



RULES FOR CLASSIFICATION OF

Ships/High Speed, Light Craft and Naval Surface Craft

PART 5 CHAPTER 14

SPECIAL SERVICE AND TYPE
ADDITIONAL CLASS

Naval and Naval Support Vessels

JULY 2011

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FOREWORD

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The Rules lay down technical and procedural requirements related to obtaining and retaining a Class Certificate. It is used as a contractual document and includes both requirements and acceptance criteria.

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CHANGES

General

The present edition of the rules includes amendments and additions approved by the Executive Committee as of June 2011 and supersedes the January 2011 edition of the same chapter.

The rule changes come into force as described below.

This chapter is valid until superseded by a revised chapter.

Main changes coming into force 1 January 2012

- **Sec.10 Fire Safety**
 - References have been changed to directly refer to SOLAS Ch. II-2 in lieu no longer relevant parts of the DNV rules and without reproducing the relevant SOLAS text. Document requirements have been standardized in table format and reflect the actual rule requirements. Additional rule requirements have been added to better cover the typical naval vessel design and operational needs. Rule text already covered by the SOLAS references has been removed, to avoid unnecessary duplication of the same requirement.

Corrections and Clarifications

In addition to the above stated rule requirements, a number of corrections and clarifications have been made in the existing rule text.

CONTENTS

Sec. 1 General Regulations	12
A. Introduction	12
A 100 Purpose.....	12
A 200 The examination system for naval surface vessels	12
A 300 International codes and regulations	12
B. Examination Principles.....	12
B 100 Application.....	12
B 200 Class notations	13
C. Definitions	14
C 100 Terms	14
D. Classification of Newbuildings	15
D 100 Risk and vulnerability analysis	15
D 200 General requirements for documentation.....	15
D 300 Classification basis	15
D 400 Yard qualification	15
D 500 Working relations	15
D 600 Certification of components and equipment	16
D 700 Confidentiality	16
D 800 Area identification	16
E. Deviations from the Rules	16
E 100 General.....	16
Sec. 2 Arrangements	17
A. Deck Arrangements	17
A 100 Deck definitions	17
A 200 Rescue area	17
A 300 Guard-rails and handholds	17
B. Watertight Compartments	17
B 100 Watertight bulkheads	17
B 200 Watertight bulkheads (for HS, LC and NSC)	17
B 300 Collision bulkhead (for HS, LC and NSC)	18
C. Zones	18
C 100 General principle.....	18
C 200 Fire control zones.....	18
C 300 Damage control zones.....	18
C 400 Gastight division	18
C 500 Hazardous areas	18
D. Accommodation (for HS, LC and NSC).....	18
D 100 General (for HS, LC and NSC).....	18
E. Stores (for HS, LC and NSC).....	19
E 100 General (for HS, LC and NSC).....	19
Sec. 3 Design Loads	20
A. General Requirements	20
A 100 General.....	20
A 200 Direct calculations and model tests (for HS, LC and NSC)	20
A 300 Vertical design acceleration (for HS, LC and NSC).....	20
B. Hull Girder Loads (for HS, LC and NSC).....	20
B 100 Longitudinal still water loads (for HS, LC and NSC)	20
B 200 Longitudinal wave bending loads (for HS, LC and NSC)	20
B 300 Horizontal bending moment and shear force (for HS, LC and NSC)	21
B 400 Torsional moment (for HS, LC and NSC).....	21
C. Local Loads (for HS, LC and NSC).....	21
C 100 Sea pressures (for HS, LC and NSC).....	21
C 200 Slamming and impact pressures (for HS, LC and NSC)	21
C 300 Liquid pressure in tanks (for HS, LC and NSC).....	22
C 400 Dry cargo, stores and equipment (for HS, LC and NSC)	22

C 500	Loads on foundations.....	22
D. Operational Loads.....		22
D 100	General.....	22
E. Accidental Loads		22
E 100	Local damage.....	22
E 200	Global damage	22
Sec. 4 Structural Strength		23
A. General Requirements.....		23
A 100	Structural strength.....	23
A 200	Plan and particulars.....	23
B. Structural Arrangement.....		23
B 100	Main structure	23
B 200	Bulkheads.....	23
B 300	Mast for support of sensors and sensor's systems	23
C. Local Strength		23
C 100	Minimum thickness.....	23
C 200	Local structure	24
C 300	Damage of local structure	24
C 400	Acceptance criteria - damaged condition.....	24
D. Global Strength		24
D 100	General.....	24
D 200	Direct calculations (for HS, LC and NSC)	24
D 300	Intact condition	24
E. Weld Connections		25
E 100	Application of fillet welds	25
F. Buckling (for HS, LC and NSC)		25
F 100	General (for HS, LC and NSC).....	25
G. Direct Strength Calculations.....		25
G 100	Modelling of hull structure (for HS, LC and NSC)	25
G 200	Modelling of hull structure	25
Sec. 5 Stability, Watertight and Weathertight Integrity		26
A. General.....		26
A 100	Applicability	26
A 200	Plans and calculations	26
B. Freeboard, External Watertight Integrity (for HS, LC and NSC).....		26
B 100	Applicability	26
B 200	Design waterline	26
B 300	External doors	26
B 400	Side and stern doors	26
B 500	External hatches	26
B 600	Air pipes.....	26
B 700	Ventilators.....	27
B 800	Scuppers and discharge.....	27
B 900	Freeing ports	27
B 1000	Windows	28
B 1100	Deadlights	28
C. Intact Stability Requirements		28
C 100	Loading conditions	28
C 200	Calculation of stability.....	29
C 300	Calculation of effects from external loads.....	29
C 400	Intact stability for monohull vessel.....	31
C 500	Intact stability for multihull vessels.....	32
D. Internal Watertight Integrity.....		32
D 100	Watertight subdivision	32
D 200	Extent of damage for monohull vessels.....	33
D 300	Extent of damage for multihull vessels.....	34
D 400	Survival criteria after damage, all vessels.....	34

Sec. 6 Piping Systems	36
A. General.....	36
A 100 Application.....	36
A 200 Definitions	36
A 300 Plans and particulars	36
A 400 Materials	37
B. Design Principles	37
B 100 General.....	37
B 200 Arrangements.....	37
B 300 Operation of valves.....	38
C. Pipes, Pumps, Valves, Flexible Hoses and Detachable Pipe Connections.....	38
C 100 General.....	38
C 200 Pumps.....	38
D. Manufacture, Workmanship, Inspection and Testing.....	38
D 100 General.....	38
E. Marking.....	39
E 100 General.....	39
F. Machinery Piping Systems	39
F 100 General.....	39
F 200 Seawater cooling systems	39
F 300 Fresh water cooling systems	39
F 400 Lubricating oil systems	39
F 500 Fuel oil systems	39
F 600 Air inlets for main and auxiliary engines.....	40
F 700 Exhaust systems.....	40
F 800 Hydraulic systems.....	40
F 900 Machinery space ventilation	40
G. Vessel Piping System.....	40
G 100 General.....	40
G 200 Air, sounding and overflow pipes.....	40
G 300 Main seawater system.....	40
G 400 Bilge systems	42
G 500 Drainage.....	43
G 600 Oil pollution prevention.....	44
G 700 Ballast systems.....	44
Sec. 7 Machinery, Propulsion and Positioning	45
A. General Requirements.....	45
A 100 Application.....	45
A 200 Documentation.....	45
B. Operational Conditions	45
B 100 Operational conditions.....	45
C. Arrangement and System Design	46
C 100 Basic principles.....	46
C 200 Machinery space arrangements.....	46
C 300 Redundancy	46
C 400 Arrangement of air intake	47
D. Component Specific Requirements	47
D 100 Propeller.....	47
D 200 Shafting and vibration.....	47
D 300 Steering gear	47
D 400 Thrusters	47
Sec. 8 Electric Power Generation and Transfer.....	48
A. General Requirements.....	48
A 100 Application.....	48
A 200 Definitions	48
A 300 Documentation.....	48
B. Design Principles	48
B 100 Environmental conditions.....	48
B 200 Earthing.....	49

B 300	Marking	49
B 400	Indicator lights	49
C.	System Design	49
C 100	Supply systems	49
C 200	D.C. voltage variations	50
C 300	Main source of electrical power	50
C 400	Emergency source of electrical power	51
C 500	Casualty power distribution system	51
C 600	Distribution	52
C 700	Shore connection	52
C 800	Choice of cable and wire types	52
C 900	Control gear for motors and other consumers	53
C 1000	Battery supplies	53
D.	Switchgear and Control Gear Assemblies	53
D 100	Mechanical construction	53
D 200	Remote operated switchboard	53
E.	Rotating Machinery	53
E 100	Motors	53
F.	Miscellaneous Equipment	53
F 100	Switchgear	53
F 200	Galley equipment	54
F 300	Batteries	54
G.	Installation and Testing	54
G 100	Principles	54
G 200	Generators	54
G 300	Switchboards	54
G 400	Cables	54
G 500	Screening and earthing of cables	55
G 600	Marking of cables	55
G 700	Batteries	55
G 800	Low intensity illumination	55
G 900	Emergency lighting	56
H.	Electric Propulsion	56
H 100	General	56
H 200	Design principles	56
H 300	System design	56
Sec. 9	Control and Monitoring	57
A.	General Requirements	57
A 100	General	57
A 200	Application	57
B.	Documentation	57
B 100	Requirements for documentation	57
C.	System Design	57
C 100	General	57
C 200	Minimum extent of control and monitoring (for HS, LC and NSC)	57
C 300	Data communication links	57
C 400	System independence	57
D.	Component Design and Installation	57
D 100	Enclosure	57
D 200	Temperature	58
D 300	Electromagnetic interference	58
D 400	Inclination	58
D 500	Sensors	58
E.	Alarm System	58
E 100	Alarm system in the accommodation	58
F.	Damage Control System	58
F 100	General	58
G.	Monitoring and control	58
G 100	General	58

H. Control Systems.....	59
H 100 General.....	59
H 200 Steering control system.....	59
H 300 Water jet control system	59
H 400 Stabiliser control system.....	59
Sec. 10 Fire Safety	60
A. General.....	60
A 100 General.....	60
B. Rule References and Definitions	60
B 100 Fire technical definitions	60
C. Documentation	60
C 100 Documentation Requirements.....	60
D. Structure	61
D 100 Structural integrity	61
E. Fire Control Zones	61
E 100 Fire control zones.....	61
F. Fire Integrity of Bulkheads and Decks	62
F 100 Fire Integrity of Bulkheads and Decks	62
G. Means of Escape	62
G 100 Arrangement	62
G 200 Emergency escape breathing devices.....	62
H. Ventilation Systems.....	63
H 100 Requirements for ventilation system	63
I. Material Requirements.....	63
I 100 Restricted use of combustible material	63
J. Fire Detection System	63
J 100 Areas to be protected	63
J 200 Requirements for systems.....	63
K. Fixed Fire-extinguishing System.....	64
K 100 Fixed fire-extinguishing systems for machinery spaces	64
K 200 Fixed local application fire extinguishing system	64
K 300 Design considerations	64
K 400 Fixed extinguishing in service spaces.....	64
L. Fire-extinguishing Equipment	64
L 100 Portable fire extinguishers	64
L 200 Portable foam applicators outside machinery spaces.....	64
M. Fire Pumps and Fire Main	64
M 100 Capacity of fire pumps.....	64
M 200 Water distribution system	64
N. Firefighter's Outfit.....	65
N 100 Number and location.....	65
N 200 Personal equipment and breathing apparatus.....	65
O. Other Spaces	65
O 100 Storage rooms for explosives.....	65
O 200 Spaces containing diving systems.....	65
O 300 Storage spaces for vehicles	66
P. Helicopter Facilities	66
P 100 Helicopter facilities.....	66
Q. Fire Control Plans	66
Q 100 Requirements	66
Sec. 11 Fire Safety Requirements for FRP Naval Vessels	67
A. General Requirements.....	67
A 100 General.....	67
A 200 Rule references and definitions.....	67
A 300 Requirements for documentation.....	67

B. Structural Fire Protection, Materials and Arrangements.....	67
B 100 Fire control zones.....	67
B 200 Structural fire protection.....	68
B 300 Material requirements	68
B 400 Arrangements.....	68
B 500 Means of escape.....	68
C. Ventilation.....	68
C 100 Ventilation zones and active smoke control	68
D. Fire Detection System	69
D 100 Arrangement	69
E. Fire Extinguishing Systems and Hazardous spaces	69
E 100 Fixed fire extinguishing system for machinery spaces	69
E 200 Other fire hazardous spaces or equipment	70
F. Fire Pumps, Fire Main and Portable Extinguishers	70
F 100 Fire pumps, fire main and fire hoses.....	70
F 200 Portable fire extinguishers	71
G. Sprinkler System	71
G 100 Sprinkler system	71
H. Firefighter's outfit.....	71
H 100 General.....	71
I. Additional Fire Protection (optional).....	72
I 100 General.....	72
I 200 Accommodation.....	72
I 300 Engine room.....	72
Sec. 12 Safe Evacuation of Personnel	73
A. General and Definitions	73
A 100 General.....	73
A 200 Definitions	73
A 300 Exemptions	74
A 400 Special requirements for class notation Naval Support	74
B. Communications.....	74
B 100 Communication.....	74
B 200 Signalling equipment	75
C. Personal Life-saving Appliances.....	75
C 100 Lifebuoys	75
C 200 Lifejackets.....	75
C 300 Immersion and anti-exposure suits	75
D. Muster List, Emergency Instructions and Manuals	75
D 100 General.....	75
E. Operating Instructions	76
E 100 General.....	76
F. Survival Craft Stowage.....	76
F 100 General.....	76
G. Survival Craft and Rescue Boat Embarkation and Recovery Arrangements	77
G 100 General.....	77
H. Line-throwing Appliance.....	77
H 100 General.....	77
I. Operational Readiness, Maintenance and Inspections	77
I 100 Operational readiness.....	77
I 200 Maintenance.....	77
I 300 Servicing on inflatable liferafts, inflatable lifejackets and inflated rescue boats	78
J. Survival Craft and Rescue Boats.....	78
J 100 Vessels with length less than 30 m	78
J 200 Vessels with length above 30 m	78
K. Additional Requirements for Equipment	79
K 100 Liferafts.....	79

K 200 Climbing nets	79
Sec. 13 Radiation Hazards.....	80
A. General.....	80
A 100 Application.....	80
B. Definitions	80
B 100 Terms	80
C. Documentation	80
C 100 Plans and particulars	80
D. Design Principles	81
D 100 General.....	81
D 200 Prevention of auto ignition	81
D 300 Prevention of personnel exposure.....	81
E. Installation	83
E 100 General.....	83
E 200 Marking.....	83
F. Testing	83
F 100 Harbour Acceptance Tests (HAT) for the vessel.....	83
Sec. 14 Electromagnetic Compatibility	84
A. General.....	84
A 100 Application.....	84
A 200 Principles	84
B. Definitions	84
B 100 Terms	84
C. Documentation	85
C 100 Plans and particulars	85
D. Design Principles	85
D 100 General.....	85
D 200 Lightning protection	86
D 300 Electrostatic discharge	86
E. Installation	86
E 100 General.....	86
E 200 Shielding.....	86
E 300 Bonding and grounding	86
E 400 Cabling.....	87
E 500 Filtering.....	87
E 600 Lightning protection	87
E 700 Electrostatic discharge	88
E 800 Marking.....	88
F. Testing	88
F 100 General.....	88
F 200 Factory Acceptance Tests (FAT) for equipment	88
F 300 Harbour Acceptance Tests (HAT) for the vessel.....	88
F 400 Sea Acceptance Tests (SAT) for the vessel	88
Sec. 15 Storage Rooms for Explosives.....	89
A. General.....	89
A 100 Application.....	89
A 200 Definitions	89
B. Basic Requirements.....	89
B 100 General.....	89
B 200 Plans and particulars to be submitted	89
C. Arrangements	89
C 100 General.....	89
D. Structure	90
D 100 Structural requirements	90
E. Fire Safety	90
E 100 General.....	90

E 200	Structural fire protection.....	90
E 300	System fire safety.....	91
E 400	Fire protection.....	91
F.	Radiation Hazards	91
F 100	Electromagnetic radiation protection.....	91
G.	Signboards	91
G 100	General.....	91

SECTION 1 GENERAL REGULATIONS

A. Introduction

A 100 Purpose

101 Subsection A explains the Society's quality assurance system for the design, fabrication and operation of naval vessels, how it works, conditions of validity and how it functions.

102 The information included in A shall not be understood as rule requirements, but as general principles and background information.

A 200 The examination system for naval surface vessels

201 These rules are an international standard defining acceptance criteria for design, construction, survey and testing of naval surface vessels, their machinery installation, systems and equipment, applicable to the newbuilding and operational phase (military systems are excluded).

202 By assigning class to a naval surface vessel it shall be understood that the navy will utilise the Society's quality assurance system for the design, fabrication and operation of the vessel (military systems excluded). The system shall be considered as a part of the navy's internal control system and will in no way replace the navy's responsibility towards national authorities and international maritime conventions.

203 The terms *class* and *classification* shall in this context be understood as the Society's safety examination system for naval surface vessels.

204 Safety examination implies an activity, in which the vessel is surveyed during construction on the basis of design approval, tested before being taken into service, and surveyed regularly during its whole operational life until it is scrapped. The aim shall verify that the required rule standard is built in, observed and maintained.

205 The safety examination system is not performed as a substitute for the navy's own quality and safety control and related duties, but is intended as a supplementary quality assurance measure in line with current international maritime safety thinking.

206 It is the navy's responsibility to maintain the vessel so as to comply with the rules at all times.

A 300 International codes and regulations

301 International codes and conventions are covered to the extent specified in the rule text. On request, the Society may, in addition, verify that specific international codes and conventions are complied with.

302 The rules under this chapter are based upon a safety regime administered by a national naval administration.

Guidance note:

A naval administration is a supervisory body being responsible for HSE (Health, Safety and Environmental) aspects on a naval vessel

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B. Examination Principles

B 100 Application

101 The rules in this chapter will generally apply to ships of war and troopships. The requirements shall be regarded as supplementary to those given for assignment of main class.

102 A naval vessel built in accordance with the Rules for Classification of High Speed, Light Craft and Naval Surface Craft (HS, LC and NSC) is not required to comply with the requirements given in Pt.1 Ch.1 Sec.2, A102 to A107.

103 The rules in this chapter do not apply to military systems unless as specifically defined in the following sections.

Guidance note:

Military systems are defined as:

- weapon systems
- sensor systems

- C³I systems (Command, Control, Communication and Information systems).

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104 Military systems that influence the vessel and vessel systems shall be identified. Required support to military systems from vessel and vessels systems shall be specified.

Guidance note:

Support requirements to military systems may typically be:

- foundation loads
- power supply
- water supply
- heating, ventilation and air conditioning.

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105 Conditions regarding the use of the vessel, which were established or presumed at the time of class assignment, shall be presented in a design brief report describing the intended operational use of the vessel. (See D300).

B 200 Class notations

201 A vessel flying a naval flag, administered by a national naval administration and complying with main class requirements, Pt.1 through Pt. 4 and that of this chapter will be given the class notation ✱ **1A1 Naval**.

Guidance note:

The design, construction and operation of a naval vessel should generally be designed, constructed and operated in accordance with the Rules for Classification as given in Table B1.

Table B1 - Suggested applicable rules for given vessel characteristics				
L_{pp}	Service restriction	Δ	V	Rules for Classification of:
$L_{pp} \geq 150$ m				Ships
Any	Unrestricted	$\Delta > (0.16 LB)^{1.5}$		Ships
Any	R0-R3	$\Delta > (0.16 LB)^{1.5}$		Ships
Any	Unrestricted	$\Delta > (0.16 LB)^{1.5}$	$V < 7.16 \Delta^{0.1667}$	Ships
Any	R0-R3	$\Delta > (0.16 LB)^{1.5}$	$V < 7.16 \Delta^{0.1667}$	Ships
$L_{pp} < 150$ m	Unrestricted	$\Delta \leq (0.16 LB)^{1.5}$	$V \geq 7.16 \Delta^{0.1667}$	HS, LC and NSC
$L_{pp} < 150$ m	R0-R3	$\Delta \leq (0.16 LB)^{1.5}$		HS, LC and NSC
$L_{pp} < 150$ m	R0-R3	$\Delta \leq (0.16 LB)^{1.5}$	$V \geq 7.16 \Delta^{0.1667}$	HS, LC and NSC
L_{pp} = length between perpendiculars Δ = maximum permissible displacement L = overall length of the underwater watertight envelope of the rigid hull excluding appendages, at or below the design water line in the displacement mode with no lift or propulsion machinery active B = waterline breadth at $L/2$ V = maximum speed (knots).				

202 A vessel flying a naval flag, administered by national naval administration, and complying with the sections specified hereunder and the Rules for Classification of Ships, is given the additional class notation ✱ **1A1 Naval Support (....)** where the content of the (....) may contain any of the elements as specified below:

- **hull**: additional naval requirements for arrangements as given in Sec.2, loads in Sec.3 and hull strength in Sec.4 have been applied
- **stab**: naval requirements for stability as given in Sec.5 have been applied
- **system**: additional naval requirements for piping as given in Sec.6, machinery in Sec.7, electrical in Sec.8, control and monitoring in Sec.9 have been applied
- **fire**: additional naval requirements for fire safety as given in Sec.10 or 11 have been applied
- **evac**: naval requirements for safe evacuation as given in Sec.12 have been applied
- **radhaz**: naval requirements for radiation hazards as given in Sec.13 have been applied
- **emc**: naval requirements for electromagnetic compatibility as given in Sec.14 have been applied
- **sam**: naval requirements for storage rooms for ammunition as given in Sec.15 have been applied.

203 A vessel flying a naval flag, administered by national naval administration, and complying with the sections specified hereunder and the Rules for Classification of Highs Speed Light Craft and Naval Surface Craft, is given the additional class notation ✱ **1A1 LC Naval Support (.....)** where the content of the (....) may contain any of the elements as specified below:

- **hull**: additional naval requirements for arrangements as given in Sec.2, loads in Sec.3 and hull strength in Sec.4 have been applied
- **stab**: naval requirements for stability as given in Sec.5 have been applied
- **system**: additional naval requirements for piping as given in Sec.6, machinery in Sec.7, electrical in Sec.8, control and monitoring in Sec.9 have been applied
- **fire**: additional naval requirements for fire safety as given in Sec.10 or 11 have been applied
- **evac**: naval requirements for safe evacuation as given in Sec.12 have been applied
- **radhaz**: naval requirements for radiation hazards as given in Sec.13 have been applied
- **emc**: naval requirements for electromagnetic compatibility as given in Sec.14 have been applied
- **sam**: naval requirements for storage rooms for ammunition as given in Sec.15 have been applied.

204 The class notation **Naval Support (....)** or **LC Naval Support (....)** may be combined with other ship type class requirements.

205 A vessel flying a naval flag, administered under national naval administration and complying with main class and or ship type class requirements as given in the Rules for Classification of Ships will be given the class notation ✱ **1A1 Naval Support**.

206 A vessel flying a naval flag, administered under national naval administration and complying with main class and a ship type class requirements as given in the Rules for High Speed Light Craft and Naval Surface Craft (HS, LC and NSC) will be given the class notation ✱ **1A1 LC Naval Support Patrol, Cargo, Car Ferry, Crew, Yacht or Passenger**.

207 The notation ✱ **1A1(Hull)** will be assigned to ships with class notations **Naval** or **Naval Support** with hull and equipment in compliance with the rule requirements as given in Pt.2 and Pt.3, Ch.1 or Ch 2 and Pt.3 Ch.3 Sec.1 to Sec.7 in the Rules for Classification of Ships.

208 The notation **1A1(Hull) LC** will be assigned to vessels with class notation **Naval**, **Naval Support** or **Naval Landing Craft** with hull and equipment in compliance with the rule requirements as given in Pt.2 and Pt.3 Ch.1 to Ch.5 in the Rules for High Speed Light Craft and Naval Surface Craft (HS, LC and NSC).

209 Additional requirements for hull and hull equipment shall follow the principles as defined in the Rules for Classification of Ships or Rules for High Speed Light Craft and Naval Surface Craft.

Guidance note:

The scope as stated in paragraphs 207 to 209 implies that machinery and systems are excluded from class scope. It is assumed that these areas are covered by the Naval Authority's quality assurance system in line with A302.

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210 Naval surface vessel having special equipment and or systems found to satisfy relevant requirements in Pt.6, will be given corresponding additional class notations if so desired by the navy.

C. Definitions

C 100 Terms

101 *FMEA*. Failure Mode and Effect Analysis.

102 *HAZOP*. Hazard Operation.

103 *Area classification* is a way of identifying special sections on the vessel with special protective requirements.

104 *NBC*. Nuclear, biological and chemical threats to a naval surface vessel.

105 *C³I*. Command, Control, Communication and Information.

106 *ARM*. Availability, reliability and maintainability. Usually the design objective for commercial ships.

107 *VR*. Vulnerability reduction. Usually the design objective for warships.

108 *Survivability*. Capability of a warship to float, to move and to fight. Achieved by vulnerability and susceptibility reduction measures.

109 *Susceptibility measures*. Design aspects to prevent detection and weapon attraction, to decoy and avoid the attacking weapon and to destroy the attacking weapon. Related to signature reduction.

110 *Vulnerability measures*. Design aspects to resist weapon effects, minimise damage and maximise recoverability. Related to weapon effect reduction.

111 *Naval threat*. The threat to a naval vessel:

- accidents

- terrorist attack
- conventional war
- nuclear war.

112 *Contractual shock level.* A shock design load specified by the customer and to be used in the system and component design covered by the class notation **Naval**.

113 *Military object.* Object installed on the vessel that is not needed for safe operation of the vessel in peacetime.

114 *STANAG.* Standardised NATO Agreement.

115 *AQAP.* Allied Quality Assurance Publication.

D. Classification of Newbuildings

D 100 Risk and vulnerability analysis

101 The design, construction and operation of systems intended to protect the vessel from a threat shall where appropriate be supported by a suitable risk and vulnerability analysis identifying:

- dimensioning accidental events and accidental loads
- a list of recommended risk and vulnerability reducing measures.

Guidance note:

For the purpose of carrying out risk analysis, aids like recognised methods of analysis for qualitative and or quantitative analysis should be used. Qualitative methods of analysis may be of the FMEA, HAZOP or similar types.

Only threats to hull, machinery installations and equipment as covered by these rules should be considered.

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102 Arrangements, systems or equipment, which are deviating from that addressed by these rules, might be utilised if it can be demonstrated that an equivalent or higher safety level as aimed for in these rules is achieved.

