Australian Government

MARL5007A Demonstrate basic knowledge of marine control systems and automation

Release 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MARL5007A Demonstrate basic knowledge of marine control systems and automation

Modification History

Release 1
This is the first release of this unit.

Unit Descriptor

This unit involves the knowledge of marine automation and process control required engineers to operate control systems on board a commercial vessel.

Application of the Unit

This unit applies to Marine Engineering Watchkeepers on commercial vessels greater than 750 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Watchkeeper issued by the Australian Maritime Safety Authority (AMSA).

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

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 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 covered 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 positioned is 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

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required Skills:

- Access information and sketch diagrams to interpret and explain testing requirements related to control systems on commercial vessels
- Assess own work outcomes and maintain knowledge of current codes, standards, regulations and industry practices
- Explain basic principles of marine automation and process control
- Identify and interpret numerical and graphical information, including schematic diagrams, relevant to control systems on commercial vessels
- Identify and suggest ways of rectifying faults and malfunctions in control systems on commercial vessels
- Identify methods, procedures and materials needed to operate and maintain control systems on commercial vessels
- Impart knowledge and ideas through verbal, written and visual means
- Read and interpret written information related to the operation of control systems on commercial vessels

Required Knowledge:

- 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 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

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, the required skills and knowledge, the range statement and the Assessment Guidelines for the Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the Elements, Performance Criteria, Required Skills, Required Knowledge and include:

- providing accurate and reliable information
- providing appropriate level of detail in responses.

Context of and specific resources for assessment

Performance is demonstrated consistently over time and in a suitable range of contexts.

Resources for assessment include access to:

- industry-approved marine operations site where basic knowledge of marine control systems and automation can be demonstrated
- technical reference library with current publications on automation and process control
- tools, equipment and personal protective equipment currently used in industry
- relevant regulatory and equipment documentation that impacts on work activities
- range of relevant exercises, case studies and/or other simulated practical and knowledge assessments
- appropriate range of relevant operational situations in the workplace.

In both real and simulated environments, access is required to:

- relevant and appropriate materials and equipment
- applicable documentation including workplace procedures, regulations, codes of practice and operation manuals.

Method of assessment

Practical assessment must occur in an:

- appropriately simulated workplace environment and/or
- appropriate range of situations in the workplace.

A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate to this unit:

- direct observation of the candidate demonstrating basic knowledge of marine control systems and automation
- direct observation of the candidate applying relevant WHS/OHS requirements and work practices.

Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. In all cases where practical assessment is used it should be combined with targeted questioning to assess Required Knowledge. Assessment processes and techniques must be appropriate to the language and literacy requirements of the work being performed and the capacity of the candidate.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below.

Components may include:	• Actuators • Responders • Sensors
Mediums may include:	• Compressed air • Electric currents • Electric voltages • Hydraulic fluids

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering