



Australian Government

Department of Education, Employment and Workplace Relations

**TDMMB4007A MANAGE THE TESTING,
DETECTION OF FAULTS,
MAINTENANCE AND RESTORATION
OF ELECTRONIC CONTROL
EQUIPMENT TO OPERATING
CONDITION ON VESSELS OF
UNLIMITED PROPULSION POWER**

Release: 1



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Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required by a Chief Engineer to manage the testing, detection of faults, maintenance and restoration of electronic control equipment to operating condition on a commercial vessel powered by main propulsion machinery of unlimited propulsion power. This includes the management and coordination of relevant maintenance and fault finding activities and the application of advanced diagnostic and problem solving techniques to maintenance procedures.

Note: All installation, servicing and repair of AC (50 volts or above) or DC (above 115 volts) must be carried out only by a suitably qualified engineer or licensed tradesman. Relevant State/Territory electrical licensing requirements must be fulfilled by any persons carrying out installation, servicing and repair of electrical circuits and systems at such voltages on a vessel.

Application of the Unit

Application of the unit	The unit has application in qualifications for Chief Engineer on a vessel of unlimited propulsion power operating in international waters, i.e. Advanced Diploma of Transport&Distribution(Marine Engineering Class 1).
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Licensing/Regulatory Information

Licensing/legislative requirements	The unit is consistent with the relevant sections of STCW 95 and Marine Orders under the Australian Navigation Act, describing requirements for a Chief Engineer on a vessel of unlimited propulsion power operating in international waters.
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Pre-Requisites

Not applicable.

Employability Skills Information

Not applicable.

Elements and Performance Criteria Pre-Content

<i>Elements describe the essential outcomes of a unit of competency.</i>	<i>Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.</i>
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1 Manage the detection, identification and investigation of electronic equipment malfunctions and faults	a The detection, identification and investigation of malfunctions and faults in shipboard electronic equipment is correctly coordinated and managed b The operation of shipboard electronic equipment is monitored in accordance with vessel's survey requirements, planned maintenance requirements and manufacturer's instructions and performance is compared with specifications and recommended limits of performance c Out of specification performance and faults are identified as per marine practice

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ELEMENT	PERFORMANCE CRITERIA
1 Manage the detection, identification and investigation of electronic equipment malfunctions and faults (continued)	- d Advanced diagnostic techniques are used to investigate poor performance and faults, and appropriate action is initiated to rectify the identified - e Appropriate action is taken to prevent damage/failure in accordance with vessel's planned maintenance system or procedures, established marine engineering practice, safety regulations and manufacturer's instructions - f Faulty equipment and components are identified and are reported and action is initiated as required for isolation, tagging and repair or replacement as per company procedures and established marine engineering practice - g Decisions are made to carry out temporary or permanent repairs depending on the vessel's position and circumstances - h Appropriate consultation is undertaken with classification society and marine administration concerning the nature of the repairs and any contingency or emergency action required - i Management of the repair processes and the organisation and control of engine room personnel to facilitate repairs is in accordance with company procedures and established marine engineering practice
2 Manage the repair of faults in electronic equipment	- a Investigation of identified faults in shipboard electronic equipment is managed in accordance with the scope of responsibilities of a Chief Engineer - b Malfunctioning or faulty electronic equipment is correctly isolated, disassembled, if necessary, in accordance with manufacturer's instructions and established marine engineering practice

ELEMENT	PERFORMANCE CRITERIA
	c Damaged or faulty components are repaired or replaced in accordance with company planned maintenance system procedures, manufacturer's instructions and established marine engineering practice d Repaired electronic equipment is reassembled in accordance with manufacturer's instructions and established marine engineering practice e Repaired electronic equipment is tested and adjusted in accordance with vessel's procedures and manufacturer's instructions and in consultation with relevant personnel f Repaired electronic equipment and associated safety devices, control systems and alarms are restarted/reactivated and their performance tested in accordance with manufacturer's instructions g Tests are conducted to the requirements of class and statutory surveys h Performance against recommended performance specifications is confirmed and the electronic equipment is recommissioned in accordance with vessel's procedures and established marine electrical/electronic practice

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ELEMENT	PERFORMANCE CRITERIA
3 Complete maintenance and repair documentation	a Correct records are made relating to maintenance and repair operations and equipment failure incidents b All planned maintenance system and repair documentation is completed in accordance with survey and company requirements and regulations

ELEMENT	PERFORMANCE CRITERIA
4 Follow safety and hazard control procedures	- a Tests, inspections and repairs of vessel's electronic equipment and associated safety devices, control systems and alarms are conducted in accordance with safety regulations and company procedures - b Maintenance and repair hazards are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment - c Safety, hazard minimisation and pollution control procedures and national and international regulations are followed at all times during maintenance and repair operations - d Where relevant, procedures and precautions necessary for entry into confined spaces on a vessel are correctly followed - e Action is taken in the event of an electronic equipment failure or emergency to isolate and secure the electronic equipment and the vessel and maintain the safety of the vessel and persons involved - f Shipboard emergency and contingency plans are followed in the event of an electronic equipment failure or emergency

