



Australian Government

Department of Education, Employment and Workplace Relations

**TDMMB4207A TEST, DETECT FAULTS
AND MAINTAIN AND RESTORE
ELECTRONIC CONTROL EQUIPMENT
TO OPERATING CONDITION ON
VESSELS OVER 750 KW PROPULSION
POWER**

Release: 1



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Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required to test, detect faults and maintain and restore electronic control equipment to operating within the limits of responsibility of a Marine Engineer Class 2 on a commercial vessel powered by main propulsion machinery of 750 kW propulsion power or above. This covers the knowledge and skills required to work as:

- **Chief Engineer on vessels between 750 kW and 3,000 kW propulsion power**
- **First Engineer (Second Engineer for STCW 95 Code) on vessels over 750 kW propulsion power.**

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 between 750 kW and 3,000 kW propulsion power operating in international waters, i.e. Advanced Diploma of Transport & Distribution (Marine Engineering Class 2).
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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 1912, describing requirements for a Chief Engineer on vessels between 750 and 3,000 kW propulsion power and a First Engineer (Second Engineer for STCW 95 Code) on vessels over 750 kW propulsion power.
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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 Detect, identify and investigate electronic equipment malfunctions and faults	. a The operation of shipboard electronic equipment is monitored as per vessel's survey requirements, planned maintenance requirements and manufacturer's instructions and performance is compared with specifications and recommended limits of performance b Poor performance and faults are identified in accordance with marine engineering practice c Poor performance and faults are investigated in accordance with level of responsibility and appropriate action initiated to rectify the identified problem

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ELEMENT	PERFORMANCE CRITERIA
1 Detect, identify and investigate electronic equipment malfunctions and faults (continued)	- d Appropriate action is taken to prevent damage as per planned maintenance procedures, marine practice, safety regulations and manufacturer's instructions - e Faulty equipment and components are identified and are reported and action is initiated as required for isolation, tagging and repair or replacement - f Decisions are made to carry out temporary or permanent repairs depending on the vessel's position and circumstances - g Appropriate consultation is undertaken with classification society and marine administration concerning the nature of the repairs and any contingency or emergency action required - h Coordination of the repair processes and the organisation and control of engine room personnel to facilitate repairs is in accordance with level of responsibility
2 Repair faults in electronic equipment	- a Identified faults in shipboard electronic equipment are investigated using established fault finding techniques - b Malfunctioning or faulty electronic equipment is correctly isolated, and disassembled if necessary, as per level of responsibility and manufacturer's instructions - c Damaged or faulty components are repaired or replaced as per planned maintenance procedures, manufacturer's instructions and marine practice - d Repaired electronic equipment is reassembled in accordance with manufacturer's instructions and marine practice - e Repaired electronic equipment is tested and adjusted as per procedures and manufacturer's instructions and in

ELEMENT	PERFORMANCE CRITERIA
	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 as per level of responsibility
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

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ELEMENT	PERFORMANCE CRITERIA
4 Follow safety and hazard control procedures	a Safety, hazard minimisation and pollution control procedures and national and international regulations are followed at all times during maintenance and repair operations b Maintenance and repair hazards are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment c Where relevant, procedures and precautions necessary for entry into confined spaces on a vessel are correctly followed d 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

ELEMENT	PERFORMANCE CRITERIA
	vessel and persons involved e 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 Relevant national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders
- 2 Relevant OH&S legislation and policies
- 3 Established procedures 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 between 750 and 3,000 kW propulsion power
- 5 Planned maintenance systems and procedures for the condition monitoring of electronic equipment, including responsibilities and requirements covered by various forms of vessel survey
- 6 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
- 7 Procedures 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
- 8 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
- 9 Concepts of unmanned machinery spaces (UMS) and automated monitoring and control of machinery
- 10 Principles and techniques for finding faults in shipboard electronic control

REQUIRED KNOWLEDGE

systems

- 11 Procedures for the calibration and adjustment of transmitters and controllers in control systems
- 12 Principles and applications of programmable logic controllers (PLCs)
- 13 Knowledge and ability to read and interpret electronic equipment performance readings and instrumentation
- 14 Common active devices and their application in power electronic and electronic circuits typically used on vessels of typically 750 kW propulsion power and 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
- 15 Common integrated circuit devices and their application in shipboard electronic instrumentation and power supply circuits, including:
 - a operational amplifiers
 - b voltage regulators
 - c multivibrators

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- 16 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

