



**Australian Government**

**Department of Education, Employment and Workplace Relations**

**TDMMB4107A TEST, DETECT FAULTS  
AND MAINTAIN AND RESTORE  
ELECTRICAL MACHINERY AND  
EQUIPMENT TO OPERATING  
CONDITION ON VESSELS OVER 750  
KW PROPULSION POWER**

Release: 1



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# **TDMMB4107A TEST, DETECT FAULTS AND MAINTAIN AND RESTORE ELECTRICAL MACHINERY AND EQUIPMENT TO OPERATING CONDITION ON VESSELS OVER 750KW PROPULSION POWER**

## **Modification History**

Not applicable.

## **Unit Descriptor**

### **UNIT DESCRIPTOR:**

**This unit involves the skills and knowledge required to test, detect faults and maintain and restore electrical equipment to operating condition 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.**

**This includes the management and coordination of relevant preventative maintenance and fault finding activities and the application of 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**

<b>Application of the unit</b>	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

<b>Licensing/legislative requirements</b>	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
<p>1 <b>Detect, identify and investigate electrical machinery equipment malfunctions and faults</b></p>	<p>a The operation of shipboard electrical 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</p> <p>b Poor performance and faults are identified as per marine engineering practice</p> <p>c Poor performance and faults are identified in accordance with level of responsibility and appropriate action initiated to rectify the identified problem</p>

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ELEMENT	PERFORMANCE CRITERIA
<p><b>1 Detect, identify and investigate electrical machinery equipment malfunctions and faults (continued)</b></p>	<p>d Appropriate action is taken to prevent damage as per planned maintenance procedures, marine practice, safety regulations and manufacturer's instructions</p> <p>e Faulty equipment and components are identified and are reported and action is initiated as required for isolation, tagging and repair or replacement</p> <p>f Decisions are made to carry out temporary or permanent repairs are appropriate for the vessel's position and circumstances</p> <p>g Consultation is taken with classification society and marine administration concerning the nature of the repairs and any contingency or emergency action required</p> <p>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</p>
<p><b>2 Repair faults in electrical machinery and equipment</b></p>	<p>a Identified faults in shipboard electrical equipment are investigated using established fault finding techniques</p> <p>b Malfunctioning or faulty electrical equipment is correctly isolated, disassembled, if necessary as per level of responsibility and manufacturer's instructions</p> <p>c Damaged or faulty components are repaired or replaced as per planned maintenance procedures, manufacturer's instructions and marine practice</p> <p>d Repaired electrical equipment is reassembled in accordance with manufacturer's instructions and established marine engineering practice</p>

ELEMENT	PERFORMANCE CRITERIA
	<ul style="list-style-type: none"> <li>e Repaired electrical equipment is tested and adjusted as per procedures, manufacturer's instructions and in consultation with relevant personnel</li> <li>f Repaired electrical equipment and associated safety devices, control systems and alarms are restarted/reactivated and their performance tested</li> <li>g Tests are conducted to the requirements of class and statutory surveys</li> <li>h Performance against recommended performance specifications is confirmed and the electrical equipment is recommissioned as per level of responsibility</li> </ul>
<p><b>3 Complete maintenance and repair documentation</b></p>	<ul style="list-style-type: none"> <li>a Correct records are made relating to maintenance and repair operations and equipment failure incidents</li> <li>b All planned maintenance system and repair documentation is completed in accordance with survey and company requirements and regulations</li> </ul>

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ELEMENT	PERFORMANCE CRITERIA
<p><b>4 Follow safety and hazard control procedures</b></p>	<ul style="list-style-type: none"> <li>a Safety, hazard minimisation and pollution control procedures and safety regulations are followed at all times during maintenance and repair operations</li> <li>b Maintenance and repair hazards are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment</li> <li>c Where relevant, procedures and precautions necessary for entry into confined spaces on a vessel are correctly followed</li> <li>d Action is taken in the event of an electrical equipment failure</li> </ul>