D 200 General requirements for documentation

201 Additional plans and particulars that normally shall be submitted when the additional class notation given in B are applied for, are given in Sec.2 to Sec.14. The documentation shall show clearly that the rule requirements are fulfilled.

202 Other plans, specifications or information may be required depending on the arrangement and the equipment used on each separate vessel.

D 300 Classification basis

301 Documents describing the intended operational characteristics of the vessel shall be submitted to the Society for information.

Guidance note:

In addition to data specified for main class requirements, operational characteristics should as appropriate include items such as:

- service speed, top speed
- ballasting requirements
- cargo capacity
- sea-state limitations.

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302 Conditions regarding the use of the vessel, which were established or presumed at the time of class assignment, shall be presented in a design brief report describing the intended operational use of the vessel.

303 Contractual shock reference levels for equipment shall, as appropriate, be submitted to the Society for information and will be a basis for approval of system interfaces and equipment.

D 400 Yard qualification

401 The yard and its main subcontractors shall operate a certified quality assurance system corresponding to AQAP series, ISO 9000 series or equivalent and applicable for their work task.

D 500 Working relations

501 The yard shall arrange for regular quality meetings discussing relevant issues and building progress. All

relevant parties shall attend the meetings.

D 600 Certification of components and equipment

601 Combat and other naval installations that shall be used in the vessel and that are not certified by the Society shall be identified stating their structural and system demand as covered by these rules.

D 700 Confidentiality

701 Personnel assigned to supervise compliance with the rules will be subjected to confidentiality and security requirements set forward by the ordering navy.

702 The Society will store files and records in accordance with confidentiality and security requirement agreed with the ordering navy.

703 Communication between yard and the Society shall comply with relevant security procedures identified by the ordering navy.

D 800 Area identification

801 The vessel shall be classified into operational areas identifying protective measures and or operational limitations allowed in these areas. The areas shall be described identifying special measures taken to accommodate the restrictions placed on the area.

E. Deviations from the Rules

E 100 General

101 The navy may decide that a naval vessel shall deviate from the requirements put forward in the rules.

102 In case of deviations from the rules and given class notation and or service restriction, the class notation on the certificate shall have the following letters assigned in brackets: **(navdist)** - meaning naval distinction.

103 Any deviations from the requirements for the assigned class notation shall be addressed in the class certificate and explained in the "Appendix to the classification certificate".

Guidance note:

Deviations should be subject to special consideration, and evaluations made in terms of technical scope and responsibilities.

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SECTION 2 ARRANGEMENTS

A. Deck Arrangements

A 100 Deck definitions

101 *Bulkhead deck* is the watertight deck at which all main watertight bulkheads terminate.

102 *1.deck* is the uppermost deck extending completely and continuously from stem to stern. *2.deck*, *3.deck* etc. are respectively the first, second, etc. deck below 1.deck. *01 deck*, *02 deck*, etc. are respectively the first, the second, etc. deck above 1.deck.

103 *'Tween deck* is a generic term for the inner decks between the tank top and the main deck.

104 *Damage control deck* is the deck providing the following facilities:

- 1) good access throughout the ship horizontally and vertically;
- 2) ready access to emergency stops for equipment in compartments below;
- 3) ready access to controls for fire pumps, fixed fire fighting systems and flooding control systems (like bilge ejectors);
- 4) ready access to controls to limit the spread of smoke throughout the ship;
- 5) damage control stations, providing good weather protection for equipment stored and personnel.

A 200 Rescue area

201 Naval vessel may be arranged with a permanent deck area applicable to rescue persons from the sea. A rescue area shall be well protected from propeller, rudder or other protrusions from the hull, and visibility to the area from the wheelhouse shall be arranged for, i.e. by video camera if necessary. Separate rescue searchlights shall cover the deck rescue area and the corresponding side of the vessel.

A 300 Guard-rails and handholds

301 For safe working on deck, adequate guard-rails and handholds shall be arranged where it is considered necessary for personnel safety. Guard-rail around the anchoring position is required. Guard-rails are in general to have a height of minimum 1 000 mm above deck. For decks not intended for crew access at sea, it may be accepted to have an arrangement with portable railing for in harbour use.

B. Watertight Compartments

B 100 Watertight bulkheads

101 A watertight bulkhead is a structural bulkhead dimensioned to withstand a prescribed pressure head without water leakage.

102 The primary functions of the watertight bulkheads are:

- to limit the extent of flooding after accidental or action damage
- to form the limits of the NBC-zones
- to support the hull plating and structure and maintain the external hull form
- to help resist hull torsional loads
- to support the internal decks and equipment attached to the bulkheads.

103 Access and ventilation openings in watertight bulkheads shall have watertight closing appliances of approved type.

104 Access and ventilation openings shall be kept closed and monitored in the damage control centre machinery control room in accordance with established watertight and gastight conditions in force.

105 For smaller vessels, step or recess in collision bulkheads above the level of the deepest waterline or double bottom can be accepted.

B 200 Watertight bulkheads (for HS, LC and NSC)

201 At least the following transverse watertight bulkheads shall be fitted:

- collision bulkhead
- bulkhead at each end of machinery space(s).

202 For smaller vessels, 3 watertight compartments may be accepted. A collision bulkhead and a bulkhead in front of the engine room shall be installed as a minimum requirement, provided damage stability criteria are met.

Guidance note:

Smaller vessels are normally considered to be vessels with
 $L < 30$ m.

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203 For watertight bulkheads in a region with raised quarterdeck, only collision bulkhead needs to be extended to the quarterdeck.

B 300 Collision bulkhead (for HS, LC and NSC)

301 Below the deepest waterline or double bottom, whichever is the upper level, the longitudinal position of collision bulkhead shall comply with the requirement in Pt.3 Ch.1 Sec.1 B301.

C. Zones

C 100 General principle

101 To minimise the consequences of damage, fire and NBC contamination, a vessel shall be divided into zones in order to:

- avoid catastrophic loss of an important system capability by a single incident
- restrict the spread of fire, smoke, flooding, blast and fragments
- avoid loss of primary functions due to damage, which is remote from the main components of that system.

102 Zones shall be sufficiently self-contained to operate for periods with the zone boundary closed.

C 200 Fire control zones

201 *Fire control zones* are zones with boundaries (e.g. decks, bulkheads) which are fire insulated to reduce spreading of fire to adjacent zones and which are fitted with facilities to prevent the spread of smoke to adjacent zones. Boundaries for fire control zones shall coincide with watertight divisions. Within a fire control zone a further watertight subdivision is possible.

C 300 Damage control zones

301 *Damage control zones* are zones, which are allocated to specific damage control teams for initial fire fighting, flooding control and repair activities. Damage control zone boundaries coincide with watertight and fire resistant subdivisions of the ship. Inside a damage control zone there shall be at least one damage control station.

C 400 Gastight division

401 A gastight division is provided by gastight bulkheads and decks forming a gastight compartment to avoid ingress of NBC-agents to a zone or citadel.

C 500 Hazardous areas

501 Hazardous areas are all areas in which explosives and flammable materials are stored or transported as a part of normal operation.

D. Accommodation (for HS, LC and NSC)

D 100 General (for HS, LC and NSC)

101 Naval vessels may be arranged with sleeping cabins. Sleeping cabins may be arranged below bulkhead deck, but not forward of the collision bulkhead.

102 Seat accommodation shall be designed to withstand the design acceleration of the vessel.

103 Naval vessels with a length less than 50 m shall have established operational procedures for requiring personnel to be seated at high acceleration levels.

E. Stores (for HS, LC and NSC)

E 100 General (for HS, LC and NSC)

101 In stores adequate means shall be fitted to prevent shifting of stored goods in accordance with the design acceleration of the vessel.

SECTION 3 DESIGN LOADS

A. General Requirements

A 100 General

101 A naval vessel shall comply with the design principles and design loads applicable for main class with the modifications specified in this section.

A 200 Direct calculations and model tests (for HS, LC and NSC)

201 For vessels with a length greater than 50 m the global wave loads are generally to be determined by direct calculations. Methods incorporating numerical analysis shall be in accordance with Pt.3 Ch.9 in the Rules for Classification of HS, LC and NSC.

202 Global wave loads that are determined by methods incorporating model test shall be agreed upon with the Society.

A 300 Vertical design acceleration (for HS, LC and NSC)

301 Naval surface vessels shall at least be designed for the following minimum vertical design acceleration at LCG:

$$a_{cg} = \left(\frac{V}{\sqrt{L}} \right) \left(\frac{3.2}{L^{0.76}} \right) f_g g_0 \quad (\text{m/s}^2)$$

$\frac{V}{\sqrt{L}}$ need not be taken greater than 3.0.

V, L as defined in Pt.3 Ch.1 Sec.1 D101 in the Rules for Classification of HS, LC and NSC.

$g_0 = 9.81 \text{ m/s}^2$

f_g = acceleration factor as given in Table A1

a_{cg} = vertical design acceleration

Table A1 Acceleration factor f_g					
Type and service notation	Service area restriction notation				
	None	R0	R1	R2	R3
Naval	8	7	5	3	1
None = unrestricted service					

Guidance note:

Vertical design acceleration a_{cg} should be considered as a design parameter used for calculation of local and global loads and for specification of operational restrictions for the vessel.

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For definition of service area restrictions see Pt.1 Ch.1 Sec.2 B400 in the Rules for Classification of HS, LC and NSC.

302 The vertical design acceleration may be based on documentation of capability of the vessel to maintain speed with maximum engine rating in various sea states.

303 The vertical design acceleration will be stated in the "Appendix to the classification certificate".

B. Hull Girder Loads (for HS, LC and NSC)

B 100 Longitudinal still water loads (for HS, LC and NSC)

101 Still water shear force and bending moment shall be calculated for the most unfavourable hogging and sagging condition within the range between "Full load condition" and "Minimum operating condition" and consistent with the ballasting policy.

B 200 Longitudinal wave bending loads (for HS, LC and NSC)

201 The wave loads given in the following are considered to be suitable for the calculation of the preliminary design, giving the order of magnitude.

For larger vessels of novel design the loads should preferably be checked by direct calculations for the vessel considered.

If other data are available from full scale measurements or model experiments, which are documented to have a higher reliability than the present formulae and curves in giving the right magnitude of wave loads, these data shall be used.

202 Midship vertical wave bending moment and shear force shall be according to Sec.3 and Pt.3 Ch.1 in the Rules for Classification of HS, LC and NSC.

B 300 Horizontal bending moment and shear force (for HS, LC and NSC)

301 The horizontal bending moment (M_H) and shear force (Q_H) is normally related to the vertical values through the following relations:

$$M_H = \left(0.04 + \frac{L}{1000}\right) M_V \text{ (kNm)}$$

$$Q_H = \left(0.04 + \frac{L}{1000}\right) Q_V \text{ (kN)}$$

These equations are applicable at any section along the vessel.

302 For naval surface vessels with length above 100 m the horizontal bending moment and shear force shall be established by direct calculations.

B 400 Torsional moment (for HS, LC and NSC)

401 Torsional moment for twin hulls shall be according to Pt.3 Ch.1 Sec.3 in the Rules for Classification of HS, LC and NSC.

402 The torsional moment for a monohull, M_{TO} , acting on a longitudinal axis at D/2 above the bottom of the vessel is given by the following relation:

$$M_{TO} = \left(\frac{B}{L}\right)^2 \left(0.5 + \frac{L}{400}\right) M_V \text{ (kNm)}$$

For finding the torsional moment at the shear centre of the section the horizontal shear force shall be taken into account as given by the following equation:

$$M_T = \sqrt{M_{TO}^2 + (z_o Q_H)^2} \text{ (kNm)}$$

z_o = the vertical distance from the shear centre of the section to a point situated D/2 above the keel.

This assumption is considered reasonable for practical purposes. The given equations are valid for all sections along the vessel.

403 For naval surface vessels with length above 100 m the torsion moment shall be established by direct calculations.

C. Local Loads (for HS, LC and NSC)

C 100 Sea pressures (for HS, LC and NSC)

101 Sea pressure acting on vessel's bottom, sides, decks and superstructures shall be according to Pt.3 Ch.1 Sec.2 C500 in the Rules for Classification of HS, LC and NSC. Minimum sea pressures shall be according to Pt.3 Ch.1 Sec.2 C501 Table C1 in the Rules for Classification of HS, LC and NSC shall be applied and the service restriction None and **R0** are equivalent.

102 Watertight bulkhead design pressure shall be according to Pt.3 Ch.1 Sec.2 C503 in the Rules for Classification of HS, LC and NSC.

C 200 Slamming and impact pressures (for HS, LC and NSC)

201 Bottom slamming pressures and bow impact pressures shall be according to Pt.3 Ch.1 Sec.2 C200 and C300 in the Rules for Classification of HS, LC and NSC.

202 For multi-hull vessels, slamming pressure on flat cross structures shall be according to Pt.3 Ch.1 Sec.2 C400 in the Rules for Classification of HS, LC and NSC.

C 300 Liquid pressure in tanks (for HS, LC and NSC)

301 Liquid pressure in tanks shall be according to Pt.3 Ch.1 Sec.2 C600 in the Rules for Classification of HS, LC and NSC. The pressure in tanks shall not in any case be taken less than:

$$P = \rho h_s (g_0 + a_v) \text{ (kN/m}^2\text{)}$$

C 400 Dry cargo, stores and equipment (for HS, LC and NSC)

401 Pressure concentrated forces from dry cargo, stores, equipment and heavy units shall be according to Pt.3 Ch.1 Sec.2 C700 and C800 in the Rules for Classification of HS, LC and NSC.

C 500 Loads on foundations

501 For all equipment, including weapon systems, with a mass of more than 1 tonne, their mass and centre of gravity shall be specified. The weapon system itself is not within the scope of classification. For cranes and other lifting appliances a working diagram for moments shall be included.

D. Operational Loads

D 100 General

101 Loads caused by gas pressure and or heat during launching of weapon systems shall be considered. The manufacturer shall specify the loads.

102 Ice build-up shall be evaluated as a loading condition in connection with determination of hull global strength and stability calculations.

E. Accidental Loads

E 100 Local damage

101 Frames and decks shall be checked for extreme loading due to water filling caused by battle type damage. All relevant combinations of water filling shall be considered.

E 200 Global damage

201 If a global hull damage case has been specified for the vessel, the hull girder loads in damaged conditions have to be calculated by direct load calculations.

SECTION 4 STRUCTURAL STRENGTH

A. General Requirements

A 100 Structural strength

101 Naval vessels made of steel shall comply with the strength requirements given for main class with the modifications and additions specified in this section.

A 200 Plan and particulars

201 The following plans shall be submitted for approval:

- structural support of main weapon(s) and weapon system(s)
- structural support of main sensor(s) and sensor system(s).

202 The following plans and documentation shall be submitted for information as far as applicable:

- arrangement and particulars of main weapon(s) and weapon system(s), including loads acting on the supporting structure
- arrangement and particulars of main sensor(s) and sensor system(s), including loads acting on the supporting structure

B. Structural Arrangement

B 100 Main structure

101 Special attention shall be paid to ensure continuity of main structural elements.

102 At discontinuities of the longitudinal structure, e.g. where sonar domes are fitted, the longitudinal as well as the transverse strength shall be maintained, e.g. by fitting bottom girders and or heavy frames.

103 Design of local details shall seek to keep stress concentrations to a minimum.

104 Heavy beams or deck girders to absorb forces shall be preferred to pillars carried directly to the bottom structure. Such pillars may transfer shocks from underwater explosions, causing detrimental effect to the equipment.

105 Doublers are not allowed as support for heavy equipment.

106 Shock sensitive equipment shall not be installed directly on pillars.

107 Pillars provided primarily to support heavy equipment shall be treated as an extension of the foundation and designed accordingly.

108 Doublers are not allowed as support for pillars.

B 200 Bulkheads

201 When air tightness only is required for the bulkhead considered, scantlings shall be designed for 2 times overpressure or 2 kN/m² whichever is highest.

B 300 Mast for support of sensors and sensor's systems

301 Static strength calculations shall be performed for mast supporting sensors and sensor systems.

C. Local Strength

C 100 Minimum thickness

101 The requirement for minimum thickness may be deviated after special consideration. As a minimum the following should be evaluated and documented if the requirement for minimum thickness shall be omitted:

- possibility for dimensioning of structure based on known loads
- deformation of the structure
- fabrication aspects
- practical aspects such as local impact and load effects not explicitly covered by the rules.

C 200 Local structure

201 The strength of structure exposed to loads caused by the firing of weapons shall be considered. The calculation shall take into account the exposed area, load response and duration.

202 Armament foundations shall be designed for the following loads:

- static loads
- reaction loads
- pressure and blast and heat during firing of weapons.

203 Structure shall be designed locally with respect to ice build-up.

C 300 Damage of local structure

301 Frames, bulkheads and decks shall be designed for extreme loading occurring when the vessel is damaged, i.e. with internal spaces filled with water.

If the vessel has watertight 'tweendeck(s) the damage shall be assumed to the above each deck as one loading condition and below same as another. The water head shall be taken to the bulkhead deck in both cases.

302 The structure of storage rooms for explosives shall be designed for flooding, i.e. with the complete space filled with water, see Sec.15.

C 400 Acceptance criteria - damaged condition

401 Allowable stresses in damaged condition shall be according to Table C2, where:

σ = allowable bending stress, in N/mm²

τ = allowable shear stress, in N/mm²

f_1 = material factor, given in Pt.3.

Table C2 Allowable stresses in damaged condition			
	Plate	Stiffener	Girder
σ	220 f_1	220 f_1	220 f_1
τ			120 f_1

D. Global Strength

D 100 General

101 Global strength FEM calculation shall be made for vessels with:

- unusual hull form and construction
- specified global damage.

D 200 Direct calculations (for HS, LC and NSC)

201 For naval vessels with a length greater than 50 m, the global strength is generally to be determined by direct calculations according to Pt.3 Ch.9 with the additional requirements specified in this section.

202 For naval vessels with a length less than 50 m, the global strength shall be taken in accordance with Pt.3 Ch.2 with loads as given in Pt.3 Ch.1 Sec.3 and Sec.3.

Direct calculations will be accepted for vessel with length less than 50 m.

D 300 Intact condition

301 In intact condition the midship section modulus about the transverse neutral axis shall be taken according to Pt.3 Ch.2 Sec.4 in the Rules for Classification of HS, LC and NSC.

The midship section modulus about the vertical neutral axis (centre line) is normally not to be less than:

$$Z_{OH} = \frac{M_{WH}}{\sigma} 10^3 \text{ (cm}^3\text{)}$$

M_{WH} = the longitudinal horizontal midship bending moment

σ = 88 f_1 N/mm²

The requirement for Z_{OH} may be disregarded provided the combined effects of vertical and horizontal bending stresses at bilge and deck corners are proved to be within 195 f_1 N/mm².

The combined effect may be taken as:

$$\sigma_s + \sqrt{\sigma_w^2 + \sigma_{wh}^2}$$

σ_s = stress due to still water bending moment

σ_w = stress due to vertical wave bending moment

σ_{wh} = stress due to horizontal wave bending moment

E. Weld Connections

E 100 Application of fillet welds

101 Double continuous fillet welds only, shall be applied in structures subjected to significant dynamic loading, in foundation joints to bottom and 1. deck, and in connections where the supporting member is subjected to large bending moments or shear forces.

F. Buckling (for HS, LC and NSC)

F 100 General (for HS, LC and NSC)

101 Buckling control shall be carried out according to Pt.3 Ch.2 Sec.10 in the Rules for Classification of HS, LC and NSC.

102 If considered necessary, buckling control for overall buckling shall be performed according to Classification Note 30.1 with the usage factors given in Pt.3 Ch.2 Sec.10 in the Rules for Classification of HS, LC and NSC.

G. Direct Strength Calculations

G 100 Modelling of hull structure (for HS, LC and NSC)

101 For vessels with a length greater than 50 m, the global strength is generally to be determined by Finite Element Method (FEM) analysis. Methods incorporating FEM analyses shall be in accordance with Pt.3 Ch.9 in the Rules for Classification of HS, LC and NSC.

G 200 Modelling of hull structure

201 For naval vessels the deformations in certain areas are of major importance with respect to the operation of the vessel. Some of these areas are not relevant for the global strength, but shall be included in the global model due to deformation. Thus, attention shall be paid during modelling with respect to superstructure and mast-houses. For special equipment such as main weapons, main sensors and masts, extra finite element models may have to be prepared if necessary.

SECTION 5

STABILITY, WATERTIGHT AND WEATHERTIGHT INTEGRITY

A. General

A 100 Applicability

101 Vessels with class notation **Naval** or **Naval Support (stab)** shall comply with the requirements for stability, watertight and weathertight integrity applicable for main class with the modifications specified in this section.

A 200 Plans and calculations

201 A report on damage stability calculations and an internal watertight integrity plan are required. The calculations shall demonstrate that the vessel for the prescribed loading conditions meet the intact and the damage stability requirements.

202 The stability manual shall contain documentation of the loading conditions specified in C101. Operational recommendations, such as instructions on fuel oil consumption and ballasting and restrictions on use of rolling tanks shall be clearly stated in the stability manual, as far as applicable.

203 It is recommended to develop maximum allowable VCG curves based on the criteria in C and D. It is recommended to include separate curves covering conditions with ice, if applicable.

B. Freeboard, External Watertight Integrity (for HS, LC and NSC)

B 100 Applicability

101 The requirements in B200 through B1000 apply to High Speed Craft only. The corresponding requirements for steel ships are covered by the main class requirements.

B 200 Design waterline

201 The design waterline is determined on the basis of the vessel's ability to comply with the relevant intact and damage stability requirements as given in C and D. The design waterline shall correspond to the draught of the full load condition, including allowance for possible weight increase, with no lift or propulsion machinery active.

202 The design waterline shall be clearly marked amidships on the vessel's outer sides, either by a separate mark or a scale of draught marks.

203 The vessel shall have scale of draught marks at the bow and stern on both port and starboard side.

B 300 External doors

301 The Rules for Classification of HS, LC and NSC, Pt.3 Ch.6 Sec.1 E100 apply, with the exception that hinges are not accepted as efficient closing devices.

302 Doors in superstructures or companionways on the weather deck, giving access to spaces below the weather deck shall have a sill height of at least 460 mm. Lower heights may be considered in relation to operational requirements, the integrity of the vessel and the arrangement.

B 400 Side and stern doors

401 The Rules for Classification of HS, LC and NSC, Ch.3 Sec.2 B and D apply, as applicable.

B 500 External hatches

501 The Rules for Classification of HS, LC and NSC, Ch.3 Sec.2 E apply for cargo hatches.

502 Access hatches shall have the same strength as their surrounding structure. Weathertight hatches shall be fitted with gaskets and a sufficient number of closing devices. The hatch covers shall be permanently attached.

503 The minimum height of hatch coamings shall be as follows: 450 mm on weather deck abaft 0.25 L, 600 mm forward of 0.25 L from FP. Lower heights may be considered in relation to operational requirements, the integrity of the vessel and the arrangement.

B 600 Air pipes

601 Pt.4 Ch.6 Sec.4 in the Rules for Classification of Ships apply.

B 700 Ventilators

701 General

- 1) Ventilators to spaces below weatherdeck or decks of enclosed superstructures shall be constructed to withstand the relevant loads and be properly connected to the deck. Where the coamings of any ventilators exceed 900 mm in height they shall be specially supported.
- 2) Ventilator openings shall be provided with efficient permanently attached weathertight closing appliances. Ventilators on the weatherdeck shall have coamings of a height of at least 900 mm above the deck.
- 3) Ventilators on the weatherdeck, the coamings of which extend more than 4.5 m upwards, need not be provided with weathertight closing, unless required by the stability calculations.
- 4) In exposed positions, the height of coamings may be required to be increased.

702 Arrangement

- 1) Where ventilators are proposed to be led overboard in an enclosed superstructure deck house or vessel side, a plan showing the closing arrangement shall be submitted for approval. If such ventilators are lead overboard more than 4.5 m above the weatherdeck, closing appliances may be omitted, if satisfactory baffles and drainage arrangements are provided.
- 2) To ensure satisfactory operation in all weather conditions, machinery spaces and emergency generator room ventilation inlets and outlets shall be located in such positions that closing appliances will not be necessary (minimum 4.5 m above the weatherdeck). Alternatively, depending on vessel's size and arrangement, lesser coaming heights may be accepted if weathertight closing appliances are provided in accordance with 601 and in combination with suitable means arranged to ensure uninterrupted and adequate supply of air to these spaces.

Guidance note:

With suitable means is meant e.g. that direct and sufficient supply of air is provided through open skylights, hatches or doors at a higher level than the heights required by the Reg. 19 of the International Convention on Load Lines, 1966.

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703 For vessels with service restrictions, the minimum heights of ventilators without weathertight closing appliances can be reduced as follows:

Service restriction **R2**: 2 400 mm

Service restriction **R3**: 1 800 mm.

B 800 Scuppers and discharge

801 The Rules for Classification of Ships, Pt.3 Ch.3 Sec.6 K100, shall be complied with, as applicable.

802 The thickness and diameter of piping between hull plating and closable or non-return valve shall be chosen so as to achieve equivalent strength as the surrounding structure.

B 900 Freeing ports

901

- 1) Where bulwarks on the weather portions of the weatherdecks form wells, ample provision shall be made for rapidly freeing the decks of water and for draining them. Except as provided in paragraphs 2) and 3) of this Regulation, the minimum freeing port area (A) on each side of the vessel for each well on the freeboard deck shall be that given by the following formula in cases where the sheer in way of the well is standard or greater than standard. The minimum area for each well on superstructure decks shall be one-half of the area given by the formula. Where the length of bulwark (l) in the well is 20 m or less:

$$A = 0.7 + 0.035 l \quad (\text{m}^2)$$

Where l exceeds 20 m:

$$A = 0.07 l \quad (\text{m}^2)$$

l need in no case to be taken greater than 0.7 L .

If the bulwark is more than 1.2 m in average height, the required area shall be increased by 0.004 m²/m of length of well for each 0.1 m difference in height. If the bulwark is less than 0.9 m in average height, the required area may be decreased by 0.004 m²/m of length of well for each 0.1 m difference in height.

- 2) For vessels with no sheer the area calculated according to paragraph 1) of this Regulation shall be increased by 50%. Where the sheer is less than the standard the percentage shall be obtained by linear interpolation.
- 3) For vessels having superstructures that are open at either or both ends, adequate provision for freeing the space within such superstructures shall be provided to the satisfaction of the Society.
- 4) The lower edges of the freeing ports shall be as near the deck as practicable. Two-thirds of the freeing port

area required shall be provided in the half of the well nearest the lowest point of the sheer curve.

