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DIVISION 5: REMOTE AND AUTONOMOUS SYSTEMS

SECTION 4: LARGE UNCREWED SURFACE VESSELS

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

AMENDMENTS

Proposals for amendments to the ANCA Manual (Volume 2) may be sent to:

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Division 5: Remote and Autonomous Systems (RAS) Rules
Section 4: Large Uncrewed Surface Vessel (L-USV)
Part 1: ANC Rules

Chapter 03: Buoyancy and Stability

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Australian Naval Classification Rules

Rule 0. Goal

0.1 The buoyancy, freeboard, main sub-division compartment and stability characteristics of the Large Uncrewed Surface Vessel (L-USV) 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 L-USV is to operate;

0.1.2 Provide stability to maintain operation of essential safety and, where specified in the Operating and Support Intent (OSI), mission critical functions and avoid capsizing in all foreseeable intact and damaged conditions, in the environment for which the L-USV is to operate, under the precepts of good seamanship and Autonomous Control System (ACS) control;

0.1.3 Permit End Users to carry out L-USV missions as safely as reasonably practical;

0.1.4 Protect the essential safety functions in the event of foreseeable accidents and emergencies at least until the threat has receded; 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 the environment and property at sea whilst maintaining freedom of manoeuvre in all foreseeable intact and damaged conditions, in the environment for which the L-USV is to operate.

1.3 In addition to the hazards facing merchant shipping, the risk of collision from L-USV 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 L-USV 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 *Core Design Rules* 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 *Core Design Rules* Chapter 01 *General Requirements* shall be met.

1.6.1 Division 3 *Ship Rules* Chapter 03 *Buoyancy and Stability* goal applies to all Naval Vessels greater than 24m length overall that carry persons. Therefore, to meet the Chapter 01

Buoyancy and Stability goal, a L-USV that requires embarked persons shall meet the requirements of both this chapter and the requirements of Division 3 *Ship Rules* Chapter 03 *Buoyancy and Stability* as applicable to the design.

1.6.2 The Rules listed in this Chapter are based on those in the corresponding Chapter within Division 3 *Ship Rules* and have been adapted for L-USV. When referring to Division 2 or 3, the following terms may be interchanged:

1.6.2.1 'Ship' as ' L-USV';

1.6.2.2 'Crew' or ‘Operator’ or ‘Embarked Person’ as 'End User';

1.6.2.3 'Primary, Main or Damage Control Station' as 'Remote Command Unit (RCU)';

1.6.2.4 ‘Bridge’ or ‘conning position’ as RCU;

1.6.2.5 'Signature Reduction' as 'Signature Management';

1.6.3 The Buoyancy and Stability arrangements of the L-USV shall match its RAS Maturity Level to allow End Users to safely operate the L-USV to achieve missions listed in the OSI.

General Performance Requirements

1.7 The L-USV shall:

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

1.7.2 Be designed to eliminate or minimise the risk so far as reasonably practicable 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 equipment;

1.7.2.3 loss of watertight integrity;

1.7.2.4 collision;

1.7.2.5 grounding (Intentional or unintentional);

1.7.2.6 static capsizes due to changing loading conditions;

1.7.2.7 errors in the L-USV's handling; and

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.

1.7.4 Be provided with End User guidance, as required in Rule 8 *Provision of Operational Information*, to facilitate safe handling of the L-USV.

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 Chapter 03 *Buoyancy and Stability* Part 3 Rule 1 *General*.

Rule 2. Watertight Integrity

2.1 The L-USV shall comply with Division 3 *Ship Rules* Chapter 03 *Buoyancy and Stability* Rule 2 *Watertight Integrity* as amended in Table 1.1 below:

Table 1.1: Division 3 Chapter 03 Rule 2 Amendments

Rule Number	Amendment
2.5	Not used.
2.8	Not used.
2.21.1	Not used.
2.21.2	Not used.
2.21.5	Not used.
2.22	Not used.

