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Defence

AUSTRALIAN NAVAL CLASSIFICATION AUTHORITY MANUAL (VOLUME 2)

DIVISION 3: SHIP RULES

CHAPTER 03: BUOYANCY AND STABILITY

PART 1: ANC RULES

This document is issued for use by Defence and Defence Industry personnel and is effective forthwith.

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1 https://www.legislation.gov.au/Series/C1968A00063

2 https://www.legislation.gov.au/Series/C2004A04868

3 https://www.legislation.gov.au/Series/C2004A03712

4 http://drnet/AssociateSecretary/security/policy/Pages/dspf.aspx

AUSTRALIAN NAVAL CLASSIFICATION RULES

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[5] https://www.defence.gov.au/business-industry/industry-governance/australian-naval-classification-authority/australian-naval-classification-rules

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Division 3: Ship Rules
Part 1: ANC Rules

Chapter 03: Buoyancy and Stability

Contents

Australian Naval Classification Rules

Rule 0. Goal

0.1 The buoyancy, freeboard, main sub-division compartment and stability characteristics of the ship shall be designed, constructed and maintained to:

0.1.1 Provide an adequate reserve of buoyancy in all foreseeable intact and damaged conditions, in the environment for which the ship is to operate;

0.1.2 Provide adequate stability, under the precepts of good seamanship, to:

0.1.2.1 maintain operation of Essential Safety Functions;

0.1.2.2 where specified in the Operating and Support Intent (OSI), maintain operation of Mission Critical Functions; and

0.1.2.3 avoid capsizing in all foreseeable intact and damaged conditions, in the environment for which the ship is to operate;

0.1.3 Permit embarked persons to carry out their duties as safely as reasonably practical;

0.1.4 Protect the embarked persons and essential safety functions in the event of foreseeable accidents and emergencies at least until the persons have reached a place of safety or the threat has receded including preventing the malfunction of the life-saving systems and equipment; and

0.1.5 Provide the required post damage capability.

Rule 1. General

Functional Objective

1.1 The purpose of this Rule is to outline the principles and framework of Chapter 03 *Buoyancy and Stability*.

Purpose

1.2 Adequate reserve of buoyancy and stability shall be provided to safeguard life and property at sea whilst maintaining freedom of manoeuvre in all foreseeable intact and damaged conditions, in the environment for which the ship is to operate.

1.3 In addition to the hazards facing merchant shipping, the risk of collision from operation in close proximity to other shipping, particularly during replenishment at sea, blockade, interdiction or multi-platform operations shall be considered in determining foreseeable damage.

1.4 Ships exposed to extreme threat conditions shall also consider the realisation of specified extreme threats in determining damage conditions.

1.5 The ability to be deployed to any area of interest defined in the OSI shall be maintained.

Application

1.6 Division 2 Chapter 01 *General Requirements* applies to all chapters of this Division and therefore in order to meet the Chapter 03 *Buoyancy and Stability* goal, the requirements of both this chapter and Division 2 Chapter 01 *General Requirements* shall be met.

General Performance Requirements

1.7 The ship shall:

1.7.1 Have a level of inherent seaworthiness including motions tolerable by equipment and embarked persons, controllability and the ability to remain afloat and not capsize;

1.7.2 Be designed to eliminate, or minimise So Far As Reasonably Practicable (SFARP), the risks faced by hazards to naval shipping, including but not limited to:

1.7.2.1 The impact of the environment causing dynamic capsize;

1.7.2.2 Broach or damage to embarked persons and equipment;

1.7.2.3 Loss of watertight integrity;

1.7.2.4 Collision;

1.7.2.5 Grounding;

1.7.2.6 Static capsize due to changing loading conditions;

1.7.2.7 Errors in ship handling;

1.7.2.8 Where applicable, extreme threats;

1.7.3 Remain afloat, stable when damage to the hull causes subsequent loss of watertight integrity. The consequences of this flooding are not to impair the provision of essential safety and, where specified in the OSI, mission critical functions; and

1.7.4 Be provided with operator guidance, as required in Rule 8 *Provision of Operational Information*, to facilitate safe handling of the ship.