- 5) Rails or bars spaced approximately 230 mm apart shall protect all such openings in the bulwarks. If shutters are fitted to freeing ports, ample clearance shall be provided to prevent jamming. Hinges shall have pins or bearings of non-corrosive material. If shutters are fitted with securing appliances, these appliances shall be of approved construction.

(ICLL Reg.24)

B 1000 Windows

1001 Pt.3 Ch.6 Sec.1 G (Rules for Classification of HS, LC and NSC) applies.

B 1100 Deadlights

1101 Documentation of the arrangement of deadlights shall be submitted for approval.

1102 Deadlights for windows shall be arranged as given in the Table B1.

Table B1 Deadlights for windows					
<i>Location</i>	<i>Service restriction</i>				
	<i>None</i>	R0	R1	R2	R3
Below bulkhead deck	100%	100%	100%	100%	100%
1 st tier above bulkhead deck forward of midship	100%	100%	1 of each type	1 of each type	0

1103 Deadlights shall have the same strength as the surrounding panel structure.

1104 Deadlights shall be clearly marked if they are not hinged to the window. The arrangement for stowage and mounting shall be such that quick and safe mounting is possible.

C. Intact Stability Requirements

C 100 Loading conditions

101 Compliance with the intact and damage stability criteria shall be demonstrated for the loading conditions shown in Table C1, and for any conditions of loading in the operating range between full load and minimum operating condition that will give poorer stability. In addition a loading condition with ice load according to 303 shall be included, if applicable.

Guidance note 1:

For vessels having an operational profile which implies that the loading conditions deviate from those indicated in Table C1, alternative conditions may be accepted as the basis for the approval.

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Guidance note 2:

Excessive metacentric heights should be avoided in particular for conventional monohull vessels, as it will result in rapid and violent motions.

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102 The harbour condition corresponds to the minimum operating condition, as found in Table C1, except that all tanks are empty. This is a non-operating condition to which the stability criteria does not apply. However, the metacentric height shall be calculated. If this is negative, the harbour condition shall be avoided by ballasting. The harbour condition and if applicable, the ballasting instructions, shall be stated in the stability manual.

Table C1 Loading conditions for intact and damage stability criteria		
<i>Load item</i>	<i>Full load condition</i>	<i>Minimum operating condition</i>
Vessel's complement*	All persons with effects onboard	All persons with effects onboard
Ammunition	Magazines and ready service stowages filled to maximum capacity	1/3 of full load ammunition with maximum quantities in ready service stowage and remainder in magazines
Mines	Maximum number onboard	Maximum number onboard
Missiles	Maximum number onboard	Least favourable quantity and disposition is assumed
Torpedoes	Maximum number onboard	Least favourable quantity and disposition is assumed
Aircraft	All onboard	All onboard
Provisions	Stores filled	1/3 of full load
General stores	All onboard	2/3 of full load

Table C1 Loading conditions for intact and damage stability criteria (Continued)		
<i>Load item</i>	<i>Full load condition</i>	<i>Minimum operating condition</i>
Lubrication oil	95% of maximum capacity	2/3 of full load
Fuel oil	95% of maximum capacity	Least favourable realistic disposition (Normally 5%)
Aviation fuel	95% of maximum capacity	1/2 of full load
Feed water	95% of maximum capacity	1/2 of full load and least favourable disposition
Fresh water	95% of maximum capacity	1/2 of full load and least favourable disposition
Bilge water tanks	Empty **	Empty **
Trim and ballast tanks	Empty **	Empty, unless full tanks are needed in order to obtain a favourable trim and/or sufficient stability **
Roll damping tanks	Filled to operating capacity	Filled to operating capacity
Overflow tank	1/2 full	Empty
Septic tanks	Empty	Empty
* The centre of gravity of the vessel's complement with effects is taken to be at deck level, 1. deck, mass 120 kg/person.		
** Design conditions may be used.		

C 200 Calculation of stability

201 First and second tier superstructure and first tier deckhouses may be taken into account in the stability calculations provided:

- enclosing bulkheads are of efficient construction
- access openings if any, and other openings in sides or ends of the superstructure, or deckhouses are fitted with efficient weathertight means of closing.

C 300 Calculation of effects from external loads

301 The heeling arm due to wind shall be obtained from the formula:

$$t_w = \frac{0.02 \cos^2 \theta}{1000 \Delta} \sum_{i=1}^n V_i^2 A_i l_i \quad (\text{m})$$

A_i = projected area of i^{th} portion, m^2

l_i = lever arm from half draught to centre of wind pressure on i^{th} layer, m

Δ = displacement, tonnes

θ = angle of heel

V_i = wind velocity in knots at centre of wind pressure on i^{th} layer

n = number of layers into which the area is divided

The following minimum wind velocities shall be applied:

For vessels without service area restriction and service area restriction **R0** or **R1**: 80 knots

For vessels with service area restriction **R2** or **R3** that will be recalled to harbour or protected waters if winds over Beaufort force 8 are expected: 60 knots. This shall be stated as a limitation in the stability manual.

The nominal velocities are given for a height of 10 m above the waterline. The velocity to be applied at height z shall be derived from the following formula:

$$v_z = v_{10} \left(\frac{z}{10} \right)^{0.15}$$

For calculation of the total heeling arm, the projected area is divided into layers of 1 to 2 m thickness depending on the size of the vessel. The centre of wind pressure for each layer shall be taken to be at the centroid of the particular layer. Reasonable account shall be taken of miscellaneous items contributing to the projected area.

Guidance note 1:

Horizontal surfaces, such as a helicopter deck, may contribute significantly to the wind heeling arm as the vessel heels. Therefore such surfaces should be included in the calculations.

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Guidance note 1:

For ships with smooth surfaces (e.g. stealth designs) where the drag coefficient may be considered to be less than for a conventional ship, a reduction in the wind heeling arm may be taken into account, but not by more than 10%.

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302 Vessels that will not be allowed to operate in conditions where icing may occur need not to comply with 303. This shall be stated as a limitation in the stability manual.

303 *Stability during conditions with beam wind combined with topside icing.*

The weight and distribution of accumulated ice shall be assumed as follows:

- mass of accumulated ice per m² of all exposed weather decks, platforms and front bulkheads of superstructure and deckhouse shall be assumed not less than 30 kg/m²
- mass of accumulated ice per m² on both sides of projected lateral area of the portion of the vessel above the water plane shall be assumed not less than 15 kg/m²
- mass of ice accumulated on rails, spars (except masts which shall be included above), rigging and small miscellaneous objects shall be taken into account by increasing the total projected lateral area above by 5% and the total static moment of this area by 10%
- the location of centre of gravity of the accumulated ice shall be determined in accordance with the actual location and assumed distribution given above.

The effect of beam wind shall be considered as given in 301. The wind velocities to be applied are as follows:

For vessels without service area restriction and service area restriction **R0** or **R1**: 60 knots

For vessels with service area restriction **R2** or **R3** that will be recalled to harbour or protected waters if winds over Beaufort force 8 are expected: 50 knots. This shall be stated as a limitation in the stability manual.

304 For vessels equipped with cranes the heeling arm due to lifting masses over the side shall be calculated by the formula:

$$h_l = \frac{Wb}{\Delta} \cos \theta \text{ (m)}$$

W = mass of lift

b = transverse distance from centre line of vessel to end of boom, m

Δ = displacement including mass of lift

θ = angle of heel.

305 The heeling arm due to the centrifugal force acting on the vessel during a turn shall be obtained from the formula:

$$h_t = \frac{v^2 t}{g R} \cos \theta \text{ (m)}$$

v = linear velocity of vessel in turn, m/s, not to be taken less than 0.65 v_{max}

v_{max} = maximum speed, m/s

g = acceleration due to gravity, m/s²

t = distance between vessel's centre of gravity and half draught, with vessel upright, m

R = radius of turning circle, m not to be taken greater than 2.5 L

L = overall length of the underwater watertight envelope of the rigid hull excluding appendages, at or below the waterline (B201) in the displacement mode with no lift or propulsion machinery

θ = angle of heel.

Guidance note:

In those cases where the vessel's arrangement makes the above anticipated values unreasonable, alternative values documented by model tests and full scale tests may be applied.

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306 The heeling due to concentration of personnel at 1.deck on one side of the vessel shall be considered as follows: The total number of persons onboard is assumed located at 1.deck. For the purpose of calculation, the mass of each crew member shall be taken as 80 kg and the centre of gravity 1.0 m above deck. The heeling arm shall be calculated by the formula:

$$h_c = \frac{Ws}{\Delta} \cos \theta \text{ (m)}$$

W = mass of total number of persons

s = distance from the centre line of the vessel to the centre of gravity of the crew. It is assumed that the total complement have moved as far as possible to one side, each person occupying 0.2 m² of deck space

Δ = displacement

θ = angle of heel.

C 400 Intact stability for monohull vessel

401 When the vessel is subject to wind and icing resulting in a heeling arm as described in 301 and 303, the criteria as given in 402 shall be complied with.

402 These stability conditions assume the vessel to be heeled over by the force of the wind alone until equilibrium occurs and then roll 25 degrees from this point to windward.

The stability is considered satisfactory if:

- The heeling arm at the intersection of the righting and heeling arm curve, point C in Fig.1, is not greater than six tenths of the maximum righting arm. See Fig.1.
- The angle of heel corresponding to point C in Fig.1 does not exceed 15 degrees.
- The area A_1 indicated in Fig.1 is not less than 1.4 A_2 where the area A_2 extends 25 degrees to windward from point C. The area A_1 is limited to the angle at which downflooding occur.
- The range of the GZ curve is at least 70 degrees.
- The GZ-curve is positive over the complete range.

Guidance note:

The GZ curve should be terminated at the downflooding angle.

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403 When the vessel is subject to a heeling moment as described in 304 to 306 as far as applicable, the criteria in 404 shall be complied with.

404 The stability is considered satisfactory if:

- The heeling arm at the intersection of the righting and heeling arm, point C in Fig.2, is not greater than six tenths of the maximum righting arm. See Fig.2.
- The angle of heel corresponding to point C in Fig.2 does not exceed 15 degrees. This angle may however be increased up to 20 degrees if all safety systems and machinery are designed for operation at such angles.
- The reserve dynamic stability (shaded area in Fig.2) is not less than four tenths of the total area under the righting arm curve.
- The GZ-curve is positive over the complete range.

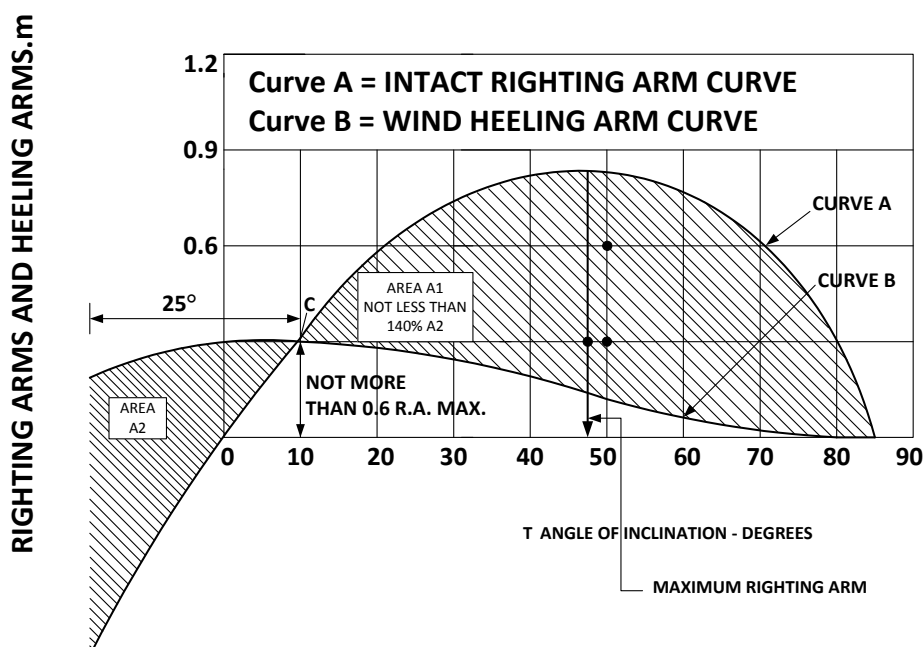


Fig. 1
Stability criteria

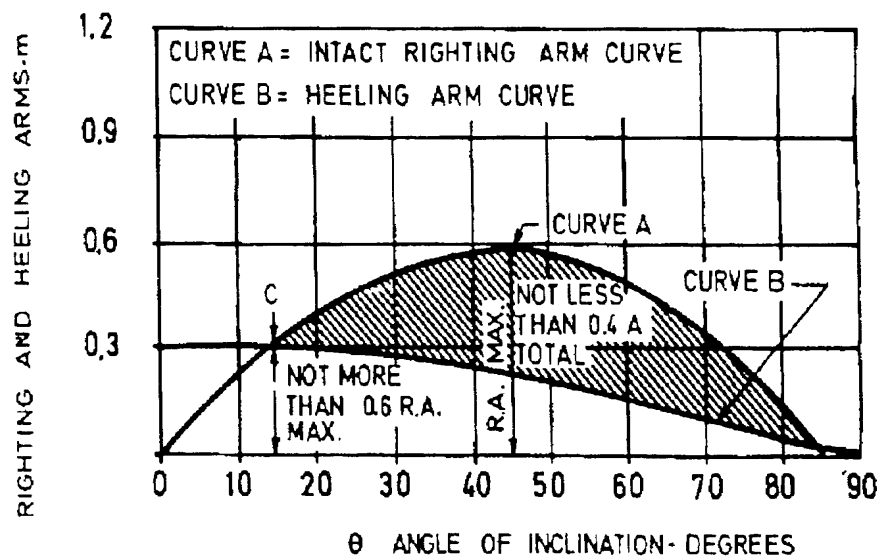


Fig. 2
Stability criteria

Guidance note 1:

The GZ curve should be terminated at the downflooding angle.

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Guidance note 2:

The vessel's behaviour in following seas, may be studied by carrying out stability calculations at an assumed wave, with shape, height and length as given below:

The trochoidal wave applied should have the following characteristics: Wave length: λ (in meter) equal to the length of vessel.

$$\text{Wave height: } H = \frac{\lambda}{10 + 0.05\lambda} \text{ (m)}$$

- 1) The vessel should comply with the requirements given in 402 with a righting arm curve calculated as the average of the curves obtained assuming a trochoidal wave as described above assuming wave crest amidships and wave trough amidships.
- 2) The vessel should, when assuming:
 - a) the wave crest amidships
 - b) the wave trough amidships
 - c) and wave characteristics as described above, comply with the following criteria:
 - the righting arm is positive over a range of at least 10 degrees
 - between 0 and 45 degrees inclination
 - the maximum righting arm is at least 0.05 m.

It is not necessarily the conditions with wave crest amidships that will provide the weakest GZ-curve. This depends on the shape of the vessel and will occur at the longitudinal section with the largest cross-section area. For vessels with an unusual shape it may be required to document the stability characteristics with model tests.

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C 500 Intact stability for multihull vessels

501 The same requirements shall be applied as for monohull vessels.

D. Internal Watertight Integrity

D 100 Watertight subdivision

101 Pipes, electrical cables and remote control extensions penetrating watertight and gastight bulkheads and decks, shall be arranged with penetration fittings with the same degree of tightness as the actual bulkhead.

102 Main watertight bulkheads shall be installed and located to fulfil stability and buoyancy requirements according to D. Sill heights shall be at least 230 mm. Access openings leading to tanks, cofferdams and voids shall be fitted with watertight manhole covers.

103 All pipes piercing the collision bulkhead shall be fitted with screw down valves capable of being operated from above the damage control deck.

104 No doors, manholes (other than manholes leading to tanks), access openings, or ventilation ducts are permitted in main transverse watertight bulkheads below the damage control deck. The number of openings above the damage control deck shall be reduced to the minimum compatible with the design and proper working of the vessel.

Doors shall have the same closing appliances as in B200.

Where pipes, scuppers, ventilation ducts and electric cables are carried through watertight subdivision bulkheads, arrangement shall be made to ensure the integrity of the watertightness of the bulkheads.

Valves and cocks not forming part of a piping system shall not be permitted in watertight subdivision bulkheads below the damage control deck.

Lead, plastics or other heat sensitive materials shall not be used in systems other than electric systems, which penetrate watertight subdivision bulkheads, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads.

105 Steps or recesses in main transverse bulkheads shall be avoided. However, if there are steps or recesses in transverse bulkheads bounding floodable compartments, only a total longitudinal depth of maximum 1.0 m is permissible for one-compartment vessels. See 203.

106 As a consequence of 105, double bottom or side tanks shall be divided in line with main transverse bulkheads, however, a total misalignment of maximum 1.0 m is permissible for one-compartment vessels.

107 *Arrangement of cross-flooding ducts*

Where it is necessary to correct large angles of heel, cross-flooding may be arranged. In that case, the following requirements shall be satisfied:

- 403 shall be complied with
- Cross-connecting ducts or pipes shall be as large as possible to allow cross flooding to take place in shortest possible time. The time needed for equalisation shall not exceed 15 minutes, so that cross-connected compartments can be virtually treated as one.

D 200 **Extent of damage for monohull vessels**

201 The damage is assumed to extend vertically without any limit. If damage of a lesser extent results in a more severe condition, such lesser extent shall be assumed (e.g. intact double bottom).

202 The transverse penetration of damage is assumed to reach to the centre line of the vessel, but leaving any centre line bulkhead intact. If damage of a lesser extent results in a more severe condition, such lesser extent shall be assumed.

203 The longitudinal extent of damage is determined by the following minimum requirements.

a) Vessels with $L \leq 30$ m

These vessels shall be capable of withstanding flooding of any single main compartment, i.e. one-compartment vessels.

Adjacent main transverse bulkheads shall be spaced at least $(2.0 + 0.03 L)$ m apart to be considered effective. Where main transverse bulkheads are spaced at lesser distance, one or more of these bulkheads shall be assumed as non-existent.

The longitudinal extent of damage in way of any such compartment is assumed to be equal to the length of that compartment less 1.0 m.

b) Vessels with $30 \text{ m} < L \leq 90 \text{ m}$

The longitudinal extent of damage is given by

$$l_d = 0.15 L - 2.6 \text{ m}$$

At least 2 adjacent main compartments shall be considered flooded. The vessel shall be capable of withstanding flooding wherever the damage is located.

c) Vessels with $L > 90 \text{ m}$

The longitudinal extent of damage shall be 15 percent of the vessel's length or 21 m whichever is less. The vessel shall be capable of withstanding flooding wherever the damage is located.

L = overall length of the underwater watertight envelope of the rigid hull excluding appendages, at or below the waterline (B201) in the displacement mode with no lift or propulsion machinery.

204 The permeability of flooded compartments shall be assumed as given in Table D1.

Table D1 Permeabilities	
<i>Compartments</i>	<i>Permeabilities</i>
Machinery spaces	0.85
Intended for liquids	0 or 0.95 *)
Other compartments	0.95
Stores	0.6
Computed permeabilities	**))
* Whichever results in the more sever requirements.	
** If computed values of actual permeabilities are found to deviate substantially from the values given above, these computed values may be used. In this case curves showing the actual permeability as a function of the depth of the vessel for each compartment shall be submitted for approval.	

205 The flooding of the storage rooms for explosives (see Sec.15) shall be documented.

D 300 Extent of damage for multihull vessels

301 The extent of damage is the same as for monohull vessels.

D 400 Survival criteria after damage, all vessels

401 Restrictions to limit flooding:

- The final waterline after flooding, taking into account sinkage, heel, and trim shall be at least 0.30 m below the lower edge of any opening through which progressive flooding may take place.
- Openings, the lower edge of which shall not be submerged, include such as air pipes and ventilators, with weathertight closing, and weathertight hatches and doors.
- Openings, which may be submerged, include manholes, watertight hatches, watertight doors, and side scuttles of the non-opening type.
- If pipes, ducts or tunnels are situated within the assumed extent of penetration of damage as defined in 200, arrangements shall be made so that flooding cannot thereby extend beyond the limits assumed for the calculation of the damaged condition in question.
- No unprotected openings shall be located within a distance of 1.5 m measured from the equilibrium waterline.

402 The angle of heel (Point C in Fig.3) shall not exceed 15 degrees in the final condition of equilibrium.

When the damaged vessel is subject to a wind force calculated as outlined in C301, assuming a nominal wind speed of 40 knots, the following criteria shall be met:

The available dynamic stability beyond point D in Fig.3 up to the angle θ_1 , i.e. the shaded area shall not be less than 0.025 mrad. The angle θ_1 shall be taken as 45 degrees or the angle at which progressive flooding (submersion of unprotected opening) would occur, whichever is less.

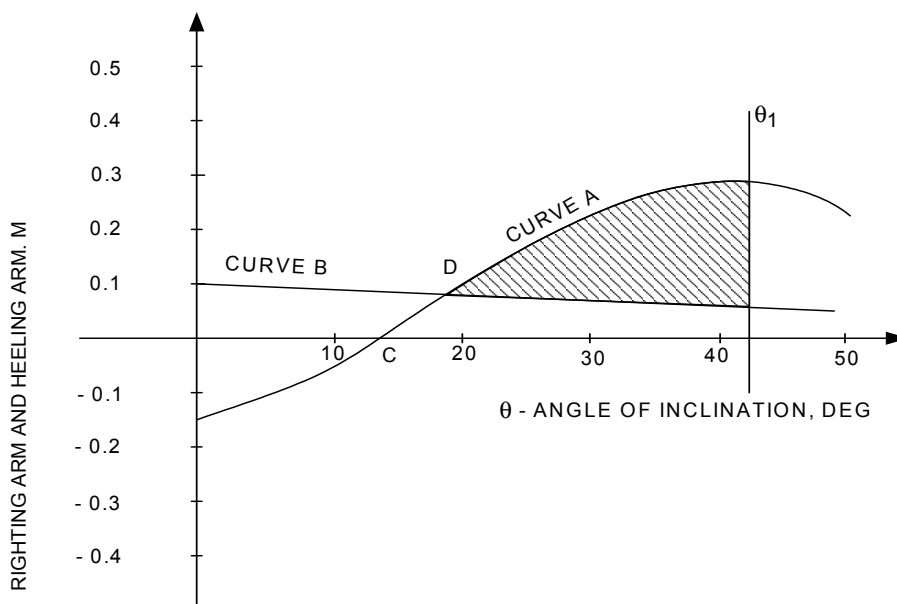


Fig. 3
Stability criteria for flooded condition

For vessels with service area restriction **R2** and **R3** a nominal wind speed of 30 knots may be applied.

403 The stability in the intermediate stages of flooding is considered satisfactory if:

- the angle of heel does not exceed 20°
- all openings through which progressive flooding of assumed intact spaces may occur, are above any intermediate damaged waterline
- the residual area requirements in excess of the wind heeling arm are as in 402.

SECTION 6 PIPING SYSTEMS

A. General

A 100 Application

101 Naval vessels with an overall length L (as defined in Sec.1 B201) of more than 50 m shall in general comply with the requirements in the Rules for Classification of Ships, Pt.4 Ch.1 and Pt.4 Ch.6, with the additional requirements specified in this section.

Naval vessels with L less than 50 m shall in general comply with the requirements in the Rules for Classification of HS, LC and NSC, Pt.4 Ch.6 and with the additional requirements specified in this section.

102 Classes of piping systems are specified in the Rules for Classification of Ships, Pt.4 Ch.6 Sec.1 Table B1.

A 200 Definitions

201 Active components in this section is any component transforming energy e.g. pumps, compressors, fans, electric motors and generators, combustion engines and turbines. Heat exchangers and boilers are normally not considered as active components.

202 Main functions in this section are defined in the Rules for Classification of HS, LC and NSC, Pt.1 Ch.1 Sec.2 A300.

203 Essential machinery- and vessel piping systems in this section are systems in which a failure will cause loss of main function, or cause deterioration of functional capability to such an extent that the safety of the vessel, personnel or environment is significantly reduced.

Guidance note:

In general essential systems are:

- cooling water systems
- lubricating oil systems
- fuel oil systems
- feedwater, condensate and steam systems
- hydraulic oil systems
- compressed air systems
- ventilation systems
- exhaust systems
- bilge (salvage) systems
- main seawater systems
- air, overflow- and sounding systems
- drainage systems
- ballast systems.

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204 The following definitions of the vessel's speed is used for the arrangement of machinery and piping system:

Cruising speed: normal cruising speed used for extended periods.

Maximum speed: maximum speed the vessel is designed for.

205 The redundancy and capacity requirements in this rule section will be based on the vessel's cruising speed. Power units with corresponding systems used for gaining maximum speed will only be defined as essential systems if this is specified by the owner.

A 300 Plans and particulars

301 Plans and particulars shall be submitted for machinery and hull piping systems according to the Rules for Classification of Ships, Pt.4 Ch.6 Sec.1 C.

For naval vessels with overall length L of less than 50 m, the plans and particulars given in the Rules for Classification of HS, LC and NSC, Pt.4 Ch.6 Sec.1 C are acceptable.

In addition, the following documentation shall be submitted for naval vessels:

- plans showing arrangement of all piping systems within each compartment with location of components
- arrangement plan showing structurally fire protected- and watertight divisions, including damage and fire control zones if relevant.

In addition to the requirements in the Rules for Classification of Ships, plans shall include details of penetrations in watertight- and structurally fire protected divisions.

A 400 Materials

401 Materials used in the construction of piping systems shall be manufactured and tested in accordance with the Rules for Classification of Ships, Pt.4 Ch.6.

For naval vessels with overall length L of less than 50 m, the plans and particulars given in the Rules for Classification of HS, LC and NSC, Pt.4 Ch.6 are acceptable.

When selecting materials due attention shall be paid to long life endurance.

402 The requirements for lifetime evaluations given in Sec.7 A are applicable for essential machinery and vessel piping systems.

403 Special light weight materials may be considered used in valves and components (when necessary for reduction of weight), provided in accordance with a recognised standard.

Measures shall be taken to reduce the risk of galvanic corrosion.

404 Plastic piping is in general to comply with the Rules for Classification of Ships, Pt.4 Ch.6 Sec.2.

For naval vessels with overall length L of less than 50 m, plastic piping shall comply with the Rules for Classification of HS, LC and NSC, Pt.4 Ch.6.

The following constraints apply for plastic pipes:

- plastic pipes are not accepted led through structurally fire protected or watertight boundaries
- plastic pipes are not accepted in piping systems for flammable fluids or essential machinery and vessel piping systems
- low flame spread, smoke generation and toxicity characteristic shall be proven according to a recognised standard.

