satisfied by electric illumination, it is to comply with the following requirements.

2.3.2 The LLL system is to be connected to the emergency switchboard and is to be capable of being powered either by the main source of electrical power, or by the emergency source of electrical power for a minimum period of 60 minutes after energising in an emergency.

2.3.3 The power supply arrangements to the LLL are to be arranged so that a single fault or a fire in any one fire zone or deck does not result in loss of the lighting in any other zone or deck. This requirement may be satisfied by the power supply circuit configuration, use of cables of a fire-resistant type complying with Pt C, Ch 2, Sec 9, [2.1.11], and/or the provision of suitably located power supply units having integral batteries adequately rated to supply the connected LLL for a minimum period of 60 minutes.

2.3.4 Single lights and lighting assemblies are to be designed or arranged so that any single fault or failure in a light or lighting assembly, other than a short-circuit, will not result in a break in visible delineation exceeding 1 metre.

2.3.5 Light and lighting assemblies are to be flame-retardant as a minimum, to have an ingress protection of at least IP55 and to meet the type test requirements as specified in Pt C, Ch 3, Sec 6, Tab 1.

2.3.6 The LLL system is to be capable of being manually activated by a single action from the continuously manned damage control station. It may, additionally, be continuously operating or be switched on automatically, e.g. by the presence of smoke within the space(s) being served.

2.3.7 When powered, the systems are to achieve the following minimum luminance:

- for any planar source: 10 cd/m^2 from the active parts in a continuous line of 15 mm minimum width
- for any point source: 35 mcd in the typical track directions of approach and viewing which is to be considered:
  - for sources which are required to be viewed from a horizontal position, i.e. deck mounted or horizontally bulkhead mounted fittings, within a 60° cone having its centre located 30° from the horizontal mounting surface of the point source and in line with the track direction, see Fig 1
  - for sources which are required to be viewed vertically, i.e. the vertical LLL marking up to the door handles, within a 60° cone having its centre located perpendicular to the mounting service of the point source, see Fig 2.

Spacing between sources is not to exceed 300 mm.

Figure 1 : Minimum luminance for LLL point sources mounted on horizontal surfaces

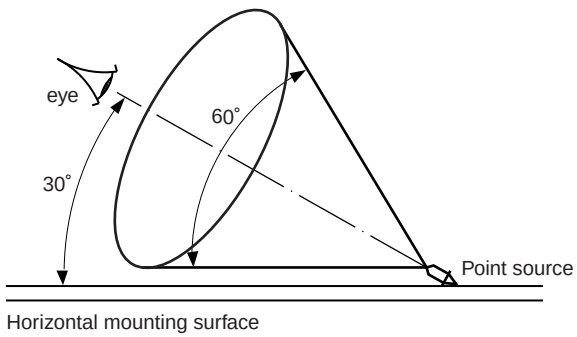
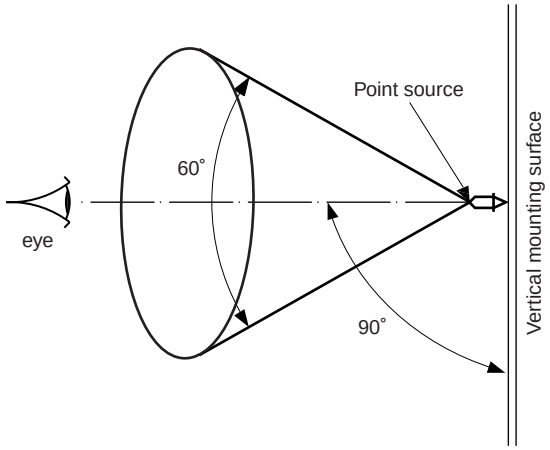


Figure 2 : Minimum luminance for LLL point sources mounted on vertical surfaces



2.3.8 The lights or lighting assemblies are to be continuous except as interrupted by constructional constraints, such as corridors or cabin doors etc., are to provide a visible delineation along the escape route and, where applicable, are to lead to the exit door handles. Interruption of the LLL system due to constructional constraints is not to exceed 2 metres.

2.3.9 The lighting is to be provided on at least one side of the corridor or stairway. In corridors and stairways in excess of 2 metres width, lighting is to be provided on both sides.

2.3.10 In corridors the lighting is to be installed either on the bulkhead within 300 mm of the deck or, alternatively, on the deck within 150 mm of the bulkhead.

2.3.11 In stairways the lighting is to be installed within 300 mm above the steps such that each step may be readily identified from either above or below that step. The top and bottom steps are to be further identified to show that there are no further steps.

2.4 Supplementary emergency lighting

2.4.1 In addition to the emergency lighting required in [2.2], on every amphibious vessel with ro-ro cargo spaces or special category spaces:

a) all public spaces and alleyways shall be provided with supplementary electric lighting that can operate for at least three hours when all other sources of electrical power have failed and under any condition of heel. The illumination provided shall be such that the approach to the means of escape can be readily seen. The source of power for the supplementary lighting shall consist of accumulator batteries located within the lighting units that are continuously charged, where practicable, from the emergency switchboard. Alternatively, any other means of lighting which is at least as effective may be accepted by the Society. The supplementary lighting shall be such that any failure of the lamp will be immediately apparent. Any accumulator battery provided shall be replaced at intervals having regard to the specified service life in the ambient conditions that they are subject to in service;

b) a portable rechargeable battery operated lamp shall be provided in every crew space alleyway and recreational space and every working space which is normally occupied unless supplementary emergency lighting, as required in (a), is provided.

2.5 Emergency lighting in cabins

2.5.1 In amphibious ships, supplementary emergency lighting shall be provided in all cabins to clearly indicate the exit so that occupants will be able to find their way to the door. Such lighting, which may be connected to an emergency source of power or have a self-contained source of electrical power in each cabin, shall automatically illuminate when power to the normal cabin lighting is lost and remain on for a minimum of 30 min.

3 General emergency alarm and public address systems

3.1 General emergency alarm system

3.1.1 An electrically operated bell or klaxon or other equivalent warning system installed in addition to the ship's whistle or siren for sounding the general emergency alarm signal is to comply with the following requirements.

3.1.2 The general emergency alarm system is to be supplemented by either a public address system complying with the requirements in [3.2] or other suitable means of communication.

3.1.3 The entertainment sound system is to be automatically turned off when the general alarm system is activated.

3.1.4 The system is to be continuously powered and is to have an automatic change-over to a standby power supply in case of loss of the normal power supply.

An alarm is to be given in the event of failure of the normal power supply.

3.1.5 The system is to be powered by means of two circuits, one from the ship's main supply and the other from the emergency source of electrical power required by [2.1] and Ch 2, Sec 4, [3.2].

3.1.6 The system is to be capable of operation from the navigation bridge and, except for the ship’s whistle, also from other strategic points.

Note 1: Other strategic points are taken to mean those locations, other than the navigation bridge, from where emergency situations are intended to be controlled and the general alarm system can be activated. A fire control station or a petrol control station is normally to be regarded as strategic points.

3.1.7 The alarm is to continue to function after it has been triggered until it is manually turned off or is temporarily interrupted by a message on the public address system.

3.1.8 The alarm system is to be audible throughout all the accommodation and normal crew working spaces and on all open decks.

3.1.9 The minimum sound pressure level for the emergency alarm tone in interior and exterior spaces is to be 80 dB (A) and at least 10 dB (A) above ambient noise levels existing during normal equipment operation with the ship underway in moderate weather.

3.1.10 In cabins without a loudspeaker installation, an electronic alarm transducer, e.g. a buzzer or similar, is to be installed.

3.1.11 The sound pressure level at the sleeping position in cabins and in cabin bathrooms is to be at least 75 dB (A) and at least 10 dB (A) above ambient noise levels.

3.1.12 For cables used for the general emergency alarm system, see Pt C, Ch 2, Sec 3, [9.6.1], Pt C, Ch 2, Sec 11, [5.2.1] and Pt C, Ch 2, Sec 11, [5.2.5].

3.1.13 Electrical cables and apparatus for the general emergency alarm system and their power supply are to be arranged so that the loss of the system in any one area due to localised fire is minimised.

3.1.14 Where the fire alarm to summon the crew operated from the navigating bridge or fire control station is part of the ship’s general alarm system, it is to be capable of being sounded independently of the alarm in the embarked troops spaces.

3.2 Public address system

3.2.1 The public address system is to be one complete system consisting of a loudspeaker installation which enables simultaneous broadcast of messages from the navigation bridge, and at least one other location on board for use when the navigation bridge has been rendered unavailable due to the emergency, to all spaces where crew members or embarked troops, or both, are normally present (accommodation and service spaces and control stations and open decks), and to assembly stations (i.e. muster stations).

In spaces such as under deck passageways, bosun’s locker, hospital and pump room, the public address system may not be required.

3.2.2 The public address system is to be arranged to operate on the main source of electrical power, the emergency source of electrical power and transitional sources of electrical power as required by Pt C, Ch 2, Sec 3, [2.3] and Pt C, Ch 2, Sec 3, [3.6].

3.2.3 The controls of the system on the navigation bridge are to be capable of interrupting any broadcast on the system from any other location on board.

3.2.4 Where an individual loudspeaker has a device for local silencing, an override arrangement from the control station(s), including the navigating bridge, is to be in place.

3.2.5 The system is not to require any action by the addressee.

3.2.6 It is to be possible to address crew accommodation and work spaces separately from embarked troops.

3.2.7 In addition to any function provided for routine use aboard the ship, the system is to have an emergency function control at each control station which:

a) is clearly indicated as the emergency function

b) is protected against unauthorised use

c) automatically overrides any other input system or program, and

d) automatically overrides all volume controls and on/off controls so that the required volume for the emergency mode is achieved in all spaces.

3.2.8 The system is to be installed with regard to acoustically marginal conditions, so that emergency announcements are clearly audible above ambient noise in all spaces where crew members or embarked troops, or both, are normally present (accommodation and service spaces and control stations and open decks), and at assembly stations (i.e. muster stations).

3.2.9 With the ship underway in normal conditions, the minimum sound pressure level for broadcasting emergency announcements is to be:

a) in interior spaces 75 dB (A) and at least 20 dB (A) above the speech interference level, and

b) in exterior spaces 80 dB (A) and at least 15 dB (A) above the speech interference level.

Evidence of this level is to be shown with test result in open sea or equivalent quay measurement with appropriate correction factor.

3.2.10 The system is to be arranged to prevent feed-back or other interference.

3.2.11 The system is to be arranged to minimise the effect of a single failure so that the emergency messages are still audible (above ambient noise levels) also in the event of failure of any one circuit or component.

3.2.12 Each loudspeaker is to be individually protected against short-circuits.

3.2.13 For cables used for the public address system, see Pt C, Ch 2, Sec 3, [9.6.1], Pt C, Ch 2, Sec 11, [5.2.1] and Pt C, Ch 2, Sec 11, [5.2.5].

3.2.14 All areas of each fire zone are to be served by at least two dedicated loops of flame-retardant cables which are to be sufficiently separated throughout their length and supplied by two separate and independent amplifiers.

3.2.15 A temperature alarm is to be provided in the public address cabinets in case of forced air cooling.

3.3 Combined general emergency alarm - public address system

3.3.1 Where the public address system is the only means for sounding the general emergency alarm signal and the fire alarm, in addition to the requirements of [3.1] and [3.2], the following are to be satisfied:

- the system automatically overrides any other input system when an emergency alarm is required.
- the system automatically overrides any volume control provided to give the required output for the emergency mode when an emergency alarm is required.
- the system is arranged to minimise the effect of a single failure so that the alarm signal is still audible (above ambient noise levels) also in the event of failure of any one circuit or component, by means of the use of more than one device for generating an electronic sound signal.

4 Installation

4.1 Electrical equipment located in special spaces

4.1.1 Electrical equipment located in fuel oil tanks (Diesel oil, JP5, petrol) are to be certified intrinsically safe apparatus Ex(ia). They are to be explosion group IIa and temperature class T3 minimum.

4.1.2 The following spaces are to be considered as hazardous areas and electrical equipment located in these areas are to be of certified safe type temperature class T6, explosive group IIa:

- ammunition storage
- ammunition transit room
- ammunition elevator.

4.1.3 Following spaces are to be considered as hazardous areas and electrical equipment related to these areas are to comply with the requirements of Pt C, Ch 2, Sec 3, [10.7]:

- paint stores or tanks
- medical product storage rooms
- workshop where solvent are used.

4.1.4 Flour storage spaces are to be considered as hazardous areas and electrical equipment related to these areas are to have a degree of protection IP 65 and maximum surface temperature of 100°C.

4.1.5 Following spaces are to be considered as hazardous areas and electrical equipment related to these areas are to comply with the requirements of Pt C, Ch 2, Sec 3, [10.6]:

- hydrogen distribution dispenser
- batteries rooms
- oxygen plant.

4.2 Installations in special category spaces situated above the bulkhead deck

4.2.1 On any deck or platform, if fitted, on which vehicles are carried and on which explosive vapours might be expected to accumulate, except platforms with openings of sufficient size permitting penetration of petrol gases downwards, electrical equipment and cables are to be installed at least 450 mm above the deck or platform.

Electrical equipment is to be of a type compliant with zone 2 hazardous area as stated in Pt C, Ch 2, Sec 3, [10.2.7] and electrical cables as stated in Pt C, Ch 2, Sec 3, [10.5.3].

4.2.2 Where the installation of electrical equipment and cables at less than 450 mm above the deck or platform is deemed necessary for the safe operation of the ship, the electrical equipment is to be of a certified safe type as stated in Pt C, Ch 2, Sec 3, [10.2.6] and the electrical cables are to be as stated in Pt C, Ch 2, Sec 3, [10.5.2].

