



Australian Government

MARL6013A Demonstrate intermediate knowledge of marine control systems and automation

Release 1

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Modification History

Release 1

This is the first release of this unit.

This unit replaces and is equivalent to TDMMB4207A Test, detect faults and maintain and restore electronic control equipment to operating condition on vessels over 750 kW propulsion power.

Unit Descriptor

This unit involves the skills and knowledge required to operate control systems on board a commercial vessel.

Application of the Unit

This unit applies to the work of a Marine Engineer Class 2 on commercial vessels greater than 3000 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Class 2 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

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| 1 Analyse open and closed loop systems | 1.1 Open loop systems are distinguished from closed loop systems |
| | 1.2 Closed loop manual, time based automatic open loop and feed forward open loop are explained |
| 2 Explain principles and operation of pneumatic control element and systems | 2.1 Operation of a nozzle flapper and pneumatic amplifier unit is analysed and applied to transmitters, basic controllers and valve positioners |
| | 2.2 Control air supply system is defined |
| | 2.3 Principle of operation of direct and reverse acting pneumatic relays and application is clarified |
| | 2.4 Application of computing relays is analysed |
| 3 Compare temperature transmitters | 3.1 Pneumatic temperature transmitter is defined |
| | 3.2 Effect of changes in ambient temperature on thermocouples and RTDs is explained |
| | 3.3 Testing procedures and methods of simulation for both RTDs and thermocouples are explained |
| | 3.4 Characteristics and application of thermistors are outlined |
| 4 Analyse application of differential pressure transmitters | 4.1 Application of differential pressure transmitters on board ships is confirmed |
| | 4.2 Arrangements of differential pressure transmitters for measurement of liquid levels in both closed and open tanks are explained |
| | 4.3 Mechanics for viscosity measurement using a differential pressure transmitter are analysed |
| | 4.4 Principle of using a differential pressure transmitter for flow measurement and the need for a square root extractor is explained |
| | 4.5 Use of a differential pressure transmitter for flow measurement is compared and contrasted |

- with other types of *meters*
- 5 Explain engine room monitoring systems**
- 5.1 Application of different speed sensing systems is analysed
 - 5.2 Operating principles of torque monitoring systems applied to propeller shafting are explained
 - 5.3 Arrangements of shaft power and indicated power monitoring are compared
 - 5.4 Horizontal and vertical float level systems are compared with other tank level monitoring system in common use
 - 5.5 Operating principle of oil-water interface sensor is explained
 - 5.6 Methods of bearing temperature monitoring applied to diesel engine rotating parts are outlined
 - 5.7 Machinery space monitoring and alarm system from a central control room are outlined
- 6 Explain procedure for transmitter calibration**
- 6.1 Procedure for transmitter calibration for both pneumatic and electronic transmitters is applied
 - 6.2 Test equipment is used for transmitter calibration
 - 6.3 Relationship between process variables and output signals is demonstrated in a graph
 - 6.4 Effects of transmitter dead band are defined
- 7 Explain operation of pneumatic 3-term controller and controller adjustment procedures**
- 7.1 Common controller actions and applications are outlined
 - 7.2 Operating principle of pneumatic 3-term controllers is outlined
 - 7.3 Procedure for adjusting 3-term pneumatic controllers is applied and effects if incorrectly adjustment are explained
 - 7.4 Typical controller settings for a PID controller are detailed

- 7.5 Integrated hand/auto station and 3-term controller are outlined and bumpless transfer is demonstrated
- 8 Explain actuators and control valves**
 - 8.1 Arrangements to provide fail safe requirements are outlined
 - 8.2 Control valve and actuator are explained
 - 8.3 Different *types of actuators* are identified
 - 8.4 Operating principle of pneumatic valve positioners is explained
- 9 Analyse operation of hydraulic governors**
 - 9.1 Operating principle of proportional action hydraulic governors is explained
 - 9.2 Importance of spring stiffness in relation to response is clarified
 - 9.3 Purpose of an isochronous governor is outlined
 - 9.4 Principle of operation of an isochronous hydraulic governor is outlined
 - 9.5 Governor droop and its requirements for stable load sharing and engine stability is explained
- 10 Interpret electronic systems circuit diagrams**
 - 10.1 Electrical symbols commonly used in electronic circuits and sub-circuits are defined
 - 10.2 Printed and colour codes used in electronic circuits are defined
 - 10.3 Operation and maintenance manuals commonly used in the fault finding electronic circuits are used correctly
- 11 Explain basic operation of programmable logic controllers**
 - 11.1 Principles and operation of integrated circuit gates are explained
 - 11.2 Operational function of input/output devices connected to a digital programmable logic controller is detailed
 - 11.3 Methods of operation of flip flops, adders, counters, multiplexers and decoders are outlined

- 11.4 Methods employed when changing set point values in a digital programmable logic controller are outlined
- 12 Explain typical machinery space control loops and unmanned machinery spaces requirements**
 - 12.1 Fuel oil heating, LO cooling and JW cooling loop showing cascade and split range systems are outlined
 - 12.2 Fuel oil viscosity control loop is outlined
 - 12.3 Common methods of boiler water control and simple combustion control with burner management for an auxiliary boiler are outlined
 - 12.4 Requirements and system arrangements for bridge control of main propulsion machinery including change over from local to bridge are explained
 - 12.5 Common pressure control loops found in a ship's engine room are identified
 - 12.6 Unmanned machinery spaces (UMS) requirements are outlined
 - 12.7 Troubleshooting procedures associated with control systems are outlined
 - 12.8 Procedures for software version control are outlined

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 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 operate control systems on commercial vessels

Required Knowledge:

- Actuators and control valves
- Australian standards for drawing symbols/layouts for schematic diagrams
- Bridge control systems
- Concepts of UMS and automated monitoring and control of machinery
- Control and monitoring of ship machinery
- Differential pressure transmitters
- Electronic systems circuit diagrams
- Engine room monitoring systems
- Machinery space control loops and UMS requirements
- Mechanical and electrical sensors
- Open and closed loop systems
- Operation of hydraulic governors
- Operation of pneumatic 3-term controller and controller adjustment procedures
- Operation of programmable logic controllers
- Pneumatic and electrical instrumentation transmitters
- Principles and operation of pneumatic control element and systems
- Principles of basic pneumatic systems and action of pneumatic instruments
- Principles of process control

- Temperature transmitters
- Tests and procedures required to meet UMS requirements
- Total bridge control
- Transmitter calibration
- 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 intermediate 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 intermediate 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.

Meters may include:

- Area meter
- Rotometer
- Target meter

Types of actuators may include:

- Electric
- Hydraulic
- Pneumatic

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering