



Australian Government

**MARH041 Apply knowledge of core
Autonomous Surface Vessels (ASV)
operations**

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Modification History

Release	Comments
1	This unit of competency was first released in MAR Maritime Training Package Release 12.0.

Application

This unit involves the skills and knowledge required to apply knowledge of core Autonomous Surface Vessels (ASV) operations.

This includes demonstrating knowledge of small vessel operations relevant to ASV; applying principles of ASV communication and navigation; applying safe handling techniques; applying knowledge of data handling and storage, principles of ASV mission planning software, tracking technologies and surface piloting techniques; identifying key working components, conducting safe launch and recovery (LAR), assessing mission data and evaluating ASV mission in a simulated and real-world environment.

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

- ASV Operator
- ASV Technician.

This unit applies to ASV operations being conducted in Near Coastal (NC) waters within the limits of the operators Australian Maritime Safety Authority Certificate of Competency.

Licensing/Regulatory Information

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

Pre-requisite unit(s)

No prerequisite units.

Competency field(s)

H - Navigation

Unit sector(s)

Autonomous Maritime Sector

Elements and Performance Criteria

Elements		Performance criteria	
Elements describe the essential outcomes.		Performance criteria describe the performance needed to demonstrate achievement of the element.	
1	Demonstrate knowledge of small vessel operations relevant to ASV	1.1	Key International Regulations for Preventing Collisions at Sea (COLREG) rules are identified
		1.2	Key lessons from historical cases of vessel collision are identified
		1.3	Key buoyage and light symbols are identified
		1.4	Key principles of visual navigation and chart-based navigation are identified
2	Apply safe handling techniques for an ASV	2.1	Location of safe lifting points and sensitive ('no touch areas') are identified
		2.2	ASV is transitioned from storage to operational area safely
		2.3	Process for initialising, shutting down and recharging ASV is conducted safely
		2.4	Process for data transfer of mission and payload data is conducted according to procedures
		2.5	Process for checking ballast, trim and stability is conducted according to procedures
		2.6	Process for checking watertight integrity is conducted according to procedures
3	Identify key working components of an ASV	3.1	Communication and navigation systems are identified

		3.2	Power, control and propulsion systems are identified
		3.3	Sensor payloads and data transfer system are identified
4.	Demonstrate knowledge of the principles of ASV communication and navigation	4.1	Key principles of radio frequency (RF) theory are identified
		4.2	Key principles of radar and radar navigation are identified
		4.3	Key principles of advanced global navigation satellite system (GNSS) and automatic identification systems (AIS) are identified
5.	Apply knowledge of data handling and storage	5.1	Units of data to be used when conducting ASV operations are explained
		5.2	Application of 'raw' and 'working' data management is completed according to operational procedures
		5.3	ASV logbooks and metadata records are completed according to operational procedures
		5.4	Data plan and data workflow are produced
		5.5	General principles of data redundancy and security are outlined
6.	Apply principles of ASV mission planning software	6.1	Process for loading navigational charts into the mission planning software is outlined
		6.2	Start and end points are set using mission planning software according to operational requirements
		6.3	Mission waypoints and transects are set using mission planning software according to operational requirements

		6.4	Optimal speed control is set using mission planning software according to operational requirements
		6.5	Total mission timing and distance are estimated manually and using mission planning software
		6.6	Mission files are uploaded from mission planning software to the ASV following operating procedures
7.	Apply ASV tracking technologies	7.1	ASV is located in visual line of sight (VLOS) using radio link
		7.2	ASV is located beyond visual line of sight (BVLOS) using RF link (point-to-point or satellite)
		7.3	Best practises for focusing ASV search and rescue operations are described
8.	Conduct safe launch and recovery (LAR) of an ASV	8.1	Critical factors required for safe launch and recovery systems (LARS) operations are outlined
		8.2	Deck-handling skills and equipment used to support ASV LAR are outlined
		8.3	ASV LAR from a stationary vessel is conducted according to operational procedures
		8.4	ASV LAR from a stationary vessel using a davit is conducted according to operational procedures
9.	Apply ASV surface piloting techniques	9.1	Establish remote control of the ASV at the surface
		9.2	ASV piloting to and from the support vessel and around obstacles through the adjustment of course and speed is conducted
10.	Conduct assessment of ASV mission data	10.1	Key information within master mission log file and operator logbook are accessed and interpreted
		10.2	Post-mission analysis is conducted to assess the success of the mission relative to payload objectives

		1 0. 3	Vehicle performance analysis is conducted to assess the engineering behaviour of the ASV
1 1 .	Plan, conduct and evaluate an ASV mission in a simulated and real-world environment	1 1. 1	ASV mission is designed and planned according to operational requirements
		1 1. 2	ASV mission is conducted following a standard operating procedure in a simulated environment
		1 1. 3	PMA of simulated mission is completed with a post-mission debrief
		1 1. 4	ASV mission is conducted following a standard operating procedure, implementing a simulated mission into the real-world environment
		1 1. 5	Post-mission analysis, including vehicle performance analysis, is completed with a post-mission debrief

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.