4.2.3 Electrical equipment and cables in exhaust ventilation ducts are to be as stated in [4.2.2].

4.2.4 The requirements in this item are summarised in Tab 1.

4.3 Installations in special category spaces situated below the bulkhead deck

4.3.1 Any electrical equipment installed is to be as stated in Pt C, Ch 2, Sec 3, [10.2.6] and electrical cables are to be as stated in Pt C, Ch 2, Sec 3, [10.5.2].

4.3.2 Electrical equipment and cables in exhaust ventilation ducts are to be as stated in [4.3.1].

4.3.3 The requirements in this item are summarised in Tab 2.

4.4 Installations in petrol spaces other than special category spaces intended for the carriage of motor vehicles

4.4.1 The requirements for installations in special category spaces situated below the bulkhead deck, as stated in [4.3], apply.

4.4.2 All electric circuits terminating in petrol holds are to be provided with multipole linked isolating switches located outside the holds. Provision is to be made for locking in the off position.

This requirement does not apply to safety installations such as fire, smoke or gas detection systems.

Table 1 : Electrical equipment permitted in special category spaces above the bulkhead deck

No.	Description of spaces	Electrical equipment	Hazardous area **(1)**
1	Areas at less than 450 mm above the deck or platforms for vehicles, if fitted, without openings of sufficient size permitting penetration of petrol gases downward	a) any type that may be considered for zone 0 or zone 1	Zone 1
2	Exhaust ventilation ducts	As stated under item 1.	Zone 1
3	• areas above a height of 450 mm from the deck • areas above a height of 450 mm from each platform for vehicles, if fitted, without openings of sufficient size permitting penetration of petrol gases downward • areas above platforms for vehicles, if fitted, with openings of sufficient size permitting penetration of petrol gases downward	a) any type that may be considered for zone 1 or zone 2	Zone 2
(1) Alternatively, area classification according to IEC 60079-10-1:2020 may be applied with special consideration by the Society.			

Table 2 : Electrical equipment permitted in special category spaces below the bulkhead deck

No.	Description of spaces	Electrical equipment	Hazardous area **(1)**
1	Special category spaces	a) any type that may be considered for zone 0 and zone 1	Zone 1
2	Exhaust ventilation ducts	As stated under item 1.	Zone 1
(1) Alternatively, area classification according to IEC 60079-10-1:2020 may be applied with special consideration by the Society.			

4.5 Electrical installation in well-dock space

4.5.1 When embarked vessels are foreseen to be supplied by ship power system, then provision of suitable means for preventing earth faults on connected vessel from affecting the main distribution system is to be made (galvanic isolation, tripping of the faulty circuit).

4.5.2 When electrical equipment needs to be installed in the higher part of the dock-well, appropriate design and protection against high temperatures caused by exhaust gas of embarked vessels are to be arranged.

4.6 Wheelhouse arrangement

4.6.1 The visibility from the wheelhouse is to be in accordance with Pt E, Ch 11, Sec 4, [6.2.1]. Where there is blind sectors larger than 5°, due to the asymmetrical location of the wheelhouse, cameras or equivalent vision systems are to be provided in appropriate location so as to cover the blind area.

4.6.2 No blind space of the landing area is to be found from the wheelhouse. If this is not achievable, cameras are to be provided in appropriate location so as to cover the blind area, unless appropriate visibility is possible from a dedicated bridge for aeronautical activities.

4.6.3 A status panel is to be provided in wheelhouse console to indicate the positions of the hangar doors and the positions of the helicopter elevators.

4.6.4 Due to asymmetric location of the wheelhouse, port bridge wing may be omitted.

5 Type approved components

5.1

5.1.1 Components for Low-Location Lighting systems (LLL) in escape routes are to be type approved or in accordance with [5.1.2].

5.1.2 Case-by-case approval based on submission of adequate documentation and execution of tests may also be granted at the discretion of the Society.

5.1.3 Accumulator lamps for the supplementary electric lighting, alarm systems for closing devices of openings and water leakage detection systems if of electronic type, and television surveillance systems are to be type approved or in accordance with [5.1.2].

Section 6 Fire Protection

1 General

1.1 Application

1.1.1 The installations or equipment used for specific military operations which are not permanently fixed to the hull of the ship, such as mobile containers used to occasionally accommodate a mobile hospital or a mobile headquarters, are not required to comply with the requirements of this section. All other installations and equipment, including portable equipment required in this section, are to comply with the relevant requirements outlined in this Section.

1.2 Documents to be submitted

1.2.1 The interested party is to submit to the Society the documents listed in Pt C, Ch 4, Sec 1, [1.3].

2 Detection and alarm

2.1 Fixed fire detection and fire alarm system

2.1.1 The fixed fire detection and fire alarm system is to be capable of remotely and individually identifying each detector and manually operated call point. Fire detectors fitted in cabins, when activated, are also to be capable of emitting, or cause to be emitted, an audible alarm within the space where they are located.

2.1.2 A section of detectors and manually operated call points shall not be situated in more than one main vertical zone.

3 General requirements

3.1 Vertical subdivisions

3.1.1 The interior of the ship, shall be subdivided into at least two main vertical zones by A-60 class divisions. Steps and recesses shall be kept to a minimum, but where they are necessary they shall also be A-60 class divisions. Where a category (5), (9) or (10) space defined in item b) of Pt C, Ch 4, Sec 5, [1.2.3] is on one side or where fuel or diesel oil or JP5 NATO (F44) tanks or water capacity are on both sides of the division, the standard can be reduced to A-0.

3.1.2 The subdivisions into main vertical zones and vertical safety zones shall fall into line between each others. That means that a main vertical zone shall not be astride on two vertical safety zones and one vertical safety zone.

3.1.3 The length of each vertical safety zones is not to exceed 80 m but may be extended to a maximum of 100 m in order to bring the furthermost ends of the ship such as its bow or corbelled parts of the ship. If the length of the vertical safety zone exceed 80 m, the total area of the vertical safety zone is not to be more than 3400 m² on any deck. The maximum length of a vertical safety zone is the maximum distance between the furthermost points of the bulkheads bounding it.

3.1.4 If the part of the ship located forward of the collision bulkhead forms one vertical safety zone, or if the hangar or well dock forms one horizontal safety zone, this safety zone is to contain only one main vertical zone. This vertical safety zone and main vertical zone need not to comply with the requirements of Pt C, Ch 4, Sec 6, [1.3.2] for the fire pump and Pt C, Ch 4, Sec 8, [4.4.1] for the assembly and embarkation stations but the provisions of [4.3.1] for ventilation apply.

3.2 Horizontal subdivisions

3.2.1 The ship may accommodate some additional horizontal safety zones to enclose any large ro-ro or vehicles spaces or well dock. In this case, the horizontal safety zone may contain only one main horizontal zone.

3.2.2 These horizontal safety zones may extend on more than one deck provided that the total overall clear height for vehicles does not exceed 10 m.

3.2.3 The requirements of ventilation systems and ducts, openings in A class divisions and penetrations in A class divisions for maintaining the integrity of vertical safety zone in this Chapter shall be applied equally to decks and bulkheads forming the boundaries separating horizontal safety zones from each other and from the remainder of the ship. That means that the requirements for A-30 class steel ducts and A-30 class divisions of Pt C, Ch 4, Sec 5, [1.2.1] item a) are to be replaced by requirements for A-60 class steel ducts and A-60 class divisions.

3.3 Damage control stations

3.3.1 One damage control station is to be provided in each safety zone and so equipped in such a way that one damage control station can be replaced by an other one.

4 Containment of fire

4.1 Fire integrity of bulkheads and decks

4.1.1 The fire integrity of all bulkheads and decks prescribed in Pt C, Ch 4, Sec 5, Tab 1 and Pt C, Ch 4, Sec 5, Tab 2 is to be replaced by the requirements of the following Tab 1 and Tab 2.

Table 1 : Bulkheads not bounding neither vertical zones nor horizontal zones nor safety zones

SPACES		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Control stations and equivalent spaces	(1)	B-0 [a]	A-0	A-0	A-0	A-0	A-60	A-60	A-60	A-0	A-0	A-60	A-60	A-60	A-60	A-30
Stairways	(2)		A-0 [a]	A-0	A-0	A-0	A-0	A-15	A-15	A-0 [c]	A-0	A-15	A-30	A-15	A-30	A-30
Corridors	(3)			B-15	A-60	A-0	B-15	B-15	B-15	B-15	A-0	A-15	A-30	A-0	A-30	A-30
Evacuation stations and external escape routes	(4)				–	A-0	A-60 [b] [d]	A-60 [b] [d]	A-60 [b] [d]	A-60 [d]	A-0	A-60 [b]	A-60 [b]	A-60 [b]	A-60 [b]	A-30
Open deck spaces	(5)					–	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30 [e]
Accommodation spaces of minor fire risk	(6)						B-0	B-0	B-0	C	A-0	A-0	A-30	A-0	A-30	A-30
Services spaces and accommodation spaces of moderate fire risk	(7)							B-0	B-0	C	A-0	A-15	A-60	A-15	A-60	A-30
Accommodation spaces of greater fire risk	(8)								B-0	C	A-0	A-30	A-60	A-15	A-60	A-30
Sanitary and similar spaces	(9)									C	A-0	A-0	A-0	A-0	A-0	A-30
Tanks, voids and auxiliary machinery spaces having little or no fire risk	(10)										A-0 [a]	A-0	A-0	A-0	A-0	A-30 [e]
Auxiliary machinery spaces and other similar spaces of moderate fire risk	(11)											A-0 [a]	A-0 [f]	A-0 [f]	A-15 [f]	A-30

[a] : Where adjacent spaces are in the same numerical category and letter "a" appears, a bulkhead or deck between such spaces need not be fitted if deemed unnecessary by the Society. For example, in category (12) a bulkhead need not be required between a galley and its annexed pantries provided the pantry bulkheads and decks maintain the integrity of the galley boundaries. A bulkhead is, however, required between a galley and machinery space even though both spaces are in category (12).

[b] : The ship's side, to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to liferafts and evacuation slides may be reduced to A-30.

[c] : Where public toilets are installed completely within the stairway enclosure, the public toilet bulkhead within the stairway enclosure may be of B class integrity.

[d] : Where spaces of category (6), (7), (8) and (9) are located completely within the outer perimeter of the assembly station, the bulkheads of these spaces are allowed to be of B-0 class integrity. Control positions for audio, video and light installations may be considered as part of the assembly station.

[e] : When an ammunition space is adjacent or above a water tank, or adjacent to the shell of the ship below the lowest possible waterline, only "A-0" standard is required.

[f] : A fire division of at least A-30 standard is required between spaces containing a section of main switchboards and spaces of categories (12), (13) or (14).

[g] : The boundaries between battery rooms containing Li-ion-type batteries and machinery spaces of category A are to have A-60 fire integrity.

SPACES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Machinery spaces of category A and equivalent spaces of high fire risk (12)												A-0 [a] [g]	A-0	A-60	A-60
Service spaces of high risk (13)													A-0 [a]	A-0	A-30
Special purpose spaces (14)														A-30	A-30
Ammunition spaces and other equivalent spaces (15)															A-30

[a] : Where adjacent spaces are in the same numerical category and letter "a" appears, a bulkhead or deck between such spaces need not be fitted if deemed unnecessary by the Society. For example, in category (12) a bulkhead need not be required between a galley and its annexed pantries provided the pantry bulkheads and decks maintain the integrity of the galley boundaries. A bulkhead is, however, required between a galley and machinery space even though both spaces are in category (12).

[b] : The ship's side, to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to liferafts and evacuation slides may be reduced to A-30.

[c] : Where public toilets are installed completely within the stairway enclosure, the public toilet bulkhead within the stairway enclosure may be of B class integrity.

[d] : Where spaces of category (6), (7), (8) and (9) are located completely within the outer perimeter of the assembly station, the bulkheads of these spaces are allowed to be of B-0 class integrity. Control positions for audio, video and light installations may be considered as part of the assembly station.

[e] : When an ammunition space is adjacent or above a water tank, or adjacent to the shell of the ship below the lowest possible waterline, only "A-0" standard is required.

[f] : A fire division of at least A-30 standard is required between spaces containing a section of main switchboards and spaces of categories (12), (13) or (14).

[g] : The boundaries between battery rooms containing Li-ion-type batteries and machinery spaces of category A are to have A-60 fire integrity.

Table 2 : Decks not forming steps in main vertical zones nor bounding horizontal zones nor safety zones

SPACE below	SPACE above														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Control stations and equivalent spaces (1)	A-30	A-30	A-15	A-0	A-0	A-0	A-15	A-30	A-0	A-0	A-0	A-60	A-0	A-60	A-30
Stairways (2)	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30	A-0	A-30	A-30
Corridors (3)	A-15	A-0	A-0 [a]	A-60	A-0	A-0	A-15	A-15	A-0	A-0	A-0	A-30	A-0	A-30	A-30
Evacuation stations and external escape routes (4)	A-0	A-0	A-0	A-0	–	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Open deck spaces (5)	A-0	A-0	A-0	A-0	–	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30 [e]
Accommodation spaces of minor fire risk (6)	A-60	A-15	A-0	A-60	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Services spaces and accommodation spaces of moderate fire risk (7)	A-60	A-15	A-15	A-60	A-0	A-0	A-15	A-15	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Accommodation spaces of greater fire risk (8)	A-60	A-15	A-15	A-60	A-0	A-15	A-15	A-30	A-0	A-0	A-0	A-0	A-0	A-0	A-30

Note 1: The notes [a] to [g] of Tab 1 apply to Tab 2, as appropriate.

[h] : Where a ro-ro space is subdivided with internal decks, if the fixed water-based fire-extinguishing system cannot simultaneously cover the applicable area above and below a given deck, this deck shall be of "A-30" standard while any ramps and doors between decks are to be made of steel and of a design being as tight as practical. If the fixed water-based fire-extinguishing system can simultaneously cover the applicable area above and below a given deck, the rating can be reduced to A-0.