B. Design Principles

B 100 General

101 Piping systems for naval vessels are in general to comply with the design principles in the Rules for Classification of Ships, Pt.4 Ch.6 Sec.3 with the additional requirements given in Sec.7 A and in this section.

For naval vessels with overall length L of less than 50 m, piping systems shall in general comply with the design principles in the Rules for Classification of HS, LC and NSC, Pt.4 Ch.6 Sec.3.

102 When the following systems are defined as essential, each system shall perform with 100% capacity when one component is out of function:

- fuel oil systems
- lubricating oil system
- cooling systems
- hydraulic systems
- pneumatic systems
- ventilation systems.

Guidance note 1:

In this connection a component is defined as an active component, a filter or a pressure reduction unit.

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Guidance note 2:

For multi engine plants with minimum 4 engines with engine driven pumps, a complete spare pump ready for mounting may be accepted.

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B 200 Arrangements

201 Essential machinery and vessel piping systems shall be designed and located to minimise the effect of battle damage.

202 Where machinery and equipment essential for the operation of the vessel is separated by watertight or fire divisions, piping systems serving such machinery and equipment shall be separated accordingly. Cross connections may be arranged if means for isolation are provided on both sides of the division.

Guidance note:

This implies that sea inlets and discharges as well as service and expansion tanks should be located in the same damage zone as the machinery it serves.

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203 Precaution shall be taken as to prevent progressive flooding through damaged pipelines between flooded and intact compartments. For this purpose, where any part of a pipe system has an open end into an assumed intact compartment, an isolating valve situated outside the damaged area and operable from an accessible position when the vessel is in damaged condition shall be fitted.

Guidance note:

For bilge piping, remotely operated valves may be replaced by non-return valves of the shut-down type. Isolation of air pipes may not be acceptable.

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204 Piping systems shall in general be easily accessible for damage control and maintenance purposes.

205 Pipes shall in general not be led through chain lockers, sea- and fresh water tanks, fuel oil tanks, spaces or trunks containing electrical and electronic equipment or storage rooms for explosives.

206 Piping within storage rooms for explosives or light flammable liquids shall have all welded connections.

B 300 Operation of valves

301 Requirements for operation of valves are given in the Rules for Classification of Ships, Pt.4 Ch.6 Sec.3. In addition, all remotely operated valves in dry compartments shall have means for local manual operation. Such means shall be readily available and simple to execute.

C. Pipes, Pumps, Valves, Flexible Hoses and Detachable Pipe Connections

C 100 General

101 Pipes, pumps, valves, flexible hoses and detachable pipe connections shall comply with the requirements in the Rules for Classification of Ships, Pt.4 Ch.6 Sec.6 with the additional requirements as specified in this section.

102 Piping systems for naval surface vessels shall in general be joined by butt welding. The number of detachable pipe connections shall be limited to those, which are strictly necessary for mounting and dismantling.

Detachable pipe connections that are partly constructed of non-metallic materials shall comply with the requirements for plastic piping in A400.

C 200 Pumps

201 Shut-down non-return valves shall be provided on the pressure side of pumps.

202 Centrifugal pumps located above their reservoir shall be of self priming type or connected to a priming system.

203 Remotely operated pumps shall also be arranged for local operation.

204 For pumps intended to operate against closed valves (e.g. pressurised systems such as the main seawater system), arrangements shall be provided for prevention of overheating of pumps. For displacement pumps, see the Rules for Classification of Ships, Pt.4 Ch.6 Sec.6 B200.

**D. Manufacture, Workmanship, Inspection
and Testing**

D 100 General

101 The requirements for manufacture, workmanship, inspection and testing shall comply with the requirements in the Rules for Classification of Ships, Pt.4 Ch.6 Sec.7 with the additional requirements as specified in this section.

102 Welded joints in class III piping systems shall be made by approved welding shops. Qualified welders using approved welding procedures shall carry out the welding.

103 After installation onboard, all essential machinery- and vessel piping systems shall be subjected to a hydrostatic test at a pressure of minimum 1.5 times the design pressure, minimum 4 bar.

E. Marking

E 100 General

101 All pipelines shall be marked according to a recognised standard.

102 Name plates with adequate information shall be attached to all valves and components. For remote controlled valves inside tanks or cofferdams, name plates shall be fitted at the control station.

F. Machinery Piping Systems

F 100 General

101 The requirements for machinery piping systems shall comply with the requirements in the Rules for Classification of Ships, Pt.4 Ch.6 Sec.5 with the additional requirements as specified in this section.

102 Specific requirements for functioning during electrical power failure are given in Sec.7 A.

F 200 Seawater cooling systems

201 The arrangement of seawater cooling inlets shall be in accordance with C200. As far as practicable, the cooling system for machinery for propulsion and power generation shall be connected to at least two seawater inlets.

202 If water inlets for propulsion engines are shared with main water systems or other consumers, it shall be capable of delivering the maximum required capacity to all systems and consumers simultaneously.

203 Main propulsion engines shall have a separate seawater cooling system.

Guidance note:

The main seawater system may be used for cooling purposes for other systems.

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F 300 Fresh water cooling systems

301 Fresh water cooled components in essential machinery systems shall have separate fresh water cooling systems.

302 Where fresh water cooled components in essential machinery systems are separated by watertight or fire divisions, freshwater cooling systems shall as far as practicable be arranged, with full separation between systems.

F 400 Lubricating oil systems

401 Arrangement of lubricating oil service tanks shall be in compliance with C200.

402 It shall be possible to clean lubricating oil filters without interrupting the oil supply. Bypass of filter units is not an acceptable mean of ensuring lubricating oil supply during cleaning.

403 Drip trays shall be fitted and arranged equivalent to that required for fuel oil tanks and systems.

F 500 Fuel oil systems

501 Arrangement of fuel oil daily service tanks shall be in compliance with C200.

502 Fuel oil service tank capacity shall in general comply with the Rules for Classification of Ships, Pt.4 Ch.6 Sec.5, but the calculations should be based on cruising speed as defined in A204. Alternative arrangements may be accepted upon special consideration.

For naval vessels with overall length L of less than 50 m, the daily service tanks shall have 100% redundancy, i.e. each main and auxiliary engine shall have fuel supply from at least two daily service tanks.

503 The fuel oil supply lines to propulsion machinery shall be separate from the supply lines to the machinery for power generation.

504 Remote shut-off valves in supply lines for propulsion machinery shall be separated from those serving machinery for power generation.

The control for the remote shut off valves in the different engine rooms shall be located in separate lockers to avoid erroneous operation.

505 The fuel oil system shall include arrangements for removing water and harmful contaminants.

506 The fuel oil transfer system shall be arranged such that fuel can be transferred from any tank to any other tank, or transferred to another vessel. Transfer pumps shall be arranged with built in redundancy.

F 600 Air inlets for main and auxiliary engines

601 General requirements for engine air inlets are given in Sec.7 and Sec.10. For vessels with class notation **NBC** these requirements shall be complied with.

F 700 Exhaust systems

701 All exhaust outlets shall be provided with silencers or equivalent.

702 Exhaust uptakes for machinery shall not be combined unless precautions are taken to prevent the return of exhaust gases to a stopped engine. Exhaust systems shall be installed to prevent noise and vibration.

703 The pressure drop in the system shall not exceed the values recommended by the engine manufacturer.

704 If exhaust outlets are located in the vicinity of the waterline, arrangements for prevention of water ingress shall be provided.

F 800 Hydraulic systems

801 Hydraulic pumps shall be equipped with high temperature alarm, giving alarm in manned control station.

802 In systems where rupture of hoses may be critical, flexible hoses shall be arranged with automatic hose rupture shut off valve to stop the outflow of liquid.

803 Hydraulic systems serving essential equipment shall be arranged in accordance with C200. In systems for remote control of valves, exemptions may be given provided relevant valves are arranged with manual remote control.

804 Drip trays shall be fitted and arranged equivalent to that required for fuel oil tanks and systems.

F 900 Machinery space ventilation

901 The capacity and arrangement of machinery space ventilation shall cover demands for operating machinery and boilers at full power in all weather conditions, as well as prevent excessive temperatures due to heat emission from machinery and electrical equipment.

Environmental conditions, including ambient temperatures, are specified in the Rules for Classification of Ships, Pt.4 Ch.6.

Guidance note:

For vessels intended to operate under cold climatic conditions heating appliances of sufficient capacity should be provided in the machinery space(s).

For vessels with class notation **NBC**, see corresponding requirements.

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902 One single failure in the machinery space ventilation system shall not result in more than 50% reduction in the ventilation capacity.

G. Vessel Piping System

G 100 General

101 Vessel piping systems shall comply with the requirements in the Rules for Classification of Ships, Pt.4 Ch.6 Sec.4 with the additional requirements as specified in this section.

G 200 Air, sounding and overflow pipes

201 Arrangement of air, overflow and sounding pipes shall take into account the requirements in C200.

Guidance note:

For vessels with class notation **NBC**, see corresponding requirements.

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202 Sounding pipes shall be provided with striking plates.

203 Fuel oil tanks that can be pumped up shall be provided with overflow pipes.

204 Due to the possibility of ignition, air pipe outlets from tanks containing flammable liquids or tanks with anodes for cathodic protection shall not be located within the blast zone of weapon systems. Outlets located in the vicinity of such zones shall be provided with flame screens.

G 300 Main seawater system

301 The main seawater system shall in general supply the following:

- fixed and portable fire extinguishing systems as described in Sec.10
- driving water for bilge ejectors as described in 400
- water spray systems for storage rooms for explosives
- seawater cooling supply to essential machinery and equipment except for cooling for main engines, if relevant
- ballast operations, if relevant
- pre-wetting systems for vessels with class notation **NBC**, protection shall be provided accordingly.

302 At least one main seawater pump shall be provided in each fire control zone.

Guidance note:

Note that two additional fire pumps are required in 308.

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303 The main seawater system shall be either continuously pressurised or arranged with remote start of pumps in order to ensure that water supply is readily available.

304 For vessels with class notation **NBC**, the larger of the required capacity in 305 and the total capacity required for the pre-wetting shall be applied.

305 The total capacity of the main seawater pumps shall be as follows:

For vessels below 800 tonnes displacement:

- 100 m³/h plus
- the required capacity for fighting a fire in the machinery space, a fire on flight deck and hangar, the required capacity of water spray systems for storage rooms for explosives according to Sec.15, whichever is greater.

For vessels from 800 up to 4 000 tonnes displacement:

- 150 m³/h plus
- the required capacity for fighting a fire in the machinery space, a fire on flight deck and hangar, the required capacity of water spray systems for storage rooms for explosives according to Sec.15, whichever is greater.

For vessels with 4 000 tonnes displacement and above:

- 250 m³/h plus
- the required capacity for fighting a fire in the machinery space, a fire on flight deck and hangar, the required capacity of water spray systems for storage rooms for explosives according to Sec.15, whichever is greater.

For vessels below 400 tonnes displacement the capacity could be specially considered based on calculations of actual sea water need.

Guidance note:

For vessels above 800 tonnes the capacities include simultaneous operation of: 4 portable bilge ejectors, each demanding 12.5m³/h, 8 and 16 hoses respectively, each demanding 12.5 m³/h.

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The pumps shall deliver the required capacity at a pressure corresponding to a hose pressure of 5 bar with the given number of hoses in operation.

306 Other systems (such as seawater cooling systems) that are connected to the main seawater system and that may operate during fire fighting operations shall be added to the total capacity described in 305.

Guidance note:

Required capacity for bilge and ballast operations need not be included.

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307 The required total main seawater pump capacity shall be equally divided between the required number of pumps.

308 The vessel shall, in addition to the pumps required above, have two independently driven fire pumps. The capacity of each independently driven pump shall as far as practicable be the same as for one of the main seawater pumps. The location of the pumps shall be in the fore and in the aft part of the vessel. The pumps shall be fitted with separate suction lines with length not exceeding 5 m. Other equivalent arrangements may be accepted.

For ships of length below 50 m the additional fire pumps may be omitted provided at least two main seawater pumps are provided.

309 The sectional area of the main seawater pipe and its branch connections shall be sufficient for efficient distribution of the maximum required supply.

310 Main seawater pumps serving the fire fighting systems and their seawater inlets shall be located within the same fire control zone.

311 Main seawater pumps separated by watertight- or fire divisions shall not be connected to the separating bulkheads.

312 The pump connections to the main seawater pipe and the extensions from pumps to main deck (pump risers) shall not penetrate the vertical watertight- or fire divisions bounding the compartment in which the pump is located.

313 The main seawater system shall be arranged in accordance with C200 and shall extend throughout the length of the vessel. The number of branch connections to the main seawater system shall be limited for damage control purposes.

314 The main seawater system shall be so arranged that all fire hydrants in the vessel, except those in a damaged section can be supplied from a seawater pump not located in the compartment containing the damaged section.

315 The fire main shall be arranged as a ring main for supply to all areas onboard. Each fire pump shall be so connected to the ring fire main that sufficient supply of water is maintained with single damage to any section of the ring fire main or one fire pump system.

316 Isolation valves shall be provided in the main seawater system in order to facilitate:

- isolation of each of the main seawater pump's connection from the main seawater system
- isolation of the main seawater system from damaged sections in adjacent compartments when separated by watertight or fire divisions.

317 A separation of the different systems defined to be part of the main sea water system into subsystems can be accepted as an alternative to a common main seawater system.

In such a case the bilge ejectors should be driven from a system with minimum the capacity needed for keeping at least 4 ejectors in operation simultaneously, when the ejector size is in compliance with H410. The ejector driving system should also comply with the general requirements to main sea water system.

A separate fire system shall incorporate the relevant systems for water-spray. The total capacity for such a fire system shall be as required in 306, less 50m³/hour. The other requirements to the main seawater system are also relevant for a separate fire system.

Combinations of the different sub-systems are acceptable, and then the capacity requirements will be added as relevant.

G 400 Bilge systems

401 Bilge systems are divided into the following:

- main bilge system (salvage) for removal of large amounts of water in an emergency flooding situation
- auxiliary bilge system (ullage) for removal of minor amounts of waters (including oily bilge water from machinery spaces) during normal operation.

402 The main bilge system shall be arranged for efficient drainage of all essential dry compartments through at least one suction in all conditions of trim and heel after sustaining a damage as specified in Sec.5.

Guidance note:

Essential dry compartments are compartments, which contain components in essential machinery and vessel piping systems. Large dry compartments where flooding will impair the stability of the vessel are also to be regarded as essential.

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403 The main bilge system shall be based on ejectors, with driving water supply from the main seawater system. Ejectors shall as far as practicable be distributed throughout the vessel, but one ejector shall be located in each machinery space. Not less than two ejectors shall be provided.

Guidance note:

Bilge pumps may be accepted, provided capable of operating in submerged condition.

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404 The bilge system is normally to consist of a main bilge pipe in each compartment containing an ejector, with branch suctions led to this compartment and to other essential dry compartments. Location of bilge piping shall comply with C200.

405 Each bilge suction shall as far as practicable be connected to at least two bilge ejectors, with isolation valves at the watertight or fire divisions separating the compartments in which ejectors are located.

406 Each bilge ejector shall have an overboard discharge outlet within the watertight compartment in which it is located.

407 In machinery spaces one of the bilge suction required in 402 shall be a direct suction. This shall be so arranged that it can be used at the same time as another ejector is drawing from the main bilge line. The direct bilge suction is normally to have a sectional area equivalent to that of the main bilge pipe.

408 In addition to the branch bilge suction, an emergency bilge (salvage) suction shall be provided in each machinery space, leading to the largest available power driven pump in each machinery space. The suction pipe shall be provided with a shut-down non-return valve and shall have sectional area equal to that of the line on the pump pressure side.

The emergency bilge suction shall be located on the opposite side of the direct bilge suction in 407.

409 The total capacity of the main bilge system in the vessel shall be as follows:

$$Q = 6\sqrt{L(B + D)} \text{ (m}^3\text{/h)}$$

L = length of vessel between perpendiculars (m)

B = breadth of vessel (m)

D = depth of vessel to bulkhead deck (m).

410 The total capacity in 409 shall be divided between the number of bilge ejectors provided. The capacity of each ejector shall be in accordance with the volume of the compartments served.

The capacity of any unit shall however not be less than 10% of that given in 409.

411 In addition to the permanent bilge units, portable submersible bilge pumps and portable bilge ejectors shall be provided as follows:

- 1 pump and 1 ejector for vessels below 500 tonnes displacement
- 2 pumps and 2 ejectors for vessels between 500 and 1 500 tonnes displacement
- 4 pumps and 4 ejectors for vessels above 1 500 tonnes displacement.

For vessels with displacement above 6 000 tonnes the required number of portable units will be specially considered.

412 Connections for power supply to portable bilge pumps, driving water for portable ejectors and overboard discharge shall be provided on damage control deck. Such connections shall as far as practicable be provided for every watertight compartment and on both sides of the vessel.

413 Half of the portable bilge pumps shall have capacity sufficient for emergency drainage of essential compartments, considering loss of one main ejector. The remaining pump(s) is accepted with smaller capacity.

Guidance note:

Pump capacities need not exceed 100 m³/h and 36 m³/h, respectively.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

414 Bilge ejectors shall have a minimum capacity of 12.5 m³/h.

415 The following valves essential for the operation of the main bilge system shall be remotely operated from above the damage control deck as follows:

- valves in driving water supply lines from main seawater system to bilge ejectors
- valves in overboard outlets from bilge ejectors
- isolation valves where bilge lines penetrate boundaries of the watertight compartments in which ejectors are located
- valves serving one bilge suction in the watertight compartment in which the ejector is located.

416 Dry compartments not covered by the main bilge system shall be arranged for drainage by portable bilge pumps.

417 An auxiliary bilge system shall be installed for drainage of oily bilge water from all machinery spaces and transfer to bilge water tanks, reception flange on deck or overboard through a bilge water separator according to 600.

G 500 Drainage

501 Essential dry compartments located above the waterline shall normally be provided with drain pipes of sufficient capacity for removal of fire water.

502 For vessels with class notation **NBC**, drain pipes led to within the vessel or overboard shall be arranged

to preserve gas tight division.

G 600 Oil pollution prevention

601 Requirements for oil pollution prevention according to MARPOL 73/78, Annex I shall be fulfilled as given in the Rules for Classification of Ships, Pt.4 Ch.6 Sec.4.

G 700 Ballast systems

701 The ballast system may consist of independent pumps or be connected to the main seawater system. Drainage may be provided through the main bilge system.

Ballasting by using gravity may be acceptable.

SECTION 7

MACHINERY, PROPULSION AND POSITIONING

A. General Requirements

A 100 Application

101 Naval vessels shall comply with the requirements given for main class in Pt.4, and with the additional requirements specified in this section.

A 200 Documentation

201 The following documentation is yard's responsibility and shall be submitted in addition to documentation as listed in the relevant sections in Pt.4:

- Shaft alignment calculation.
- Shaft strength calculation for load cases exceeding scope in Pt.4 Ch.4.
- Steering gear strength calculations for maximum expected loads, according to yards specification (and contracting navy loading profile).
- Strength calculation for steering gear locking arrangement.

The following documentation shall be submitted upon request:

- Vessel hull deflection calculations for extraordinary flexible hull designs.
- Machinery shafting system analysis, documenting tolerance for hull deflections.
- Documentation from the machinery vendor to document that the maximum deflections on his components as given by the hull deflection analysis is acceptable.
- Evaluation with conclusion on the impact of special naval operating requirements to the machinery.
- Documentation that the engine(s) can tolerate rapid load increase.

202 Type approvals may be the basis for certification. Additional documentation, such as test report or analysis, may be requested to verify that requirements in this section are complied with.

B. Operational Conditions

B 100 Operational conditions

101 Machinery with foundation and fastenings and machinery systems, including auxiliary systems, shall be designed for the following environmental conditions, both statically and dynamically:

- Permanent trim: $\pm 5^\circ$
Permanent list: $\pm 15^\circ$
Pitching: $\pm 10^\circ$
Rolling: $\pm 30^\circ$, typically with period 10 s for a monohull.

Other values than given above may be used if it can be documented that they are applicable. Environmental conditions less than specified in Pt.4 Ch.1 (Rules for Classification of Ships) will not be accepted.

Extreme values are not regarded as acting simultaneously. For simultaneously occurring values, see the Rules for Classification of HS, LC and NSC, Pt.4 Ch.1 Sec.1 A200 and the Rules for Classification of Ships, Pt.4 Ch.1.

102 Machinery with foundation and fastenings and machinery systems with control systems shall be designed for long time operation at full load. Operation requirements pertaining to naval surface vessels may also include:

- operation during extreme sea and weather conditions
- rapid acceleration and deceleration of propulsion machinery
- long time service on part loads
- long periods in harbor, with machinery out of use.

Details concerning operational requirements shall be decided by the contracting Navy.

The Society reserves the right to request documentation for compliance with the project specific requirements.

C. Arrangement and System Design

C 100 Basic principles

101 Main functions of the vessel shall be available at all times. This implies that:

- single failure in any main unit shall not lead to complete loss of main functions
- single failure of active component in auxiliary systems shall not result in reduced capacity of main functions.

102 Naval vessels shall have extra robustness to provide damage limitation. This is ensured by:

- duplication and separation of equipment
- use of separate compartments.

C 200 Machinery space arrangements

201 In order to accommodate a wide range of naval craft with different requirements for survivability, the following machinery space arrangements are defined:

Basic machinery space configuration (B):

Main propulsion units placed in one compartment.

There is no requirement for propulsion power after flooding or fire in the machinery space.

This arrangement requires acceptance by the contracting Navy.

Standard machinery space configuration (S):

Main propulsion units are placed in separate compartments divided by a watertight and fire insulated bulkhead.

Reduced propulsion power will be available after flooding or fire in any of the compartments.

Enhanced machinery space configuration (E):

Main propulsion units placed in separate compartments with a compartment in between where the bulkheads are watertight and fire insulated.

Reduced propulsion power will be available after fire in any one of the compartments or flooding from a certain damage length as defined in Sec.5.

Machinery space configuration Standard (S) is considered as default unless otherwise agreed.

202 For Standard (S) and Enhanced (E) machinery space configurations, the following applies:

- the propulsion lines shall be separated from each other with respect to fire
- auxiliary systems for each propulsion line shall be arranged to comply with the requirement to survivability of the applicable machinery space arrangement defined in C201.

C 300 Redundancy

301 Machinery systems shall be arranged with built in redundancy according to Table C1.

302 Lifting fans with shafting and prime movers shall be considered as part of the propulsion machinery.

Table C1 Main unit redundancy		
Main function	Main units	Redundancy
Propulsion:	<ul style="list-style-type: none"> — engine / turbine/electric motor — reduction gear — shaft — propeller / water jet unit / azimuth thruster — control and monitoring system 	The vessel shall be provided with sufficient redundancy of main units to ensure propulsion power in the event of single failure in any main unit with sufficient speed to ensure the ability to steer.
Steering:	<ul style="list-style-type: none"> — main steering gear — power actuating system — rudder actuator — control and monitoring system 	A single main steering gear shall be supplemented by an auxiliary steering gear. Auxiliary steering gear is defined as equipment other than any part of the main steering gear necessary to steer the vessel in the event of failure in the main steering gear. See Pt.4 Ch.14.
Electrical Power supply:	<ul style="list-style-type: none"> — engine — shaft — gear, if any — generator — main switchboard — control and monitoring system 	The vessel shall be provided with sufficient redundancy of main units to ensure propulsion power and steering ability in the event of single failure in any main unit.

C 400 Arrangement of air intake

401 In the case where combustion air is fed directly to the engine via external ducts; water drainage systems and filters to remove salt shall be included in the air intake. The air quality shall be in accordance with engine manufacturer's specification.

D. Component Specific Requirements

D 100 Propeller

101 The propulsion line shall be designed such that the blade failure load (see below) shall not cause damage in other parts of the propulsion line (i.e. blade connection to hub, propeller hub, pitch mechanism, shaft connection and aft end of propeller shaft).

Blade failure load is the load causing plastic bending of the propeller blade in a section just outside the root fillet.

Guidance note 1:

By damage in this context should be understood as when the stresses in the highest loaded part of the considered cross section reaches yield stress. The local effect of stress raisers may be ignored.

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Guidance note 2:

Formula for blade failure load may be found in the Rules for Classification of Ships, Ch.1 Sec. 4 J400 as formula for F_{ICE} .

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102 The propeller design shall accommodate repetitive lifting of propeller out of water at full speed and subsequent submerging. If not otherwise documented, M_t shall be taken as 1.0. See Pt.4 Ch.5 Sec.1 and Classification Note 41.5

D 200 Shafting and vibration

201 For vessels equipped with more than one shaft, the shafts shall be equipped with a shaft brake.

202 Due to long-time part load operation and frequent speed variations, barred speed ranges are not accepted for normal operation of propulsion machinery. Barred speed ranges may be accepted for operation of engine with one cylinder misfiring. Special attention shall be made to avoid resonance in the shafting system in the low-speed region.

D 300 Steering gear

301 Each rudder shall be equipped with an effective locking mechanism to stabilize the rudder in case of damage or change of steering gear.

The locking mechanism shall be designed with capacity to withstand forces equivalent to 25% of rule rudder torque (M_{TR} , as defined in the Rules for Classification of Ships, Pt.3 Ch.3 Sec.2 D202 and the Rules for Classification of HSLC and NSC, Pt.3 Ch.5 Sec.1 E402).

D 400 Thrusters

401 Auxiliary azimuth thruster that shall serve as propulsion thruster in emergency conditions shall comply with the Rules for propulsion thrusters in Pt.4 Ch.5 Sec.3 F202 and F203.

SECTION 8 ELECTRIC POWER GENERATION AND TRANSFER

A. General Requirements

A 100 Application

101 Naval surface vessels shall comply with the requirements given in Pt.4 Ch.8 with the modifications specified in this section.

102 This section shall govern whenever there is a conflict between the requirements of this section and Pt.4 Ch.8.

A 200 Definitions

201 *Casualty power system*

A distribution network of portable and permanently installed cables and connection terminals to provide temporary power supply to damaged parts of the permanent electrical installation.

202 *Damage control system(s)*

Vessel systems with primary objective to:

- take preliminary measures to prevent damage to the vessel
- minimize and localize damage
- accomplish emergency repairs, restore equipment to operation, and care for injured personnel.

The services to be included in the damage control system(s) shall be as specified by the contracting Navy.

Guidance note:

Examples of damage control system functions:

- Preserve or re-establish watertight integrity, stability, manoeuvrability, and offensive power.
- Control list and trim.
- Repair material and equipment.
- Limit the spread of, and provide protection from fire.
- Limit the spread of, remove the contamination by, and provide adequate protection against chemical and biological agents or noxious gases and nuclear radiation.
- Care for wounded personnel.