Unit Mapping Information

Current Code and Title	Previous Code and Title	Comments	Equivalence
MARH041 Apply knowledge of core	MARH031 Apply knowledge of core	This unit replaces and is not equivalent	Not equivalent

Autonomous Surface Vessels (ASV) operations	Autonomous Surface Vessels (ASV) operations	to MARH031 Apply knowledge of core Autonomous Surface Vessels (ASV) operations.	
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Assessment Requirements for MARH041 Apply knowledge of core Autonomous Surface Vessels (ASV) operations

Modification History

Release	Comments
1	This unit of competency was first released in MAR Maritime Training Package Release 12.0.

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:

- completing an Autonomous Surface Vessel (ASV) ‘walk-around’ identifying key components, including safe lifting points and ‘no-touch’ areas
- completing an ASV mission under supervision, including preliminary briefing, analysis and post-mission presentation
- conducting a launch and recovery (LAR) from stationary platform safely by hand and with a davit system
- correcting ballast on a ASV for optimum buoyancy, trim and stability
- initialising an ASV on ‘shore’ power, determining current battery levels and safely completing charging operations
- producing a post-mission analysis report which includes preliminary post-mission analysis and vehicle performance analysis
- surface piloting an ASV in a realistic maritime environment with obstacles that inhibit direct line of sight
- unpacking an ASV from storage and preparing for transportation to operational area safely
- using a radio frequency (RF) link to track and locate a lost ASV
- using a simulator to test ASV missions, with and without emergency procedures.

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:

- advanced positioning systems, including:
 - accuracy of positioning
 - augmentation systems (SBAS)
 - eLoran
 - global navigation satellite systems (GNSS)
 - interference
 - real-time kinematic (RTK) and post-processing
 - sources of errors
 - VHF data exchange system (VDES) R-mode
- application of hydrostatics on ASV ballast, including:
 - environmental conditions relevant to ballasting
 - optimal ASV pose
 - safe ballasting of ASV
- application of the International Regulations for Preventing Collisions at Sea (COLREG) when conducting ASV operations and lessons learned from historical cases of vessel collision
- automatic identification systems (AIS), including:
 - Class A/Class B
 - range limitations
 - update rates
- commonly used mission planning software packages, including processes to:
 - estimate total mission length and timing
 - set start and end mission points
 - set waypoints and transects
 - source and load a navigational chart
- critical ASV performance parameters, including:
 - impacts of drag on speed and current consumption
 - loiter radius
 - maximum speed and revolutions per minute (RPM)
 - minimum turn radius

- key elements of a post-mission briefing, including:
 - lessons learnt
 - recap of objectives
 - sensor performance
 - summary of outcomes
 - vehicle performance
- key elements of a pre-mission briefing, including:
 - objective
 - operational timing
 - payload
 - region-of-interest
 - risk assessment and mitigation
 - team roles
- key working components of an ASV, including:
 - ballasting system
 - buoyage and lights
 - communication and navigation systems
 - data transfer system
 - power, control and propulsion systems
 - sensor payloads
- oceanographic and environmental factors for consideration in ASV mission planning, including:
 - flotsam
 - obstacles
 - strong currents
 - uncertain bathymetry (coastline)
 - wind
- principles of radar and radar navigation, including:
 - automatic radar plotting aid (ARPA)
 - basic components of a marine radar
 - electromagnetic radiation hazards
 - factors impacting radar performance
 - using range and bearing to determine speed and course

- principles of RF theory, including:
 - electric and magnetic components of RF waves
 - propagation at various frequencies
 - received signal strength indicator (RSSI)
 - receiver sensitivity
 - relative power (dBm) and Watts
 - spectrum management
 - wave motion (reflection, refraction, diffraction, scattering and absorption)
- safe handling techniques for an ASV, including:
 - process for transferring data of mission and payload data
 - safe lifting points and sensitive (no touch areas)
 - safely transitioning an ASV from storage to operational area
- safe launch and recovery (LAR) techniques for ASV operations, including:
 - critical factors for safe LAR operations
 - davit ASV LAR from stationary vessel
 - deck-handling skills and equipment
- surface piloting techniques, including:
 - adjusting ASV speed and course to negotiate obstacles
- tracking technologies, including:
 - strategies for focusing ASV search and rescue operations
 - RF link.

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

Simulated workplace may be used to augment real-world operational situations and does not replace real-world operations in prescribed water conditions.

Resources for assessment must include access to:

- applicable documentation such as workplace procedures, regulations, codes of practice, operation manuals, manufacturer instructions and procedures
- tools, equipment, machinery, materials and relevant personal protective equipment (PPE) currently used in industry, including:
 - ASV aligned with the required size and class that a seafarer will need to operate
 - ASV with dual-propulsion and an integrated obstacle avoidance system
 - water conditions consistent with mission requirements as outlined in this unit of competency and must include access to water in excess of 100 m, high energy tidal waters and permanently stratified waters.

Links

Companion volumes, including implementation guides, are found in TGA - <https://training.gov.au/training/details/MAR/summary>