SPACE below		SPACE above														
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Sanitary and similar spaces	(9)	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-30
Tanks, voids and auxiliary machinery spaces having little or no fire risk	(10)	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0 [a]	A-0	A-0	A-0	A-0	A-30 [e]
Auxiliary machinery spaces and other similar spaces of moderate fire risk	(11)	A-60	A-60	A-60	A-60	A-0	A-0	A-15	A-30	A-0	A-0	A-0 [a]	A-0 [f]	A-0 [f]	A-30 [f]	A-30
Machinery spaces of category A and equivalent spaces of high fire risk	(12)	A-60	A-60	A-60	A-60	A-0	A-60	A-60	A-60	A-0	A-0	A-30 [f]	A-30 [a] [g]	A-0	A-60	A-60
Service spaces of high fire risk	(13)	A-60	A-30	A-15	A-60	A-0	A-15	A-30	A-30	A-0	A-0	A-0 [f]	A-0	A-0	A-0	A-30
Special purpose spaces	(14)	A-60	A-60	A-60	A-60	A-0	A-60	A-60	A-60	A-0	A-0	A-0 [f]	A-30	A-30	A-30 [h]	A-30
Ammunition spaces and other equivalent spaces	(15)	A-30	A-30	A-30	A-30	A-30 [e]	A-30	A-30	A-30	A-30	A-30 [e]	A-30	A-60	A-30	A-30	A-30

Note 1: The notes [a] to [g] of Tab 1 apply to Tab 2, as appropriate.

[h] : Where a ro-ro space is subdivided with internal decks, if the fixed water-based fire-extinguishing system cannot simultaneously cover the applicable area above and below a given deck, this deck shall be of "A-30" standard while any ramps and doors between decks are to be made of steel and of a design being as tight as practical. If the fixed water-based fire-extinguishing system can simultaneously cover the applicable area above and below a given deck, the rating can be reduced to A-0.

4.1.2 Fire integrity of the flight decks

Except when a space of category (5), (9) or (10) is located below the flight decks, the flight decks may be of A-30 standard.

In addition, A-60 fire insulation is to be applied below the helideck landing areas.

Note 1: When accepted by the Naval Authority, the above requested A-30 standard may locally be reduced to A-0.

Note 2: The A-60 fire insulation indicated above does not take account of the landing operation of STOVL aircrafts.

4.2 Protection of openings in fire-resistant divisions

4.2.1 The requirements of item d) of Pt C, Ch 4, Sec 5, [3.1.1] are to be replaced by the following requirements applicable to fire doors in main vertical zone bulkheads, stairway enclosures and galley boundaries, other than watertight doors and those which are normally locked:

a) The doors are to be self-closing and be capable of closing with an angle of inclination of up to 3,5° opening closure.

b) The approximate time of closure for hinged fire doors is to be not more than 40 s and not less than 10 s from the beginning of their movement with the ship in upright position. The approximate uniform rate of closure for sliding doors is to be not more than 0,2 m/s and not less than 0,1 m/s with the ship in upright position.

c) The doors, except those for emergency escape trunks, are to be capable of remote release from the continuously manned damage control station, either simultaneously or in groups, and are to be capable of release also individually from a position at both sides of the door. Release switches are to have an on-off function to prevent automatic resetting of the system.

d) Hold-back hooks not subject to remote release from the continuously manned damage control station are prohibited.

e) A door closed remotely from a damage control station is to be capable of being re-opened from both sides of the door by local control. After such local opening, the door is to close again automatically.

f) Indication is to be provided at the fire door indicator panel in the continuously manned damage control station whether each door is closed.

g) The release mechanism is to be so designed that the door is to close automatically in the event of disruption of the control system or central power supply.

h) Local power accumulators for power-operated doors are to be provided in the immediate vicinity of the doors to enable the doors to be operated at least ten times (fully opened and closed) after disruption of the control system or central power supply using the local controls.

i) Disruption of the control system or central power supply at one door is not to impair the safe functioning of the other doors.

j) Remote-release sliding or power-operated doors are to be equipped with an alarm that sounds at least 5 s but not more than 10 s after the door begins to move, and continues sounding until the door is completely closed.

k) A door designed to re-open upon contracting an object in its path is to re-open not more than 1 m from the point of contact.

l) Double-leaf doors equipped with a latch necessary for their fire integrity are to have a latch that is automatically activated by the operation of the doors when released by the system.

m) Doors giving direct access to ro-ro spaces which are power-operated and automatically closed need not be equipped with the alarms and remote-release mechanisms required in items c) and J).

n) The components of the local control system are to be accessible for maintenance and adjusting.

o) Power-operated doors are to be provided with a control system of an approved type which is to be able to operate in case of fire and be in accordance with the Fire Test Procedure Code. This system is to satisfy the following requirements:

- the control system is to be able to operate the door at the temperature of at least 200°C for at least 60 min., served by the power supply
- the power supply for all other doors not subject to fire is not to be impaired, and
- at temperatures exceeding 200°C, the control system is to be automatically isolated from the power supply and is to be capable of keeping the door closed up to at least 945°C.

4.2.2 Hose ports

With reference to the provision of Pt C, Ch 4, Sec 5, [3.1.1], as far as practicable, self-closing hose ports are to be provided on all A class doors except watertight doors, weathertight doors (semi-watertight doors), doors leading to the open decks and doors required to be gas-tight.

As far as practicable, where a weathertight door is fitted in a respective internal weathertight bulkhead, a respective weathertight opening capable of being opened from both sides of the bulkhead is to be provided on this bulkhead close to the door for permitting the passage of a fire hose through this bulkhead when the door is closed. Suitable measures are to be taken to ensure that this opening is closed at sea.

4.2.3 Stairway enclosures

a) With reference to the provision of Pt C, Ch 4, Sec 5, [1.2.4], stairways not enclosed within enclosures formed of A class divisions in compliance with Tab 1 and Tab 2 are not to be permitted.

b) Nevertheless, stairways which are fitted in accordance with [5.1.4] may not be enclosed within A class divisions, provided that the stairway penetrates a single deck and is protected, at a minimum, at one level by at least B class divisions and self-closing doors.

4.3 Ventilation sytems

4.3.1 Application

For the application of this Chapter, the requirement of Pt C, Ch 4, Sec 5, [6.3.7] is to be replaced by:

“The ventilation fans shall be so disposed that the ducts reaching the various spaces remain within the main vertical zones.

The air conditioning units shall not serve more than one main vertical zone. However the air inlets and outlets of the ventilation system serving one main vertical zone may be located outside the main vertical zone provided that they are located inside the same vertical safety zone. In this case, the requirement of Pt C, Ch 4, Sec 5, [6.3.7] will apply for the dedicated ventilation duct passing through the main vertical zone boundary.

If the part of the ship located forward the collision bulkhead forms one vertical safety zone containing one single main vertical zone, the dedicated air conditioning units serving this main vertical zone can be located outside this main vertical zone provided that they are located inside the immediately adjacent aftward main vertical zone. In the same way, the air inlets and outlets of the ventilation system serving this vertical safety zone can be located outside this vertical safety zone provided that they are located inside the immediately adjacent aftward safety zone. In these two cases, the requirement of Pt C, Ch 4, Sec 5, [6.3.9] will apply for the dedicated duct passing through the main vertical zone boundary or vertical safety zone boundary.

Except for the particular cases mentionned above, a ventilation duct is to pass neither through a main vertical zone boundary nor through a vertical safety zone boundary.”

4.3.2 Ventilation dedicated to Well docks

The requirements and the general provisions for ro-ro spaces as defined in Pt C, Ch 4, Sec 13, [2] are applicable to well docks except for Pt C, Ch 4, Sec 13, [2.1.4] item b), for which the A-30 class is to be replaced by A-60 class.

5 Means of escape

5.1 Application

5.1.1 The requirements of Pt C, Ch 4, Sec 8 are to be replaced by the applicable requirements of SOLAS, Chapter II-2, Part D, Regulations 12 and 13 as applicable, for Ro-Ro passenger ships carrying more than 36 passengers, and the applicable

requirements of the Fire Safety System Code, Chapter 13, and other relevant IMO Resolutions, Circulars, Guidelines and other standards referred therein, except that:

a) regulations 13.3.2.1 and 13.3.2.4.1 are replaced by the following [5.1.2] to [5.1.5]

b) regulation 13.3.2.3 is replaced by the following [5.1.6]

c) regulation 13.3.4 is replaced by Pt C, Ch 4, Sec 8, [3]

d) d)requirement 2.1.1 of FSS Code, Ch 13, is replaced by the following [5.1.9]

e) requirement 2.2.3 of FSS Code, Ch 13, is replaced by the following [5.1.10]

f) requirement 2.1 of FSS Code, Ch 11, is replaced by the following [5.1.11].

5.1.2 Escape from spaces below damage control deck

a) Below the damage control deck, two means of escape are to be provided from each watertight compartment or similarly restricted space or group of spaces.

b) At least one of the means of escape required in item a) above is to consist of a readily accessible enclosed stairway (Category [2]), which is to provide continuous fire shelter from the level of its origin to the appropriate embarkation decks.

c) the continuous fire shelter is also provided on the damage control deck through a route protected as a category [2] space (horizontal stairway).

d) When external escape routes are provided, they are to be provided with emergency lighting in accordance with SOLAS Ch III regulation 11 and slip-free surfaces underfoot. Boundaries facing external open stairways and passage-ways forming part of an escape route and boundaries in such a position that their failure during a fire would impede escape to the embarkation deck are to have fire integrity, including insulation values, in accordance with Tab 1 and Tab 2, as appropriate, for category [4] spaces.

e) The stairway arrangement required by the preceding item b) for below damage control deck compartments of one main vertical zone can be arranged by:

   1) one enclosed stairway which provides a continuous fire shelter from the level of its origin to the embarkation deck in one watertight compartment, and

   2) each of the other watertight compartments of the main vertical zone has an enclosed stairway which provides a continuous fire shelter from the level of its origin to the damage control deck, and

   3) the continuous fire shelter is also provided on the damage control deck through a route protected as a category [2] space (horizontal stairway).

f) In the bottom of the well dock, the means of escape arrangement required by the preceding item a) are to be provided with the length between each ladders not exceeding 80m, in each side of well dock.

5.1.3 Escape from spaces above the damage control deck: fire scenario

Above the damage control deck there is to be at least two means of escape from each main vertical zone or similarly restricted space or group of spaces, at least one of which is to give access to a stairway forming a vertical escape providing continuous fire shelter to the embarkation deck.

5.1.4 Escape from spaces between damage control deck and bulkhead deck: flooding scenario

a) Between damage control deck and bulkhead deck, at least one means of escape independent from watertight doors and giving access to embarkation deck is to be provided at each deck level from each watertight compartment or similarly restricted space or group of spaces.

b) The means of escape required in item a) above are to be, as far as practicable, a stairway, but where the purpose and forms of the ship make it impracticable, the means of escape may be a ladder or ladders (depending on the number of persons to be evacuated), to the satisfaction of the Society.

5.1.5 Additional requirements

a) When it is not possible to cross from one side to the other of the ship, the requirements [5.1.2] to [5.1.4] are applicable to each side of the ship.

b) The stairways referred to in [5.1.2] and [5.1.3] (fire scenario - continuous fire shelter) are to be sized considering that the total number of persons to be evacuated use those stairways. Other stairways which may be added for compliance with requirement [5.1.4] but do not comply with [5.1.2] are not to be considered as main escape routes for fire scenario evacuation analysis.

5.1.6 Direct access to stairway enclosures

Stairway enclosures in accommodation and service spaces are to have direct access from the corridors and be of a sufficient area to prevent congestion, having in view the number of persons likely to use them in an emergency.

Within the perimeter of such stairway enclosures, only public toilets, lockers of non-combustible material providing storage for non-hazardous safety equipment are permitted.

Only public spaces, accommodation spaces of minor fire risk (category 6) as defined in Pt C, Ch 4, Sec 5, [1.2.3], item b), corridors, lifts, public toilets, pantries containing no cooking appliances, special purpose spaces and open ro-ro spaces to which

any embarked troops carried can have access, other escape stairways required by provisions [5.1.2] to [5.1.5] and external areas are permitted to have direct access to these stairway enclosures.

Small corridors or "lobbies" used to separate an enclosed stairway from galleys or main laundries may have direct access to the stairway provided they have a minimum deck area of 4,5 m^2, a width of not less than 900 mm and contain a fire hose station

5.1.7 Evacuation analysis

Escape routes are to be evaluated by an evacuation analysis early in the design process.

The analysis is to be used to identify and eliminate, as far as practicable, congestion which may develop during an abandonment, due to normal movement of embarked troops and crew along escape routes, including the possibility that crew may need to move along these routes in a direction opposite to the movement of embarked troops. In addition, the analysis is to be used to demonstrate that escape arrangements are sufficiently flexible to provide for the possibility that certain escape routes, assembly stations, embarkation stations or survival craft may not be available as a result of a casualty.

Note 1: For the application of the IMO Circular MSC.1/Circ.1533, the scenarios and given values such as Response duration (R), Total travel duration (T), Embarkation and launching duration (E+L), counterflow factor, walking speed, etc. may be replaced by more effective scenarios and values given by the Naval Authority.

5.1.8 Around the flight decks, corridors on open deck, giving access to a safe route to the assembly stations, are to be provided. The persons evacuating by these external corridors are to be protected from the liquids falling from the flight decks by a suitable gutter arrangement.

5.1.9 Minimum clear width of means escapes

a) Stairways are not to be less than 700mm in clear width. The minimum clear width of stairways is to increase by 10 mm for every person provided in excess of 70 persons. The total number of persons to be evacuated by such stairways is assumed to be two thirds of the total number of the crew and embarked troops in the areas served by such stairways.

b) Stairways are not to be less than 700mm in clear width. The clear width of the stairways is not to be inferior to the width calculated as per the Fire Safety Systems Code, Ch 13, 2.1.2, considering the distribution of persons given in [1.3] hereafter.

