



Australian Government

MARH043 Conduct advanced Autonomous Surface Vessels (ASV) operations

MARH043 Conduct advanced 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.

Application

This unit involves the skills and knowledge required to conduct advanced Autonomous Surface Vessel (ASV) operations.

This includes applying knowledge of environmental dynamics and radio frequency communication principles; explaining control theory in relation to performance; conducting advanced vehicle performance analysis, post-mission analysis, search and rescue operations, and advanced ASV missions; and following operations procedures for planning, execution and analysis.

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	Apply knowledge of environmental dynamics when planning ASV operations	1	Surface layer upwelling and downwelling due to wind stress curl and frontal activity and their potential impact on ASV operations is outlined
		1	
		1	ASV operations are planned with specific consideration for the risks associated with ocean currents and tides
		2	
2	Apply knowledge of radio frequency (RF) communication principles to optimise ASV missions	2	Principles of ASV mission planning and execution in a global navigation satellite system (GNSS)-denied environment are outlined
		1	
		2	ASV missions with enhanced RF techniques are conducted
		2	
3	Explain control theory in relation to ASV performance	3	Concepts of input, output, error, feedback and gain for a simple control system are described
		1	
		3	Principle of tuning the three components of proportional-integral-derivative (PID) control to improve the achievement of an ASV navigation goal is outlined
		2	
4	Conduct advanced vehicle performance analysis	4	Post-mission extraction and storage of ASV engineering data is conducted following a data plan
		1	
		4	Numerical and graphical analysis of ASV engineering data is conducted using nominated software package
		2	

		4 . 3	ASV performance is assessed relative to original equipment manufacturer (OEM) standard benchmarks of USV operation
5 . 1	Conduct advanced post-mission analysis	5 . 1	Extraction and storage of sensor payload data is conducted following a data plan
		5 . 2	Numerical and graphical analysis of sensor data is conducted using nominated software package
		5 . 3	ASV sensor data quality is assessed relative to OEM standard benchmarks of USV operation
		5 . 4	Anomalies in ASV sensor data is assessed relative to vehicle performance analysis
6 . 1	Conduct advanced search and rescue operations for a lost ASV	6 . 1	ASV location operation with RF link is conducted in visual line of sight (VLOS) conditions according to operational requirements
		6 . 2	ASV location operation with RF link is conducted in beyond visual line of sight (BVLOS) conditions according to operational requirements
7 . 1	Conduct advanced ASV missions following operations procedures for planning, execution and analysis	7 . 1	ASV mission applying advanced knowledge of navigation options for GPSS-denied environment is conducted
		7 . 2	ASV bathymetry mission applying advanced knowledge of sonar and bottom imaging is conducted
		7 . 3	ASV mission applying knowledge of passage planning is conducted
		7 . 4	ASV mission examining towing performance is conducted

		7 . 5	ASV mission examining impact of sensor positioning on hydrodynamic performance is conducted
		7 . 6	Operational logbook entries are completed

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
MARH043 Conduct advanced Autonomous Surface Vessels (ASV) operations	MARH033 Conduct advanced Autonomous Surface Vessels (ASV) operations	This unit replaces and is not equivalent to MARH033 Conduct advanced Autonomous Surface Vessels (ASV) operations.	Not equivalent

Assessment Requirements for MARH043 Conduct advanced 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 and include:

- analysing numerical and graphical engineering and sensor data of Autonomous Surface Vessels (ASV) to assess performance against known benchmarks
- conducting an advanced ASV search and rescue operation with a radio frequency (RF) link
- conducting an ASV mission in a high-current and high-wind environment
- conducting consecutive ASV missions that build upon collected knowledge to improve a bathymetry survey
- conducting consecutive ASVs to collect and analysing vehicle engineering performance data
- planning, executing and analysing three operational ASV missions in NC waters under supervision, including a minimum of:
 - one mission operating in a global navigation satellite system (GNSS)-denied environment
 - one mission specific to bathymetry survey
 - one mission specific to passage planning
 - completing an ASV logbook, including recording operational logbook entries for each mission
- planning, executing and analysing two diagnostic ASV missions in Near Coastal (NC) waters under supervision, including a minimum of:
 - completing an ASV logbook, including recording operational logbook entries for each mission
 - one mission specific to impact of re-configuring sensor payloads on hydrodynamic performance

- one mission specific to towing performance
- producing a metadata record for one vehicle data parameter and one sensor data parameter
- producing and executing a data workflow.

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 ASV mission operations, including:
 - bathymetry mission using sonar and bottom imaging
 - operating in a GNSS-denied environment
 - towing operations
- ASV data management, including:
 - data plan
 - data redundancy
 - data security
 - data workflow
 - fundamental units of data
 - metadata
 - 'raw' and 'working' data
- ASV performance benchmarks, including:
 - heading
 - maximum revolutions per minute (RPM) and speed
 - minimum turn radius
 - position error
- environmental ocean dynamics and operational risks when conducting ASV operations, including:
 - coriolis, ekman transport and wind stress curl
 - estuary dynamics
 - langmuir circulations
 - ocean currents and tides
 - turbulent and laminar flows

- waves
- methods and techniques used to determine ASV performance against standard benchmarks, including:
 - process for identifying anomalies in ASV sensor data
 - quality of ASV sensor data
- methods used to analyse data, including:
 - calculation of mean and standard deviation for sub-sampled data
 - graphical analysis for rates of change in parameters
 - use of software packages
- operational data units and conversions, including:
 - distance in metres and nautical miles
 - speed in knots and metres per second
- process for conducting advanced search and rescue operations
- processes used to handle and store data including:
 - completing ASV logbooks and metadata records
 - extraction and storage of ASV engineering data
 - extraction and storage of sensor payload
 - producing a data plan and data workflow
- proportional-integral-derivative (PID) control
 - error
 - gain
 - input
 - Kp, Ki and Kd coefficients
 - output
- radio navigation.

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>