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203 *Darkened ship*

A situation where all normal lighting, including navigating lights, are switched off and hatches closed. Low intensity illumination (see G800) is accepted switched on.

204 *Essential equipment*

In addition to the services defined in Pt.4 Ch.8 Sec.13 A301, the following services shall also be considered essential for the **Naval** notation:

- Systems necessary to maintain satisfactory operation of the weapon systems and the damage control services.

A 300 Documentation

301 The following information shall be submitted for approval:

- power consumption balance for the “alongside” operational mode.

Guidance note:

The balance should give information necessary to have correct dimensioning criteria for the shore connection circuits.

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B. Design Principles

B 100 Environmental conditions

101 All electrical components shall be able to withstand electric static distortion as specified by the contracting navy.

B 200 Earthing

201 Aluminium superstructures, which are provided with insulating material between aluminium and steel in order to prevent galvanic corrosion, shall be earthed to the hull. For this purpose, corrosion-resistant metal wires or bands shall be used. The distance between such connections shall be less than 10 m. Aluminium superstructures shall be earthed to at least 4 points. The total resistance of all connections for one superstructure shall be less than that equal to 50 mm² copper, and the resistance of each connection shall be less than that equal to 16 mm² copper. Measures shall be taken to prevent corrosion at the point of connection.

B 300 Marking

301 Switchgear and safety equipment for each circuit shall be marked with:

— circuit number, name of the equipment supplied, location of equipment, fuse current, or adjustment of over-current protection

302 Wires and cables in control boards and connecting systems, except for very short lengths of internal wires, shall be marked near their ends. The marking shall be in accordance with the designations given in the corresponding wiring diagram.

B 400 Indicator lights

401 The colour of the indicator lights shall normally be chosen in accordance with Tables B1 to B2. The choice and number of colours and use of flashing or continuous light depends on the type of alarm, or signal system. Flashing lights shall normally be used in instances where messages require immediate action. When indicator lights are used to indicate the position of remote operated valves and cowl ventilators, the colours of the lights shall be in accordance with Table B3.

Table B1 Colour of indicator lamps		
Colour	Significance	Examples of use
Red	Crisis alarm	Stop of important machinery, e.g. steering gear, lubricating oil pump for propulsion machinery or other motors. Pressure failure in lubricating oil system for propulsion machinery, hydraulic system. Near critical level for temperature and pressure (water, oil). Breakdown of important connections.
Yellow or amber	Warning of abnormal conditions	Temperature and pressure conditions that deviate from normal level. Temperature rise of cooling water, but not to a critical value.
Green	Normal condition	Engine operation, liquid circulation. Pressure, temperature, current.
Blue	Instruction and information	Engine ready to start. No generators ready for connection. Electric heating circuit for electric machines out of order.
White or clear	Additional indications and general information	Earthing failure indicator. Synchronising lamps. Telephone calls. Automatically controlled equipment.

Table B2 Colours of rotating warning lights	
Colour	Significance
Red	Clear ship alarm. Action station alarm. NBC alarm. Damage control alarm.
Blue	Fire-medium release alarm.
Yellow	Machinery surveillance (E0-alarm).
White or clear	Telephone call in noisy room or space.

Table B3 Colour of indicator lights used to indicate the position of remote operated valves, cowl ventilators	
Colour	Significance
Red	Closed
Green	Open

C. System Design

C 100 Supply systems

101 The following supply systems are normally to be used:

- a) In D.C. installations:
 - two wire, insulated.
- b) In A.C. installations:

- single phase, two wire, insulated neutral point
- three phases, three wire, insulated neutral point.

Guidance note 1:

Other supply systems may be accepted on a case-by-case basis and upon agreement with the contracting Navy.

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Guidance note 2:

The number of system voltages should be kept as low as possible. The design should take into consideration the possible interface to other vessels and shore systems.

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C 200 D.C. voltage variations

201 D.C. Generators

D.C. generators shall not be used for feeding distribution systems onboard naval surface vessels.

C 300 Main source of electrical power

301 System requirements

- a) The installation shall consist, as a minimum, of two mutually independent electrical power supply systems. Each system shall consist of an electrical source of power and an associated main switchboard.

Guidance note:

The requirement for independence is also valid for all auxiliary systems (e.g. fuel oil, lubricating oil and cooling water) and alarm, control and safety systems.

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- b) With any one of the two main electrical power supply systems out of operation, the remaining shall have capacity to supply power to all services necessary to keep the vessel in normal operational and habitable condition. In addition there shall be sufficient capacity to supply the vessel's combat systems.

302 Arrangement

The two power sources and their main switchboards respectively, shall be located in separate watertight compartments with at least one compartment in between. In the event of flooding of one generator space plus the intermediate compartment, the remaining power source and its associated main switchboard shall still be fully operable.

Guidance note:

The damage length with regards to flooding is defined in Sec.5 D200.

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303 The fire integrity of the boundaries of the spaces containing the main power sources and their associated main switchboards shall be in accordance with SOLAS Ch. II-2 Reg. 9.2.3 Table 9.5 and 9.6, but shall not be less than A-60 when adjacent to a machinery space of category A.

Guidance note:

One generator and corresponding switchboard shall normally be in the same watertight compartment and fire control zone.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

304 For vessels with basic engine room configuration B, as defined in Sec.7, an electrical system with one main source of power and one emergency source of power in accordance with Pt.4 Ch.8 may be accepted.

305 The requirements in C300 are not made applicable for small naval vessels (with rule length less than 50 m). For small naval vessels the main electrical power system shall be in accordance with Pt.4 Ch.8 Sec.2 B.

Where redundancy in main source of power is waived for small naval vessels, any requirement for redundancy in main transforming equipment and/or the main distribution system is also waived.

Guidance note:

Choice of a simplified system arrangement as described in 304/305 above shall be communicated with the contracting Navy.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

306 Duplicated essential or important equipment shall for each equipment type be divided between different main switchboards or between distribution switchboard supplied by different main switchboards.

307 Where only one main switchboard is installed in accordance with 304, the main bus bars shall be divided

into at least two parts by use of a circuit breaker. The generating sets and other duplicated essential and important equipment shall be equally divided between the parts.

308 Essential or important equipment, which are not duplicated, shall have two sources of power supply. The primary supply shall be from the primary main switchboard and the alternative supply from an alternative main switchboard. A transfer switch shall allow switching between the primary and the alternative power supply. Local manual switching shall be available for all relevant equipment. For essential equipment, automatic switching shall be arranged.

Guidance note:

- a) The requirement for automatic switching applies in general for e.g. steering gear and steering machinery control systems, electric alarm and control systems for main and auxiliary machinery, as well as electric "stand by" oil pumps and weapon systems.
- b) Consideration should be given to the need for remote switching from a manned control position. See Pt.4 Ch.1 Sec.3 B and C in the Rules for Classification of HS, LC and NSC and Pt.4 Ch.9 Sec.2 A and B.
- c) Manual transfer switches used, shall be located near the equipment, so that operation of this can take place as part of the re-connection procedure, unless otherwise specified. Consideration should be given to the possible connection of two separate power systems.
- d) When only one main switchboard is installed in accordance with 304, the two sources of power supply may be taken from different halves of the main switchboard.

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C 400 Emergency source of electrical power

401 The requirements for emergency source of electrical power which are given in Pt.4 Ch.8, are not made applicable to naval surface vessels. Availability and independence are covered by the requirement for alternative source of power as required by 300 and 600.

For vessels with Basic Engine Room Configuration (B), the requirements in Pt.4 Ch.8 Sec.2 C may be applied. Reference is made to C303 above.

402 At least one generator in each main power supply system shall comply with the requirements for emergency generator.

403 Naval vessels with rule length less than 50 m shall comply with the requirements for emergency source of power given in Pt.4 Ch.8 Sec.2 C, where redundancy in the main source of power is waived according to (above ref.). The emergency source of power shall be capable of simultaneously supplying the services listed in Rules for Classification of HS, LC and NSC, Pt.5 Ch.1 Sec.5 A202.

C 500 Casualty power distribution system

501 General

A casualty power distribution system shall be arranged to provide temporary power supply to damaged parts of the permanent electrical installation.

The casualty power cable network shall consist of portable flexible cables and casualty power connection terminals. The number and length of permanently installed casualty power cables shall be kept to a minimum.

502 System requirements

Casualty power supply connections shall be provided for at least the following services:

- fire fighting foam station switchboards
- communication switchboards
- fire and bilge pump starters
- main switchboards and load centres (in the design of the casualty power systems, these switchboards are considered as sources of casualty power)
- CIWS and other craft self-defence switchboards
- IC switchboards
- lighting system transformers (except when located with casualty power equipped switchboards)
- machinery space propulsion and electric plant auxiliary control centres or switchboards
- distribution switchboards serving receptacles for portable submersible pumps and other damage control equipment
- steering gear switchboards
- damage control switchboards
- hospital/sick bay.

503 Arrangement

- a) Fore and aft casualty power runs shall be established port and starboard throughout the damage control

deck.

Alternatively the casualty power runs may be established throughout a continuous deck below the main deck, having through fore and aft access.

- b) Vertical risers shall be provided from the deck containing the horizontal run to switchboard spaces and to spaces with consumers requiring casualty power on other deck levels.
- c) The connection between terminals and the portable flexible cables shall be of pluggable/lockable type.
- d) Permanently installed cables shall be limited to risers. Where structural arrangements prevent the use of bulkhead terminals, two riser terminals, connected by a short length of permanent cable, may be installed.

Sufficient cable with plug assemblies shall be provided within a compartment to connect casualty power terminals on switchboards, lighting transformers, panels, and controllers to bulkhead terminals within the space.

C 600 Distribution

601 Sub-distribution systems or boards or panels supporting different naval functions shall be kept separated, each having supply from one or more main switchboards, as required in 305.

Guidance note:

The intention is to separate e.g. weapon systems, navigation systems, NBC systems, non-important naval systems.

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602 If the vessel is designed for zone distribution, where load centres supply groups of loads and consumers located in general proximity to each other, 306 and 308 are still applicable. Loss of a load centre shall not lead to loss of important or essential functions for the vessel.

603 The main lighting shall be arranged as at least two separate secondary systems supplied from different main switchboards. Light sources in each compartment, except for galley and deck lighting, shall be equally distributed between the systems. In case of failure of one of the lighting transformers, the remaining transformer(s) shall have capacity to supply all main lighting via manual connection.

Lighting transformers shall be of an air-cooled three-phase type.

604 Navigation lights

Switchboards for navigation lights shall be located in the wheel house, being equipped for regulating the luminous intensity from maximum to zero for all lights simultaneously.

Emergency lanterns shall have 24 V D.C. supply connected to a separate switchboard and have a separate cable leading to the fixture.

Guidance note:

Reference is made to International Regulations for Preventing Collisions at Sea 1972 with later amendments (COLREG).

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605 Signal lights shall have a separate switchboard located in the wheelhouse or an adjacent, easily accessible compartment. The switchboard shall be supplied as described for navigation lights, see the Rules for Classification of HS, LC and NSC, Pt.4 Ch.11.

C 700 Shore connection

701 In the main switchboard, the shore connection circuit shall be provided with a circuit breaker with short circuit and over current protection.

The breaker shall normally be interlocked with the generator breakers so that the shore connection cannot be effected when one or several generators are connected, and vice versa. A bypass function of this interlock may be arranged to give possibility for short time (maximum 5 s) synchronising of shore and vessel systems as to prevent black-out upon shifting from one source to another.

A phase switch or phase sequence protection shall be mounted for vessels with three-phase plant.

702 In plants with several main switchboards, the shore connection shall be located in the connection area of the primary main switchboard. Power supplies from ashore and from another vessel shall not take place simultaneously.

703 For vessels constructed of aluminium, shore connections shall be through isolating transformers.

C 800 Choice of cable and wire types

801 Only cables and wires of temperature class 85°C or higher shall be used.

802 Cables and wires shall be chosen as to minimise the possibility of smoke evolution and release of

halogens during a fire.

Guidance note:

Relevant standards are

- * IEC 60754 (1/2) for halogen-free cables
- * IEC 61034 for low smoke cables.

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803 Cables supplying the following functions shall be of a type fulfilling the requirements to fire resistant cables defined in IEC 60331 Series:

- navigation systems
- combat systems
- communication systems.

Exceptions may be made for cables located in the same fire zone or compartment as the equipment it supplies, and for redundant cables run in different fire zones or compartments.

C 900 Control gear for motors and other consumers

901 D.C. motors should normally not be used. If being the only possible solution, it shall be possible to start D.C. motors of up to 0.5 kW upon direct connection of full voltage.

C 1000 Battery supplies

1001 Supply to weapon-electronics, navigation and platform management systems from starting batteries shall be avoided.

1002 Charging equipment shall be dimensioned for the maximum load and the maximum load current that occurs while charging the batteries. There shall be automatic control to prevent overloading. Temperature controlled charging shall be used.

1003 For buffer operation, or other situations where the battery is loaded while the battery is being charged, the maximum charge voltage shall not exceed the maximum allowable voltage for any appliance connected. If this is not possible, a voltage adapter, or some other method of voltage control, shall be used.

D. Switchgear and Control Gear Assemblies

D 100 Mechanical construction

101 The switchboard construction shall be of a design preventing accidental operation of the breakers or switches.

Guidance note:

An acceptable construction is having the operator handle in line with the switchboard front panel.

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D 200 Remote operated switchboard

201 If remote operated switchboards are used; the possibility for manual operation shall be designed for fulfilling the requirements in Pt.4 Ch.8. Damage to the remote control system or cables supporting this function, shall not jeopardise the possibility of manual operation of the switchboard.

E. Rotating Machinery

E 100 Motors

101 Motors shall be designed in accordance with specified radio interference requirements for the vessel. Motors shall not emit disturbing mechanical operating noise in the normal operating area.

F. Miscellaneous Equipment

F 100 Switchgear

101 Mercury switches are not permitted.

102 Remote operated circuit breakers shall have the possibility for manual operation in case of an emergency.

F 200 Galley equipment

201 All fixed galley equipment shall be supplied from one or more isolating transformers.

F 300 Batteries

301 Battery cells shall be designed to prevent electrolyte leakage from occurring on heeling up to 40°.

G. Installation and Testing

G 100 Principles

101 Electric cables and equipment shall be located so that they are not in the way when machinery shall be installed or dismantled.

G 200 Generators

201 The generator sets, including frames, shall be so rigid that extra stiffening after installation is unnecessary. All pipe and cable connections shall be flexible enough to withstand maximum possible deflections.

202 The centre line of the generator shaft and the transmission shaft shall coincide. The maximum permissible radial eccentricity in the generator shaft is 5/100 mm. In the case of diesel prime movers the shaft eccentricity shall not exceed 5/100 mm between the crank arm in the course of one rotation.

203 The generator sets shall be located on vibration damping elements.

G 300 Switchboards

301 Location

As far as possible the switchboards should be located in athwart-ships direction.

G 400 Cables

401 Cable runs through compartments that may be flooded shall be installed as high as possible.

402 Cables for equipment which require two alternative power supplies (in accordance with C300 or C600), and for equipment which is duplicated because of its importance, shall be laid to achieve the maximum degree of transverse and vertical separation.

403 Cable installations in the radio room shall be limited to radio station requirements. The radio room shall be regarded as screened, and the laying of extraneous cables through such rooms, is not permitted.

404 At the interface between hull and machinery, the cables shall have enough slack to prevent them being damaged by vibration. On resiliently mounted equipment, cables shall have slack between the last fastening point and the entrance to the equipment. The slack of cable and cable fixing point shall allow for relative movement by vibrations of the machinery.

405 The protection provided by the vessel's hull shall be exploited to the full. Where practicable, cables shall be laid on the inner side of beams and other parts of the construction. Cables shall not be laid externally on superstructures unless absolutely necessary, and in cases where this must be done, they shall be protected as specified in 409.

406 Cables shall not be installed such that they are permanently submerged unless the whole installation is approved for such applications.

407 Where plastic pipes are used, consideration shall be given to plastic's large thermal expansion coefficient and to radio interference.

408 Cables shall normally not be painted.

Guidance note:

Painting of cables can be accepted provided that it is documented that the paint does not damage the cables.

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409 Airtight compression and threaded glands shall normally be used when laying cables through airtight bulkheads. Other methods may be accepted if requirements to tightness can be achieved through good fitting and use of sealing compounds.

410 When single compression glands are used, a sealing compound shall be used as filling around the cable on both sides of the penetration.

411 Cables passing through a deck shall be supported and mechanically protected up to a height of at least

200 mm above the deck.

412 Cables laid through insulation in the refrigeration and cooling rooms, shall be laid in heat insulated penetrations of wood, plastic or similar heat insulating material.

413 Cables shall normally not penetrate watertight bulkheads under the damage control deck.

Guidance note:

If such cable penetrations are unavoidable, a watertight cable penetration may be accepted. It should be documented that the cable penetration will withstand the strains the bulkhead is designed for.

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G 500 Screening and earthing of cables

501 The cable's sheath, armouring, braiding or screening shall normally be earthed at both ends of the cable.

Guidance note:

Normally not applicable for mine warfare vessels.

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502 The screening the vessel structure itself may provide, shall be exploited to the maximum. Cable shafts and ducts shall be used if necessary.

503 For vessels of non-conductive materials, exceptions from the above may be given.

Guidance note:

Special magnetic signature requirements may require other solutions.

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G 600 Marking of cables

601 Each permanent fixed cable shall be marked so that it can be identified in all separate compartments where it is required to be accessible. If the cable can be easily tracked within one compartment, marking at one side is sufficient.

Guidance note:

In practice this means that cables should be marked at junction points, and on each side of penetrations in the deck or bulkhead.

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602 For cable penetrations with several cables, marking of the individual cables may be omitted. Instead an identification signboard shall be mounted adjacent to the penetration. This shall give the cable's reference designation relevant to its place in the penetration. Identification signboards shall be white with black engraving, and be fixed with screws to the bulkhead.

603 Marking of individual cables shall be in accordance with the cable identification made in the drawings.

G 700 Batteries

701 Batteries shall be installed so that protection against vibration is achieved.

702 Battery boxes exposed to wind and weather shall have a drainage outlet in the base.

703 Ventilation air to the battery location shall be preheated or drawn from a heated compartment.

G 800 Low intensity illumination

801 A low intensity lighting system shall be installed in addition to the required normal lighting. The low intensity lighting shall provide illumination during "darkened ship" operation. The low intensity illumination wave-length shall be 600 nm or more.

802 Fixtures for low intensity illumination shall be mounted so that light does not normally shine directly into the eyes. (E.g. when they are installed right next to berths, at the top of stairs and ladders). If necessary the globes shall have metal shades.

803 Low intensity illumination shall be installed or shaded to prevent, at any time, the light showing outside of the vessel.

804 Low intensity illumination shall not be connected to door switches. This lighting shall be connected to separate circuits from the nearest light switchboard. All switches shall have double poles, and be appropriately located. The switches shall be specially marked.

805 Low intensity illumination fixtures shall be installed along passage ways that lead from the accommodation to the control stations. Where access is through large rooms, such lights shall only be installed

as passage lights.

806 Washrooms and lavatories with doors to access passages shall have low intensity illumination. This lighting shall also be installed in accommodation as well as in washrooms and lavatories outside accommodation. It shall be installed as continuous lighting.

807 Normally low intensity illumination shall be installed at plotting tables and working stations. The fixtures shall have dimmers.

G 900 Emergency lighting

901 There shall be installed an emergency lighting system throughout the vessel to provide minimum illumination necessary to carry out at least the following activities:

- restoration of main power
- repair work on equipment - in technical rooms
- medical surgery
- fire fighting.

The emergency lighting shall as a minimum cover:

- all service and accommodation alleyways, stairways, exits and emergency exits
- personnel lift cars and lift trunks
- machinery spaces and main generating stations, including their control positions and switchboards
- stowage positions for firemen's outfit.

902 The emergency lighting shall be operable for a minimum of 3 hours.

903 The source of power for the emergency lighting shall normally consist of accumulator batteries located within the lighting fixtures. The batteries shall be continuously charged.

Guidance note:

Alternative arrangements providing the same availability of the emergency lighting may be accepted.

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904 It shall be possible to switch off the emergency lighting.

H. Electric Propulsion

H 100 General

101 The requirements of H apply in addition to those of Pt.4 Ch.8 and other parts of this section, and are applicable to propulsion machinery or systems on vessels where the main propulsion consists of electric motor(s).

H 200 Design principles

201 Propulsion motors

- a) The motors may be cooled by air or water. In case of water cooling, only double piped freshwater coolers with temperature and leakage alarms will be accepted.
- b) There shall be redundancy in the propeller motor cooling system. Load capability at reduced cooling shall be specified.
- c) Ball and roller bearings or slide bearings may be used. Motors having bearings with pressurised lubrication shall have their own individual lubrication system, that meets the requirements of banking and heeling, see Sec.7.

H 300 System design

301 The following supply systems are accepted for the electric propulsion system:

- insulated
- high impedance earthed.

Guidance note:

The power system should withstand a single-phase earth fault for 30 minutes and the fault current shall be limited to 2 A.

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SECTION 9 CONTROL AND MONITORING

A. General Requirements

A 100 General

101 The requirements in this section are of a general character in as much as the damage control and monitoring philosophy depends on the vessel's prescribed operating philosophy. The principles identified apply to specified control and monitoring tasks.

A 200 Application

201 The requirements in this section are additional to the requirements given for the main class.

B. Documentation

B 100 Requirements for documentation

101 The plans and particulars that shall be submitted are given in Pt.4 Ch.9 Sec.1.

C. System Design

C 100 General

101 The systems shall be designed to enable future modification, upgrade and replacements.

C 200 Minimum extent of control and monitoring (for HS, LC and NSC)

201 Means shall be available to control and monitor the fire detection and extinguishing systems and the bilge fluid detection and removal system when the vessel is out of normal operation.

Guidance note:

The control and monitoring may be from a manned location on board the vessel or from a position outside the vessel (from shore or from another vessel).

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C 300 Data communication links

301 Data communication links interconnecting essential and important systems in separate compartments shall be duplicated.

The cables shall be installed well protected and as far apart as practicable.

Guidance note:

Due to the probability of hull damage, the cables should not be installed adjacent to the shell plating. Bus networks are typically to be installed on each side, one high, one low. HUB's for star networks are typically to be installed in a centre position towards the bow and the stern of the vessel.

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C 400 System independence

401 A failure in one zone shall not have a negative effect of systems in another zone.

Guidance note:

Applies to different autonomous zones, if any.

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D. Component Design and Installation

D 100 Enclosure

101 Minimum requirement for enclosure on bridge shall normally be IP44 unless the risk for water ingress on the bridge is small.

D 200 Temperature

201 Table C1 is an extension of Table B1 of Pt.4 Ch.9 Sec.5.

Table C1 Parameter class for the different locations on board		
<i>Parameter</i>	<i>Class</i>	<i>Location</i>
Temperature	E	Open deck, masts for vessels to operate in arctic climate
	F	Inside cabinets and desks with temperature rise of 5°C or more installed in location E

202 Class E: Ambient temperatures – 40°C to + 55°C.

203 Class F: Ambient temperatures – 40°C to + 70°C.

D 300 Electromagnetic interference

301 See Sec.14.

D 400 Inclination

401 See Sec.7 A100.

D 500 Sensors

501 For sensors belonging to essential functions, use of switches shall be avoided as far as practicable.

E. Alarm System

E 100 Alarm system in the accommodation

101 Any alarm condition in the engine room shall initiate an alarm in the watch-keeping engineer officer's cabin and day rooms. Acknowledgement in the cabin shall be indicated on the bridge when the engine room is unattended.

102 101 may be waived if the engine room shall be permanently manned.

F. Damage Control System

F 100 General

101 The damage control system is an essential system.

Guidance note:

Related to the definition and additional requirements found in Pt.4 Ch.9.

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G. Monitoring and control

G 100 General

101 Workstations for monitoring shall be arranged for the following (as applicable):

- 1) damage stability
- 2) fire detection
- 3) fire pumps
- 4) fire doors
- 5) ventilation
- 6) watertight doors
- 7) bilge
- 8) ballast
- 9) seawater main
- 10) high water level in relevant rooms under water level
- 11) hatches (as relevant)

12) monitoring of NBC parameters as follows:

- automatic detection of NBC pollution
- overpressure in citadel
- NBC ventilation
- NBC filters
- pre-wetting.

Guidance note 1:

The above may be combined in an NBCD plotting system.

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Guidance note 2:

The number and position of the workstations will depend upon the type of vessel.

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102 Remote control shall be arranged at these workstations for the following (as applicable):

- bilge and ballast systems
- fire extinguishing systems
- fans and dampers
- seawater main
- pre-wetting
- electrical power supply.

H. Control Systems

H 100 General

101 Means shall be available to override automatic safety actions for essential systems. Overrides shall be clearly indicated and identified.

H 200 Steering control system

201 The control system for steering of vessels shall be designed to handle extreme operating manoeuvres, and extreme load changes.

H 300 Water jet control system

301 The control system for water jets shall be designed to handle rapid and numerous subsequent deaerations due to loss of water (sudden load shedding).

H 400 Stabiliser control system

401 The stabiliser control system shall be designed to handle extreme load changes.

SECTION 10 FIRE SAFETY

A. General

A 100 General

101 The requirements for fire protection in this section apply to naval vessels made of steel or other equivalent materials. In addition, the requirements given in SOLAS Ch. II-2 for cargo vessels shall be complied, regardless of tonnage, with unless otherwise stated in this section. For naval vessels equipped to carry fuel that is not for own use, the requirements in SOLAS for tankers shall apply.

Guidance note:

For the DNV's interpretations to SOLAS regulations, see DNV Statutory Interpretations.

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102 Fire fighting components and systems required to be of an approved type shall be approved by the Society. Documentation verifying approval shall in such cases be submitted.