5.1.10 Vertical rise and inclination of stairways

Stairways are not to exceed 3,5 m in vertical rise without the provision of a landing. Their angle of inclination is to be in general 45°, but not greater than 50°, for the stairways used by embarked troops in normal operation.

5.1.11 Low-location Lighting systems

The requirements as defined in Pt C, Ch 4, Sec 8, [2.3.2] in item [g] shall be applied except for the photoluminescent systems exposed to a red lighting during 11 hours. Such photoluminescent equipment are to be also tested and applied with a red lighting. The luminance performance shall be at the satisfaction of the Society with the agreement of the Naval Authority.

5.2 Dispensation and application

5.2.1 When it is not practical to apply one requirement of the mentioned rules above, the arrangement is to be at the satisfaction of the Society with the agreement of the Naval Authority.

At least one assembly station and one embarkation station is to be provided for each vertical safety zone. The assembly stations shall have sufficient clear deck space to accommodate all persons assigned to muster at that station but at least 0,35 m^2 per person.

Note 1: The assembly stations and embarkation stations may include spaces such as corridors, landings of stairway enclosures, accommodation and service spaces but a an assembly station is not to include a control station, a machinery space, an ammunition space or a bottom of well dock. In any case, a space which requires a key for access can not be included in an assembly station or an embarkation station unless the key is enclosed in a beak-glass type enclosure conspicuously located an indicated near the normally locked access door.

5.3 Distribution of persons

5.3.1 For the application of the provision of the Fire Safety System Code, Chapter 13 [2.1.2.2.2.1], cases 1 and 2 are to be replaced by:

a) Case 1 (night time)

- the total number of the embarked troops in its cabins
- the total number of the members of crew not operating by watch in its cabins and berthing
- 2/3 of the members of the crew operating by watch in its cabins and berthing spaces, and service spaces
- 1/3 of the crew operating by watch in its service space.

b) Case 2 (day time)

- embarked troops in public space occupied to the maximum capacity
- 1/3 of the remaining embarked troops in its vehicles and aircrafts maintenance spaces
- 2/3 of the remaining embarked troops in cabins
- 1/4 of the members of crew not operating by watch in its public spaces
- 3/4 of the members of crew not operating by watch in its service spaces
- 1/3 of the crew operating by watch in its cabins and berthing spaces
- 1/3 of the crew operating by watch in its service spaces, and
- 1/3 of the crew operating by watch in its public spaces.

Note 1: For the application of the provision of Fire Safety System Code, Chapter 13 [2.1.2.1.4], the number of persons to be distributed in each public space is to be proportional to the deck area of these public spaces, as per the following formula:

$n = N \cdot a / A$

where:

N : Total number of persons to be distributed in the public spaces

a : Deck area of the selected public space

A : Total deck area of the public spaces available to the total number of persons to be distributed in the public spaces.

Note 2: Other cases of distribution of persons may be considered in replacement of, or in addition to, cases 1 and 2 above by more effective scenarios given by the Naval Authority.

6 Fire-extinguishing arrangement

6.1 Fire pump capacity

6.1.1 The capacity of each large capacity fire pump required by Pt C, Ch 4, Sec 6, [1.3.2] is to be not less than 100 m^3/h.

6.2 Sprinkler installation

6.2.1 A sprinkler system of an approved type and complying with the requirements of Pt C, Ch 4, Sec 14, [8] is to be fitted in all control stations, accommodation and service spaces.

Alternatively, control stations where water may cause damage to essential equipment, may be fitted with an approved fixed fire-extinguishing system of another type.

Spaces having little or no fire risk such as voids, public toilets, carbon dioxide rooms and similar spaces need not be fitted with a sprinkler system.

7 Flight decks

7.1 General

7.1.1 Fixed fire protection

The flight decks are to be protected by a fixed fire protection system for flight decks complying with the provisions of Pt C, Ch 4, Sec 14, [10].

7.1.2 Drainage facilities

In addition to the requirements of Pt C, Ch 1, Sec 10, [8.10.7], drainage facilities from flight decks are to comply with the requirements of Pt C, Ch 4, Sec 10, [3.2], as applicable to helidecks.

8 Well docks

8.1 General

8.1.1 Application

The requirements and the general provisions as defined in Pt C, Ch 4, Sec 13 for any vehicles, rescue boat or operational boats using internal combustion engines also with combustibles having a flash point below 60°C, shall be applied to well docks

8.1.2 Classification

Well docks are to be classified as category (14) “Special purpose spaces”.

8.1.3 Portable fire extinguishers

The provisions of Pt C, Ch 4, Sec 13, [4.2.1] are applicable except on the deck in submerged part during the amphibious operations, constituted by the bottom of well dock.

9 Ro-ro spaces

9.1 General

9.1.1 Application

The requirements and the general provisions for a ro-ro space as defined in Pt C, Ch 4, Sec 13 shall also be applied to any vehicles using internal combustion engines having combustibles with a flash point below 60°C.

9.1.2 Classification

Ro-ro spaces to be classified as category (14) "Special purpose spaces".

9.1.3 If a fixed water-based deluge system is used for ro-ro spaces, then a fire detection and fire alarm system identifiable to the same sections of the deluge system is to be arranged.

9.1.4 The fire detection and fire alarm system is to be designed with a system interface which provides logical and unambiguous presentation of the information, to allow a quick and correct understanding and decision-making. In particular, section numbering of the alarm system is to coincide with that of other systems, such as a fixed water-based fire-extinguishing system or video monitoring system, if available.

9.2 Video monitoring

9.2.1 An effective video monitoring system is to be arranged in the ro-ro space for continuous monitoring. The system is to be provided with immediate playback capability to allow for quick identification of fire location, as far as practicable. Cameras are to be installed to cover the whole space, high enough to see over cargo and vehicles after loading.

9.2.2 The videos recorded by this monitoring system are to be available for replay at a continuously manned control station or at the damage control station for at least seven days. The correspondence between any one video camera and the section of the fixed water-based fire-extinguishing system protecting the space covered by this camera are to be clearly displayed close to the video monitor. Continuous monitoring of the video image by the crew is not required.

10 Aircraft hangars

10.1 General

10.1.1 General definition

In addition to Ch 5, Sec 1, [1.2.8], the necessary services such as refuelling, defuelling, ammunition loading, oxygen loading can be handed on the aircrafts inside the aircraft hangar.

10.1.2 Application

a) The requirements and the general provisions for a ro-ro space as defined in Pt C, Ch 4, Sec 1, [2.32.1] are also applicable to an aircraft hangar except for the single requirement of Pt C, Ch 4, Sec 13, [2.1.1] for which the aircraft hangar can be considered as a closed vehicle space and therefore be provided with a ventilation system sufficient to give at least 6 air changes per hour.

b) Permanent openings in the side plating, the ends or deckhead of the space are to be so situated that a fire in the aircraft hangar does not endanger stowage areas and embarkation stations for survival craft and accommodation spaces, service spaces and control stations in superstructures and deckhouses above the aircraft hangar.

10.1.3 Protection of aircraft hangar access doors

Suitable means of fire-protection such as local water spraying systems are to be provided to the doors giving access to aircraft hangars from the open decks in order to withstand any projection of fired fuel oil from the flight decks.

10.1.4 Subdivided aircraft hangars

Where an aircraft hangar is internally divided into several sub-aircraft hangars by means of internal subdividing bulkheads extending across the full breadth of the aircraft hangar, the doors fitted in the subdividing bulkheads need not have A class integrity nor be made of steel, if agreed by the Society. However, when such a door does not have A class integrity or is not of steel construction, a water curtain capable of delivering at least 5 l/min/m^2 of water is to be provided on both sides of the bulkhead.

Indicators are to be provided at the damage control station showing whether these doors are open or closed.

10.1.5 Drainage facilities

Drainage from aircraft hangars directly to the sea is to be avoided as far as possible. In addition to the requirements of Pt C, Ch 1, Sec 10, [8.10.7], drainage facilities from aircraft hangars are to comply with the requirements of Pt C, Ch 4, Sec 10, [3.2.2].

10.1.6 Aircraft refuelling facilities

In addition to the requirements of Pt C, Ch 1, Sec 10, [11], aircraft refuelling facilities are to comply with the requirements of Pt C, Ch 4, Sec 10, [4.1], as applicable, to helicopter facilities.

10.2 Operational

10.2.1 Vehicles

Where vehicles such as cars, fire-fighting trucks (VLIP), trucks using internal combustion engine for their own propulsion are running or stored inside the aircraft hangar, their fuel is not to have a flash point below 60°C. At any time of operation, the total number of such vehicles in the aircraft hangar is to be such that the total power output of these vehicles does not exceed 0,02 kW/m^3.

For vehicules using electrical engines, their own propulsion are running or stored inside the aircraft hangar, the provisions in Ch 5, Sec 5, Tab 1Ch 5, Sec 5, Tab 1 are to be applied.

10.2.2 Battery charging

When some vehicle using electrical engines or other batteries are located in the aircraft hangar, the charging of such batteries will not be permitted in the aircraft hangar. The charging of such batteries is to be done in a dedicated spaces considered as a battery room.

10.2.3 Aircraft refuelling

The aircraft refuelling may be permitted inside the aircraft hangar if suitable safety devices are provided and safety procedures are ensured.

In case of aircraft refuelling operation inside the hangar, the dedicated area is to be fitted with a mechanical ventilation system providing at least 10 air changes per hour during the refuelling operations.

Ventilation fans are to be of non-sparking type.

10.3 Fire protection

10.3.1 Fire-fighting system

With regards to the risk analysis proceeded by the Naval Authority, the fire-fighting system required by Pt C, Ch 4, Sec 13, [4.1] may be replaced by a more suitable technical solution on the agreement of the Society.

11 Oxygen production

11.1 Oxygen production and storage installation

11.1.1 Where oxygen for aircraft breathing is produced aboard the ship, special consideration is to be given to the oxygen production and storage installation, with regard to fire prevention, containment of fire, ventilation, fire detection and fire fighting.

Where fitted, such installation is to be to the satisfaction of the Society.

Section 7 Facilities for Flammable Products with Flashpoint less or equal to 60 °C

1 General

1.1 Application

1.1.1 Amphibious vessels complying with the requirements of this Section may stored and delivered flammable liquids with flashpoint ≤ 60°C in limited amounts not exceeding the maximum oil product specified in [1.2.1].

1.2 Maximum capacity of flammable liquid with flashpoint ≤ 60°C

1.2.1 The total capacity of tanks designed to store oil product having is to be less than 1000 m^3.

1.3 Definitions

1.3.1 Petrol

The term "Petrol" is to be used to nominate oil products having flammable liquids with a flash point ≤ 60°C. This oil products are exclusively used to be delivered onboard, to tenders, rescue boats, operational boats, landing barges, road vehicules, aircrafts and dedicated carts to supply aircrafts.

1.3.2 Petrol area

With regards to the stowage of flammable liquids with flashpoint ≤ 60°C and corresponding requirements of this Section, the petrol area is that part of the ship where petrol and petrol vapours are likely to be present and includes petrol tanks, petrol slop tanks, petrol pump rooms, petrol delivery station, petrol delivery area, hold spaces in which independent tanks are located, cofferdams or void spaces surrounding integral tanks and the following deck areas:

- within 3 m of a petrol tank installed on deck
- within 3 m of a petrol tank outlet or access, in case of independent tanks installed below deck
- within 3 m of a petrol tank or petrol slop tank outlet or access in case of integral tanks installed below deck and separated from the weather deck by a cofferdam
- the deck area above an integral petrol tank, petrol slop tank without an overlaying cofferdam plus the deck area extending transversely and longitudinally for a distance of 3 m beyond each side of the tank
- within 3 m of any petrol liquid or vent pipe, flange, petrol valve, gas or vapour outlet, or entrance or exhaust to a petrol pump-room.
- within 3 m of any petrol delivery stations, petrol delivery areas with flexible hose under pressure or petrol vapour outlet fitting tanks of trucks, aircrafts, tenders or crafts.

1.3.3 Hazardous ares

The different spaces are to be classified according Tab 1.

1.3.4 Petrol delivery station

Petrol delivery station is a closed space in which the petrol refuelling facilities are fitted.

A petrol delivery station and petrol pump room dedicated to petrol refuelling may be located in the same space.

1.3.5 Petrol delivery area

Petrol delivery area is the area where the delivery of petrol is performed at vehicles, aircrafts or boats.

Petrol delivery area includes 3m around to the vehicle, aircraft or boat in which the petrol is supplied

1.3.6 Petrol pump room

Petrol pump room is a space containing pumps and their accessories for the handling of petrol.

A petrol pump room and petrol delivery station may be located in the same space.

1.3.7 Cofferdam

The cofferdam is a void space surrounding one or several tank, permitting to isolate a tank from adjacent spaces or areas.

Table 1 : Space descriptions and hazardous area zones for vessel using flammable liquids having a flash point not exceeding 60°C

No.	Description of petrol spaces	Hazardous area
1	Interior of petrol tanks, petrol slop tank, any pipework	Zone 0
2	Cofferdams	Zone 1
3	Petrol Pump room, delivery station or compartment for hoses	Zone 1
4	Areas on open deck or semi-enclosed spaces on open deck, within 3 m of any petrol tank outlet, petrol vent outlet, valve, pipe flange, petrol pump room ventilation outlets	Zone 1
5	Areas on open deck or semi-enclosed spaces on open deck, within 1.5 m of pump room entrance, pump room ventilation entrance, openings into cofferdam or other zone 1 spaces.	Zone 1
6	Enclosed or semi-enclosed spaces in which welded pipes containing petrol are located.	Zone 2
7	Petrol delivery areas on open deck or semi-enclosed spaces on open deck or in enclosed spaces, within 3m around the hoses used to filling operations and refueled tanks.	Zone 1
8	Areas of 1.5 surrounding a areas of zone 1	Zone 2
9	Areas on open deck extending to the coaming fitted to keep any spills on deck and away from the accommodation and service space and 3 m beyond these up to a height of 2,4 m above the deck	Zone 2

2 General arrangement

2.1 Compartment arrangement

2.1.1 Length of tanks

The length of each tank may not exceed 10 meters or one of the values of Ch 4, Sec 8, Tab 1, as applicable, whichever is the greater.