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Required Skills and Knowledge

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

- 1 National and international regulations, IMO Conventions and Codes, including AMSA Marine Orders applicable to the management of shipboard electronic equipment maintenance and repair operations on vessels of unlimited propulsion power
- 2 Relevant OH&S legislation, policies and procedures
- 3 Established engineering practice for the checking, maintenance and repair of marine electronic equipment, systems and equipment
- 4 Operational characteristics and performance specifications for the different types of shipboard electronic equipment usually found on a vessel of unlimited propulsion power
- 5 Advanced diagnostic techniques for carrying out testing, troubleshooting and repair of shipboard electronic equipment as part of maintenance procedures to ensure compliance with the company and survey requirements and established safety rules and regulations
- 6 Procedures for coordinating the overall management of planned maintenance systems and procedures for the condition monitoring of electronic equipment, including responsibilities and requirements covered by various forms of vessel survey
- 7 The nature and causes of typical shipboard electronic equipment malfunctions and the available methods for their detection and repair, including marine electronic equipment malfunction fault finding techniques
- 8 Advanced diagnostic and repair techniques for carrying out shipboard electronic equipment testing, troubleshooting and repair as part of routine maintenance procedures to ensure compliance with the company and survey requirements and established safety rules and regulations

REQUIRED KNOWLEDGE

- 9 Procedures for the initiation and coordination of temporary and permanent repair and/or replacement procedures for electronic equipment on board vessels at sea, alongside and in dry dock
- 10 An understanding of the power distribution and control circuits typically used on board a vessel of unlimited propulsion power and their associated operational electronic equipment
- 11 Concepts of unmanned machinery spaces (UMS) and automated monitoring and control of machinery
- 12 Principles and techniques for finding faults in shipboard control systems
- 13 Procedures for the calibration and adjustment of transmitters and controllers in control systems
- 14 Elementary programming and program modification for programmable logic controllers (PLCs), including principles and applications
- 15 Common active devices and their application in power and electronic circuits typically used on vessels of 3,000 kW propulsion power or more, including:
 - a ability to identify the devices and their circuit symbols
 - b operating characteristics of common active devices
 - c applications of common active devices

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- 16 Common integrated circuit devices and their application in shipboard electronic instrumentation and power supply circuits, including:
 - a operational amplifiers
 - b voltage regulators
 - c multivibrators

- 16 Common integrated circuit devices and their application in shipboard electronic instrumentation and power supply circuits, including:
- 17 Common digital electronic circuits and their application in shipboard electronic instrumentation systems, including:
 - a digital integrated circuits
 - b analogue to digital converters
 - c microprocessors
 - d digital communication bus transmission system using optical and electronic subsystems
- 18 Principles and procedures for electronic measurement, including the use of oscilloscopes and multimeters, and insulation resistance measurement using a Megger
- 19 Procedures for diagnosing and repairing faults in 4 to 20 mA loops, including:
 - a open and short circuits
 - b earth faults
 - c high resistance joints
 - d power supply faults
 - e electronic component failure
- 20 Principles of electrotechnology, marine electrical practice and marine automation and control relevant to detection, identification and repair of faults, including
 - a electromagnetism and electrostatics
 - b electrolytic action and cells
 - c the electrical circuit
 - d theory and calculations of AC and DC machines and related electronic control equipment
 - e control and switch gear
 - f deck electronic equipment
 - g theory and setting/tuning of two and three term controllers, including microprocessors

- 16 Common integrated circuit devices and their application in shipboard electronic instrumentation and power supply circuits, including:
- 21 principles, calculations and diagnostics for shipboard electronic components and systems, including:
 - a electronics principles
 - b integrated circuits, microprocessors and PLCs

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- c process control theory
- d instruments, calibration and testing
- e electronic control, surveillance, measurement and recording systems
- f telemetering devices
- g alarm systems, including fire and emergency alarm systems

c process control theory

- 22 Maintenance and repair records that must be maintained on a vessel to meet the requirements of the company, survey requirements and regulatory authorities
- 23 Maritime communication techniques needed during maintenance and repair operations
- 24 Maintenance and repair hazards and problems and appropriate preventative and remedial action and solutions during maintenance and repair of shipboard electronic equipment
- 25 Safety, environmental and hazard control precautions and procedures relevant to shipboard electronic equipment inspection and maintenance operations
- 26 Safe procedures for the use of hand and power tools and maintenance equipment and for handling heavy electronic equipment and component parts during maintenance and repair of shipboard electronic equipment

REQUIRED SKILLS

This describes the basic skills required for this unit.

