



Australian Government

MARH042 Conduct advanced Autonomous Underwater Vehicles (AUV) 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 conduct advanced Autonomous Underwater Vehicles (AUV) operations.

This unit includes applying advanced knowledge of data handling and storage, environmental dynamics when conducting AUV operations and acoustic communication principles; conducting advanced vehicle performance analysis, post-mission analysis; and following operation procedures for planning, execution and analysis.

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

- AUV Operator
- AUV Technician.

This unit applies to AUV 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 data handling and storage	1.1	Units of data to be used when conducting AUV operations are explained	
	1.2	Application of 'raw' and 'working' data management is completed according to operational procedures	
	1.3	AUV logbooks and metadata records are completed according to operational procedures	
	1.4	Data plan and data workflow are produced	
	1.5	General principles of data redundancy and security are outlined	
2 Conduct advanced vehicle performance analysis	2.1	Extraction and storage of AUV engineering data is conducted following a data plan	
	2.2	Numerical and graphical analysis of AUV engineering data is conducted using nominated software package	
	2.3	AUV performance is assessed relative to original equipment manufacturer (OEM) standard benchmarks of AUV operation	
3 Conduct advanced post-mission analysis	3.1	Extraction and storage of sensor payload data is conducted following a data plan	
	3.2	Numerical and graphical analysis of sensor data is conducted using nominated software package	
	3.3	AUV sensor data quality is assessed relative to OEM standard benchmarks of AUV operation	

		3.4	Anomalies in AUV sensor data is assessed relative to vehicle performance analysis
4	Conduct advanced search and rescue operations for a lost AUV	4.1	AUV location operation with homing is conducted according to operational requirements
		4.2	Disabled AUV rescue with remotely operated vehicle is conducted according to operational requirements
5	Conduct advanced AUV missions following operations procedures for planning, execution and analysis	5.1	AUV mission applying advanced knowledge of acoustic navigation with long baseline (LBL) is conducted
		5.2	AUV mission applying advanced knowledge of ballasting for a stratified water column is conducted
		5.3	AUV bathymetry mission applying advanced knowledge of sonar and bottom imaging is conducted
		5.4	AUV mission in water depth greater than 100 meters is conducted
		5.5	AUV missions to optimise vertical and horizontal positioning are conducted
		5.6	AUV mission with advanced target identification is conducted
6	Apply knowledge of environmental dynamics when conducting AUV operations	6.1	AUV operations taking into consideration the risks associated with ocean currents and tides are conducted
		6.2	Surface layer upwelling and downwelling due to wind stress curl and frontal activity and their potential impact on AUV operations is outlined
		6.3	Varying different seafloor types and the potential impact on AUV operations is outlined

7	Apply knowledge of acoustic communication principles to optimise AUV missions	7.1	Fundamentals of sound propagation in water in relation to acoustic communication are outlined
		7.2	Fundamentals of geometry are applied to the localisation of an AUV using acoustic beacons

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
MARH042 Conduct advanced Autonomous Underwater Vehicles (AUV) operations	MARH032 Conduct advanced Autonomous Underwater Vehicles (AUV) operations	This unit replaces and is not equivalent to MARH032 Conduct advanced Autonomous Underwater Vehicles (AUV) operations.	Not equivalent

Assessment Requirements for MARH042 Conduct advanced Autonomous Underwater Vehicles (AUV) operations

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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 and include:

- analysing numerical and graphical Autonomous Underwater Vehicles (AUV) engineering and sensor data to assess performance against AUV benchmarks
- conducting an advanced AUV search and rescue operation with homing and a remotely operated vehicle
- conducting 10 AUV missions in Near Coastal (NC) waters, including a minimum of:
 - completing an AUV logbook for 10 missions
 - conducting consecutive AUV missions to collect and analyse vehicle engineering performance data
 - consecutive AUV missions that build upon collected knowledge to improve a bathymetry survey
 - one mission in a highly stratified marine environment
 - one mission in water depth greater than 100 meters
 - one mission that demonstrates inertial navigation system (INS) drift with doppler velocity logger (DVL) off
- producing a metadata record for one vehicle data parameter and one sensor data parameter
- producing and executing data workflow according to operational 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:

- acoustic communication, including:
 - amplitude-shift keying (ASK), frequency-shift keying (FSK) and phase-shift keying (PSK) data transfer
 - decibels
 - frequency, wavelength and amplitude
 - power usage
 - Pythagoras' theorem and fundamental trigonometry
 - speed of sound in air and water
 - the trade-off between range, bandwidth and frequency
 - wave speed
- advanced AUV mission operations, including:
 - advanced target identification
 - bathymetry mission using sonar and bottom imaging
 - operating requirements when water depth is greater than 100 m
 - use of acoustic navigation with long baseline (LBL)
 - use of ballasting for a stratified water column
 - vertical and horizontal positioning
- AUV data management, including:
 - 'raw' and 'working' data
 - data plan
 - data redundancy
 - data security
 - data workflow
 - fundamental units of data
 - metadata
- AUV performance benchmarks, including:
 - acoustic doppler current profilers (ADCP) rejection rate
 - INS horizontal error
 - maximum climb angle
 - maximum dive angle

- maximum revolutions per minute (RPM) and speed
 - minimum turn radius
 - position error
- environmental ocean dynamics and operational risks when conducting AUV operations, including:
 - coriolis, ekman transport and wind stress curl
 - estuary dynamics
 - langmuir circulations
 - ocean currents and tides
 - turbulent and laminar flows
 - upwelling and downwelling associated with fronts
 - waves
- methods and techniques used to determine AUV performance against standard benchmarks, including:
 - process for identifying anomalies in AUV sensor data
 - quality of AUV sensor data
 - vehicle performance analysis
- methods used to analyse data, including:
 - mean values, rates of change, turning points, minimum and maximum values
 - 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, including:
 - homing
 - remotely operated vehicle
- processes used to handle and store data, including:
 - completing AUV logbooks and metadata records
 - extraction and storage of AUV engineering data
 - extraction and storage of sensor payload
 - producing a data plan and data workflow.

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:
 - AUV aligned with the required size and class that a seafarer will need to operate
 - AUV with minimum depth rating of 100 m and INS
 - 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>