2.1.2 Segregation

The petrol tanks are to:

a) be segregated from others spaces no defined as petrol tanks or petrol slop tanks by means of a cofferdam,

b) have separate pumping and piping systems which may not pass through other tanks,

c) have separate tank venting systems.

The associated tanks, slop tanks, pump rooms, delivery stations and areas are to be as remote as is practical from accomodation spaces, escape routes and embarkation stations.

2.1.3 Restricting openings

Access doors, air inlets and openings to accommodation spaces, service spaces and control stations are not to face the petrol area.

2.2 Access arrangement

2.2.1 Tank and cofferdam

Access to cofferdam may be direct by pump-room. Access to tanks may be directly from pump room, through the cofferdam.

Note 1: Safe access to tanks or cofferdam shall be at means tohatches Their dimensions are to be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment. The minimum clear opening is to be not less than 600mm x600mm.

Note 2: Access shall be enable to the evacuation of an injured person from bottom of tanks or cofferdam.

2.2.2 Pump-room and delivery station

Access to pump-room or delivery stations is to be direct from an open deck

2.2.3 Access to the gas-safe spaces

Gas-safe spaces such as accommodation, service space, machinery and other similar spaces shall not have any direct communication with hazardous spaces as defined in [1.3.3].

2.3 Petrol tanks

2.3.1 Tank and associated equipment are to be surrounded by a cofferdam to protected it against physical damage and from a fire in an adjacent space or area.

2.3.2 Where independent tanks are used, special attention shall be given to:

- inspection procedures.
- location of the petrol tank, which are to be fitted on the weather deck or in the well dock, in zone where a suitable possibly removable containment coaming is to be fitted such as to prevent any spillage and/or leakages from flowing to gas-safe areas.
- storage of the tank, which are to be securely fastened to the hull structure.
- a space is to be left between tanks and ship sides sufficient to allow easy passage of ship personnel and transfer of fire-fighting arrangements.
- the petrol handling system serving portable tanks is to be such that liquid heads higher than those allowable for petrol tanks, if any served by the same system cannot occur.
- electric bonding.
- provision are to be made such that any portable tank is easily identifiable by means of markings or suitable plates.

2.4 Cofferdam

2.4.1 The cofferdams around the petrol tanks are to be fitted with:

a) a gas detection system with alarms centralized at the continuously manned damage control station

b) a fixed water-spraying fire-extinguishing system to water the bulkheads and ceiling, complying with the provisions of Pt C, Ch 4, Sec 14, [7], activated at least from the damage control station

c) a fixed means of flooding for submerging totally the space, activated at least from the damage control station

d) an effective power ventilation system, sufficient to give permanently at least 30 air changes per hour, to maintain hydrocarbon concentration below 2% by volume, with arrangement such as to prevent air stratification and formation of air pockets. The cofferdam may be fitted with a refrigerated air ventilation used to maintain the temperature of petrol tank under the 25°C.

e) or/and an inert system controlled from the damage control station. The inert gas system is to comply with the provisions of Ch 4, Sec 8, [4.5.4] or with another standard deemed acceptable by The Society.

The width of the cofferdams is to allow easy passage for inspection purposes.

3 Bilge

3.1 Bilge system

3.1.1 Petrol pump rooms, petrol delivery station and duct keels below or petrol slop tanks, hold spaces in which independent petrol tanks are installed and all hazardous space, dry cofferdams are to be served by an independent bilge pumping system entirely situated within the petrol area as defined in [1.3.2] and fitted with pumps or ejectors. No connection is permitted with the bilge system serving gas-safe spaces of the ship.

4 Petrol system

4.1 Petrol tanks

4.1.1 Level gauging

Each petrol tank or petrol slop tank is to be fitted with a remote level gauging system as defined in Ch 4, Sec 9, [4.5.2].

4.1.2 Overflow protected

Each petrol tank or petrol slop tank is to be fitted with a protection against tank overfilling system as defined in Ch 4, Sec 4, [5.5]

4.1.3 Venting

Petrol tanks and petrol slop tanks are to be provided with gas venting systems entirely separate from any vent pipes serving other compartments.

Such systems are to comply with the requirements of Ch 4, Sec 9, [4.5.3] and Ch 4, Sec 9, [4.5.4] for cargo tanks of auxiliary naval vessels.

4.2 Petrol delivery system

4.2.1 General

The area shall be provided for the petrol facilities and delivery area which shall be away of more than 3m from the accommodation spaces, service spaces, control stations and escape routes and evacuation stations accordance to [1.3.2]

The petrol facilities area shall be provided with arrangement whereby petrol spillage may be provided with collected and drained to a dedicated slop tank and isolated from any source of ignition, except to refuelling operation in well dock or close aboard.

Fixed arrangements are to be provided at the refuelling station for filtering and sampling.

4.2.2 Materials

Materials for construction of tanks, piping, valves fittings and pumps are to be of steel or iron cast.

4.2.3 Petrol piping system

The petrol piping system is to be installed, except as stipulated in [3.3.3], within the petrol tank and petrol independent tank area and is not to run through tanks and other compartments not belonging to the petrol area.

Where necessary, petrol piping is to be provided with joints or expansion bends.

Pipe lengths serving petrol tanks are to be provided with shut-off valves operable from petrol station.

In order to prevent any generation of static electricity, the outlets of filling lines are to be led as low as possible in the tanks. In opposite case, the offloading capacity shall be limited not more than 1m/s.

Inside the ship, pipe lengths serving between petrol pump room and petrol station are to be welding.

4.2.4 Petrol systems safeties

The delivery system is to be fitted with shutdown valve on petrol piping.

The shutdown valve is automatically closed, petrol pump stopped and audible alarm triggered if:

a) manual emergency stop buttons activation

b) refueled tank overflow/overpressure is detected automatically by an integrated system to the refueling installation

c) fire or concentration of gas hazard is detected

d) unusual overheating of the pump or no flow are detected.

The manual emergency stop buttons shall be provided close to each exit from delivery station and delivery area.

Where a gravity fuelling system is installed, equivalent closing arrangement shall be provided to isolate the petrol piping.

The fuel pumping system shall incorporate a device which will prevent over-pressurization of delivering hose.

4.3 Petrol pump room

4.3.1 The pump room is to comply with the applicable requirements for oil tankers. Refer to NR467, Pt D, Ch 7, Sec 4.

For the construction, installation and operation of petrol pumps, the applicable requirements for oil tankers are to be complied with. Refer to NR467, Pt D, Ch 7, Sec 4.

5 Petrol delivery facilities

5.1 General

5.1.1 Requirements of Pt C, Ch 4, Sec 12 are to be complied with.

5.2 Ventilation

5.2.1 The effective power ventilation system shall be sufficient to give at least 20 air changes per hour, during the petrol refuelling operations, inside the petrol delivery station and area, with arrangement such as to prevent air stratification and formation of air pockets.

The ventilator stop failure is to be connected to shutdown valve located before the flexible hose and is ti be fitted with a shutdown alarm centralized in the continuously manned damage control station.

Ventilation fans are to be of non-sparking type.

6 Fire and gas protection

6.1 Fire fighting system

6.1.1 Fixed system

In addition to the requirements of Pt C, Ch 4, Sec 12, [4], at least one foam portable extinguisher and one dry powder portable extinguisher shall be located at each access to delivery station.

6.1.2 Portable system

One foam applicator is to be connected to the hydrant located at least 10 m of each delivery area. This foam applicator shall be capable of delivering foam at a rate not less than 400l/min during at least 5 minutes.

6.2 Fire and gas detection system

6.2.1 General

Petrol areas, such cofferdam, pump room, delivery stations and delivery areas, except into the tanks and on the flight deck, are to be fitted with a fixed fire and gas detection system alarms. This system should be capable of indicating at the continuously

manned damage control station and in petrol areas, by audible and visual means the presence and location of a fire and an accumulation of flammable gas.

6.2.2 Fire detection system

The fire detection system are to be compliant with Pt C, Ch 4, Sec 13, [9]. The provisions regarding power supply, such required in Pt C, Ch 4, Sec 13, [9] to fire detection and fire alarm systems, shall be also required to gas detection and gas alarm systems.

A manually operated call points shall be provided close to each exit from delivery station and delivery area.

6.2.3 Gas detection system

The combustible gas detectors are to alarm at not more than 25% and at 60% of the lower explosive limit (LEL).

7 Electrical installations

7.1 Hazardous locations and types of equipment

7.1.1 In addition to the general requirements of Ch 5, Sec 5, electrical equipment and hazardous areas definitions are to comply with requirements of NR467, Pt D, Ch 7, Sec 5, [2].

7.1.2 Static electric discharge risk

To avoid static electric discharge at connection of hose, the metallic tanks of road vehicle, carts, tenders, boats, barges or aircrafts shall be connected to the hull structure of ship. The cable square section is to be minimum 6mm^2.

7.1.3 Radio electric discharge risk

To avoid fire ignition risk, in addition to the requirement **Pt C, Ch 4, Sec 10, [4.2]**, “No radio” signs shall be displayed at appropriate locations, around the filling points to prohibit to use radio devices.

8 Operation manual

8.1 General

8.1.1 Manual operation

Each petrol facilities shall have an operations manual, including a description and a checklist of safety precautions, procedures and equipment requirements. This manual may be part of the ship’s emergency response procedures.

The procedures and precautions to be followed during refueling operations shall be in accordance with recognized safe practices and contained in the operations manual.

CHAPTER 6
MILITARY OFFSHORE PATROL VESSEL

Section 1 General

Section 2 Hull and Stability

Section 3 Machinery and Systems

Section 4 Electrical Installations and automation

Section 5 Fire Protection

Section 1 General

1 General

1.1 Application

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **military OPV**, as defined in Pt A, Ch 1, Sec 2, [4.7].

1.1.2 The applicable set of requirements are governed by the following main characteristics:

- rule length
- high speed criteria, as defined in [1.2.1]
- hull material (steel, aluminium or composites).

1.1.3 Ships dealt with in this Chapter are to comply with:

- Part A
- the applicable requirements according to Tab 1
- NR216 Materials and Welding, as applicable.

Table 1 : Applicable requirements

Item		L ≥ 60 m	L < 60 m
Ship arrangement		• Part B, Chapter 1 Part B • Articles [2] and [3]	• NR566**(1)** • Articles [2] and [3]
Hull**(1)**	Slow speed	• Part B • Ch 6, Sec 2	• Part B • Ch 6, Sec 2
	High speed	• Part B • Ch 3, Sec 2 • Ch 6, Sec 2	• Part B • Ch 3, Sec 2 • Ch 6, Sec 2
Stability		• Part B	• NR 566**(2)**
Machinery and systems		• Ch 3, Sec 3	• NR 566**(2)** • Ch 6, Sec 3
Electrical installations and automation		• Part C • Ch 6, Sec 4	• NR566**(2)**
Fire protection, detection and extinction		• Part C • Ch 3, Sec 5**(1)**	• NR566**(2)** • Ch 6, Sec 5 **(3)**
(1) Case-by-case examination for hull in composites. **(2)** Requirements to be applied, except the specific rules for passenger ships not to be taken into account. **(3)** Special consideration will be given with regard to escape and circulation for ships carrying more than 60 persons. **Note 1:** NR566: Hull Arrangement, Stability and Systems for Ships less than 500 GT.			

1.2 Definitions

1.2.1 High speed criteria

Offshore patrol vessels are considered complying with the high speed criteria when the following condition is fulfilled:

$V \geq 7{,}16\ \Delta^{1/6}$

where

V : Maximum ahead service speed V, in knots, at displacement Δ defined below

Δ : Moulded displacement, in tons, in full load condition “end of life”.

Offshore patrol vessels complying with the above criteria are considered High speed.

Offshore patrol vessels not complying with the above high speed criteria are considered Slow speed.

2 Double bottoms

2.1 General

2.1.1 A double bottom is to be fitted extending from the collision bulkhead to the after peak bulkhead, as far as this is practicable and compatible with the design and proper working of the ship.

2.1.2 Any part of a naval ship not fitted with a double bottom in accordance with [2.1.1] shall be capable of withstanding bottom damages as specified in [2.1.3].

2.1.3 Compliance with [2.1.2] is to be achieved by demonstrating that, for the loading conditions defined in Pt B, Ch 1, Sec 2, [5.2] to Pt B, Ch 1, Sec 2, [5.4], when the ship is subjected to a bottom damage assumed to be at any position along the bottom with an extent specified in Tab 2 for the affected part of the ship:

- the GZmax is greater than or equal to 0,12m
- the range is greater than or equal to 16°, and
- the heel at the equilibrium is less than or equal to 15°.

Table 2 : Bottom damage extent

Longitudinal extent	1/3 $L^{2/3}$
Transverse extent	B/6
Vertical extent measured from the keel line	B/20 with a minimum of 760 mm

3 Doors in watertight bulkheads

3.1 Application

3.1.1 In case of ships where a single deck acts as watertight deck as defined in Pt B, Ch 1, Sec 2, [6.4] and as bulkhead deck as defined in Pt B, Ch 1, Sec 2, [6.2], the requirements of [3.2] apply.