Rule 3. Reserve of Buoyancy

3.1 The L-USV shall comply with Division 3 *Ship Rules* Chapter 03 *Buoyancy and Stability* Rule 3 *Reserve of Buoyancy* as amended in Table 1.2 below:

Table 1.2: Division 3 Chapter 03 Rule 3 Amendments

Rule Number	Amendment
3.2.4	Not used.
3.7	Means to determine the fluid levels of L-USV's tanks shall be provided to the End User at the RCU or locally as required by the OSI.

Rule 4. Reserve of Stability

4.1 The L-USV shall comply with Division 3 *Ship Rules* Chapter 03 *Buoyancy and Stability* Rule 4 *Reserve of Stability* as amended in Table 1.3 below:

Table 1.3: Division 3 Chapter 03 Rule 4 Amendments

Rule Number	Amendment
4.2.1.2	Permit End Users to carry out L-USV missions as safely as reasonably practical;

Rule 5. Not Used

Rule 6. Safety of Embarked Persons and Seakeeping

6.1 The L-USV shall comply with Division 3 *Ship Rules* Chapter 03 *Buoyancy and Stability* Rule 6 *Safety of Embarked Persons and Seakeeping* as amended in Table 1.4 below:

Table 1.4: Division 3 Chapter 03 Rule 6 Amendments

Rule Number	Amendment
6.1	The L-USV shall behave in a manner that allows End Users to carry out L-USV's missions as safely as reasonably practical, in all Foreseeable Operating Conditions;
6.3.1	Not used.
6.4	Not used.
6.5	Not used.
6.6	Not used.

Rule 7. Not Used

Rule 8. Provision of Operational Information

8.1 The L-USV shall comply with Division 3 *Ship Rules* Chapter 03 *Buoyancy and Stability* Rule 8 *Provision of Operational Information* as amended in Table 1.5 below:

Table 5: Division 3 Chapter 03 Rule 8 Amendments

Rule Number	Amendment
8.2.3	Pertaining to L-USV's operations (e.g. in heavy weather) or manoeuvres in order to eliminate or minimise risk so far as reasonably practicable to the equipment.

Rule 9. Limiting KG Curve

9.1 The L-USV shall comply with Division 3 *Ship Rules* Chapter 03 *Buoyancy and Stability* Rule 9 *Limiting KG Curve*.

Rule 10. Remote Monitoring

Functional Objective

10.1 The L-USV shall have Remote Monitoring capabilities to ensure effective buoyancy and stability.

Scope

10.2 This rule is applicable for L-USV with a Remote Monitoring (RM) level of RM1 or greater.

Performance Requirements

10.3 L-USV systems with a Remote Monitoring level of RM1 or greater shall have the capability to remotely monitor the stability state of the vessel.

10.4 L-USV systems with a Remote Monitoring level of RM2 or greater shall have the capability to monitor the status of stability monitoring systems.

10.5 L-USV systems with a Remote Monitoring level of RM3 or greater shall have the capability to remotely monitor the draught.

10.6 L-USV systems with a Remote Monitoring level of RM4 shall have the ability to remotely monitor the state, status, and availability of systems that impact or modify the buoyancy and stability of the L-USV.

Rule 11. Remote Control

Functional Objective

11.1 The L-USV shall have Remote Control capabilities to ensure effective buoyancy and stability.

Scope

11.2 This rule is applicable for L-USV with a Remote Control level of RC4.

Performance Requirements

11.3 L-USV systems with a Remote Control level of RC4 shall have the capability to remotely adjust the buoyancy and ballast to achieve the OSI requirements.

Rule 12. Autonomy

Functional Objective

12.1 The L-USV shall have autonomy control and decision-making capabilities to ensure effective buoyancy and stability.

Scope

12.2 This rule is applicable for L-USV with an Autonomy level of A3 or greater.

Performance Requirements

12.3 L-USV systems with an Autonomy level of A3 or greater shall have the ability to autonomously control its buoyancy and stability at a level to achieve the OSI requirements.