



Australian Government

MARL056 Demonstrate basic knowledge of marine control systems and automation

Release: 1

MARL056 Demonstrate basic knowledge of marine control systems and automation

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 of marine automation and process control required by engineers to operate control systems on board a commercial vessel.

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

- Electro-Technical Officer (STCW Electro-Technical Officer Unlimited)
- Engineer Class 3 Near Coastal
- Engineer Watchkeeper (STCW Engineer Watchkeeper Unlimited).

Licensing/Regulatory Information

Legislative and regulatory requirements are applicable to this unit.

- Regulatory requirements include STCW International Maritime Organization (IMO) model course competencies and areas of knowledge, understanding and proficiency, together with the estimated total hours required for lectures and practical exercises. Teaching staff should note that timings are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability, equipment and staff available for training.

Near Coastal Qualifications:

- This unit is one of the requirements to obtain Australian Maritime Safety Authority (AMSA) certification as an Engineer Class 3 Near Coastal as defined in the Marine Order 505 (Certificates of competency - National Law) 2013.

Blue Waters Qualifications:

- This unit is one of the requirements to obtain Australian Maritime Safety Authority (AMSA) certification as an Electro-Technical Officer (STCW Electro-Technical Officer Unlimited) or Engineer Watchkeeper (STCW Engineer Watchkeeper Unlimited) and to meet regulatory requirements this unit must be delivered consistent with Marine Orders and with the relevant sections of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).

Pre-requisite Unit

Not applicable.

Competency Field

L - Engineering

Unit Sector

Not applicable.

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	Outline basic actions and functions of automation equipment in marine contexts	1.1	Basic concept of an automatic control system is explained using a simple block diagram, correct standard symbols and layout
		1.2	Components and operation of automatic control systems are outlined
		1.3	Relative advantages and disadvantages of different mediums used in shipboard automatic control systems are explained
2	Explain action of nozzle/flapper mechanism in pneumatic instruments	2.1	Principle of operation of nozzle/flapper as a pneumatic control system component is outlined
		2.2	Modifications required to make the simple nozzle/flapper mechanism suitable for use in process

			control systems are explained
3	Explain operating principles and application of sensing and transmitting elements	3.1	Different methods of measuring level in an unpressurised tank and in a closed pressurised vessel are sketched and outlined
		3.2	Applications at sea, advantages and disadvantages and temperature ranges of filled system thermometers are outlined
		3.3	Operating principles of resistance temperature detector and thermocouple are outlined
		3.4	Different methods for measuring flow onboard ships that are suited to remote indication and automatic control are identified
		3.5	Different methods for measuring pressure onboard a ship that are suited to remote indication and automatic control are identified
4	Explain function of controller element and associated hand/auto changeover station in an analogue control loop	4.1	Difference between 'OFF-ON' control action and fully modulating proportional control action is explained
		4.2	'Offset' and how it may be removed is explained
		4.3	Basic principles of operation of a simple pneumatic controller are

			outlined
		4.4	Action and function of hand/auto changeover station in an automatic control loop is explained using suitable schematic diagrams
5	Explain basic operating principles of electronic circuits and components	5.1	Components are identified and electronic circuit diagrams are interpreted
		5.2	Correct methods of testing electronic components are detailed
		5.3	Basic operation of operational amplifiers is outlined
6	Explain use of solid-state diodes and transistors to control monitoring and alarm systems	6.1	Basic concept of logic and operation of logic gates is outlined
		6.2	Operation of input/output devices and their application to sequential control systems are explained
7	Explain ‘fail safe’ philosophy and its implications for design and operation of main types of actuators available for operating final correcting elements	7.1	Purpose and function of a typical valve actuator and positioner are confirmed
		7.2	Constructional differences between typical ‘air-to-open’ and ‘air-to-close’ actuators are confirmed

		7.3	Why 'fail safe' may mean valves could either close, open, or remain where they are, upon failure of their associated automatic (or servo remote) operating system, is clarified
		7.4	Pneumatic piston actuator/positioner assembly used to move final correcting elements pneumatically is outlined
		7.5	Operating principles of electrical actuators are outlined
		7.6	Operation of a hydraulic steering gear actuator is compared and contrasted with valve actuator and positioner assemblies
8	Specify requirements for a pneumatic control system air supply	8.1	Standard specifications for cleanliness, moisture and oil content of a typical control air system are outlined
		8.2	Importance of ensuring that standards for cleanliness, moisture and oil content are maintained throughout operation of control air system is explained
		8.3	Typical system that is able to supply compressed air that meets required standards for cleanliness, moisture and oil content is outlined
9	Explain mechanisms for control of physical parameters in a ship's machinery	9.1	Typical control loops associated with centralised cooling systems that serve the cooling water system