3.1.2 For ships with a watertight deck and a bulkhead deck, the requirement of Pt B, Ch 2, Sec 1, [6] are applicable.

3.2 Doors below the watertight deck

3.2.1 General

Doors provided to ensure the watertight integrity of internal openings which are normally closed at sea are to be sliding watertight doors capable of being remotely closed from the bridge and are also to be operable locally from each side of the bulkhead. Indicators are to be provided at the control position showing whether the doors are open or closed, and an audible alarm is to be provided at the door closure. The power, control and indicators are to be operable in the event of main power failure. Particular attention is to be paid to minimise the effect of control system failure. Each power-operated sliding watertight door is to be provided with an individual hand-operated mechanism.

If indicated in the specification, hinged watertight doors may be accepted in lieu of watertight sliding doors. Those hinged watertight doors are to be fitted with open/closed/locked indicators locally and at the wheelhouse and a notice on both sides to indicate that these doors are to be kept closed at sea (open for the passage and immediately closed after).

3.2.2 Openings permanently kept closed at sea

Doors provided to ensure the watertight integrity of internal openings which are kept permanently closed at sea may be hinged watertight doors. They are to be provided with a notice which is to be affixed to each such closing appliance to the effect that it is to be kept closed. Manholes fitted with closely bolted covers need not be so marked.

Section 2 Hull and Stability

1 General

1.1 Application

1.1.1 The provisions of this Section apply to the ships having the service notation **military OPV**.

1.1.2 The requirements for structure of ships built in composites are to be defined on a case-by-case basis.

1.1.3 The applicable requirements are given in Ch 6, Sec 1, Tab 1.

1.1.4 If applicable, the additional requirements given in Articles [2] and [3] are also to be complied with.

2 Stability

2.1 General

2.1.1 Offshore patrol vessels may be assigned the service notation **military OPV** only after it has been demonstrated that their stability is adequate.

Adequate stability means compliance with standard laid down by the relevant Naval Authority or with the requirements specified in this Section.

In any case, the level of stability is not to be less than that provided by the Rules.

2.2 Intact stability

2.2.1 Regarding intact stability, ships granted with the service notation **military OPV** are to comply with:

- NR566, Ch 1, Sec 3, [2] for ships with length less than 60 m
- Pt B, Ch 3, Sec 2 for ships with length greater than or equal to 60 m.

2.3 Damage stability

2.3.1 Regarding damage stability, ships granted with the service notation **military OPV** are to comply with:

- NR566, Ch 1, Sec 3, [3] as applicable to cargo ships, for ships with length less than 60 m
- Pt B, Ch 3, Sec 3 for ships with length greater than or equal to 60 m.

3 Structure

3.1 Structure in way of weapons systems - All vessels

3.1.1 The weapons firing dynamic loads are to be taken according to Pt B, Ch 5, Sec 6, [9].

3.1.2 The requirements for plating in way of weapon systems are given in Pt B, Ch 7, Sec 1, [2], Pt B, Ch 7, Sec 1, [3] and Pt B, Ch 7, Sec 1, [5], as applicable.

3.1.3 The requirements for ordinary stiffeners in way of weapon systems are given in Pt B, Ch 7, Sec 1, [2] and Pt B, Ch 7, Sec 1, [4], as applicable.

3.1.4 The requirements for primary supporting members in way of weapon systems are given in Pt B, Ch 7, Sec 3 and Pt B, Ch 7, Sec 1, [2], as applicable.

3.2 Aft ramp - All vessels

3.2.1 Plating of the aft ramp and the lower part of the aft ramp side

The gross thickness of plating of the aft ramp and the lower part of the aft ramp side is to be increased with respect to that calculated according to Ch 6, Sec 1, Tab 1, for side plating with the same plate panel dimensions.

The gross thickness addition is to be taken not less than:

- 1 mm for steel material
- 2 mm for aluminium alloy material.

3.2.2 Plating of the upper part of the aft ramp side

The thickness of plating of the upper part of the aft ramp side is to be not less than the value calculated according to Ch 6, Sec 1, Tab 1 for side plating with the same plate panel dimensions.

3.3 Deck structure in way of launching appliances used for special force craft - All vessels

3.3.1 The scantlings of deck secondary stiffeners and primary supporting members are to be determined by direct calculations.

3.3.2 The loads exerted by launching appliance are to correspond to the SWL of the launching appliance.

3.3.3 The combined stress, in N/mm^2, is not to exceed the smaller of $R_{eH}/(2,2\ \varphi)$ and $R_m/(4,5\ \varphi)$,

where:

R_{eH} : Minimum yield stress of the primary supporting member material, in N/mm^2. For aluminium structure, welded condition has to be considered

R_m : Ultimate minimum tensile strength of the primary supporting member material, in N/mm^2. For aluminium structure, welded condition has to be considered

φ : Dynamic safety factor, to be taken equal to:

- 1,0 if the special force craft is intended for launching with mother ship ahead speed of 5 knots and in calm water
- the value to be specified by the Designer if the special force craft is intended for launching with mother ship speed more than 5 knots or in severe sea condition. This value is not to be less than 1,1.

3.4 Vessels with length more than 24 m and less than 60 m

3.4.1 Applicable Rules

Unless otherwise specified in this Section, the requirements of Part B are applicable.

In addition, for High speed ships as defined in Ch 6, Sec 1, [1.2.1], the requirements of Ch 3, Sec 2 are applicable.

3.4.2 Hull girders loads

The requirements of Pt B, Ch 5, Sec 2 are to be applied, considering:

$C = (118 - 0,36\ L)\ L / 1000$

3.4.3 Flooding loads

The requirements of Pt B, Ch 5, Sec 6 are to be applied, with:

d_0 : Distance, in m, to be taken equal to:

$d_0 = 1,3$ m.

3.5 Vessels with length less than or equal to 24 m

3.5.1 Applicable Rules

Unless otherwise specified in this Section, the requirements of Part B are applicable, with the exception of Part B, Chapter 6.

In addition, for High speed ships as defined in Ch 6, Sec 1, [1.2.1], the requirements of Ch 3, Sec 2 are applicable.

3.5.2 Hull girders loads

The requirements of Pt B, Ch 5, Sec 2 are to be applied, considering:

$C = (118 - 0,36\ L)\ L / 1000$

3.5.3 Flooding loads

The requirements of Pt B, Ch 5, Sec 6 are to be applied, with:

d_0 : Distance, in m, to be taken equal to:$d_0 = 1,3$m.

3.5.4 Hull scantlings

The requirements of Part B, Chapter 7 and Part B, Chapter 8 are to be applied, with:

σ_{x1} : In-plane hull girder normal stress, in N/mm^2:$\sigma_{x1} = 0$

τ_1 : In-plane hull girder shear stress, in N/mm^2:$\tau_1 = 0$

R_y : Minimum yield stress of the material, in N/mm^2, to be taken equal to:

$R_y = \gamma_{x1}\ 235 / k$

with γ_{x1} as defined in Tab 1.

Table 1 : Coefficient γ_{x1}

Element	γ_{x1}
Plates contributing to the hull girder strength	0,95
Secondary stiffeners or primary supporting members contributing to the hull girder strength	0,90
Elements not contributing to the hull girder strength	1,00

Section 3 Machinery and Systems

1 General

1.1 Application

1.1.1 The provisions of this Section apply to ships having the service notation **military OPV**.

1.1.2 The applicable requirements are given in Ch 6, Sec 1, Tab 1.

2 Additional requirements for OPV with length less than 60 m

2.1 Prevention of progressive flooding

2.1.1 Requirements of Pt C, Ch 1, Sec 10, [5.5] apply.

2.2 Bilge pumping arrangement

2.2.1 Pt C, Ch 1, Sec 10, [6] is to be applied instead of NR566, Ch 2, Sec 5, [1], unless otherwise specified in [2.2.2] and [2.2.3].

2.2.2 An oily bilge water draining system is not required.

Therefore, offshore patrol vessels of length less than 60 m are not to comply with the following requirements:

- Pt C, Ch 1, Sec 10, [6.2.1], item a)
- Pt C, Ch 1, Sec 10, [6.2.2], item c)
- Pt C, Ch 1, Sec 10, [6.5.4]
- Pt C, Ch 1, Sec 10, [6.6.1], item a)
- Pt C, Ch 1, Sec 10, [6.6.3], item a)
- Pt C, Ch 1, Sec 10, [6.7.1].

2.2.3 At least two bilge suctions are to be provided for draining the propulsion engine room. At least one of the suction is to be connected directly to a bilge pump.

2.3 Capacity of fuel oil service tanks

2.3.1 Pt C, Ch 1, Sec 10, [11.9.2] is to be applied instead of NR566, Ch 2, Sec 6, [4.2.2].

Section 4 Electrical Installations and automation

1 General

1.1 Application

1.1.1 The provisions of this Section apply to ships granted with the service notation **military OPV** and with a length greater than or equal to 60 m. These requirements are additional to those of Part C, Chapter 2 and Part C, Chapter 3.

1.1.2 The text “at every muster station” in Pt C, Ch 2, Sec 3, [3.6.3], item a) is to be replaced by “at main and emergency evacuation stations, as defined in Ch 3, Sec 5, [1.2.1] and Ch 3, Sec 5, [1.2.2]”.

Section 5 Fire Protection

1 General

1.1 Application

1.1.1 Unless otherwise specified, the provisions of this Section apply to the ships granted with the service notation **military OPV** and having a length less than 60 m.

1.1.2 Applicable Rules

Ships dealt with in this Section are to comply with the Rules stipulated in Ch 6, Sec 1, Tab 1, according to the length of the ship. The requirements of this Section are to be applied in addition.

1.2 Definitions

1.2.1 Control stations

For the application of this Section, the definition given in NR566, Ch 4, Sec 1, [4.4.8] is to be completed by:

"Rooms containing naval systems, as detection, command or weapon control operating room, except technical spaces not normally manned, are to be categorized as control stations.

Spaces containing network cabinets for computer and control centers, electronic cabinet systems or control computers managing data related to the control of the ship.

Spaces containing the ship's radio equipment for safety or ship navigation communication are to be categorized as control stations. Spaces containing radio equipment for other purposes need not be categorized as control stations."

1.2.2 Open deck

For the application of this Section, the definition of category (10) given in NR566, Ch 4, Sec 4, [2.2.2], item b), 2) is to be completed by:

"Open deck spaces for the stowage of any embarkation such as tender or special force craft".

1.2.3 Evacuation stations

The evacuation stations are the areas from which the persons to be evacuated have access to the liferafts when launched at sea.

1.2.4 Machinery spaces

For the application of this Section, the definition given in NR566, Ch 4, Sec 1, [4.4.15] is to be completed by:

"The spaces containing naval systems, not normally manned, are to be considered as machinery spaces".

1.2.5 Ammunition spaces

Ammunition spaces are defined in Pt C, Ch 4, Sec 1, [2.4].

Note 1: The ready for use lockers located on open deck may be not considered as ammunition spaces.

2 Suppression of fire

2.1 Detection and alarm

2.1.1 Protection of ammunition spaces

Ammunition spaces are to be provided with a fixed fire detection and alarm system complying with the requirements of Pt C, Ch 4, Sec 3, [4].

When the required smoke detector cannot be contained into the ammunition lockers, this detector is to be installed into the space where the ammunition lockers are located.

2.2 Fire containment

2.2.1 Space categorisation

When the mast contains one radio or a navigation equipment as required by SOLAS or by the Naval Authority, including the one for flight assistance, it is to be categorized as control station.

2.2.2 Fire integrity of ammunition spaces

The bulkheads and decks of ammunition spaces are to be insulated to A-30 standard. Fire insulation for the boundaries of ammunition spaces is to be installed outside of the ammunition spaces as much as possible.

When an ammunition space is adjacent or above a water tank, or adjacent to the shell of the ship below the lowest possible waterline, only A-0 standard is required.

2.2.3 Ventilation systems

a) Ventilation systems intended to be used during normal operation are to comply with the requirements of NR566, Ch 4, Sec 4, [5] and with the applicable requirements of the present Sub-Article.

These requirements are not intended to apply to alternative configurations used solely in casualty situations. In any case, arrangements intended for use solely in casualty situations are not to impair compliance of the ventilation systems intended for normal operation with the requirements of NR566, Ch 4, Sec 4, [5] and with the applicable requirements of the present sub-article.

b) For ships provided with CBRN protection, parts of the ventilation system not fully complying with the requirements NR566, Ch 4, Sec 4, [5] and with those of the present sub-article may be accepted provided that:

- they are used solely during CBRN operation, and suitably marked to this end, and
- they are separated from parts of the ventilation system that will be used during normal operation, to the satisfaction of the Society, and
- the ventilation system in use during normal operation is fully compliant with the requirements of the present Article, and
- suitable arrangements are provided to prevent the fire extinguishing medium, especially CO_2, from leaving the protected space in case of release during CBRN operation or normal operation.

Attention is drawn to the provisions of Pt E, Ch 8, Sec 3, [2] for ships to be assigned the **CBRN** additional class notation.

2.2.4 Ventilation systems for ammunition spaces

The ventilation systems serving ammunition spaces shall be separated from the ventilation systems serving other types of space. No ventilation duct shall pass through any ammunition space except the ducts provided for the ventilation of this ammunition space. Torpedo magazines shall be provided with a dedicated ventilation system capable of being stopped locally.

Note 1: If a common duct serves several ammunition spaces, this common duct is to be located outside the served spaces.

Ducts provided for the ventilation of ammunition spaces shall not pass through other spaces unless the ducts are constructed of steel and arranged to preserve the integrity of the division.

The capacity of the ventilation systems serving ammunition spaces are to comply with the requirement of Pt C, Ch 4, Sec 5, [6.7.1].

2.2.5 Fuel oil with a flashpoint less than 43°C

Use and storage of fuel oil having a flash point less than 43°C may be accepted only for special force craft or unmanned aircraft, as per arrangement specially reviewed by the Society.

The aggregate quantity on board of such fuel oil is to be as low as possible and properly justified.