- 16 Common digital electronic circuits and their application in shipboard electronic instrumentation systems, including:
- 17 Principles and procedures for electronic measurement
- 18 Procedures for identifying faults and carrying out basic repairs on 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
- 19 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 principles and practical characteristics of AC and DC machines and related electronic control equipment
 - e cabling, distribution and lighting systems
 - f control and switch gear
- 20 Principles of operation of shipboard electronic components and systems, including:
 - a electronics principles
 - b integrated circuits, microprocessors and PLCs
 - c process control theory
 - d instruments, calibration and testing
 - e electronic control, surveillance, measurement and recording systems
 - f telemetering devices

16 Common digital electronic circuits and their application in shipboard electronic instrumentation systems, including:

- g alarm systems, including fire and emergency alarm systems
- h main and auxiliary machinery control and UMS

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- i principles of two and three term controllers

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

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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 electrical equipment
- 2 Interpret and follow procedures for testing and maintaining electronic control equipment and systems
- 3 Read and interpret material safety data sheets
- 4 Read and interpret vessel and electronic equipment specifications, equipment drawings, operational manuals, and control circuit diagrams
- 5 Work collaboratively with other shipboard personnel when testing and maintaining electronic control equipment and systems
- 6 Solve problems that can occur when testing and maintaining electronic control

REQUIRED SKILLS

- equipment and systems and take appropriate remedial action and solutions
- 7 Carry out calculations required when testing and maintaining electronic control equipment and systems
 - 8 Adapt to differing types of electronic systems from one vessel to another and when systems are changed
 - 9 Select and use 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 Monitor the performance of shipboard electronic equipment against specifications on a vessel within limits of responsibility - b Identify malfunctioning and faulty electronic equipment and components and initiate appropriate action for repair or replacement within limits of responsibility - c Use basic troubleshooting techniques to investigate malfunctioning and faulty electronic equipment and carry out required repairs within limits of responsibility - d Exercise all required safety, environmental and hazard control precautions and procedures when overseeing the operation, maintenance and repair of shipboard electronic equipment
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	- e Identify typical electronic equipment maintenance and repair problems and hazards and take appropriate action within limits of responsibility - f Communicate effectively with others during maintenance and repair operations, including effective use of internal communication systems
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 electronic equipment and identifying malfunctions and on a vessel of more than 750 kW propulsion power 2 taking action to minimise any damage and safety risk that could be caused by electronic equipment malfunctions 3 carrying out repairs of shipboard electronic equipment 4 identifying and evaluating electronic equipment maintenance and repair problems and determining appropriate courses of action 5 identifying and implementing improvements to electronic equipment checking, maintenance and repair procedures 6 applying safety precautions 7 completing maintenance and repair documentation and records - c Shows evidence of application of relevant workplace procedures, including:

Evidence Guide (continued)

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2 Evidence required for demonstration of consistent performance (continued)	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 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, 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
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 vessels of more than 750 kW propulsion power; and/or - b complete checks and related repairs of shipboard electronic equipment in a range of operational situations on a commercial or training vessel of 750 kW propulsion power or more

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 mandatory rules and regulations and IMO Conventions and Codes, including the relevant sections of the AMSA Marine Orders, and ensuring that applicable codes, guidelines and standards recommended by IMO, the classification societies and maritime industry organisations are taken into account

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

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 basic fault finding techniques to the repair of electronic control equipment typically found on a vessel of 750 kW propulsion power or more 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 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 750 kW propulsion power or more
b Performance monitoring and repair of shipboard electronic control equipment may be carried out:	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

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 computer displays of performance parameters 3 hand tools, such as soldering irons, pliers, cutters, wire strippers, spanners, wrenches, screwdrivers, hacksaws, etc.

VARIABLE

SCOPE

- 4 electric and pneumatic power tools, such as drills, etc.
- 5 material safety data sheets
- 6 protective clothing and equipment such as:
 - i eye and ear protection
 - ii safety boots
 - iii dust and fume masks
 - iv boilersuit/overalls
 - v safety helmet

Range Statement (continued)

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VARIABLE

SCOPE

e Maintenance and repair hazards may include:

- 1 exposed live circuits
- 2 faulty earth connections
- 3 moving heavy loads using unsafe lifting procedures
- 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

VARIABLE	SCOPE
	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 noxious and dangerous cargoes
f Emergencies may include:	1 loss of electronic/electrical control of systems 2 failure of emergency alarm and control systems 3 loss of refrigeration
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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VARIABLE	SCOPE
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 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 9 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 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 B 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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