Australian Government

MARL032 Demonstrate advanced knowledge of marine control systems and automation

Release: 1

MARL032 Demonstrate advanced knowledge of marine control systems and automation

Modification History

Release 1. New unit of competency.

Application

This unit involves the skills and knowledge required to operate control systems on board a commercial vessel. It includes basic knowledge of control theory and knowledge required to analyse the operation and performance of signal transmissions systems, electronic transmitters, final control element arrangements, electronic temperature sensors and transmitters, governors, PID electronic controllers, machinery space monitoring alarm and control systems.

It also includes knowledge of fault finding techniques for control systems, measurement and test equipment used for fault finding electronic apparatus, operational applications of analogue and digital programmable logic controllers, and procedures for programming, operating, and maintaining PLC controlled systems.

This unit applies to the work of a Marine Engineer Class 1 on commercial vessels of unlimited propulsion power and forms part of the requirements for the Certificate of Competency Marine Engineer Class 1 issued by the Australian Maritime Safety Authority (AMSA).

No licensing, legislative or certification requirements apply to this unit at the time of publication.

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 Explain control	1.1 Time lag is distinguished from time constant

	theory	1.2	Effect resistance and capacitance has on process system response is demonstrated
		1.3	Transfer function is established and defined
		1.4	Effect of variations in undamped natural frequency on control systems is illustrated
2	**Analyse signal transmissions systems used for monitoring, controlling and shutting down machinery**	2.1	Methods and limitations of different signal transmissions systems are compared
		2.2	Standard pneumatic system and standard analogue 4-20 mA system of signal transmission are compared and contrasted
		2.3	System of a communications bus using digital signal transmission with optical and electronic systems is explained
		2.4	Limitations and advantages of a communications bus system are analysed
3	**Analyse electronic transmitters**	3.1	Principles of operation of a typical 4-20 mA transmitter are explained
		3.2	Application of strain gauges and changes in capacitance as sensors for pressure and differential pressure transmitters are outlined
		3.3	Methods of testing transmitter outputs are recorded explained
		3.4	Application of differential pressure transmitters to liquid level sensing is analysed
		3.5	Use of a differential pressure transmitter to measure flow is analysed and compared with non-restrictive electronic systems
4	**Evaluate final control element arrangements**	4.1	Pneumatic, electric and hydraulic actuation are compared and contrasted
		4.2	Arrangements for locking pneumatic control valves in their last position on air failure are outlined
		4.3	Control valve trim characteristics are explained
		4.4	Control valve selection for machinery space duties are analysed
5	**Evaluate electronic temperature sensors**	5.1	Colour coding of tails and compensating cables for thermo couple types are identified

	and transmitters	5.2	Temperature/mV outputs and application of common thermo couple types are illustrated
		5.3	Relationship between resistance and temperature for PT100 resistance temperature device and method of testing three wire arrangements is explained
		5.4	Arrangements of interfacing thermo couples and RTDs with 4-20ma systems and 1-5 volt interface cards are analysed
6	**Analyse PID electronic controllers**	6.1	Principle of operation of an electronic analogue 3-term controller and how adjustments are made is explained
		6.2	Open loop response and PID controller testing and calibration is demonstrated
		6.3	Application of modern single loop digital controller is explained
		6.4	Programming requirements for manual and auto tuning when adjusting digital controllers are demonstrated
7	**Evaluate performance of machinery space monitoring alarm and control systems**	7.1	Capacitance sensing and float level monitoring systems are compared
		7.2	Single, two and three element boiler water level control systems involving feedwater and cascade systems are analysed
		7.3	Requirements and systems to provide advanced combustion control systems and sequential control for burner management are outlined
		7.4	Concepts and arrangements for central cooling and load dependent cooling control systems are explained
		7.5	Main engine control arrangements for fixed pitch propeller and CPP systems requiring sequential control are analysed
		7.6	Tests and procedures to meet UMS requirements are explained, and alarm and monitoring systems involving data loggers, alarm print outers, and trend analysis are evaluated
8	**Explain fault-finding techniques for control systems**	8.1	Governor adjustments are demonstrated and effect of incorrect adjustments is explained
		8.2	Common defects in mechanical and electronic governors are itemised

	8.3	Indication of faults and procedures of fault finding in 4-20mA loops are explained
	8.4	Fault-finding techniques in pneumatic control systems and their respective components are analysed
	8.5	Fault-finding flow diagram is illustrated
	8.6	Off limit performance, fault detection and principles of rectifications for common engine room control systems are evaluated
9 Analyse measurement and test equipment used for fault-finding electronic apparatus	9.1	Principles of operation of cathode ray oscilloscope are explained
	9.2	Need for pulse shaping in electronics is examined
	9.3	Different methods of testing common alarms systems are compared
	9.4	Methods used in stabilisation, surveillance and monitoring of control power supplies are demonstrated
10 Analyse governors	10.1	Governor faults are diagnosed and interpreted, identifying and evaluating appropriate adjustments and maintenance to be made
	10.2	Specific governor applications requiring torque limitation, critical speed range avoidance are outlined
	10.3	Typical electronic governors are explained using labelled diagrams to indicate major components and features
	10.4	Governor adjustments to allow operation of propulsion and power generation diesels in both shared load and standalone applications are specified
	10.5	Response of a diesel engine governor on change in engine load using both feedback and feed forward control is explained using labelled diagrams to indicate major components and adjustments
11 Explain operational applications of analogue and digital programmable logic controllers (PLC)	11.1	Methods of programming PLCs are assessed
	11.2	Memory applications of PLCs are outlined
	11.3	Input devices used with analogue PLCs are identified
	11.4	Fibre optic data transmission systems are explained

	11.5 Methods used for storing binary data and operating registers are explained
12 Document procedures for programming, operating and maintaining PLC controlled systems	12.1 Procedure for identifying required control system functions are explained
	12.2 Procedure for connecting PLC to system control elements is outlined
	12.3 System operating procedure is outlined
	12.4 Procedure for modifying system and program as necessary to provide adequate and appropriate safety requirements, is outlined
	12.5 Maintenance and fault-finding procedures are outlined
	12.6 Required documentation is prepared and accuracy is verified

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.

Methods of testing transmitter outputs include one or more of the following:	• MA test point • MV test point • no test points
Faults must include:	• earths • electronic component failure • high resistance joints • open circuits • power supply faults • short circuits
Governor adjustments	• mismatching between prime mover types and responses

must include:

Unit Mapping Information

This unit replaces and is equivalent to MARL6019A Demonstrate advanced 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