2.3 Fire fighting

2.3.1 Fixed fire-extinguishing systems in ammunition spaces

Ammunition spaces are to be provided with a fixed fire-extinguishing system complying with the requirements of Pt C, Ch 4, Sec 6, [6.1].

2.3.2 Fire-fighter outfits

The ship is to be provided with at least four fire-fighter outfits with a minimum of two two-way portable radiotelephone apparatuses for communication between fire-fighters. Those two-way portable radiotelephone apparatuses are to be of an explosion proof type and intrinsically safe.

Fire-fighter outfits are to comply with Pt C, Ch 4, Sec 6, [8.1]

Fire-fighter outfits are to be stored so as to be easily accessible and ready for use, in at least two separated locations.

2.3.3 Fire pumps

The requirement of NR566, Ch 4, Sec 5, [2.2.1] and Ch 4, Sec 5, [2.2.3] are to be replaced by the following provisions:

a) The total capacity of the fire pumps is to be sufficient to supply simultaneously two hydrants and the most demanding fire-fighting system using the fire main.

b) At least two independently powered fixed fire pumps are to be provided. The arrangement of sea connections, pumps and their sources of power is to be such as to ensure, in the event of a fire in any one compartment, that all the fire pumps will not be put out of actions.

2.3.4 International shore connection

At least one international shore connection complying with Pt C, Ch 4, Sec 6, [1.2.7] is to be provided.

3 Escape and circulation

3.1 Application

3.1.1 Limitation

The requirements of [3.2] are applicable for the ships with a maximum complement of less than 60 persons.

Special consideration is to be given by the Society to ships carrying more than 60 persons.

3.2 Means of escape from control stations, accommodation spaces and service spaces

3.2.1 Escape from spaces below the bulkhead deck

The requirements of NR566, Ch 4, Sec 6, [4.1.1] are to be completed by the following provisions:

"At least one of the means of escape from accommodations and service spaces below the open deck is to be a stairway sized as per [3.2.2]".

3.2.2 Details of stairways, ladders and deck hatches

The minimum clear width of a stairway between its handrails is to be 560 mm and of a ladder between its vertical main frames is to be 300 mm.

Stairways are inclined ladders having an angle not more than 70° from the horizontal.

In addition, consideration is to be given to the minimum net free passage in order that a fire-fighter with his complete equipment or an injured person on a stretcher can easily pass through a deck hatch.

3.2.3 Detail of passageways

The minimum clear width (as defined in Pt C, Ch 4, Sec 8, [4.1.1]) of a bulkhead hatch or a doorway is to be 700 mm.

3.2.4 Evacuation station

At least one evacuation station as defined in [1.2.3] is to be provided and have a clear deck of 0,35m^2 per person.

CHAPTER 7
LANDING CRAFTS

Section 1 General

Section 2 Hull and Stability

Section 3 Machinery and Systems

Section 4 Fire Protection

Section 1 General

1 General

1.1 Application

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **landing craft** as defined in Pt A, Ch 1, Sec 2, [4.8].

1.1.2 The applicable set of requirements are governed by each of the following main characteristics:

- ship is able to be docked inside the well dock of a mother ship
- rule length
- high speed criteria
- hull material.

Ships not designed to be berthed aboard a mothership are not covered by the notation **landing craft**.

Ships with rule length equal or more than 60m are not covered by the notation **landing craft**.

1.1.3 Ships dealt with in this Chapter are to comply with:

- Part A
- NR216 Materials and Welding, as applicable.
- the applicable requirements according to Tab 1

Table 1 : Applicable requirements

Item	Reference
Ship arrangement	• Article [2] • NR566 **(1)**
Hull	• Ch 7, Sec 2
Stability	• Ch 7, Sec 2
Machinery and systems	• NR 566, Ch 2 **(1)** • Ch 7, Sec 3
Electrical installations and automation	• NR566, Ch 3 **(1)**
Fire protection, detection and extinction	• NR 566, Ch 4 **(1)** • Ch 7, Sec 4
(1) Relevant requirements to be applied, except the specific requirements for passenger ships not to be taken into account. **Note 1:** NR566: Hull Arrangement, Stability and Systems for Ships less than 500 GT.	

1.2 Documentation to be submitted

1.2.1 In addition to the documentation relevant to other Rules requirements referenced in this chapter, the plans and documents to be submitted to the Society are listed in Tab 2.

Table 2 : Documentation to be submitted

No	I / A **(1)**	Description of document
1	I	General arrangement drawing
2	I	Operating manual as per [2.3.1]
3	I	Drawings of the mothership, if applicable, showing dimensions and interfaces relevant to classification of the landing craft
(1) I= for Information, A = for Approval		

2 Specific characteristics of landing crafts

2.1 Capacity to dock on the well deck of a mother ship

2.1.1 Overall dimensions of ship

Overall dimensions of ship shall be clearly mentioned in the drawings submitted. If the ship is fitted with retractable devices used when moving inside or outside a mothership, overall dimensions in these configurations shall also be clearly mentioned on drawings. When the mothership is already known and the limits for overall dimensions of the landing craft are mentioned inside the request for classification, these values can be compared to those mentioned on drawings and their validity assessed by the optional mention **-MOTHERSHIP(name of mother ship class)**.

2.1.2 Hull and appendices

Geometry of hull and appendices shall enable the docking of the ship on a plane surface without damaging any pieces of equipment or part of the ship structure. When docked, the ship shall be able to stay in a stable position without using any additional artefact.

2.1.3 Lashing

Securing points shall be arranged on the ship structure in order to keep the ship in a steady position thanks to securing devices when berthed inside the mother ship well deck.

2.2 Capacity to operate landing operations

2.2.1 Structure of ship adapted to landing operation

Bottom area is to be reinforced in beaching area according to Ch 7, Sec 2, [3.3].

In addition, the transom area might have to be reinforced against breaking waves in the surf zone, according to Ch 7, Sec 2, [3.3].

2.2.2 Ramp operation

In the present Chapter, it is considered that the bow ramp and the bow door are same equipment.

2.2.3 Capacity of ship to maintain herself in a steady position during landing operation

Means shall be available to keep ship on a steady position during landing operation. One or several of the following technical solutions shall be used:

- stern anchor(s)
- means of propulsion offering possibility to modify quickly direction of thrust when the speed of ship is equal to zero
- other solution with equivalent result.

2.2.4 Capacity to deliver on shore troops and equipment

Scantlings of external ramps are to comply with requirement of Ch 7, Sec 2, [3.2].

2.2.5 Capacity to maintain ship power production during landing operation

Specific requirements of Ch 7, Sec 3 are to be fulfilled.

2.2.6 Capacity to leave the beaching position after landing operation

Leaving beaching position, so-called de-beaching in the present Rules, could be achieved by several means (self-propulsion, push-out from the beach, pull-out from the craft, etc.), that must be formally defined and given as operating procedures, according to [2.3.1].

Specific requirements are to be complied with, according to Ch 7, Sec 2, [3.4].

2.3 Safe operation limits

2.3.1 Operating manual

Operations are to be defined in an Operating Manual detailing the operating procedures and the limitations for safe operation. This Operating Manual is to be made available on board.

Section 2 Hull and Stability

1 General

1.1 Application

1.1.1 The provisions of this Section apply to the ships having the service notation **landing craft**.

2 Stability

2.1 General

2.1.1 Considered vessels may be assigned the service notation **landing craft** only after it has been demonstrated that their stability is adequate.

Adequate stability means compliance with standard laid down by the relevant Naval Authority or with the requirements specified in this Section.

In any case, the level of stability is not to be less than that provided by the Rules.

2.1.2 High speed criteria

Landing crafts are considered complying with the high speed criteria when the following condition is fulfilled:

$V \geq 7{,}16\ \Delta^{1/6}$

where

V : Maximum ahead service speed V, in knots, at displacement Δ defined below

Δ : Moulded displacement, in tons, in full load condition “end of life”.

Landing crafts complying with the above criteria are considered high speed.

Landing crafts not complying with the above high speed criteria are considered slow speed.

2.2 Intact stability

2.2.1 The intact stability is to comply with the provisions of NR467, Part B, Chapter 3 for the loading conditions mentioned in [2.2.2], except when specified otherwise.

2.2.2 The following loading conditions have to be considered for the purpose of the stability calculations:

- ship in the fully loaded departure condition with the maximum weight of cargo and embarked troops homogeneously distributed on the dedicated spaces, with full fuel
- ship in the light arrival condition without cargo nor embarked troops, with 10% remaining fuel

2.2.3 Ice accretion

For the purpose of calculating the ice accretion, when applicable, the following values are to be used:

- 15 kg/m^2 on exposed weather decks and gangways
- 7,5 kg/m^2 for the projected lateral area on each side of the ship above the waterplane.

2.2.4 Cargo Space

For landing craft with open cargo space, the drainage system has to comply with the applicable requirements of regulation 24, paragraphs 1(b), 1(c), (4) to (6) of the International Load Line Convention, as modified by the Protocol. Alternatively, an additional amount of water equal to 0,10m above the cargo deck is to be considered for the intact stability calculations.

For landing craft with closed cargo space and fitted with a single bow door creating a possible entry of water, the stability of the ship has to be evaluated with an additional amount of seawater on the cargo deck, having a height equal to 0,30m. For this condition, the following stability criteria are to be complied with:

- the positive righting lever curve should have a minimum range of 7° beyond the angle of equilibrium
- the metacentric height (GM) should be positive
- the righting lever (GZ) is to be at least 0.05 m within the positive range.

The results of model tests may be used to determine the quantity of green water to be considered in the above calculations for open or closed cargo space, associated with a quantity of rainfall equal to 100 mm/hour.

2.3 Damage stability

2.3.1 Taking into account as initial conditions before flooding, the loading conditions defined in [2.2.2], the ship is to comply with the damage stability criteria as specified in [2.3.8], for the damage dimensions defined in [2.3.2].

2.3.2 The extent of damage is assumed to occur anywhere:

a) for side damage: on the ship's length between watertight transverse bulkheads spaced at a distance of not less than the longitudinal extent of damage specified in Tab 1

b) for bottom damage: for 0,3L from the forward perpendicular of the ship, between watertight transverse bulkheads spaced at a distance of not less than the longitudinal extent of damage specified in Tab 1.

High speed landing craft (as defined in [2.1.2]) are to consider that the damage occur anywhere along the ship's length.

Table 1 : Extent of damage

	Longitudinal extent	Transverse extent	Vertical extent
Side damage	3 + 3% L	B/5**(1)**	Full depth**(2)**
Bottom damage (For 0,3 L from the forward perpendicular of the ship)	1/3 $L^{2/3}$	B/6	B/12
(1) Measured inboard from the side of the ship perpendicularly to the centerline at the level of the summer waterline. **(2)** From the moulded line of the bottom shell plating at centerline upwards without limit.			

2.3.3 If pipes, ducts trunks or tunnels are situated within the assumed extent of damage, arrangements are to be made to ensure that progressive flooding cannot thereby extend to compartments other than those assumed to be floodable for each case of damage.

2.3.4 If damage of a lesser extent than that specified in [2.3.2] results in a more severe condition, such lesser extent is to be assumed.

2.3.5 The permeability of spaces assumed to be damaged is to be as indicated in Tab 2.

Table 2 : Values of permeability

Spaces	Permeabilities
Appropriated to cargo	by calculation but not less than 0,60
Appropriated to stores	0,60
Occupied by accommodation	0,95
Occupied by machinery	0,85
Void spaces, empty tanks	0,95
Intended for liquids	0 to 0,95**(1)**
(1) See [2.3.6].	

2.3.6 The permeability of partially filled compartments shall be consistent with the amount of liquid carried in the compartment. Whenever damage penetrates a tank containing liquids, it shall be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

2.3.7 Compliance with the requirements of [2.3.8] is to be confirmed by calculations which take into consideration the design characteristics of the ship, the arrangements, configuration and permeability of the damaged compartments and the distribution, specific gravities and free surface effect of liquids.

2.3.8 Ships are to be capable of surviving the assumed damage and the standard specified in [2.3.2], for the loading conditions defined in [2.2.2] in a condition of stable equilibrium and such as to satisfy the following criteria:

a) The final waterline, taking into account sinkage, heel and trim, is to be below the lower edge of any opening through which progressive flooding may take place. Such openings include air-pipes, ventilators and openings which are closed by means of weathertight doors or hatch covers but may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors and sidescuttles of the non-opening type.

b) In the final stage of flooding, the angle of heel due to unsymmetrical flooding should not exceed 7° when the cargo is not lashed with arrangements capable of preventing any shifting, and 15° otherwise.

c) The initial metacentric height of the ship in the final stage of flooding for the static equilibrium position in case of symmetrical flooding and for the upright position in case of unsymmetrical flooding as calculated by constant displacement method should not be less than 0,05 m before appropriate measures to increase the metacentric height have been taken.

d) The righting lever curve at the final stage of flooding should have a minimum range of 10° associated with a maximum righting equal or greater to the maximum between:

- 0,05m
- heeling moment / displacement, where heeling moment is the moment due to the crowding of the embarked troops after damage.

  For the purpose of calculating the heeling moment of crowding of embarked troops, the following assumptions shall be made:
  - 4 persons per square meter
  - a mass of 90kg for each person.
  - the persons shall be distributed on the available spaces in such away that they produce the most adverse heeling moment.

Unprotected openings may not become immersed at an angle of heel within the prescribed minimum range of residual stability unless the space in question has been included as a floodable space in calculations for damage stability. Within this range, immersion of any of the openings referred to in item a), and any other openings capable of being closed weathertight may be authorised.

e) The stability is to be sufficient during the intermediate stages of flooding. In this regard the Society applies the same criteria relevant to the final stage of flooding also during the intermediate stages of flooding.