Note: Assumptions of good seamanship are inherent in practically all stability methods that can be applied to verify the performance requirements of this chapter.

Note: Guidance on hazard identification and bounding the Foreseeable Operating Conditions for buoyancy and stability is provided in Part 3 Chapter 03 *Buoyancy and Stability* Rule 1 *General.*

Rule 2. Watertight Integrity

Functional Objectives

2.1 The ship shall have watertight and weather tight boundaries that prevent the accumulation of water in any undamaged main sub-division compartment, in any Foreseeable Operating Condition.

Performance Requirements

Watertight & Weathertight Boundaries

2.2 The structure of any main sub-division compartment shall ensure any watertight or weathertight boundary satisfies the functional objectives of this chapter in any Foreseeable Operating Condition.

2.3 The external ship's structure and fittings shall be weathertight above the submergence limit, defined in Rule 3, in all Foreseeable Operating Conditions.

Note: The ANC Authority requires that all reasonable and practicable measures shall be taken to limit the entry and spread of water above the submergence limit.

2.4 Main sub-division compartment boundaries shall be watertight below the submergence limit in all Foreseeable Operating Conditions.

2.5 In case of damage to the shell of the ship, adequate arrangements shall be required to protect embarked persons from the ingress of water. The requirements of Chapter 07 *Escape, Evacuation and Rescue* Rule 16 are to be applied in conjunction with this requirement.

2.6 Essential Safety Functions and, where specified in the OSI, Mission Critical Functions, shall be maintained from subsequent progressive flooding following ingress of water to a Main Watertight Compartment.

2.7 Compartments containing devices providing or supporting Essential Safety Functions and, where specified in the OSI, Mission Critical Functions, are to be protected from subsequent progressive flooding following ingress of water to a Main Watertight Compartment.

2.8 The Damage Control Deck, where specified in the OSI, shall be watertight and located above the submergence limit to provide safe continuous access along the length of the ship, communication and recovery activities (such as rapid closure of openings & penetrations in watertight boundaries).

2.9 Main and auxiliary machinery space boundaries shall be designed and maintained to be watertight.

2.10 The fore and aft regions of the ship shall provide protection to the remainder of the ship (extending from keel to weatherdeck) from the consequences of a collision.

2.11 Access trunks, tunnels or scuttles shall have watertight boundaries.

2.12 Damage to or loss of any appendage fitted to the ship shall not cause the loss of watertight integrity to any main sub-division compartment.

2.13 The ship shall be protected from ingress of water in case of damage to stern tube arrangements and shafting arrangements.

Openings

2.14 Where down-flooding points (such as air intakes and exhausts) are required they shall limit the ingress of water from weather or waves in any Foreseeable Operating Condition.

2.15 Openings in all main sub-division compartment boundaries shall be reduced to a minimum compatible with the design and proper working of the ship.

2.16 Openings in the hull and watertight boundaries shall:

2.16.1 Be fitted with closures of an approved type;

2.16.2 Not be fitted in bulkheads below the first watertight deck above the submergence limit unless approved by the ANC Authority; and

2.16.3 Not be fitted in the collision bulkhead.

2.17 Openings above the submergence limit, other than approved down-flooding points, shall be fitted with weathertight closing devices of an approved type that shall;

2.17.1 For openings in decks, have coamings of adequate height and strength to allow access and protection against ingress of water in all Foreseeable Operating Conditions;

2.17.2 Be of adequately robust construction to withstand minor damage; and

2.17.3 Be capable of being closed in a safe manner.

2.18 Openings formed by air pipes, ventilators and similar systems shall terminate at a location above the submergence limit.

2.19 Moving parts penetrating the hull below the submergence limit are to be fitted with watertight sealing arrangements of an approved type.

