



Australian Government

MARL005 Demonstrate basic knowledge of marine control systems and automation

Release: 1

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Modification History

Release 1. New unit of competency.

Application

This unit involves the 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 as a Marine Engineering Watchkeeper on commercial vessels greater than 750 kW or as an Engineer Class 3 Near Coastal.

This unit has links to legislative and certification requirements.

Pre-requisite Unit

Not applicable.

Competency Field

L - Marine Engineering

Unit Sector

Not applicable.

Elements and 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 Australian 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	2.1	Principle of operation of nozzle/flapper as a pneumatic control system component is outlined

	mechanism in pneumatic instruments	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 on board ships that are suited to remote indication and automatic control are identified
		3.5	Different methods for measuring pressure on board 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 change over 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 space	9.1	Typical control loops associated with centralised cooling systems that serve the cooling water system 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

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

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

Range of Conditions

Specifies different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

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

Components include one or more of the following:

- actuators
- responders
- sensors

Mediums include one or more of the following:

- compressed air
- electric currents
- electric voltages
- hydraulic fluids

Unit Mapping Information

This is a new unit. This unit is equivalent to MARL5007A Demonstrate basic knowledge of marine control systems and automation.

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 MARL005 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:

- Australian Standards for drawing symbols/layouts for schematic diagrams
- characteristics and functions of temperature, pressure and viscosity of fuel
- concept of 'fail safe' philosophy
- concepts of machinery space (UMS), and automated monitoring and control of machinery
- control and monitoring of ship machinery
- control loops
- instrument process and control terms
- mechanical and electrical sensors
- pneumatic and electrical instrumentation transmitters
- principles of:

- process control
- basic pneumatic systems and action of pneumatic instruments
- basic electronic circuits
- safety devices, alarms and monitoring systems
- sensing and transmitting elements
- tests and procedures required to meet UMS requirements
- total bridge control
- work health and safety (WHS)/occupational health and safety (OHS) legislation, policies and procedures.

Assessment Conditions

Assessors must satisfy National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) assessor requirements.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated workplace operational situations that reflect workplace conditions.

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.

Resources for assessment must include access to:

- tools, equipment, machinery, materials and personal protective equipment currently used in industry
- applicable documentation such as legislation, regulations, codes of practice, workplace procedures and operational manuals
- range of relevant exercises, case studies and/or simulations.

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