B. Rule References and Definitions

B 100 Fire technical definitions

101 For technical and space definitions, see Sec.2 and SOLAS Ch. II-2 Reg. 3 and 9.2.3.

C. Documentation

C 100 Documentation Requirements

101 Documentation shall be submitted as required by Table C1.

Table C1 – Documentation requirements			
<i>Object</i>	<i>Documentation type</i>	<i>Additional description</i>	<i>Info</i>
Vessel arrangement	Z010 – General arrangement plan	Should including Fire Control Zones (FCZ) and Damage Control Zones (DCZ) in profile and plan view. A note should clarify the chosen engine room configuration, ref. Sec.7. To be submitted as the first drawing in each project.	FI
Safety general	G040 – Fire control plan		AP
Structural fire protection arrangements	G060 - Structural fire protection drawing		AP
	V060 – Penetration drawings		AP
Fire water system	S010 – Piping diagram		AP
	S030 – Capacity analysis		AP
	Z030 – System arrangement plan		AP
Machinery space fixed fire fighting system	G200 - Fixed fire extinguishing system documentation		AP
Machinery space fixed local application water spraying fire extinguishing system	G200 - Fixed fire extinguishing system documentation		AP

Table C1 – Documentation requirements (Continued)			
<i>Object</i>	<i>Documentation type</i>	<i>Additional description</i>	<i>Info</i>
Cargo, vehicle and ro-ro space fixed fire extinguishing system	G200 - Fixed fire extinguishing system documentation	If relevant	AP
Galley exhaust duct fire fighting system	G200 - Fixed fire extinguishing system documentation		AP
Dee-fat cooking device fire fighting system	G200 - Fixed fire extinguishing system documentation		AP
Paint locker fire fighting system	G200 - Fixed fire extinguishing system documentation		AP
Escape route s	G120 - Escape route drawing		AP
Fire detection and alarm system	I200 - Documentation for control and monitoring systems.		AP
	Z030 - System arrangement plan		AP
Ventilation systems	V010 - Ducting diagram		AP
	V050 – Duct routing sketch		AP
Low location lights	Z030 – Local arrangement plan		AP
	Z090 – Equipment list		AP
Helicopter deck foam fire extinguishing system)	G200 - Fixed fire extinguishing system documentation	If relevant	AP

102 For general requirements to documentation, see Pt.0 Ch.3 Sec.1.

103 For a full definition of the documentation types, see Pt.0 Ch.3 Sec.2.

D. Structure

D 100 Structural integrity

101 SOLAS Ch. II-2 Reg. 11 shall be complied with.

102 Where an asterisk appears in SOLAS Reg. II-2, table 9.5 and 9.6, doors and hatches may be accepted made of other material than steel if the surface is documented to have low flame spread characteristics. This will typically apply to doors to hangars and escape hatches on weather deck.

E. Fire Control Zones

E 100 Fire control zones

101 Naval surface vessels shall be subdivided into fire control zones by “A” class divisions according to the requirements applicable to passenger vessels, ref. SOLAS Reg. II-2/9.2.2. The divisions shall have minimum A-0 class integrity; additional integrity requirements will apply when required by SOLAS Ch. II-2 table 9.5. and 9.6.

102 Minimum 2 fire control zones shall be provided, irrespective of the length of the vessel.

103 For ship designed for special purposes, such as closed ro-ro and vehicle, helicopter storage and amphibious-boat spaces, where the provision of the main vertical zone is not practically possible, horizontal

main fire zones may be accepted if arranged in compliance with regulations for special category spaces. SOLAS Reg. II-2/20.2.2.1 refers.

F. Fire Integrity of Bulkheads and Decks

F 100 Fire Integrity of Bulkheads and Decks

101 SOLAS Ch. II-2 Reg. 9.2.3 shall be complied with.

102 The following spaces shall be regarded as category (1) spaces with regard to fire integrity:

Wheelhouse, chartroom. Spaces containing the vessel's radio equipment. Damage control stations, damage control central (when located outside the machinery space), weapon system rooms, rooms containing radar equipment, fire-extinguishing rooms, fire extinguishing equipment rooms. Sonar equipment rooms, sonar instrument rooms, electronic countermeasure rooms, degaussing rooms, gyro rooms, IFF rooms. Control room for propulsion machinery when located outside the machinery space. Spaces containing centralised fire alarm equipment. Operation rooms (combat information centre) and combat system room.

103 For engine room bulkheads separating main propulsion units, the following apply:

- For vessels with standard engine room configuration, the division separating the main propulsion units shall be at least A-60.
- For vessels with enhanced engine room configuration, the compartment separating the propulsion units shall be at least 600 mm wide, consisting of A-class boundaries, and be insulated according to SOLAS Ch. II-2 Reg. 9.2.3 Table 9.5 and 9.6.

Guidance note:

Standard and enhanced engine room configurations are used to describe propulsion redundancy, and are defined in Sec.7.

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104 Storage rooms for explosives as defined by Sec.15 shall not be arranged below or adjacent to vessels main control centre (wheelhouse and communication central). Sec 15 item E200 is considered compulsory for all vessels that shall comply with Naval Support (fire).

G. Means of Escape

G 100 Arrangement

101 The arrangement for means of escape shall comply with SOLAS Ch. II-2/13 as applicable to cargo ships.

Guidance note:

Other escape arrangements that ensure an equivalent safety may be accepted.

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102 In spaces where more than 50 persons may be expected, at least two escape ways shall be provided.

103 In ships intended for more than 50 persons, no dead end corridors shall be permitted.

104 One of the escape ways required by 102 may be arranged as vertical escape through hatches in the deck above with minimum 800 × 800 mm clear light opening (ladders included). The ladder may be of retractable type permanently hinged below the hatch. In such cases, photo luminescent signboard positioned close to the floor level shall indicate the position of the retractable ladder above.

105 Low location lighting shall be arranged according to SOLAS Ch. II-2 Reg. 13.3.2.5 as applicable to passenger ships > 36 passengers.

106 Doors to cabins and other spaces in accommodation considered to be frequently manned with only one escape shall be fitted with kick out panels in the lower part of the door.

G 200 Emergency escape breathing devices

201 Number and position of emergency escape breathing devices in machinery spaces shall be according to SOLAS Ch. II-2 Reg. 13.4.3 and MSC/Circ. 1081.

202 For accommodation spaces, emergency escape breathing devices shall be positioned according to the following:

- Two in wheelhouse

- One in radio communication centre
- One in each damage control station
- One for each bed, positioned inside the respective cabins.

203 At least two spare emergency escape breathing devices and one training device shall be provided onboard, and stored in the accommodation area. The devices shall be clearly marked, and spare devices shall not be stored together with the training devices to prevent that the training device is confused with operational devices.

204 The number and location of emergency escape breathing devices, including spare and training devices, shall be indicated in the fire control plan.

H. Ventilation Systems

H 100 Requirements for ventilation system

101 The ventilation system shall comply with SOLAS Ch. II-2/5.2, 8.2, 9.4 and 9.7 as applicable to passenger ships carrying not more than 36 passengers.

102 The fire control zones shall be ventilated and served by an independent fan and duct system. Regarding NBC requirements for ventilation systems see Pt.6 Ch.10 in the Rules for Classification of HS, LC and NSC.

103 The main inlets of all ventilation shall as far as practicable be located in a safe distance from the exhaust of weapon systems and outlets from stores and tanks with flammable liquids.

104 For vessels with standard or enhanced engine room configuration (as defined in Sec.7), the ventilation system serving one propulsion line shall not be connected to the system serving the other propulsion line. The inlets for the two propulsion lines shall be arranged as far as practical apart, to limit the possibility of extracting smoke from an external fire into both systems.

105 Means shall be arranged for evacuation of smoke from machinery spaces of category A. This may be done either by reversing the engine room ventilation fans, or by dedicated fans. The fans used shall be supplied by the emergency source of power, and the system shall be protected from a fire in the engine rooms.

Stairway enclosures and corridors constituting the main escape from accommodation spaces shall be arranged with forced mechanical overpressure ventilation towards adjacent spaces.

I. Material Requirements

I 100 Restricted use of combustible material

101 Materials shall comply with the requirements in SOLAS Ch. II-2 Reg. 4.4, 5.3 and 6 as applicable to cargo vessels.

J. Fire Detection System

J 100 Areas to be protected

101 A fire detection system complying with SOLAS Ch. II-2/7 as applicable to passenger ships carrying more than 36 passengers shall be fitted.

J 200 Requirements for systems

201 No loop shall cover more than one fire control zone.

202 For vessels with standard or enhanced engine room configuration (as defined in Sec.7), no loop shall cover more than one main propulsion line.

203 Control panels shall be located on the bridge, at each damage control station and, if provided onboard, in the engine control room.

204 All vessels shall, at all times when at sea, or in port (except when out of service), be so manned or equipped as to ensure that any initial fire alarm is immediately received by a responsible member of the crew.

K. Fixed Fire-extinguishing System

K 100 Fixed fire-extinguishing systems for machinery spaces

101 Machinery spaces of category A shall be fitted with a fire extinguishing system complying with SOLAS Ch. II-2 Reg. 10.4.

K 200 Fixed local application fire extinguishing system

201 All machinery spaces of category A, regardless of the size of the vessel or the machinery space, shall be protected by an approved type fixed local application fire extinguishing system complying with SOLAS Ch. II-2/10.5.6.

K 300 Design considerations

301 For vessels with standard or enhanced engine room configuration (as defined in Sec.7), the fire extinguishing systems shall be so designed that full fire extinguishing capabilities are maintained in the machinery space not affected by the fire after discharge in the affected space of a fire extinguishing system required by K100 or K200.

302 The systems serving one propulsion line may be interconnected with the systems serving the other propulsion line provided discharge of the second extinguishing charge is possible by separate manual activation only.

Guidance note:

The propulsion redundancy is based on the assumption that the second propulsion line is fully operative after a fire incident in the first propulsion line. This includes the fire fighting function. When fire fighting agent intended for the second propulsion line is consumed to fight fire in the first propulsion line, the redundancy requirement is not longer fulfilled.

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K 400 Fixed extinguishing in service spaces

401 Galley exhaust ducts shall comply with the requirements in SOLAS Ch. II-2 Reg. 9.7.5 as applicable for cargo vessels.

402 Deep-fat cooking equipment shall comply with the requirements in SOLAS Ch. II-2 Reg. 10.6.4.

403 Paint lockers and flammable liquid lockers shall comply with the requirements in SOLAS Ch. II-2 Reg. 10.6.3.

404 Paint lockers shall be effectively ventilated by mechanical or natural ventilation independent of other spaces.

L. Fire-extinguishing Equipment

L 100 Portable fire extinguishers

101 Portable fire extinguishers shall comply with the requirements in SOLAS Ch. II-2 Reg. 10.3. With regard to extinguishing equipment in engine room, SOLAS Ch. II-2 Reg. 10.5. shall be fully complied with.

L 200 Portable foam applicators outside machinery spaces

201 All naval surface vessels should carry as a minimum 1 portable foam applicator in each damage control stations or a number to the satisfaction of the Society.

M. Fire Pumps and Fire Main

M 100 Capacity of fire pumps

101 Water for fire fighting purposes shall be supplied from the main seawater system as described in Sec.6.

102 There shall in addition to the pumps described in Sec.6 be provided at least one portable fire pumps located such that it can be easily transported for assistance. The pumps shall be fitted with independent source of power. The capacity of each portable fire pump shall be at least 25 m³/h.

M 200 Water distribution system

201 In addition to the requirements in Sec.6 H300 the requirements in 202 to 208 shall be fulfilled.

202 All isolating valves essential for the operation of the fire water distribution system shall be remotely

operated from above the damage control deck.

203 The pressure at any hydrant shall be in the range of 4 to 8 bars.

204 In accommodation, service spaces and machinery spaces the number and position of hydrants shall be such that at least two jets of water not emanating from the same hydrant can reach any part of the vessel when all watertight doors and all doors in fire control zones are closed.

205 The fire hoses shall be of an approved type and the maximum length shall not exceed 18 m.

206 The number of hoses shall be at least one fire hose for each of the hydrants required in 205.

207 One water fog applicator shall be provided outside each Ro-Ro space, helicopter hangar and spaces for storage of water crafts.

208 Emergency bulkhead connections for fire hoses shall be fitted in watertight divisions to allow a run of fire hoses through watertight and gastight divisions. The arrangement shall ensure that the watertight and gastight integrity is maintained.

However, where the main seawater system is so arranged that one damaged section of the fire main will not impair the supply of water within the watertight zone, emergency bulkhead connections are normally not required.

N. Firefighter's Outfit

N 100 Number and location

101 All naval surface vessels shall carry as a minimum four sets of firefighter's outfits or a number to the satisfaction to the Society.

Guidance note:

The number will vary with the size of the vessel and fire-fighting philosophy.

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102 The firefighter's outfits shall be stored so as to be easily accessible and ready for use 50% of the fire fighter outfits shall be stored in spaces with emergency light and with direct access from open deck.

Guidance note:

Ready for use implies that an arrangement for hanging up the protective clothing in suspended position shall be provided.

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N 200 Personal equipment and breathing apparatus

201 The extent of the outfits shall comply with SOLAS Ch. II-2/10.10. The breathing apparatus shall be of an approved type.

202 A high-pressure compressor with accessories suitable for filling the cylinders of the breathing apparatuses shall be installed in each fire control zone in the safest possible location. The capacity of each compressor shall be at least 75 litres per minute. The air intake for the compressor shall be equipped with a filter.

Guidance note:

Other arrangement that ensures at least one filling station in each fire control zone may be accepted as equivalent.

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O. Other Spaces

O 100 Storage rooms for explosives

101 Apart for the requirements in F104, storage rooms for explosives need not comply with the requirements in Sec.15 unless notation **Naval Support (sam)** or **Naval** is chosen.

O 200 Spaces containing diving systems

201 Fire safety requirements for diving systems will only apply if the additional class notation DSV is part of DNV's scope.

O 300 Storage spaces for vehicles

301 Ro-Ro spaces used for storage of vehicles, including helicopters and amphibious-boats with fuel in their tank, shall comply with SOLAS Reg. II-2/20 for vehicle and ro-ro spaces as applicable to cargo vessels.

302 Other spaces used for storage of fuel, either in free standing tanks or in vehicles with fuel in their tanks, shall be provided with fire detection and a fixed water-based fire extinguishing system as required for machinery spaces of category A. If petrol or other highly flammable liquids are carried, the space shall in addition comply with the requirements in SOLAS Ch. II-2 Reg.20 for ventilation and electrical equipment on ro-ro cargo vessels.

P. Helicopter Facilities

P 100 Helicopter facilities

101 Helicopter facilities shall comply with SOLAS Ch. II-2 Reg.18. Additional helicopter safety will only apply if **HELDK** -notations are part of DNV-scope.

Guidance note:

Helicopter facilities may be designed and reviewed towards naval standards upon separate request. Such standards may be APP 2(F)/MPP 2(F) or similar.

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Q. Fire Control Plans

Q 100 Requirements

101 Fire control plans shall be provided as to comply with the requirements in SOLAS Ch. II-2/15.2.4.

SECTION 11

FIRE SAFETY REQUIREMENTS FOR FRP NAVAL VESSELS

A. General Requirements

A 100 General

101 The requirements for fire protection in this section apply to naval surface vessels that are made of FRP and have an overall length of maximum 100 m.

102 The rules are intended for vessels with a manning level of up to 100 personnel. This figure is a guidance and not a rule restriction as the above requirement for overall length.

103 The requirements shall provide equivalent safety level to that defined by the HSC Code for cargo craft. Acceptance of a large number of crew and relaxed requirements for passive fire protection has been compensated with requirements for a sprinkler system, enhanced requirement for fire alarms and other requirements as specified in these rules.

104 Some alternative designs are identified in these rules. Other designs that are documented to provide equivalent safety would be accepted. Preference will be given to designs that focus on passive fire protection rather than active fire protection.

105 Special consideration shall be taken for the protection of weapon systems from fire hazards and the hull shall be protected from heat and blasts in connection with launching of weapons. Separate risk analysis will be accepted as adequate documentation. Battle damage (explosions and associated fires) are not covered by the rules.

A 200 Rule references and definitions

201 The rules are based upon Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC (HSC Code 7.1 – 7.7 and 7.9 – 7.10). Only additional requirements and exceptions are defined in this section.

202 “10 minutes fire restricting material” is a material tested according to IMO MSC.40(64) for 10 minutes with 100 kW heat source and meeting the requirements defined by this standard.

203 A “moderate flame spread material” is a material complying with either of the following standards:

- IMO FTP Code part 5 with criteria for floor coverings, or
- DIN 4102, Class B1, or
- IMO Res. MSC 90(71) with criteria as for furniture.

204 “NBC” is an abbreviation for nuclear, biological and chemical.

205 The “operator” is the navy administration in question or any other, intended to operate the vessel.

206 For other definitions, see Pt.0 Ch.6 and Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC.

A 300 Requirements for documentation

301 The following plans and particulars shall be submitted for approval:

- drawings as specified by Pt.4 Ch.10 Sec.1 C in the Rules for Classification of HS, LC and NSC, with modifications identified in this section
- sprinkler system
- ventilation zones, including operation procedures.

B. Structural Fire Protection, Materials and Arrangements

B 100 Fire control zones

101 Vessels with length above 40 m shall be subdivided into fire control zones by 60 minutes fire resisting divisions. Special considerations will be made for vessels with length of up to 60 m, as rooms with minor fire hazards, such as voids, tank compartments and steering gear rooms need not to be included in the calculations for the 40 m zone. Cabins and public areas shall not be located outside the defined fire control zones.

102 As far as practicable, the bulkheads forming the boundaries of the fire control zones above the bulkhead deck shall be in line with watertight subdivision bulkheads situated immediately below the bulkhead deck. The length and width of fire control zones may be extended to a maximum of 40 m in order to bring the ends of fire control zones to coincide with watertight subdivision bulkheads. The length or width of a fire control zone is the maximum horizontal distance between the furthestmost points of the bulkheads bounding it. Such bulkheads

shall extend from deck to deck and to the shell or other boundaries.

B 200 Structural fire protection

201 The requirements for cargo craft in Pt.4 Ch.10 of the Rules for HS, LC and NSC apply as amended and modified in and 203.

202 In addition to the fire resisting divisions specified by the rules, other load carrying structures shall be provided with fire insulation, unless it can be documented, for all parts of the vessel, that a fire in two adjacent compartments will not threaten the structural integrity of the vessel.

203 For the purpose of these rules, cabins and corridors shall be considered as areas of minor fire hazard. Divisions enclosing these spaces shall be smoketight.

B 300 Material requirements

301 The requirements in Pt.4 Ch.10 of the Rules for Classification of HS, LC and NSC apply as amended and modified in 302 to 305.

302 The floor and floor covering need not to be of fire restricting material. However, exposed floor surfaces shall comply with Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC (IMO FTP Code part 2 and 5).

303 “10 minutes fire restricting material” can be applied in auxiliary spaces having little or no fire risk as defined by Pt.0 Ch.6 in the Rules for Classification of HS, LC and NSC (pump rooms, switchboard spaces and other technical rooms).

304 “10 minutes fire restricting material” can also be applied for cabins and public spaces with a total area of not more than 50 m² when a 30 minutes structural fire protection is provided between corridors and the above-mentioned spaces. The boundaries of the 50 m² zone shall be protected by standard fire restricting materials.

305 Surfaces of void spaces and tank compartments need not to be of fire restricting materials. However, such surfaces shall document moderate flame spread properties according to the definition in this section. No fire safety requirements apply to internal surfaces of tanks.

B 400 Arrangements

401 All doors and hatches in the fire control zone shall be self-closing or automatically closing upon fire detection from any one detector, although they must allow for the exit of people inside the area or compartment. Doors to bathrooms inside cabins need not comply with this requirement.

B 500 Means of escape

501 The requirements of Pt.3 Ch.7 in the Rules for Classification of HS, LC and NSC apply as amended and modified in 502 to 504.

502 Dead end corridors serving only service spaces and machinery spaces in areas well separated from cabins and public spaces can be accepted on a case by case basis. Well separated shall in this context be another deck or another zone or through two doors.

503 All public spaces and cabins exceeding 15 m² shall be provided with at least two independent escape routes. The primary escape way shall be provided by corridors, stairways and other spaces independent of the space considered. For spaces between 15 m² and 30 m² the secondary means of escape can be provided by a kick-out panel. For spaces above 30 m² the secondary means of escape can be provided by a permanent ladder and hatch arrangement.

504 Kick-out panels shall be installed in all cabin doors (except doors between cabin and sanitary unit). The kick-out panel shall be operable from both sides in order to provide emergency escape and emergency access to cabins. A door with a kick-out panel shall be regarded as only one means of escape.

C. Ventilation

C 100 Ventilation zones and active smoke control

101 The requirements of Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC apply as amended and modified in 102 to 107.

102 The ventilation systems in public spaces, cabins and corridors areas shall be divided into zones. Each zone shall not exceed 150 m² and shall be enclosed by either fire resisting divisions or smoke tight boundaries.

103 The ventilation zones shall be independent of each other both with respect to ventilation duct layout and control of fans and dampers. Ducts can be routed through other smoke zones provided that smoke divisions and fire resisting divisions are not impaired.

104 When in line with the approved smoke control philosophy, balancing duct can be installed in divisions between cabins and corridors without the provision of smoke dampers. Elevation of balancing ducts, air intakes and extracts shall be designed with care to evacuate smoke effectively without impairing escape ways. All balancing ducts shall be provided with closing dampers operable from corridor side.

105 Each zone shall be designed to operate in the early stage of a fire. All essential components (ventilation fans, any dampers and control system for these) shall be designed to resist the smoke, moist and heat expected in the first 10 minutes of a fire.

Guidance note:

Materials capable of operating at 200°C can be used for supply ducts, steel or equivalent should be provided for exhaust ducts. Fans and electrical motors with a rating of IP56 or above and cables design according to IEC 332 are considered to meet this requirement, even when located inside the zone or exhaust ducts serving such zones.

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106 The smoke control philosophy shall be defined by the operator of the vessel.

107 Emergency operation procedures for ventilation system shall be available onboard. The procedures shall define which areas where ventilation shall be shut down in case of fire (stores) and areas where ventilation shall operate in case of fire (cabin, corridors and similar spaces) as per operator philosophy. Drawings and descriptions of smoke zones, fan and damper location and control shall be enclosed. Procedures in case of fire when the vessel is in NBC mode shall be defined.

D. Fire Detection System

D 100 Arrangement

101 The requirements of Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC apply as amended and modified in 102 to 107.

102 The detection system shall be of an addressable type being capable of identifying each detector.

103 Machinery spaces of major fire hazard shall be provided with a suitable combination of smoke and heat detectors. In addition, flame detectors shall cover all engines, heated fuel oil separators, oil-fired boilers and similar equipment. One flame detector may as a maximum cover a pair of engines.

104 Auxiliary machinery spaces of minor fire hazard, cargo spaces, fuel tank compartments and similar spaces shall also be fitted with smoke detectors meeting requirements of Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC.

105 Areas of no fire risk and areas with minor fire risk and limited area such as bathrooms within cabins, void spaces and tank compartments need not to be provided with fire detectors.

106 Switchboards shall be covered as defined in E207.

107 As a minimum, an alarm shall immediately sound in the space where a detector has been activated and in the wheelhouse. This alarm can be an integrated part of the detector or be provided from the fire detection control unit.

E. Fire Extinguishing Systems and Hazardous spaces

E 100 Fixed fire extinguishing system for machinery spaces

101 The requirements of Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC apply as amended and modified in 102 to 105.

102 The fixed fire extinguishing system shall be type approved.

103 Any of the following systems will be accepted:

- water based system according to IMO Circ.668/728
- CO₂ system as specified in Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC
- a gaseous agent according to IMO MSC/Circ.848
- a high expansion foam system (or equivalent) according to SOLAS
- an aerosol system according to IMO MSC/Circ. 1007.

104 All extinguishing systems shall be designed with 100% redundancy. Gas systems and aerosol systems shall have two independent discharges of extinguishing media. Water based systems shall have 100% redundancy in pump units, including control systems. A pressure accumulator with water storage capacity is not required.

105 Water based systems requiring fresh water shall be connected to dedicated water tanks with capacity for minimum 5 minutes operation for the largest space to be protected and automatic switch-over to sea-water supply. Such systems can alternatively be provided with a manual switchover and fresh water supply tanks design for 15 minutes operation.

Guidance note:

Utility service tanks with low-level alarms can be considered as equivalent to dedicated tanks.

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E 200 Other fire hazardous spaces or equipment

201 Storage rooms for explosives, including ammunition, decoy and similar equipment can be accepted when designed in accordance with Sec.15 or other equivalent standards.

202 Other weapon spaces and hazardous equipment shall be protected according to recognised standards.

203 Sonar cable installations can be accepted if solely located on open deck and not containing liquids with flashpoint under 100°C. Alternatively, designs complying with the requirements for seismic cable installations will be accepted.

204 Requirements for seismic cables containing flammable liquids:

Storage space for seismic cables, gun deck and other areas where equipment containing flammable liquids are handled or stored, shall be protected by fixed fire extinguishing system.

Special attention shall be given to vessels with a wooden gun deck above the steel deck, allowing for flammable liquid to collect in the closed space. In such cases the fixed fire extinguishing is also to protect the space below the wooden deck.

Guidance note:

One suitable fire extinguishing system is a low expansion foam system with the following capacity:

- 3 litre/minute/m² of streamer deck area
- 10 litre/minute/m² of cable reels area.

Sufficient foam concentrate to ensure at least 20 minutes of foam generation.

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205 Any helicopter deck and hangars shall comply with IMO Res. A.855(20) or recognised naval standards. Refuelling facilities for fuel with flashpoint below 60°C shall in addition comply with rules for low flashpoint fuel systems in Pt.4 Ch.6 Sec.5 in the Rules for Classification of HS, LC and NSC.

206 Spaces intended for storage and handling of tender boats shall comply with requirements as for enclosed car ferries (ro-ro spaces). Relaxation of these requirements can be considered case by case for tenders using only fuel with flashpoint above 60°C.

207 All switchboards shall be enclosed by cabinets made of steel or materials having equivalent fire resistance. All switchboard cabinets shall be provided with an early fire detection system and a fixed fire extinguishing system suitable for such spaces.

Guidance note:

A modular gas fire extinguishing system is recommended.

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208 Diving systems, and outer areas surrounding diving systems, shall comply with DNV-OSS-305 "Rules for Certification and Verification of Diving Systems", or equivalent navy standard. It is advised that spaces for personal diving equipment also comply with relevant part of this standard.

F. Fire Pumps, Fire Main and Portable Extinguishers

F 100 Fire pumps, fire main and fire hoses

101 The requirements of Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC apply as amended and modified in 102 to 105.

102 The fire main, including supports, couplings and valves shall be made of fire resistant and corrosion resistant materials, such as CuNi. Other materials may be considered for vessels with single fire zone and limited survivability. Such materials shall comply with IMO Res. A.753(18), L3 (test in wet condition, 30 minutes).

103 An approved fire hose with jet or spray nozzles shall be connected to each hydrant at all times. Hydrant

and hoses shall be installed in dedicated cabinets or clearly marked safety lockers. Fire hoses with a diameter exceeding 38 mm shall not be installed in accommodation areas unless the operator specifically defines another fire fighting philosophy.

104 All hydrants onboard shall have the same diameter. All couplings on nozzles, hoses and hydrants shall be interchangeable. A spanner shall be provided adjacent to each fire hydrant.

105 Water shall be immediately available from the hydrants. A continuously pressurised fire main, with start of at least one fire pump upon loss of pressure is considered to meet this requirement. Other equally reliable arrangement can be accepted.

F 200 Portable fire extinguishers

201 The requirements of Pt.4 Ch.10 in the Rules for Classification of HS, LC and NSC apply as amended and modified in 202.

202 At least three 12 kg dry powder or 9 l foam extinguisher, or equivalent types, shall be provided in corridors or stairways for each fire zone and each deck. In addition, at least one such extinguisher shall be installed in public spaces above 30 m² and any pantry. At least two extinguishers of suitable type shall be provided for the galley.

G. Sprinkler System

G 100 Sprinkler system

101 All public spaces, cabins and service spaces, storage rooms other than those required to have a fixed fire fighting system, and similar spaces shall be protected by a fixed sprinkler system meeting Standards for fixed sprinkler systems for high speed-craft, IMO Res. MSC.44 (65). Areas of no fire risk and areas with minor fire risk and limited area such as void spaces and bathrooms within cabins need not to be provided with sprinklers.

Guidance note:

See IMO MSC/Circ.912, Interpretation of standards for fixed sprinkler system for high-speed craft (Res. MSC.44 (65)).

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102 Only automatic sprinkler systems are accepted. The system shall cover the largest area of the following:

- 75 m²
- area covered by four largest sprinkler heads
- largest public space including largest space adjacent to this.

The system need not be designed with redundancy in pumps or back-up pressure tank. Supply from emergency power is not required provided that all components (except piping, section valves and sprinklers) are located outside the protected area.

103 The fresh water supply shall be arranged as for water-based fixed fire extinguishing systems. Dedicated water tanks with capacity for minimum 5 minutes operation of demanded pumps shall be provided.

104 System plans shall be displayed at each operating station. Suitable arrangements shall be made for the drainage of water discharged when the system is activated. Alternatively, documentation shall be submitted to confirm that the sprinkler system can be operated for 30 minutes (with full pump capacity) without impairing the stability of the vessel.

H. Firefighter's outfit

H 100 General

101 All vessels shall have at least three sets of firefighter's outfit as specified in the HSC Code 7.10.3, per fire control zone.

102 Each of the breathing apparatus sets shall be provided with cylinders of 1 800 litres capacity. The total weight of one apparatus (including cylinder, valves and mask) shall not exceed 12.0 kg. Two spare cylinders shall be provided for each apparatus. All cylinders, apparatus and valves shall be of the same type. Apparatus with less capacity and less weight may be accepted if they are deemed to be more suitable for the intended service and more spare cylinders are provided.

103 When more than one fire control zone is provided, the firefighter's outfits shall be divided between two fire stations placed at a safe distance from each other. The fire stations shall be clearly marked. On vessels with only one fire control zone and one locker for firefighter's outfit, this locker shall have access from open deck

or wheelhouse.

104 Each fire station shall be provided with 3 fire hoses, including nozzles and spanners, 2 portable extinguishers (12 kg powder or equivalent) and three emergency breathing apparatus (as defined by the IMO FSS Code).

105 The arrangement of the fire stations shall be such that all the equipment is easily accessible and ready for immediate use. There shall be arrangements for hanging up protective clothing in a suspended position.

106 Other arrangement (type of equipment and numbers) may be accepted in lieu of the above when this is according to the standard of the navy in question. In these cases, the navy administration shall issue a request for acceptance of equivalent arrangements.

I. Additional Fire Protection (optional)

I 100 General

101 Vessels built and equipped in accordance with the requirements in this subsection will be given the additional class notation **FIRENAV**.

I 200 Accommodation

201 Three emergency breathing apparatus (as defined by the IMO FSS Code) shall be provided along primary escape ways for each deck in each fire zone.

202 A high-pressure compressor suitable for filling cylinders for the breathing apparatus shall be installed. The compressor shall be driven by a separate diesel engine or from the emergency power plant and shall be placed in an easily accessible and safe place onboard. The capacity of the compressor shall be at least 300 litres/minute at 1 bar.

Guidance note:

When considering the compressor location it shall be kept in mind that, when a fire has broken out onboard, the compressor must be operable and that the air to be compressed must be sufficiently clean for breathing purposes.

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203 The combat control station and the ship control shall be designed as a separate smoke ventilation zone with an independent ventilation supply. The station shall be structurally fire protected as a control station. Two means of escape shall be provided, each of them through independent ventilation zones.

I 300 Engine room

301 Combustion air shall be directly fed to the engines via dedicated steel ducts. Each engine shall have one independent set of air supply ducts.

302 Engine air intakes and exhaust outlets for propulsion engines shall be designed for release of fire extinguishing agent in the engine machinery space without shutting down main engines.

303 In multi-engine installations, which are supplied from the same fuel source, means of isolating the fuel supply and spill piping to individual engines shall be provided. The means of isolation shall not affect the operation of the other engines and shall be operable from a position not rendered inaccessible by a fire in any of the engines.

304 Water drainage systems and filters to remove salt shall be included in the air intake. The air inlet quality (maximum salt content and particles) shall be in accordance with engine manufacturer's specification. Air intakes for vessels without service area restriction shall incorporate anti-icing systems preventing clogging of air intakes and louvers by ice. Anti-icing systems on vessels with service area restrictions will be considered depending on operating area.

305 Fire fighting of machinery spaces shall be possible when two or more propulsion or power generation machines are enclosed in same compartment with the machinery running at reduced power (30%) for 20 minutes.

306 In the case that two or more propulsion or power generating machines are installed in the same compartment, machinery shall be so designed that release of fire fighting agent does not damage machinery. This shall be verified through testing as far as is practicable.

SECTION 12 SAFE EVACUATION OF PERSONNEL

A. General and Definitions

A 100 General

101 The requirements for the arrangement of life saving appliances in this section are based on naval standards and replace those given in Pt.3 Ch.8 in the rules for HS, LC and NSC.

102 Life-saving appliances and arrangements shall enable abandonment of the vessel in 10 minutes.

103 Except where otherwise provided in this section, the life-saving appliances required by this section shall meet the detailed specifications set out in the LSA Code and be approved by the Society.

104 Before giving approval to life-saving appliances and arrangements, the Society shall ensure that such life saving appliances and arrangements:

- 1) Are tested to confirm that they comply with the requirements of this section, and in accordance with the recommendations listed in IMO res. A.689(17) as amended, or
- 2) Have successfully undergone, to the satisfaction of the Society, evaluation and tests which are substantially equivalent to those recommendations.

105 Before giving approval to novel life-saving appliances or arrangements, the Society shall ensure that such appliances or arrangements:

- 1) Provide safety standards at least equivalent to requirements of this chapter and have been evaluated and tested in accordance with the recommendations listed in IMO res. A.520(13), or as it may be amended.
- 2) Have successfully undergone, to the satisfaction of the Society, evaluation and tests which are substantially equivalent to those recommendations.

106 Before accepting life-saving appliances and arrangements that have not been previously approved by the Society, the Society shall be satisfied that life-saving appliances and arrangements comply with the requirements of this section.

107 Except where otherwise provided in this section, life- saving appliances required by this section for which detailed specifications are not included in the LSA Code, shall be to the satisfaction of the Society.

108 The Society requires life-saving appliances to be subjected to such product tests as are necessary to ensure that the life-saving appliances are manufactured to the same standards as the approved prototype.

109 Procedures adopted by the Society for approval shall also include the conditions whereby approval would continue or would be withdrawn.

110 The Society may determine the period of acceptability of life-saving appliances that are subject to deterioration with age. Such life-saving appliances shall be marked with a means of determining their age or the date by which they shall be replaced.

A 200 Definitions

For the purposes of this section, unless expressly provided otherwise:

201 Terms

- 1) *Anti exposure suit* is a protective suit designated for use by crew in case of evacuation, and when working in exposed positions on deck.
- 2) *Climbing net* is a net used for disembarkation of personnel to the survival craft and for the recovery of persons in the water.
- 3) *Detection* is the determination of the location of survivors or survival craft.
- 4) *Embarkation ladder* is the ladder provided at survival craft embarkation stations to permit safe access to survival craft after launching.
- 5) *Embarkation station* is the place from which a survival craft is boarded. An embarkation station may also serve as a muster station, provided there is sufficient room, and the muster station activities can safely take place there.
- 6) *Float-free launching* is that method of launching a survival craft whereby the craft is automatically released from sinking vessel and is ready for use.
- 7) *Free-fall launching* is that method of launching a survival craft whereby the craft with its complement of

persons and equipment on board is released and allowed to fall into the sea without any restraining apparatus.

- 8) *Immersion suit* is a protective suit that reduces the body heat-loss of a person wearing it in cold water.
- 9) *Inflatable appliance* is an appliance that depends upon non-rigid gas-filled chambers for buoyancy and that is normally kept deflated until ready for use.
- 10) *Launching appliance or arrangement* is a means of transferring a survival craft or rescue boat from its stowed position safely to the water.
- 11) *LSA Code* is the International Life-Saving Appliances (LSA) Code as adopted by IMO resolution MSC.48(66) as it may be amended.
- 12) *Novel life-saving appliance or arrangement* is a life-saving appliance or arrangement that embodies new features not fully covered by the provisions of this chapter but that provides an equal or higher standard of safety.
- 13) *Muster station* is a place in the vicinity of the embarkation station and that permits ready access for the crew to the embarkation stations unless in the same location. The area should be at least 0.35 m² per crew member.

Guidance note:

The muster station may be considered as the total accessible area adjacent to the embarkation station. The muster areas should be described in the vessel's operational procedures.

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- 14) *Rescue boat* is a boat designed to assist and rescue persons in distress and to marshal survival craft.
- 15) *Retrieval* is the safe recovery of survivors.
- 16) *Retro-reflective material* is a material that reflects in the opposite direction a beam of light directed on it.
- 17) *SOLAS 1996 amendments* is International Convention for the Safety of Life at Sea, 1974 as amended in June 1996 by IMO resolution MSC.47(66).
- 18) *Survival craft* is a craft capable of sustaining the lives of persons in distress from the time of abandoning the vessel.
- 19) *Thermal protective aid* is a bag or suit made of waterproof material with low thermal conductance.

A 300 Exemptions

301 The Society may exempt individual vessels or classes of vessel from the requirements of this section if the requirements are considered unreasonable or unnecessary in respect to the nature of the operation. When individual vessels or classes of vessel receive such dispensation they shall not proceed more than 20 nautical miles from the nearest land.

A 400 Special requirements for class notation Naval Support

401 The requirements given for main class shall apply

402 The navy may decide to deviate from 401. In this case the principle of equivalent safety shall be applied as far as reasonably practicable, and shall be agreed upon by the Society. In case of such deviations of the conditions of Sec.1, F100 shall apply.

B. Communications

B 100 Communication

101 Naval surface vessels shall be provided with the following radio life-saving appliances.

- 1) At least three two-way VHF radiotelephone apparatuses shall be provided on every vessel. Such apparatus shall conform to performance standards not inferior to those adopted by IMO in resolution A.809(19), or as it may be amended.
- 2) At least one radar transponder shall be carried on each side of every vessel. Such radar transponders shall conform to performance standards not inferior to those adopted by IMO in resolution A.802(19), or as it may be amended. The storage of radar transponders may be protected for military purposes.
- 3) The radar transponders shall be stowed in such locations that they can be rapidly placed in any one of the liferafts. Alternatively, one radar transponder shall be stowed in each survival craft.

102 Naval surface vessels shall be provided with the following on-board communications and alarm system:

- 1) An emergency means comprising either fixed or portable equipment or both for two-way communications

between emergency controls stations, muster and embarkation stations and strategic positions on board.

- 2) A general emergency alarm system complying with the requirements of 7.2.1 in the LSA Code shall be used for summoning crew to muster stations and to initiate the actions included in the muster list. The system shall be supplemented by either a public address system or other suitable means of communication. The system shall be operable from the combat information centre, bridge and technical control room.

B 200 Signalling equipment

201 All vessels shall be provided with a portable daylight signalling lamp which is available for use at each muster station at all times and which is not dependent on the vessel's main emergency source of electrical power.

202 Naval surface vessels shall be provided with not less than 12 rocket parachute flares, complying with the requirements of 3.1 in the LSA Code stowed in or near the bridge.

C. Personal Life-saving Appliances

C 100 Lifebuoys

101 Where crew have access to exposed decks under normal operating conditions, at least one lifebuoy on each side of the vessel capable of quick release from the control compartment and from position at or near where it is stowed, shall be provided with a self-activating light and a self-activating smoke signal. The positioning and securing arrangements of the self-activating smoke signal shall be such that it cannot be released or activated solely by the accelerations produced by collisions or groundings.

102 At least one lifebuoy shall be provided adjacent to each normal exit from the vessel and on each open deck to which crew have access, subject to a minimum of two being installed.

103 Lifebuoys fitted adjacent to each normal exit from the vessel shall be fitted with buoyant lines of at least 30 m in length.

104 Not less than half the total number of lifebuoys shall be fitted with self-activating lights. However, the lifebuoys provided with self-activating lights shall not include those provided with lines in accordance with 103.

105 The total number of lifebuoys shall be 2 for every 20 m of vessel lengths or part thereof with a minimum of 4.

106 Lifebuoys and buoyant lines shall comply with the requirements of 2.1.1 in the LSA Code.

C 200 Lifejackets

201 A lifejacket complying with the requirements of 2.2.1 or 2.2.2 in the LSA Code or an equivalent military standard shall be provided for every person on board the vessel and, in addition:

- 1) Every vessel shall carry lifejackets for not less than 20% of the total number of persons on board. These lifejackets shall be stowed in conspicuous places on deck or at muster stations.
- 2) A sufficient number of lifejackets shall be carried for persons on watch and for use at remotely located survival craft and rescue boat stations.
- 3) All lifejackets shall be fitted with a light, which complies with the requirements of 2.2.3 in the LSA Code or an equivalent military standard.

202 Lifejackets shall be so placed as to be readily accessible and their positions shall be clearly indicated.

C 300 Immersion and anti-exposure suits

301 An anti exposure suit, of an appropriate size, complying with the requirements of 2.4 in the LSA Code or an equivalent military standard shall be provided for every person assigned to crew the rescue boat.

302 Immersion suits in compliance with the requirements of 2.3 in the LSA Code, or an equivalent military standard shall be provided for 110% of the number of persons the vessel is certified to carry.

D. Muster List, Emergency Instructions and Manuals

D 100 General

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

102 Muster lists complying with the requirements of regulation III/37 of the SOLAS 1996 amendments shall be exhibited in conspicuous places throughout the vessel, including the combat information centre, bridge and technical control room, engine-room and crew accommodation spaces.

103 Illustrations and instructions in appropriate languages shall be posted in crew accommodation spaces and be conspicuously displayed at muster stations, to inform the crew of

- their muster station
- the essential actions they shall take in an emergency
- the method of donning lifejackets
- the method of donning the anti-exposure suits.

Guidance note:

At least English and the national language is recommended.

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104 A training manual complying with the requirements of SOLAS 1996 regulation III/35 shall be provided in each crew messroom and recreation room.

Guidance note:

At least English and the national language is recommended.

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E. Operating Instructions

E 100 General

101 Posters or signs shall be provided on or in the vicinity of the survival craft and their launching controls and shall:

- illustrate the purpose of controls and the procedures for operating the appliance and give relevant instructions and warnings
- be easily seen under emergency lighting conditions
- use symbols in accordance with the recommendations of IMO *.

* Refer to the Symbols related to Life-Saving Appliances and Arrangements, adopted by IMO by resolution A.760(18) or as it may be amended.

F. Survival Craft Stowage

F 100 General

101 Survival craft shall be securely stored outside and as close as possible to the accommodation and embarkation stations. The stowage shall be such that each survival craft can be safely launched in a simple manner and remain secured to the vessel during and subsequent to the launching procedure. The length of the securing lines and the arrangements of the bowing lines shall be such so as to maintain the survival craft suitably positioned for embarkation. The Society may permit the use of adjustable securing and or bowing lines at exits where more than one survival craft is used. The securing arrangements for all securing and bowing lines shall be of sufficient strength to hold the survival craft in position during the embarkation process.

102 Survival craft may be stored under deck, provided means are taken to automatically release the deck-hatches to enable float free launching should the vessel sink. The requirements given in A102 shall be fulfilled.

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

104 The launching procedure for inflatable liferafts shall, where practicable, initiate inflation. Where it is not practicable to provide automatic inflation of liferafts, the total evacuation time shall not exceed the time given in A102.

105 Survival craft shall be capable of being launched in all operational conditions and in all specified damage conditions.

106 Survival craft launching stations shall be in such positions so as to ensure safe launching, having particular regard to clearance from the propeller or water jet and steeply overhanging portions of the hull.

107 During preparation and launching, the survival craft and the area of water into which it shall be launched

shall be adequately illuminated by the lighting supplied from the main and or emergency sources of electrical power required by Sec.8.

108 Means shall be available to prevent any discharge of water on to survival craft when launched.

109 Each survival craft shall be stowed:

- so that neither the survival craft nor its stowage arrangements will interfere with the operation of any other survival craft or rescue boat at any other launching station
- in a state of a continuous readiness
- fully equipped
- as far as practicable, in a secure and sheltered position and protected from damage by fire and explosion.

110 Every liferaft shall be stowed with its painter permanently attached to the vessel and with a float-free arrangement complying with the requirements of 4.1.6 in the LSA Code so that, as far as practicable, the liferaft floats free and inflates automatically should the vessel sink.

111 Rescue boat shall be stowed:

- in a state of continuous readiness for launching in not more than 5 min
- in a position suitable for launching and recovery
- so that neither the rescue boat nor its stowage arrangements will interfere with the operation of survival craft at any other launching station.

112 Rescue boats and survival craft shall be secured and fastened to the deck so that will withstand at least 3 g in all principal directions or two times the defined design accelerations, which ever is the largest.

G. Survival Craft and Rescue Boat Embarkation and Recovery Arrangements

G 100 General

101 Embarkation stations shall be readily accessible from accommodation and work areas.

102 Evacuations routes, exits and embarkation points shall comply with the requirement in Sec.10 G100.

103 Alleyways, stairways and exits giving access to the muster and embarkation station shall be adequately illuminated by lighting supplied from the main and emergency source of electrical power required by Sec.8.

104 Where the disembarkation height in intact and damaged condition exceeds 4.5 m, climbing ladders or nets shall be installed on both sides of the vessel.

105 Rescue boat embarkation arrangements shall be such that the rescue boat can be boarded and launched direct from the stowed position and recovered rapidly when loaded with its full complement of crew, rescued persons and equipment.

H. Line-throwing Appliance

H 100 General

101 A line-throwing appliance complying with the requirements of 7.1 in the LSA Code shall be provided.

I. Operational Readiness, Maintenance and Inspections

I 100 Operational readiness

101 Before the vessel leaves port and at all times at sea, all life-saving appliances shall be in order and ready for immediate use.

I 200 Maintenance

201 Instructions for on-board maintenance of life-saving appliances complying with the requirements of regulation III/36 of SOLAS 1996 shall be provided and maintenance shall be carried out accordingly.

202 The Society may accept, in lieu of the instructions required by 201, a shipboard planned maintenance programme, which includes the requirements of regulation III/36 of SOLAS 1996.

203 *Maintenance of falls*

Falls used in launching shall be turned end-for-end at intervals of not more than 30 months and be renewed when necessary due to deterioration of the falls or at intervals of not more than five years, whichever is the

earlier.

204 *Spares and repair equipment*

Spares and repair equipment shall be provided for life-saving appliances and their components, which are subject to excessive wear or consumption and shall be replaced regularly.

205 *Weekly inspection*

The following tests and inspections shall be carried out weekly:

- all survival craft, rescue boats and launching appliances shall be visually inspected to ensure that they are ready for use
- all engines in rescue boats shall be run ahead and astern for a total period of not less than 3 minutes provided the ambient temperature is above the minimum temperature required for starting the engine
- the general emergency alarm system shall be tested.

206 *Monthly inspections*

Inspections of the life-saving appliances, including survival craft equipment, shall be carried out monthly, using the checklist required by regulation III/52.1 of SOLAS 1996 to ensure that they are complete and in good order. A report of the inspection shall be entered in the logbook.

I 300 Servicing on inflatable liferafts, inflatable lifejackets and inflated rescue boats

301 Every inflatable liferaft and inflatable lifejacket shall be serviced:

- at intervals not exceeding 12 months
- at an approved servicing station, which is competent to service them, maintains proper servicing facilities and uses only properly trained personnel. *

* Refer to the Recommendation on Conditions for the Approval of Servicing Stations for Inflatable Liferafts, adopted by IMO by resolution A.761(18) or as it may be amended.

302 All repairs and maintenance of inflated rescue boats shall be carried out in accordance with the manufacturer's instructions. Emergency repairs may be carried out on board the vessel, however, permanent repairs shall be effected at an approved servicing station.

303 *Periodic servicing of hydrostatic release units*

Hydrostatic release units shall be serviced:

- at intervals not exceeding 12 months
- at an approved servicing station, which is competent to service them, maintains proper servicing facilities and uses only properly trained personnel.

304 Provided service experience has shown that longer interval than given in 301 to 303 is acceptable, the Society may accept longer intervals between servicing.

J. Survival Craft and Rescue Boats

J 100 Vessels with length less than 30 m

101 The vessel shall be provided with a least 2 survival craft each with a capacity of 100% of the number of persons the vessel is certified to carry.

102 If a person in the water can be picked up by the vessel, a rescue boat will not be required.

J 200 Vessels with length above 30 m

201 The vessel shall be provided with survival craft capacity of minimum 150% of the number of persons the vessel is certified to carry. The survival craft shall be equally distributed at both sides of the vessel and spread out over the vessel's length. The location of the survival craft shall assure that 100% of the number of persons the vessel is certified to carry can be used on one side after damage anywhere on the vessel as defined in Sec.5.

202 If the survival craft can be moved from one side to another, then the vessel shall be provided with survival craft on each side for 50% of the number of persons the vessel is certified to carry and any combination of between 100% and 50% on each side, dependant on the number of survival craft that can be moved to either

side, as given in Table J1.

Table J1 Survival craft and rescue boats		
<i>Minimum survival craft capacity on each side</i>	<i>Movable survival craft capacity</i>	<i>Total survival craft capacity</i>
50%	50%	150%
60%	40%	160%
70%	30%	170%
80%	20%	180%
90%	10%	190%
100%	0%	200%

203 A minimum of 1 rescue boat shall be provided. The rescue boat shall meet the requirement in the LSA Code as amended for fast rescue boats. The Society may exempt from the requirement to carry a fast rescue boat if it considers the vessel's manoeuvrability makes it possible to retrieve a person over board with a rescue boat as specified in the LSA Code.

K. Additional Requirements for Equipment

K 100 Liferafts

101 Liferafts shall be automatically self-righting or canopied reversible liferafts in accordance with MSC/Circ.809.

102 Life-raft equipment shall be to the satisfaction of the Society.

K 200 Climbing nets

201 The size of climbing nets on vessels with length above 30 m shall be at least 4 m wide and have a depth not less than the intact freeboard height, whilst for smaller vessels the net shall be at least 2 m wide and have depth not less than the intact freeboard height. The following requirements apply to both sizes:

- the net shall be made from coir or manila rope
- frame rope at least 25 mm with tensile strength 10 kN (minimum)
- net rope at least 20 mm with tensile strength 3 kN (minimum)
- size of squares maximum 300 x 300 mm
- horizontally 3 planks of size 60 mm x 60 mm x 4 m shall be sewn in at the top, middle and bottom
- an iron bar with 25 mm diameter x 4 m shall be sewn in at the bottom
- at the top end of the net maximum 5 pieces of rope size 30 mm x 3 m nylon, each of tensile strength 20 kN (minimum) shall be fastened at 1 m interval.

SECTION 13 RADIATION HAZARDS

A. General

A 100 Application

101 The rules in this section cover aspects relating to electromagnetic radiation in the frequency band generally from 3 kHz up to 300 GHz generated by on board sources and representing radiation hazards to personnel, fuel or ordnance. Optical links e.g. fibre optics are also covered.

Guidance note:

‘STANAG 1380’ and applicability manual ‘RADHAZ AECp-2’ and/or national requirements may apply. In instances these requirements are different, the most stringent requirements shall apply.

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B. Definitions

B 100 Terms

101 *Average power density.* The power of radio frequency field per unit cross sectional area per square meter (W/m^2) and averaged over a given period.

102 *Contact current.* Radio frequency current flowing through an individual touching a conductive object (through hand or wrist).

103 *Hot spot.* A highly localised area of relatively intense radio frequency fields.

Guidance note:

The hot-spot manifests itself in two principal ways:

- Intense electric or magnetic fields immediately adjacent to conductive objects immersed in lower intensity ambient fields (often referred to as re-radiation)
- Localised areas, not necessarily close to conductive objects in which there exists a concentration of radio frequency fields caused by reflections (non-uniform exposure) or a concentration of radio frequency field caused by a highly directional source (partial-body exposure). In both cases the fields are characterised by very rapid changes in field strength with distance or location.

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104 *Pulsed radio frequency field.* Radio frequency electric and magnetic fields that are produced by amplitude modulating a continuous-wave carrier at a known pulse repetition frequency with a controlled duty factor.

105 *Permissible exposure level (PEL).* Exposure level of radio frequency fields the personnel can withstand without RADHAZ risk.

106 *RADHAZ.* Radiation hazards to personnel, ordnance and to fuel.

107 *Re-radiated field.* Radio frequency fields resulting from currents induced in a secondary predominantly conducting object by electromagnetic waves incident on that object from one or more primary radiating structures or antenna.

108 *Safety distance.* Minimum distance at which the PEL for personnel is not exceeded, and risk of RADHAZ is considered to be nil.

109 *Specific absorption rate (SAR).* The time rate at which radio frequency energy is imparted to an element of biological body mass. Average SAR in a body is the time rate of the total energy absorbed divided by the total mass of the body. SAR is expressed in units of watts per kilogram (W/kg). Specific absorption (SA) refers to the amount of energy absorbed over an exposure time period and is expressed in units of Joules per kilogram (J/kg).

C. Documentation

C 100 Plans and particulars

101 The following plans and particulars shall be submitted for approval:

- RADHAZ control document containing relevant technical RADHAZ information. This includes at least analysis of transmitter arrangement and equipment properties limit values, guidelines to workforce, technical solutions, drawings and test results.

Guidance note:

RADHAZ analysis for the entire vessel depends on electromagnetic environmental data at the locations and sites that the systems will be exposed to. Therefore a list of intentional EM emitters (location, output power, frequency, modulation and hours of operation and operating modes.) should be analysed. The analysis should justify the need for the zones, based on what equipment will be installed and the equipment's electrical properties.