3 Structure

3.1 General

3.1.1 Applicable Rules

Unless otherwise specified in this Section, the landing craft structure is to meet the relevant requirements of NR600, except NR600, Ch 2, Sec 2.

Note 1: NR600 Hull Structure and Arrangement for the Classification of Cargo Ships less than 65 m and Non Cargo Ships less than 90 m.

3.1.2 The navigation coefficient n which appears in the formulae of NR600 are defined in Tab 3 depending on the assigned navigation notation.

Table 3 : Navigation coefficient n

Navigation notation	Navigation coefficient n
coastal area	0,80
sheltered area	0,65

3.2 Additional requirements for external ramps

3.2.1 General

It is assumed that the ramps are not lifted with vehicles on the ramp.

The external ramps are to be able to operate with a heel angle of 5° and a trim angle of 2°.

The thicknesses of plating and the scantlings of ordinary stiffeners and primary supporting members are to be determined:

- under vehicle loads in harbour condition, at rest, as defined in NR600, Ch 5, Sec 2, Tab 1
- under sea pressure, and slamming pressure if relevant, in lifted position and locked at sea.

The locking of external ramps in lifted position at sea is examined by the Society on a case by case basis.

The ship's structure under the reactions due to the ramp is examined by the Society on a case by case basis, under vehicle loads and under sea pressure.

Internal loads exerted on ramps in lifted position at sea are to specified by the designer.

3.2.2 Plating

The gross thickness of plate panels subjected to wheeled loads is to be not less than the value obtained from NR600, Ch 4, Sec 3.

However, minimum net thicknesses are to comply with Pt B, Ch 7, Sec 1, [2.2.1].

3.2.3 Ordinary stiffeners

The gross section modulus and the gross shear sectional area of ordinary stiffeners subjected to wheeled loads is to be not less than the value obtained from NR600, Ch 4, Sec 4.

3.2.4 Primary supporting members

The primary supporting structure of external ramps is to be verified through direct calculation, considering the following cases:.

- ramp in sloped position, supported by hinges at one end and by supporting ground or mother ship at the other, under loads defined in NR600, Ch 5, Sec 2, Tab 1, in harbour condition
- ramp in lifted position, loaded by relevant loads and locked, at sea.

It is to be checked that the stresses are in accordance with the criteria defined in NR600, Ch 2, Sec 3.

3.2.5 Locking devices

It is to be checked that the combined stresses σ_{VM} in rigid supports and locking devices are in accordance with the criteria defined in NR600, Chapter 2, Section 3.

3.2.6 Tests and trials

The watertightness / weathertightness is to be tested as per applicable requirements of NR600.

The weathertightness of the bow door is to be confirmed at each renewal survey by a hose test. In addition, for watertight bow door, a specific survey is requested at each annual survey, to confirm that the proper locking and tightness are maintained.

3.3 Additional requirements for landing operations - Beaching

3.3.1 A beaching reinforced area is to be considered at bottom level on a length to be defined by the Designer measured from fore end. In any case, this length should not be less than 0,3 L.

3.3.2 Bottom beaching pressure, in kN/m², is to be calculated as per following formula:

$P_{beach} = (3,3 \cdot \Delta)/(L \cdot b)$

with:

Δ : full load displacement, in t, at end of life

b : mean transversal dimension of horizontal bottom, in m, in 0,3L forward area.

3.3.3 Bottom plating t, in mm, in beaching reinforced area is to be calculated as follows:

$t = \max(1,2 \cdot t_1, 8)$

with:

t_1 : Thickness, in mm, calculated according NR600, Ch 4, Sec 3, with $p = P_{beach}$

3.3.4 Bottom secondary stiffeners in beaching reinforced area are calculated according to requirements of NR600, Ch 4, Sec 4, with $p = P_{beach}$

3.3.5 Bottom primary supporting members in beaching reinforced area are calculated according to requirements of NR600, Ch 4, Sec 5, with $p = P_{beach}$

3.3.6 All fillet welds of bottom structure in beaching area are to be double continuous.

3.3.7 If waves are likely to break on the transom, the structural design of the transom is to be reinforced adequately to support this breaking wave pressure. In such case, the design breaking wave pressure is to be specified by the Designer, without being taken less than 50 kN/m².

3.4 Additional requirements for landing operations - De-beaching

3.4.1 The maximum de-beaching force F_{DB}, in kN, is to be defined according to the Operating Manual mentioned in (Chap 7, Sec 1, [2.3]). In case F_{DB} is not mentioned in the Operating Manual, this force is to be taken equal to 5Δ, with Δ, in t, being the full load displacement at end of life.

3.4.2 When de-beaching is operated by pushing out the landing craft from the beach (e.g. by tractors or bulldozers), the craft structure must be suitably reinforced in way of push-out force application.

The maximum push-out force is to be according to the Operating Manual mentioned in (Ch 7, Sec 1, [2.3]). In case the maximum push-out force is not mentioned in the Operating Manual, this force, in kN, is to be taken as F_{DB}, defined in [3.4.1].

3.4.3 When de-beaching is operated by pulling out the landing craft from aboard (e.g. by pull-out anchors), the craft structure must be suitably reinforced in way of winch foundations and bollards sustaining the pull-out force and the winches must be designed to deliver the pull-out force.

The maximum pull-out force is to be according to the Operating Manual mentioned in (Ch 7, Sec 1, [2.3]). In case the maximum pull-out force is not mentioned in the Operating Manual, this force, in kN, is to be taken as F_{DB}, defined in [3.4.1].

3.5 Anchoring, mooring and towing equipment

3.5.1 The anchoring capability, the mooring capability and the towing capability is left to the decision of the Naval Authority.

3.5.2 If anchors are used to pull-out the craft during de-beaching operation, the complete mooring line should be designed with a safety factor of 6 with respect to F_{DB} as defined in [3.4.1].

3.5.3 If anchoring capability is requested, equipment in anchors and chain cables is to be in compliance with NR600, Ch 5, Sec 5.

3.5.4 If mooring or towing capability is requested, corresponding equipment is to be in compliance with NR600, Ch 5, Sec 5.

3.6 Cargo lashing - securing points

3.6.1 Where cargo is secured by lashing devices, following requirements [3.6.2] to [3.6.6] are applicable.

3.6.2 Securing points are to be listed in the Operating Manual mentioned in Ch 7, Sec 1, [2.3], together with indications of Safe Working Load (SWL) and Maximum Securing Load (MSL).

3.6.3 Design of securing points, integration into craft structure and mini-maxi pulling angles are to be submitted for review.

3.6.4 Strength of lashings is outside scope of Classification.

3.6.5 checking criteria

It is to be checked that the equivalent stress σ_{VM}, in N/mm^2, induced by the pulling force SWL in the worse possible direction, is in compliance with the following formula:

$$\frac{R_y}{\gamma_R \gamma_m} \geq \sigma_{VM}$$

where:

R_y : Minimum yield stress, in N/mm^2, of the material to be taken equal to 235/k N/mm^2, unless otherwise specified

k : Material factor, defined in Pt B, Ch 4, Sec 1, [2.3] or Pt B, Ch 4, Sec 1, [4.4] as applicable

γ_R : 1,2

γ_m : 1,02

3.6.6 It is recommended to:

- avoid out of plane loading on stiffening members
- align welded attachments to decks and bulkheads with stiffeners by using a weld area suitable for load considered
- design eyeplates, lugs, etc. in accordance with recognized national or international standards suitable for considered MSL.

Section 3 Machinery and Systems

1 General

1.1 Application

1.1.1 Unless otherwise specified, the provisions of this Section apply to the ships granted with the service notation **landing craft**.

2 Availability of energy and propulsion power means of production during landing operations

2.1

2.1.1 Protection of equipment against grounding

Equipment like propellers, thrusters involved shall be fitted with physical protection against grounding.

2.1.2 Protection and position of air inlets dedicated to means of propulsion and energy production and ventilation openings for machinery spaces

a) air inlets and ventilation openings dedicated to machinery installations shall be protected against water ingress coming from waves impacting the aft part of the ship

b) air inlets and ventilation openings dedicated to machinery installations should normally not be located on the aft part of the ship.

2.1.3 Availability of means of cooling

Sea inlets and outlets shall not be located on the fore part of the ship.

2.1.4 Availability of exhaust gas piping systems

Accumulation of water through water ingress coming from waves impacting the aft part of the ship should not be possible whenever the engines were in operation or not during landing operations.

Section 4 Fire Protection

1 General

1.1 Application

1.1.1 Unless otherwise specified, the provisions of this Section apply to the ships granted with the service notation **landing craft**.

1.2 Definitions

1.2.1 Control stations

For the application of this Section, the definition given in NR566, Ch 4, Sec 1, [4.4.8] is to be completed by:

"Rooms containing naval systems, as detection, command or weapon control operating room, except technical spaces not normally manned, are to be categorized as control stations".

1.2.2 Open deck

For the application of this Section, the definition of category (10) given in NR566, Ch 4, Sec 4, [2.2.2], item b), 2) is to be completed by:

"Open deck spaces for the stowage of any embarkation such as tender or special force craft".

1.2.3 Evacuation stations

The evacuation stations are the areas from which the persons to be evacuated have access to the liferafts when launched at sea.

1.2.4 Machinery spaces

For the application of this Section, the definition given in NR566, Ch 4, Sec 1, [4.4.15] is to be completed by:

"The spaces containing naval systems, not normally manned, are to be considered as machinery spaces".

1.2.5 Ammunition spaces

Ammunition spaces are defined in Pt C, Ch 4, Sec 1, [2.4].

Note 1: The ready for use lockers located on open deck may be not considered as ammunition spaces.

2 Suppression of fire

2.1 Detection and alarm

2.1.1 Protection of ammunition spaces

Ammunition spaces are to be provided with a fixed fire detection and fire alarm system complying with the requirements of Pt C, Ch 4, Sec 3, [4].

When the required smoke detector cannot be contained into the ammunition lockers, this detector is to be installed into the space where the ammunition lockers are located.

2.2 Fire containment

2.2.1 Fire integrity of ammunition spaces

The bulkheads and decks of ammunition spaces are to be insulated to A-30 standard. Fire insulation for the boundaries of ammunition spaces is to be installed outside of the ammunition spaces as much as possible.

When an ammunition space is adjacent or above a water tank, or adjacent to the shell of the ship below the lowest possible waterline, only A-0 standard is required.

2.2.2 Ventilation systems

a) Ventilation systems intended to be used during normal operation are to comply with the requirements of NR566, Ch 4, Sec 4, [5] and with the applicable requirements of the present sub-article.

These requirements are not intended to apply to alternative configurations used solely in casualty situations. In any case, arrangements intended for use solely in casualty situations are not to impair compliance of the ventilation systems intended for normal operation with the requirements of NR566, Ch 4, Sec 4, [5] and with the applicable requirements of the present sub-article.

b) For ships provided with CBRN protection, parts of the ventilation system not fully complying with the requirements NR566, Ch 4, Sec 4, [5] and with those of the present sub-article may be accepted provided that:

- they are used solely during CBRN operation, and suitably marked to this end, and
- they are separated from parts of the ventilation system that will be used during normal operation, to the satisfaction of the Society, and
- the ventilation system in use during normal operation is fully compliant with the requirements of the present Sub-article, and
- suitable arrangements are provided to prevent the fire extinguishing medium, especially CO_2, from leaving the protected space in case of release during CBRN operation or normal operation.

Attention is drawn to the provisions of Pt E, Ch 8, Sec 3, [2] for ships to be assigned the **CBRN** additional class notation.

2.2.3 Ventilation systems for ammunition spaces

Ventilation systems of ammunition spaces are to comply with the following provisions:

a) ventilation systems for ammunition spaces are to be independent of the systems serving other categories of spaces

b) no duct is to pass through any ammunition space, except the ducts provided for the ventilation of this ammunition space

c) capacity of the ventilation systems serving ammunition spaces are to comply with the requirement of Pt C, Ch 4, Sec 5, [6.7.1]

d) ducts provided for the ventilation of ammunition spaces, when passing through any other spaces, are to be constructed of steel and arranged to preserve the integrity of the division.

2.3 Fire fighting

2.3.1 Fixed fire-extinguishing systems in ammunition spaces

Ammunition spaces are to be provided with a fixed fire-extinguishing system complying with the requirements of Pt C, Ch 4, Sec 6, [6.1.1].

2.3.2 Fire-fighter outfits

The ship is to be provided with at least four fire-fighter outfits with a minimum of two two-way portable radiotelephone apparatuses for communication between fire-fighters. Those two-way portable radiotelephone apparatuses are to be of an explosion proof type and intrinsically safe.f

Fire-fighter outfits are to comply with Pt C, Ch 4, Sec 6, [8.1].

Fire-fighter outfits are to be stored so as to be easily accessible and ready for use, in at least two separated locations.

2.3.3 Fire pumps

The requirement of NR566, Ch 4, Sec 5, [2.2.1] and Ch 4, Sec 5, [2.2.3] are to be replaced by the following provisions:

a) the total capacity of the fire pumps is to be sufficient to supply simultaneously two hydrants and the most demanding fire-fighting system using the fire main

b) at least two independently powered fixed fire pumps are to be provided. The arrangement of sea connections, pumps and their sources of power is to be such as to ensure, in the event of a fire in any one compartment, that all the fire pumps will not be put out of actions.

2.3.4 International shore connection

At least one international shore connection complying with Pt C, Ch 4, Sec 6, [1.2.7] is to be provided.

3 Escape and circulation

3.1 Application

3.1.1 Limitation

The requirements of Ch 6, Sec 5, [3.2] are applicable for the ships with a maximum complement of less than 60 persons.

Special consideration is to be given by the Society to ships carrying more than 60 persons.



BUREAU VERITAS MARINE & OFFSHORE

Tour Alto
4 place des Saisons
92400 Courbevoie - France
+33 (0)1 55 24 70 00

marine-offshore.bureauveritas.com/rules-guidelines

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