2.20 Inlets and discharges below the submergence limit shall be of an approved type and fitted with efficient and accessible means of preventing water from passing inboard.

Closures

2.21 Closures to openings in watertight boundaries shall:

2.21.1 Permit embarked persons to carry out their duties safely;

2.21.2 Be capable of being operated by embarked persons;

2.21.3 Be able to be closed rapidly in all Foreseeable Operating Conditions, in sufficient time to maintain an adequate reserve of stability and buoyancy;

2.21.4 Provide the same level of watertight integrity as the surrounding structure when closed;

2.21.5 Allow the watertight compartment to be entered following the flooding of any adjacent compartment;

2.21.6 Be minimised in number throughout the ship;

2.21.7 Be located away from areas of foreseeable damage in order to retain their watertight effectiveness;

2.21.8 Indicate to a manned central control station and other control stations, if open; and

2.21.9 Only be opened whilst afloat at times approved by the Naval Vessel Operator (NVO) and ANC Authority, and be marked accordingly to reflect the operational system for opening at sea.

2.22 Portable plates shall not be permitted.

Penetrations

2.23 Penetrations (for all piping, cabling, ducting or other purpose) shall:

2.23.1 Provide the same level of watertight and weathertight integrity as the surrounding structure;

2.23.2 Prevent the flow of water through watertight boundaries;

2.23.3 Be able to be closed rapidly in all Foreseeable Operating Conditions, and for piping, ducting and other open penetrations in watertight boundaries, be closed by remote operation from above the first watertight deck above the submergence limit;

2.23.4 Not be fitted in the forward most watertight bulkhead;

2.23.5 Not be made of materials that would impair the watertight integrity in the event of a fire or shock under Foreseeable Operating Conditions; and

2.23.6 Be of an approved type.

Drainage

2.24 A system capable of removing liquid from the bilges of any undamaged main sub-division compartment in any Foreseeable Operating Condition shall:

2.24.1 Be fitted to the ship;

2.24.2 Be indicated to a main control station and other control stations for spaces where flooding will cause a hazard to the ship;

2.24.3 Be of an approved type;

2.24.4 Have at least the capacity to remove water at the rate it can accumulate due to any credible scenario which could lead to simultaneous ingress from penetrations, down flooding points and any intact onboard systems (such as fire-fighting systems or localised flooding from domestic services); and

2.24.5 Have a liquid leakage detection system for spaces where flooding will cause great danger to the ship.

2.25 Adequate provision shall be made for the drainage of enclosed spaces, capable of operation in all foreseeable conditions.

2.26 All exposed decks shall be free draining.

Rule 3. Reserve of Buoyancy

Functional Objective

3.1 The ship shall have sufficient freeboard and buoyancy to prevent excessive shipping of green seas, plunging or foundering in any Foreseeable Operating Condition.

Performance Requirements

3.2 The ship shall, in all Foreseeable Operating Conditions:

3.2.1 Have adequate freeboard;

3.2.2 Have adequate freeboard forward to minimise shipping of green seas;

3.2.3 Remain afloat; and

3.2.4 Have sufficient reserve of buoyancy to meet Rule 7 Preservation of Life.

Design

3.3 Buoyancy in a damaged state shall be provided by sub-division or an equivalent method.

3.4 The submergence limit shall be determined from the damaged stability calculations.

3.5 The ship shall have a minimum freeboard and sub-division or any other mechanism to ensure an adequate reserve of buoyancy.

Ship Condition

3.6 A System shall be provided that enables the ship's displacement, trim and list to be determined.

3.7 Means to determine the fluid levels of ship's tanks shall be provided.

3.8 The displacement and the position of the centre of gravity shall be determined and approved by the ANC Authority, following completion of construction and periodically as detailed in the Trim and Stability Booklet.