- 1 Communicate effectively with other personnel when managing the testing, detection of faults, maintenance and restoration of electronic equipment
- 2 Interpret and follow procedures for the testing and maintenance of electronic equipment and systems
- 3 Read and interpret electronic equipment performance readings and instrumentation
- 4 Read and interpret material safety data sheets
- 5 Read and interpret vessel and electronic equipment specifications, equipment drawings, operational manuals, and electrical circuit diagrams.
- 6 Provide leadership to other shipboard personnel when managing the testing and maintenance of electronic control equipment and systems
- 7 Solve problems that can occur when managing the testing and maintenance of electronic control equipment and systems, take appropriate remedial action, and initiate appropriate solutions
- 8 Carry out calculations required when managing the testing and maintenance of electronic equipment and systems
- 9 Adapt to differing types of electronic control equipment and systems from one

- c process control theory
 - vessel to another and when equipment and systems are changed
- 10 Coordinate the selection and use of tools and equipment required for the testing and maintenance of electronic control equipment and systems

Evidence Guide

Evidence Guide

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The Evidence Guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

1 Critical aspects of evidence required to demonstrate competency in this unit	Assessment must confirm appropriate knowledge and skills to: - a Manage maintenance activities - b Monitor the performance of shipboard electronic equipment against specifications on a vessel of unlimited propulsion power - c Manage the identification of malfunctioning and faulty electronic equipment and components and initiate appropriate action for repair or replacement - d Apply advanced diagnostic techniques to the troubleshooting of malfunctioning and faulty electronic equipment and carry out required repairs in accordance with established marine engineering practice - e Exercise all required safety, environmental and hazard control precautions and procedures when overseeing the operation, maintenance and repair of shipboard electronic equipment - f Identify typical electronic equipment maintenance and repair problems and hazards and take appropriate action
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	- g Communicate effectively with others during maintenance and repair operations, including effective use of internal communication systems - h Ensure adherence to national and international regulations, IMO Conventions and Codes
2 Evidence required for demonstration of consistent performance	- a Performance is demonstrated consistently over a period of time and in a suitable range of contexts - b Consistently applies underpinning knowledge and skills when: 1 assessing operational performance of shipboard electronic equipment 2 managing the identification of shipboard electronic equipment malfunctions and faulty plant and equipment of a vessel of unlimited propulsion power 3 taking action to minimise any damage and safety risk that could be caused by electronic equipment malfunctions 4 managing, training and controlling personnel and carrying out repairs of shipboard electronic equipment 5 identifying and evaluating electronic equipment maintenance and repair problems and determining appropriate courses of action

Evidence Guide (continued)

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2 Evidence required for demonstration of consistent performance (continued)	6 identifying and implementing improvements to electronic equipment checking, maintenance and repair procedures 7 applying safety precautions relevant to electronic equipment maintenance and repair operations 8 completing maintenance and repair documentation and records
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	- c Shows evidence of application of relevant workplace procedures, including 1 relevant sections of international Conventions and Codes and AMSA Marine Orders 2 OH&S regulations and hazard prevention policies and procedures 3 ISM Code safety management system procedures, quality procedures and work instructions on the checking and repair of shipboard electronic equipment, including electronic equipment specifications and directions on equipment capability and limitations 4 following on-board housekeeping processes - d Action is taken promptly to report and/or rectify electronic equipment malfunctions, non-conformities, accidents, hazardous occurrences and safety incidents in accordance with statutory requirements, company procedures and the ISM Code - e Work is managed, controlled and completed systematically with required attention to detail - f Recognises and adapts appropriately to cultural differences in the workplace, including modes of behaviour and interactions among crew and others
3 Context of assessment	- a Assessment of competency must comply with the assessment requirements of the relevant maritime regulations - b Assessment of this unit must be undertaken within relevant marine authority approved and audited arrangements by a registered training organisation: 1 As a minimum, assessment of knowledge must be conducted through appropriate written/oral examinations, and 2 Appropriate practical assessment must occur: - i at the registered training organisation; and/or - ii on an appropriate working or training vessel

Evidence Guide (continued)

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4 Specific resources required for assessment

Access is required to opportunities to:

- a participate in a range of practical and theoretical assignments, exercises, case studies, simulated fault situations and other assessments that demonstrate the skills and knowledge to check and repair electronic equipment typically found on a vessel of unlimited propulsion power, including the ability to identify an appropriate range of possible electronic equipment malfunctions and carry out related maintenance and repair solutions; and/or
- b carrying out checks and related repairs of shipboard electronic equipment in a range of operational situations on a commercial or training vessel of unlimited propulsion power

Range Statement

Range Statement

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The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