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- The RADHAZ test plan shall describe details for the harbour acceptance tests (HAT).
- A RADHAZ marking plan shall be produced showing areas to be marked by recognised standard of RADHAZ signs.

D. Design Principles

D 100 General

101 The design of the vessel shall ensure that all relevant systems can be operated concurrently and at specified performance, without radiation hazards to vessel, its complement, fuels or ordnance.

102 RADHAZ protection shall be provided by means of careful location of radiating antennas, denial of entry for personnel and allocation of ordnance or fuel to areas with acceptable low power electromagnetic fields. Attention shall be paid to effects from re-radiated fields.

103 Control of radiated high frequency (HF) energy between different areas may require an electromagnetic barrier providing adequate attenuation of the emissions. The attenuation shall be documented by test results.

104 When possible, physical controls shall be used rather than administrative controls. Physical controls include interlocks, fences and locks. Administrative controls include signs, operational procedures and training.

D 200 Prevention of auto ignition

201 Fuels and electro initiated explosive devices shall be handled in a safe manner. The level of electromagnetic radiation shall be acceptably low to prevent auto ignition at the places where fuels and ordnance are kept.

Guidance note:

- a) The level of radiated power and field strength should be limited to safe values acceptable to the appropriate authority.
- b) For ordnance, see MIL-STD 1385B.
- c) For fuels such as diesel oil there exist no practical limit. Operational procedures should be implemented, e.g. no operation of any powerful radio transmitters during fuelling operations. For jet propellants, the limit values given in MIL STD 1399 A, section 408 and operational handbook OP 3565 may be applied.
- d) For ammunitions, see also Sec.15.

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D 300 Prevention of personnel exposure

301 Protection against harm to personnel shall be achieved by identifying each radio frequency emitter's characteristics. The applicable PEL for the system is determined, see Table D1, D2, D3 and D4, and then the system is assessed to see where personnel might be exposed to levels in excess of those PELs. Finally physical and or administrative controls shall be defined.

Guidance note:

- a) Regarding evaluation and control of personnel exposure to radio frequency fields, the limit values and procedures specified in STANAG 2345 MED have been adopted.
- b) See ACEP-2, NATO Naval Radio and Radar Radiation Hazard Manual.

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302 The basic dosimetric limit of radio frequency exposure in the frequency range of 10 kHz to 6 GHz is whole-body specific absorption rate (SAR) of 0.4 W/kg. Below 100 kHz internal current density resulting in electro-stimulation of biological tissue is the basic dosimetry parameter. Above 6 GHz the exposure are quasi-

optical and power density is the exposure parameter used. PELs are given in terms of measurable field components as a convenient correlation to SAR.

Guidance note:

- The PEL field strength and power density limits the whole body average SAR to 0.4 W/kg. This SAR is a factor of ten times lower than the threshold for the most sensitive reproducible effect reported in laboratory animals.
- Because of the safety margin incorporated into the PEL, exposure in excess of PEL is not necessarily harmful. For example, attendance in RADHAZ environment at 2.5 x PEL for 2 minutes in a period of 20 minutes would be acceptable.
- See STANAG 2345.2 MED for relaxation of the limit values in case of partial-body, non-uniform exposure and low- power exclusion.

Table D1 Radio frequency fields				
<i>Frequency f (MHz)</i>	<i>Electric field E (V/m)</i>	<i>Magnetic field H (A/m)</i>	<i>Power density S (W/m²)</i>	<i>Averaging time T_{avg} (minutes)</i>
0.003-0.1	614	163	E: 10 ³ H: 10 ⁷	6
0.1-3.0	614	16.3/f	E: 10 ³ H: 10 ⁵ / f ²	6
3-30	1 842 / f	16.3/f	E: 9 000 / f ² H: 10 ⁵ / f ²	6
30-100	61.4	16.3/f	E: 10 H: 10 ⁵ / f ²	6
100-300	61.4	0.163	10	6
300-3 000			f/30	6
3 000-15 000			100	6
15 000-300 000			100	616 000 / f ^{1.2}

Table D2 Radio frequency induced current restriction			
<i>Frequency f (MHz)</i>	<i>Maximum current through both feet (mA)</i>	<i>Maximum current each foot (mA)</i>	<i>Contact current (mA)</i>
0.003-0.1	2 000 f	1 000 f	1 000 f
0.1-100	200	100	100

Table D3 Pulsed radio frequency fields		
<i>Frequency f (MHz)</i>	<i>Peak electric field E (kV/m)</i>	<i>Peak power density / Pulse for pulse duration < 100 ms (W/m²)</i>
0.1-300 000	100	PEL · T _{avg} / 5 · pulse width (where: T _{avg} and pulse width have the same units)

Table D4 Partial body exposure		
<i>Frequency f (MHz)</i>	<i>Peak value of mean squared field (V^2/m^2) or (A^2/m^2)</i>	<i>Equivalent power density (W/m^2)</i>
0.1-300	$< 20 E^2$ or $20 H^2$	
300-6 000		< 200
6 000-96 000		$< 200 (f/6\ 000)^{0.25}$
96 000-300 000		400

E. Installation

E 100 General

101 Antenna feeder cables between antenna tuner and antenna shall be safely arranged. Cables from transmitting antennas shall be arranged in solid metal pipes between the antenna and the transmitter.

Guidance note:

High-frequency (HF) energy from transmitting systems is generated in the transmitter cabinet, and conducted to the antenna tuner by a coaxial cable. From the antenna tuner to the feed point of the antenna, a single wire is used. This wire will act as a part of the antenna and radiate high levels of HF-energy.

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102 All decks and bulkheads encapsulating shielded compartments to protect from RADHAZ shall normally be assembled by continuous welding or soldering. Spot welding, riveting or other assembly techniques will not provide acceptable shielding effectiveness. However, alternative methods giving the same or better performance may be considered.

103 Additional precautions shall be taken for fibre optic equipment in terms of shielding, such that stray optical radiation cannot result in inadvertent ignition of flammables or electro initiated explosive devices.

Guidance note:

A power level below 10 mW as maximum will normally be considered as intrinsically safe, such that additional precautions are deemed unnecessary.

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E 200 Marking

201 RADHAZ areas with levels exceeding those PELs listed in Table D1 to D4 shall be marked according to a recognised standard of RADHAZ signs.

Warning signboards shall be posted giving information on restricted occupancy. In addition to type and emission levels of electromagnetic signal, instructional or warning statements shall be inserted on the sign.

Guidance note:

The basic formats should confirm with national military standards.

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202 RADHAZ warning signs are required at all access points to areas mentioned in 201.

203 In areas where access to levels greater than 10 times the power density listed may exist, warning signs alone do not provide adequate protection. Other warning devices such as flashing lights, audible signals, barriers or interlocks will be required.

F. Testing

F 100 Harbour Acceptance Tests (HAT) for the vessel

101 Measurements shall verify that the limit values (PELs) have not been exceeded.

SECTION 14 ELECTROMAGNETIC COMPATIBILITY

A. General

A 100 Application

101 These rules cover the vessel's systems ability to function under the influence of electromagnetic interference or interactions with all kinds of electrical and electronic equipment used onboard a naval surface vessel.

Guidance note:

- *Vessel's system* means all systems other than weapon systems. Weapon systems per se are not included; however, they should not affect the vessel's systems from functioning as intended.
- Most naval vessels operate powerful transmitters concurrently with high sensitive receivers, often in close proximity to one another. This requires careful consideration in order to achieve a workable solution as equipment may be susceptible to radiated as well as conducted electromagnetic interference, hence all electrical and electronic devices should be considered a possible EMI source or victim. As mechanical structures may transfer electromagnetic interference, the vessel EMC considerations should also include relevant mechanical structures.
- Aspects that relate to electromagnetic silencing e.g. the vessel's magnetic signature and underwater electric potentials are beyond the scope of these rules.

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102 Vessels made of materials other than steel or aluminium, e.g. glass fibre reinforced plastics, shall be specially considered with respect to the shielding effectiveness of decks and bulkheads as well as the grounding system.

A 200 Principles

201 The design of the vessel shall ensure that all vessel systems, including safety systems, navigation systems, communication systems, propulsion systems and power systems can be operated concurrently, and at specified performance together with the vessel's weapons, sensor systems and combat management systems.

Guidance note:

In instances that this requirement cannot be met, e.g. during simultaneous operation of vessel system and combat system, operational restrictions may be approved in each case.

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202 The design for EMC is a process that comprises planning, analysing, testing and verification. The design shall be documented by an EMC management document containing relevant technical EMC information. This includes at least limit values, technical solutions, drawings, guidelines to workforce, analyses and test results.

Guidance note:

A method is outlined in Classification Note No. 45.1.

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203 The efforts required depend on type of equipment and on consequence of interference. The margin between the emissions and susceptibility shall be sufficiently high. If the consequence of disturbance is regarded as critical e.g. loss of life, this margin shall be at least 20 dB for onboard installations, or the probability of interference shall be acceptably low.

B. Definitions

B 100 Terms

101 *Bonding*. Electrical bonding is a means of obtaining the necessary electrical conductivity between the unit and structure, which otherwise would not have sufficient electrical contact. Resistance $\leq 25 \text{ m}\Omega$. measured at 1 kHz.

Guidance note:

Bonding and grounding has different meanings in that bonding connections are able to carry HF currents up to several hundred MHz, which is not the case for ground connections, normally made to carry currents in the range 0 to 400 Hz.

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102 *Electromagnetic compatibility (EMC)*. The ability of electrical and electronic equipment, subsystem and system, to share the electromagnetic spectrum and perform their desired functions without unacceptable

degradation from or to the specified electromagnetic environment.

103 *Electrostatic discharge or protected area (ESD/EPA)*. The basic phenomenon is the build-up of static charge e.g. on a person's body or equipment with subsequent discharge to the product when the person or equipment touches the product. ESD Protected Areas according to EN-100015-1.

104 *Grounding*. Equipotential point or plane which serves as a reference potential for a circuit or system. If ground is connected to the hull through a low impedance path, it can then be called an *earth ground* (i.e. *earthing*). Safety grounds shall always be at earth potential, whereas signal grounds are usually but not necessarily at earth potential.

Guidance note:

By hull is meant the hull itself inclusive the superstructure, main masts, bulkheads and decks if they are all jointed together by a low impedance path.

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105 *Harmonic distortion*. The phenomenon when non-linear loads, e.g. static power converters, arc discharge devices, change the sinusoidal nature of the A.C. power thereby resulting in the flow of harmonic currents in the A.C. system.

C. Documentation

C 100 Plans and particulars

101 The following plans and particulars shall be submitted for approval:

— EMC Management Control Document (EMCD) describing management methodologies and documenting tasks.

Guidance note:

- 1) The document should as a minimum contain the following information:
 - a description of the applied procedures to deal with the EMC work in the design and construction phases
 - overall vessel EMC requirements and standards (EMC zones with levels and installation procedures for each zone) including ESD and lightning protection
 - installation procedures for shielding integrity between zones
 - power distribution requirements and standards
 - equipment EMC requirements including standards with testing pass or fail criteria
 - a system by system description including special EMC installation requirements and EMC data for all systems
- 2) Note that additional national military requirements may apply.

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D. Design Principles

D 100 General

101 The design shall be based on EMC management control procedures. These procedures shall in a systematic manner address the possible interference in and between the systems, to investigate them qualitatively and quantitatively and to form the basis for working out the remedial measures for EMC.

102 The equipment and installations shall be designed according to a recognised national or international standard.

Guidance note:

An example is STANAG 4435, which provides complete measurement methods and acceptance criteria for components.

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103 It is recommended to divide the vessel and network into EMC zones and to specify limit values within each zone.

104 Various techniques can be utilised to achieve electromagnetic compatibility, e.g. selection of appropriate components with respect to emissions and susceptibility, physical separation, bonding, grounding, filtering and shielding. In instances abatement measures are required, these shall be selected in the order indicated below until the EMI problem has been resolved:

— reduction of the noise to a minimum by application of simple means i.e. by physical separation, proper

- bonding or grounding and adequate cable terminations
- separation of power and instrument cables
- cables serving different systems shall have separate routing, and the distance shall be as large as practicable
- isolation of EMI generating and EMI susceptible equipment i.e. by shielding and filtering.

D 200 Lightning protection

201 In order to reduce the possibility of occurrence of dangerous sparking, down-conductors shall be arranged. The following parts of structure may be considered as natural air-termination components:

- the vessel's metal hull
- metal components such as pipes and tanks that have a thickness of material not less than 2.5 mm.

D 300 Electrostatic discharge

301 An anti-static environment shall be provided by selecting materials with ESD properties which do not allow charging of personnel for items which may be exposed to friction, e.g. deck-coverings, railings, benches, seats and chairs.

E. Installation

E 100 General

101 Sensitive equipment shall be installed with sufficient distance from sources of interference, e.g. power cables and transmitting antennas.

Guidance note:

- The choices of signal types are critical with regards to corruption of the signal information due to susceptibility to EMI, in particular for top deck signals near transmitting antennas. Signal types for process signals should preferably be 4 to 20 mA, and signal types for communication should be balanced.
- Examples of safe distances are outlined in Classification Note No. 45.1.
- For communication it is recommended to use fibre optical links.

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E 200 Shielding

201 Proper installation techniques shall be utilised in order to ensure shielding integrity. All decks and bulkheads acting as shields shall be joined continuously.

Guidance note:

Spot welding, riveting, detachable fixings without EMI gaskets will usually not provide acceptable shielding effectiveness.

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202 Framing of shielded windows, doors, hatches shall either be welded or soldered circumferentially to the shield. Alternatively, flanges and EMI gaskets can be used if not prone to corrosion.

203 Shielded doors and hatches shall be fitted with conductive EMI-gaskets to ensure circumferential connection of the door blade or hatch to the frame when the door or hatch is closed.

204 Pipeline penetrations shall have circumferential contact with the shield.

205 Ducts and pipes penetrating a shield shall be designed to avoid degradation of the shielding effectiveness. Most important are the largest penetrations and the connection to the shield. The principle of a wave-guide beyond cut-off frequency can be utilised. If openings need to be larger than this principle allows, then e.g. honeycomb inserts shall be applied.

Documentation shall show that required attenuation of the ducts meets the shielding requirements.

206 Fibre optic cables consisting of non conducting parts that need to penetrate a shield shall be arranged through a metal pipe, see also 205.

207 All cable screens shall be terminated circumferentially when entering or leaving equipment or shielded rooms or zones.

E 300 Bonding and grounding

301 The ground system shall be the reference potential for all installations onboard the vessel. The hull, superstructure, masts, bulkheads and decks will all be part of the grounding system. It is necessary that these parts of the vessel be designed to exclude potential differences.

302 Installation of electrical and electronic equipment shall be properly HF bonded to the ground system.

Guidance note:

- HF bonding should be addressed in the EMCD.
- See MIL-STD 1310G.

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303 For cables provided with an outer screen, the screen shall normally be terminated to ground at least at both ends, and when entering or leaving shielded zones.

Guidance note:

Circumferential termination is necessary to ensure a low impedance path to ground. Pigtails are generally not allowed.

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304 For multi-screened, double screened or individually pair-screened cables, the outer screen shall be terminated to ground at both ends, and at any EMC-zone penetration. The other screens shall normally be terminated to ground at the most sensitive end only. Alternatively the other screens should be terminated to ground in accordance with provisions of the manufacturer.

305 For distributed system the zero potential reference may be grounded, but only at one single point, preferably at the main unit. The zero potential reference shall then be floated in sub-units. If necessary the zero potential reference may be floating versus the hull of the vessel.

E 400 Cabling

401 Cables that are prone to radiating EMI, shall be screened. At least one screen shall be provided, but multiple screens or other special cables suggested by the equipment manufacturer can be used.

402 Cables from receiving and transmitting antennas shall normally be arranged in solid metal pipes between the antenna and transceiver. However, alternative arrangements may be considered, e.g. physical separation or solid screen, if same or better performance can be achieved.

403 Cable trays shall be routed as close as possible to bulkheads or decks or any ground plane to minimise the pickup loop of the cable screen.

404 Cables shall be categorised according to energy level and frequency of signal. Cables carrying signals of same category can be installed next to each other. Cables with signals of different category shall be separated.

Guidance note:

See Classification Note No. 45.1 for distances of adequate segregation.

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405 Cables to the top deck equipment shall generally be routed entirely below decks or installed in metal piping.

406 Cables for equipment outside shielded zones shall avoid routing through shielded zones.

407 All unused conductors in a cable shall normally be bonded or grounded at the most sensitive end only. However, grounding or bonding at both ends may be accepted if this provide a more safe solution.

E 500 Filtering

501 If and when EMI-filters are applied, these shall be installed according to the manufacturer's specification.

Guidance note:

See STANAG 1008 and STANAG 4435 for additional information.

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502 Equipment connected to network furnished with EMI- filters, shall be marked with the following warning sign:

THIS EQUIPMENT IS CONNECTED WITH AN
EMI-FILTER.
SPECIAL ATTENTION TO BE PAID TO EARTHING.
REFER TO THE MANUFACTURER'S INSTRUCTIONS.

E 600 Lightning protection

601 Equipotential bonding shall be applied to internal lightning protection systems by means of bonding conductors or surge suppressers connecting metal framework of structure to conductive parts of the electrical and telecommunication installations within the space to be protected. Bonding Cu-conductors shall have a minimum cross section of 16 mm².

Guidance note:

In instances Cu-conductors cannot be applied due to corrosion problems, other materials may be accepted provided the electrical features of the installations are similar or better.

It may be required to analyse the impact of very high magnetic fields caused by the lightning current. This is particularly important if the hull made of aluminium or GRP.

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E 700 Electrostatic discharge

701 Selected areas such as rooms with sensitive electronics, i.e. the bridge, operational rooms, radio rooms, engine control rooms, electronic workshops, ordnance facilities and storage rooms for explosives shall be fitted with deck coverings providing discharge of electrostatic charged personnel.

Guidance note:

- Wrist straps for discharge of electrostatic charged personnel should be fitted on electronic cabinets intended for regular inspection, field service or repair.
- Electrostatic sensitive devices (spare parts) should be wrapped in metal-in/metal-out static shielding bags according to package material described in EN 100015-1 or a similar standards.

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E 800 Marking

801 Shielded zones shall be clearly marked. Signboards shall be posted at access points and at cable penetrations into other shielded zones.

802 Rooms containing electrostatic sensitive devices shall have signs for ESD protected area according to a recognised standard e.g. EN-100015-1.

F. Testing

F 100 General

101 The tests shall demonstrate that the systems or equipment or circuits or functions are unaffected by relevant levels of electromagnetic emissions, and that they are unaffected by each other when each system is operated as a source.

Guidance note:

Testing may be waived if the EMC properties of systems or equipment or circuits or functions have been satisfactory documented e.g. previously type tested.

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102 Measurements shall show that no leakage current exceeds 30 mA in any network or load configuration, and that the leakage current currents per circuit of equipment is less than 30 mA.

103 Measurements shall be carried out to show that the E-field shielding effectiveness between the various zones is as required, as well document the electromagnetic environment within each zone.

104 Measurement shall show that for distributed systems, the zero-potential reference is terminated to ground, at one single point only, if it is not floated completely.

F 200 Factory Acceptance Tests (FAT) for equipment

201 Immunity and emission tests may be required in order to verify that the limit values are not exceeded and that the equipment has been designed according to the plans and specifications.

F 300 Harbour Acceptance Tests (HAT) for the vessel

301 Immunity and emission tests shall be performed on systems on board in order to verify that the limit values are not exceeded and that the equipment has been delivered and installed according to the plans and specifications.

F 400 Sea Acceptance Tests (SAT) for the vessel

401 Systems or functions that for practical reasons could not be verified by HAT shall be subjected to SAT.

SECTION 15 STORAGE ROOMS FOR EXPLOSIVES

A. General

A 100 Application

101 The rules in this section apply to storage rooms for explosives on naval surface vessels.

A 200 Definitions

201 *Storage room for explosives* is an enclosed room designated for storage of major ammunition, explosives, torpedoes and missiles.

202 *Hazardous areas* are all areas in which explosives are stored or transported as a part of normal operational routines.

203 *Explosives* are all types of ammunition and weapon systems equipped with explosive material.

204 *Wave-guide* is a device designed to propagate radio waves between radar transceiver and antenna.

B. Basic Requirements

B 100 General

101 A safety arrangement plan shall show the location of hazardous areas.

102 Explosive storage space on deck and loading areas shall be shown on a safety arrangement plan identifying operational restrictions in the area and adjacent areas.

B 200 Plans and particulars to be submitted

201 A safety arrangement plan for storage and transportation of explosives showing the general layout and all openings or doors shall be submitted for approval.

202 Plans and particulars for storage rooms for explosives covering electrical installations and fire safety, shall be included in the general documentation to be submitted for these areas.

C. Arrangements

C 100 General

101 Access to storage rooms for explosives shall be via areas of low fire risk and secure efficient passage.

102 Access doors to storage rooms for explosives shall be equipped with a secure locking mechanism and an inspection test plug. Normal access doors and hatches shall be fitted with means for locking devices outside the storage room. Emergency escape hatches shall be fitted with means for locking devices inside the storage room.

103 Supply lines to the storage rooms for explosives shall be arranged for secure handling of the ammunition.

104 If storage rooms for explosives are situated in areas with vibrations adverse to proper storage of intended explosives, suitable measures shall be taken.

105 Arrangements shall be made such that the temperature and humidity of the air in the storage rooms for explosives can be regulated within acceptable limits for the type of ammunition to be stored.

Guidance note:

The temperature and relative humidity should generally not exceed 25 °C and 50 to 70% respectively.

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106 Storage rooms for explosives shall be fitted with arrangements for detecting temperatures in the space.

107 The location of the inlets to the ventilation system for the space shall provide sufficient protection against warm air or hazardous vapours being emitted from galleys and pump-rooms tanks.

108 Wave-guides, ventilation ducts, cables and other utility systems shall normally not be routed through storage rooms for explosives.

Guidance note:

If it is absolutely necessary to route such components inside storage rooms for explosives, they should be routed inside structural ducts.

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109 Securing arrangement for explosives shall be provided.

110 Storage rooms located below the vessel waterline shall be provided with an air and overflow arrangement of sufficient capacity in order to prevent excessive pressure build up during total water flooding.

111 Storage rooms for explosives located below the waterline shall be arranged for drainage with suitable draining facilities (see Sec.6 H400).

112 Storage rooms for explosives located above the waterline shall be arranged with drainpipes leading overboard. The drainpipes shall have a capacity of at least 125% the capacity of the water spray system. Overboard valves shall be provided with remote operation from on or above the damage control deck (see Sec.6 H500).

Guidance note:

For valves where the inboard end of the drainpipe is submerged at the final waterline after damage as defined in Sec.5, arrangements shall be provided for drainage with submersible drain pumps.

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D. Structure

D 100 Structural requirements

101 Decks of storage rooms for explosives shall be dimensioned as for cargo rooms, see Pt.3. Ch.1 in the Rules for Classification of HS, LC and NSC, or for a water head to the deck above, whichever is the greater.

102 The local structures shall be checked for heavy items placed in the storage rooms for explosives.

E. Fire Safety

E 100 General

101 Hydraulic equipment to be used in storage rooms for explosives shall use fire safe hydraulic fluids.

Guidance note:

Air powered equipment shall be preferred in storage rooms for explosives.

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E 200 Structural fire protection

201 The storage room for explosives shall be of a permanent watertight construction and surrounded by permanent A-60 or equivalent class divisions.

Guidance note:

The storage room should in general be protected from external fires.

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202 For light, high speed craft designs based on fibre composite material and sandwich constructions the storage rooms for explosives shall be of a permanent watertight construction and surrounded by permanent A-30 or equivalent class divisions.

203 Storage rooms for explosives that are an integral part of the vessel shall not be adjacent to machinery spaces of category A, galleys, battery rooms, major electrical power distribution or other spaces in fire risk category (6), (7) and (9) as defined in Sec.10 F. If this is not practicable, a cofferdam of at least 0.6 m shall be provided separating the two spaces. One of the bulkheads in the cofferdam shall be of A-60 or equivalent construction.

Guidance note:

If this is not practicable, a risk analysis may be carried out to demonstrate that an alternative solution maintains the safety objectives.

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204 Access doors to storage rooms for explosives shall be fire resistant to A-60 class or equivalent, watertight and capable of sustaining an external explosion pressure of not less than 1 bar.

205 Spaces built as an integral part of the vessel and used as an area for missile launchers shall be protected by A-60 or equivalent class divisions.

E 300 System fire safety

301 The storage rooms for explosives and adjacent rooms shall be equipped with fire detectors.

302 Electrical equipment and wiring shall not be fitted in areas where explosives are stored, unless it is essential for the safety and operation of the ship.

Only certified-safe equipment of temperature class T5 having a degree of protection IP6X shall be installed.

Guidance note:

Equipment other than of a certified-safe type may be used if documented to have a maximum surface temperature of 100°C.

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E 400 Fire protection

401 A water sprinkler system shall be installed in the space. The water spray system shall have an application rate of at least 32 l/m² per minute. Equivalent means may be accepted.

Guidance note:

The feeding pipe of the sprinkling system should be provided with a ball float stop-valve, or similar safety device, just after the entrance to the storage room unless drainage is arranged for.

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402 On activating the sprinkler system the electrical installation, if any, should be disconnected. The circuit breaker shall be located in the same place as the spray activator together with a signboard showing the correct procedure.

403 For storage rooms for explosives located below the vessel's water line, a water total flooding system shall be installed if relevant for the type of explosives to be stored in the room.

404 The sprinkler alarm system shall be connected to the main alarm system.

405 The fire extinction system for storage rooms for explosives shall be equipped for manual and or automatic operation.

Guidance note:

The requirement for automatic operation depends on the type of explosive to be stored, and will be agreed upon from a case to case basis.

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406 Valves in fire extinguishing systems for storage rooms for explosives shall be fitted with locking devices to prevent unauthorised use.

407 Storage rooms for explosives shall be arranged so as to include a back-up to the main fire water supply.

F. Radiation Hazards

F 100 Electromagnetic radiation protection

101 Storage rooms and transport routes for explosives shall be protected from electromagnetic radiation unless the explosive store in itself is adequately protected from radiation.

Guidance note:

Requirements regarding aspects related to radiation hazards may be found in Sec.13.

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G. Signboards

G 100 General

101 Storage rooms for explosives and areas identified for ammunition storage shall be marked with signboards displaying:

- no smoking
- warning against use of electronic radiating equipment
- warning against use of inflammable liquid
- warning against activity which could compromise the safety of the ammunition
- observe anti static precautions.