	space		are sketched
		9.2	Function of typical loops required for control of temperature, pressure and viscosity of fuel supplies to main and auxiliary engines are outlined and sketched
		9.3	Typical pressure and temperature control loops associated with main and auxiliary engine lubricating oil services are sketched
		9.4	Function of components of typical control loops for the automatic control of boilers are outlined and sketched
		9.5	Location and reasons for alarms associated with remote and/or automatic machinery operation to be separate from control function are explained
		9.6	Tests and procedures required to meet unmanned machinery space (UMS) requirements are specified and different types of associated alarm and monitoring systems are evaluated
		9.7	Power output and control of a main propulsion diesel engine (slow speed two-stroke) and an electrical generator prime mover (high or medium speed four-stroke) are compared and contrasted
10	Explain schematically total bridge control of a commercial vessel	10.1	Engine manufacturer schematic diagram is interpreted and how total bridge control may be

	achieved to manoeuvre and control the engine is explained
10.2	Safety interlocks in sequence of operation depicted in schematic diagram are identified and why they are required is explained
10.3	Location of engine control positions, apart from the bridge, is identified from schematic diagram
10.4	Why bridge control is preferred option for manoeuvring main engine in modern commercial vessels is explained

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

This unit replaces and is equivalent to MARL005 Demonstrate basic knowledge of marine control systems and automation.

Links

Companion Volume implementation guide can be found in VetNet - <https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>

Assessment Requirements for MARL056 Demonstrate basic knowledge of marine control systems and automation

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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:

- accessing information and sketching diagrams to interpret and explain testing requirements related to control systems on commercial vessels
- assessing own work outcomes and maintaining knowledge of current codes, standards, regulations and industry practices
- explaining basic principles of marine automation and process control
- identifying and interpreting numerical and graphical information, including schematic diagrams, relevant to control systems on commercial vessels
- identifying and suggesting ways of rectifying faults and malfunctions in control systems on commercial vessels
- identifying methods, procedures and materials needed to operate and maintain control systems on commercial vessels
- imparting knowledge and ideas through verbal, written and visual means
- providing accurate and reliable information
- providing appropriate level of detail in responses
- reading and interpreting written information related to the operation of control systems on commercial vessels.

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:

- basic control engineering, including:
 - fundamentals of automatic control
 - ON-OFF control
 - proportional-integral-derivative (PID) control
 - sequential control
 - various automatic control
- basic electronics, including:
 - basic electronic circuit elements:

- diodes
- integrated circuit (IC) and large-scale integrated circuit (LSIC)
- semiconductor
- thyristor
- electron theory
- electronic control equipment
- flowchart for automatic and control systems
- characteristics and functions of temperature, pressure and viscosity of fuel
- components, including:
 - actuators
 - responders
 - sensors
- concept of 'fail safe' philosophy
- concepts of unmanned machinery space (UMS), and automated monitoring and control of machinery
- control and monitoring of ship machinery
- control loops
- electronics and power electronics, including:
 - amplifiers
 - analogue and DC power supplies
 - cyclo-converters
 - MSI onverters
 - power electronic converters
 - rectifiers
 - stabilisers
 - transistors
- fundamentals of automatic control
- instrument process and control terms
- measurement of process value, including:
 - flow
 - general measurement of processes
 - level, including direct methods and inferential methods
 - pressure
 - temperature, including mechanical and electrical
- mechanical and electrical sensors
- mediums, including:
 - compressed air
 - electric currents
 - electric voltages
 - hydraulic fluids

- ON-OFF control
- pneumatic and electrical instrumentation transmitters
- preparation, operation, fault detection and necessary measures to prevent damage for machinery items and control systems
- principles of:
 - basic electronic circuits
 - basic pneumatic systems and action of pneumatic instruments
 - process control
- relevant industry standards for drawing symbols/layouts for schematic diagrams
- safety and emergency procedures for operation of propulsion plant machinery, including control systems
- safety devices, alarms and monitoring systems
- sensing and transmitting elements
- sequential control
- tests and procedures required to meet UMS requirements
- total bridge control
- transmission of signals, including:
 - controlling elements, including pneumatic
 - transmitters
- various automatic controls
- work health and safety (WHS)/occupational health and safety (OHS) legislation, policies and procedures.

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.

Practical assessment must occur in a workplace, or realistic simulated workplace, under the normal range of workplace conditions.

Simulations and scenarios may be used where situations cannot be provided in the workplace or may occur only rarely, in particular for situations relating to emergency procedures and adverse weather conditions where assessment would be unsafe, impractical or may lead to environmental damage.

Resources for assessment must include access to:

- applicable documentation, such as legislation, regulations, codes of practice, workplace procedures and operational manuals
- tools, equipment, machinery, materials and relevant personal protective equipment (PPE)

currently used in industry.

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