VARIABLE

SCOPE

1. GENERAL CONTEXT

a. Work must be carried out:	1 in compliance with relevant maritime regulations and codes, including AMSA Marine Orders
b. Work is performed:	1 relatively independently under broad operational requirements, with accountability and responsibility for self and others in achieving the prescribed outcomes
c. Work involves:	1 the application of marine engineering practice and advanced diagnostic techniques to the repair of electronic control equipment typically found on a vessel of unlimited propulsion power across a wide and often unpredictable variety of equipment malfunctions or faults. Contribution to the development and implementation of a broad plan or strategy for the maintenance and repair of shipboard electronic control equipment is required and accountability and responsibility for self and others in achieving the outcomes is involved
d. Work requires:	1 significant judgement in planning, engineering and leadership functions related to electronic equipment repair operations and procedures. This includes management training and control of personnel, hazard minimisation, analysis of situations and decision making

2. WORKSITE ENVIRONMENT

a Shipboard electronic control equipment may include:	1 that typically found on any Australian or international commercial vessel of unlimited propulsion power
b Performance monitoring and repair of shipboard electronic control equipment may	1 by day or night in both normal and emergency situations 2 under any permissible conditions of weather 3 while underway 4 during berthing and unberthing operations

be carried out:

Range Statement (continued)

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VARIABLE	SCOPE
b Performance monitoring and repair of shipboard electronic control equipment may be carried out: (continued)	5 while anchored or moored 6 in dry dock
c Types of electronic control equipment may include:	1 programmable logic controllers (PLCs) 2 signal transmission systems used for monitoring and control 3 temperature and pressure sensors 4 electronic PID controllers 5 analogue to digital converters 6 electronic equipment space monitoring alarm and control systems 7 electronic instrumentation and power supply circuits
d Testing and repair equipment may include:	1 electronic instrumentation meters and gauges, oxygen meters and gas detectors 2 CRO and computer displays of performance parameters 3 hand tools, such as soldering irons, pliers, cutters, wire strippers, spanners, wrenches, screwdrivers, hacksaws, etc. 4 electric and pneumatic power tools, such as drills, etc.

	5 material safety data sheets
	6 protective clothing and equipment such as:
	a eye and ear protection
	b safety boots
	c dust and fume masks
	d boilersuit/overalls
	e safety helmet
e Maintenance and repair hazards may include:	1 exposed live circuits
	2 faulty earth connections
	3 moving heavy loads in an unsafe work environment

Range Statement (continued)

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e Maintenance and repair hazards may include: (continued)	4 unsecured electronic equipment, components or repair equipment
	5 sharp tools and implements
	6 power tools
	7 moving and rotating electronic equipment
	8 faulty equipment, handling equipment and lifting gear
	9 using equipment beyond safe working limits
	10 poor housekeeping procedures
	11 non-compliance with safe working procedures
	12 electrical wiring and systems
	13 hot pipes and valves (steam, fuel oil, lubricating oil)

	14 cold pipes and valves (refrigeration and liquefied gas cargoes) 15 working at heights 16 overspeed of electrical machinery, emergency trips 17 noxious and dangerous cargoes
f Emergencies may include:	1 loss of electrical power 2 short-circuits and open circuits in distribution systems 3 loss of electronic/electrical control of systems 4 flooding of engine room 5 fire or explosion in engine room 6 failure of emergency alarm and control systems 7 loss of refrigeration 8 overloading of electrical systems
g Documentation and records may include:	1 ISM Code safety management system plans, procedures, checklists and instructions 2 vessel's and company's planned maintenance system, repair procedures and instructions 3 electronic equipment and vessel manufacturer's specifications, instructions and recommended procedures 4 electronic equipment maintenance log, running sheets and records 5 computer database of running information and maintenance records

Range Statement (continued)

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g Documentation and records may include: (continued)	6	vessel's survey procedures and instructions as they relate to shipboard electronic equipment
	7	vessel's safety and emergency contingency plans and procedures
	8	electronic equipment and vessel manufacturer's specifications, instructions and recommended procedures
	9	relevant sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and classification society rules dealing with shipboard electronic equipment maintenance and repair
	10	instructions of relevant maritime authorities and classification societies concerning shipboard electronic equipment maintenance and repair
h Applicable legislation, regulations and codes may include:	1	sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and classification society rules related to shipboard electronic equipment maintenance and repair on vessels of unlimited propulsion power
	2	relevant international, Commonwealth, State and Territory OH&S legislation
	3	relevant international, Commonwealth, State and Territory electronic engineering practice standards

Unit Sector(s)

Not applicable.

Field

Field MB Equipment Checking and Maintenance

Relationship to other units

Relationship to other units	The unit may be assessed in conjunction with other units that relate to the functions of the occupation(s) concerned.
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