



Australian Government

MARH035 Demonstrate fundamental knowledge of Autonomous Maritime Systems (AMS)

Release: 1

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Modification History

Release 1. This is the first release of this unit of competency in the MAR Maritime Training Package.

Application

This unit involves the skills and knowledge required to demonstrate fundamental knowledge of Autonomous Maritime Systems (AMS).

This includes defining Autonomous Under Vehicles (AUV) and Autonomous Surface Vessels (ASV); describing components of AMS; applying basic theory of hydrostatics, hydrodynamics, fundamental principles of AMS communications and navigation; and applying practical approaches to AMS sensors and missions.

This unit applies to people working in the maritime industry in the capacity of:

- AUV and ASV Operators
- AUV and ASV Technicians
- a person managing, leading or supporting an AMS operation.

This unit applies to AUV and ASV operations being conducted in Near Coastal (NC) waters within the limits of the operators AMSA Certificate of Competency.

Licensing/Regulatory Information

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Not Applicable

Competency Field

H – Navigation

Unit Sector

Not applicable

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1. Define AUV and ASV

2. Describe components of an AMS

3. Apply basic theory of hydrostatics in relation to AMS

4. Apply basic theory of hydrodynamics in relation to AMS

PERFORMANCE CRITERIA

Performance criteria describe the performance needed to demonstrate achievement of the element.

1.1 Key differences between crewed, uncrewed, uninhabited and autonomous platforms are identified

1.2 Key differences between autonomous and remotely operated platforms are outlined

1.3 Types of AUV and ASV are identified

2.1 Importance of well-defined mission objectives are articulated

2.2 Key logistic considerations around access to AMS mission arena are outlined

2.3 Critical factors relating to launch and recovery (LAR) systems and practices are detailed

2.4 Different types of AMS communication systems are identified

2.5 Different types of localisation and navigation for an AMS are outlined

3.1 Principles of salinity and temperature are understood in relation to density and stratification

3.2 Marine engineering principles of buoyancy, trim and stability are outlined with respect to AMS

3.3 Principles of ballasting AUVs for different environments are detailed

4.1 Forces in the horizontal and vertical planes and resultant motion are explained

4.2 Principles of thrust and power are outlined and common methods of propulsion are identified

4.3 Principles of how control surfaces work and vary across AMS is outlined

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| | 4.4 | Components of drag are outlined and factors to increase or reduce drag identified |
| 5. Explain fundamental principles of AMS communications | 5.1 | Principles of AMS communications through air are explained |
| | 5.2 | Principles of AMS communications through water are explained |
| | 5.3 | Commonly used communication systems are identified |
| 6. Explain fundamental principles of AMS navigation | 6.1 | AMS localisation is explained |
| | 6.2 | Navigation by dead-reckoning, including inertial navigation systems (INS) and improved dead-reckoning with doppler velocity logger (DVL), is explained |
| | 6.3 | External positioning, including long baseline (LBL), ultrashort baseline (USBL) and inverted USBL (iUSBL) systems, are explained |
| | 6.4 | Concept of building and improving a navigation solution is outlined |
| 7. Apply practical approaches to AMS sensors and missions | 7.1 | Typical AMS sensors are identified and operated |
| | 7.2 | General process of AMS mission planning for optimal sensor coverage is explained |
| | 7.3 | Commonly used AMS search mission patterns are outlined |
| | 7.4 | Fundamental elements of basic mission planning are summarised. |

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the MAR Maritime Training Package Companion Volume Implementation Guide.

Unit Mapping Information

This is a new unit. No equivalent unit.

Links

Companion Volume Implementation Guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>

Assessment Requirements for MARH035 Demonstrate fundamental knowledge of Autonomous Maritime Systems (AMS)

Modification History

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria on at least one occasion and include:

- describing how a basic control system works with respect to input/output and feedback/gain
- describing how operators can reduce drag to optimise the hydrodynamics of an Autonomous Maritime System (AMS)
- describing operational advantages and disadvantages of autonomous systems over crewed vessels
- describing the different types of communication systems available to AMS on the surface and underwater
- describing the importance of clear mission objectives with respect to AMS capabilities and sensor payload
- describing the operational advantages and disadvantages of autonomous systems over remotely operated systems
- describing why underwater AMS have limited communications relative to surface AMS
- identifying key changes to the environmental conditions for AMS operations that will impact buoyancy
- outlining an example of optimising mission design to meet capabilities of a key sensor
- outlining basic theory and basic principles of hydrostatics and hydrodynamics in relation to AMS
- outlining how a variety of navigation aids/techniques can be used to build an improved navigation solution
- outlining the basic steps taken to effectively ballast an underwater AMS in terms of optimal trim and buoyancy
- outlining the different levels of autonomy with respect to AMS.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria and include knowledge of:

- common digital AMS communication systems through air, including:
 - Inmarsat
 - Iridium

- medium frequency (MF)/high frequency (HF), very high frequency (VHF), ultra high frequency (UHF) and radio
- common AMS communication systems through water, including:
 - acoustic modems (AM)
 - acoustic transponders
 - doppler velocity loggers (DVL)
- common AMS missions, including:
 - environmental disaster response
 - hydrography
 - imaging
 - seafloor mapping
 - search and rescue
- common AMS propulsion systems, including:
 - buoyancy engines
 - propellers (open and ducted)
 - sails
 - wave riders
- common AMS power systems, including:
 - battery-based
 - fuel-based
- components of AMS, including:
 - communication
 - logistics
 - mission objectives
 - navigation
 - operations
 - payloads/sensing
- historic development and current examples of AMS used for:
 - industry
 - defence
 - research
- hydrodynamics of AMS, including:
 - balance of forces (buoyancy, gravity, thrust and drag)
 - components of drag
 - control surfaces
 - static and dynamic stability in relation to buoyancy and trim
- launch and recovery (LAR) systems, including:
 - automated docking and recharging systems
 - boat-based
 - land-based

- ship-based
- oceanography relating to AMS, including:
 - currents and tides
 - salinity, temperature and density with respect to buoyancy
 - turbidity
- physics of AMS communications through air and water
- principles of AMS autonomy, including:
 - basic control system
 - feedback
 - gain
 - input and output
- principles of AMS navigation, including:
 - dead-reckoning
 - DVL
 - global navigation satellite system (GNSS)
 - inertial navigation systems (INS)
 - inverted ultrashort baseline (iUSBL)
 - localisation
 - long baseline (LBL)
 - RTK-GPS
 - ultrashort baseline (USBL).

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Assessment must occur in workplace operational situations, where this is not appropriate, assessment must occur in simulated workplace operational situations that replicate workplace conditions.

Resources for assessment must include access to:

- applicable documentation such as workplace policies and procedures, regulations, codes of practice, operation manuals and operating procedures
- tools, equipment, machinery, materials and relevant personal protective equipment (PPE) currently used in industry.

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