Rule 4. Reserve of Stability

Functional Objective

4.1 The ship shall have adequate resistance to inclination to maintain operation of Essential Safety Functions and, where specified in the OSI, Mission Critical Functions. The resistance to inclination shall prevent capsize when disturbed, and adequate restoring energy to return to upright once the disturbance is removed, in any Foreseeable Operating Condition.

Performance Requirements

4.2 The ship shall, in any Foreseeable Operating Condition:

4.2.1 Adequately resist roll, heel or list caused by a disturbance to an extent that permits:

4.2.1.1 Operation of Essential Safety Functions and, where specified in the OSI, Mission Critical Functions;

4.2.1.2 Embarked persons to carry out their duties as safely as reasonably practical; and

4.2.2 Return to upright from a roll, heel or list caused by a disturbance subsequent to the removal of the disturbance.

Rule 5. Not Used

Rule 6. Safety of Embarked Persons and Seakeeping

Functional Objective

6.1 The ship shall behave in a manner that allows embarked persons to carry out their duties as safely as reasonably practical, in all Foreseeable Operating Conditions.

6.2 The ship shall behave in a manner that allows for equipment to operate in accordance with the OSI.

Performance Requirements

6.3 The behaviour of the ship in Foreseeable Operating Conditions shall;

6.3.1 Be optimised considering the stability requirements and the safety of embarked persons;

6.3.2 Be assessed to determine any limitations to safe operation; and

6.3.3 Not prevent Embarked Persons from operating the Essential Safety Functions and, where specified in the OSI, Mission Critical Functions.

6.4 Where embarked persons can access an exposed deck, that deck shall have means of preventing a person falling from that deck.

Note: This includes temporary openings in decks for maintenance or other purposes.

6.5 Both internal and external access routes to all work spaces and emergency positions shall have means to assist movement about the ship by embarked persons in Foreseeable Operating Conditions.

6.6 Arrangement shall be provided that allow Embarked Persons to remain in position and safely conduct normal activity in Foreseeable Operating Conditions.

6.7 Seakeeping requirements are as follows:

6.7.1 While complying with Rule.6.3.1, the optimisation of the behaviour of the ship in a seaway shall also consider the maximum availability of the ship's capability in the operational environment limits specified in the OSI; and

6.7.2 The seakeeping performance of a ship shall be within the motion limits selected for each environment defined in the OSI including the full range of zero crossing wave periods.

Note: Motion control systems shall comply with Chapter 04 *Engineering Systems* Rule 7 *Ship Stabilising Systems*.

Rule 7. Preservation of Life

Functional Objective

7.1 The ship shall provide a place of safety following an extreme event, for at least the duration required to evacuate all embarked persons using the ship's own escape and evacuation system.

Performance Requirements

7.2 Subsequent to an extreme event, the ship shall not take up an attitude that prevents:

7.2.1 Movement through the ship by embarked persons to a place of safety; and

7.2.2 The use of evacuation arrangements and life saving equipment provided under Chapter 07 *Escape, Evacuation and Rescue* to evacuate the ship.

7.3 This Rule shall not apply following a catastrophic event.

Rule 8. Provision of Operational Information

Functional Objective

8.1 Information required by the ship's crew, pertaining to the stability and buoyancy of the ship, shall be provided and maintained with the ship to facilitate its' safe operation in all Foreseeable Operating Conditions and for escape, evacuation and rescue.

Performance Requirements

8.2 The ship shall be provided with information:

8.2.1 To maintain the watertight and weathertight integrity;

8.2.2 To maintain adequate buoyancy and stability; and

8.2.3 Pertaining to ship operations (e.g. in heavy weather) or manoeuvres in order to eliminate or minimise risks SFARP to crew and equipment.

Rule 9. Limiting KG Curve

Functional Objective

9.1 The ship shall be provided with a clear and simple means of determining compliance with the stability criteria.

Performance Requirements

9.2 All ships shall have their limiting draught and vertical centre of gravity defined and clearly stated in the Trim and Stability Booklet.

Note: Typically, either damage stability criteria or structural strength considerations may define the limiting draught.