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b>
	<p>or emergency to isolate and secure the electrical equipment and the vessel and maintain the safety of the vessel and persons involved</p> <p>e Shipboard emergency and contingency plans are followed in the event of an electrical equipment failure or emergency</p>

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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
- 2 Relevant OH&S legislation and policies
- 3 Established procedures for the checking, maintenance, troubleshooting and repair of marine electrical equipment, systems and equipment to ensure compliance with the company and survey requirements and established safety rules and regulations
- 4 Operational characteristics and performance specifications for the different types of shipboard electrical 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 electrical equipment, including responsibilities and requirements covered by various forms of vessel survey
- 6 The nature and causes of typical shipboard electrical equipment malfunctions and the available methods for their detection and repair, including marine electrical equipment malfunction fault finding techniques
- 7 Procedures for the initiation and coordination of temporary and permanent repair and/or replacement procedures for electrical equipment on board vessels at sea, alongside and in dry dock
- 8 A basic understanding of the power distribution and control circuits typically used on board a vessel over 750 kW propulsion power or more and their associated operational electrical equipment
- 9 Concepts of unmanned machinery spaces (UMS) and automated monitoring and control of machinery



## REQUIRED KNOWLEDGE

- 10 Practical characteristics and application of shipboard electrical machines, including:
  - a AC and DC motors
  - b AC generators, including requirements for the parallel operation and the process of synchronisation
  - c three phase induction motors, including the various starting methods
  - d three phase motors, including synchronous motors
  - e three phase alternators operating singly and in parallel
  - f three phase transformers
- 11 Principles and procedures for electrical measurement, including the use of oscilloscopes and multimeters and insulation resistance measurement using a Megger
- 12 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

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- 13 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

- 13 Principles of electrotechnology, marine electrical practice and marine automation and control relevant to detection, identification and repair of faults, including:
- c the electrical circuit
  - d principles and practical characteristics of AC and DC machines and related electrical equipment
  - e cabling, distribution and lighting systems
  - f control and switch gear
  - g deck electrical equipment

- 13 Principles of electrotechnology, marine electrical practice and marine automation and control relevant to detection, identification and repair of faults, including:
- 14 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
- 15 Maritime communication techniques needed during maintenance and repair operations
- 16 Typical maintenance and repair hazards and problems and appropriate preventative and remedial action and solutions during maintenance and repair of shipboard electrical equipment
- 17 Safety, environmental and hazard control precautions and procedures relevant to shipboard electrical equipment inspection and maintenance operations
- 18 Safe procedures for handling heavy electrical equipment and component parts during maintenance and repair of shipboard electrical equipment
- 19 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 when testing and maintaining electrical equipment and systems
- 3 Read and interpret material safety data sheets
- 4 Read and interpret vessel and electrical equipment specifications, equipment drawings, operational manuals, and control circuit diagrams
- 5 Work collaboratively with other shipboard personnel when testing and

maintaining electrical equipment and systems

- 6 Solve problems that can occur when testing and maintaining electrical equipment and systems and take appropriate remedial action and solutions
- 7 Carry out calculations required when testing and maintaining electrical equipment and systems
- 8 Adapt to differing types of electrical control systems from one vessel to another and when systems are changed
- 9 Select and use tools and equipment required for the maintenance of electrical equipment and systems

## Evidence Guide

### Evidence Guide

**TDMMB4107A TEST, DETECT FAULTS AND MAINTAIN AND RESTORE ELECTRICAL EQUIPMENT TO OPERATING CONDITION ON VESSELS OVER 750 KW PROPULSION POWER**

*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.*

<b>1 Critical aspects of evidence required to demonstrate competency in this unit</b>	Assessment must confirm appropriate knowledge and skills to: <ol style="list-style-type: none"><li>a Monitor the performance of shipboard electrical equipment against specifications on a vessel</li><li>b Identify malfunctioning and faulty electrical equipment and components and initiate appropriate action for repair or replacement within limits of responsibility</li><li>c Use basic troubleshooting techniques to investigate malfunctioning and faulty electrical equipment and carry out required repairs</li><li>d Exercise all required safety, environmental and hazard control precautions and procedures when overseeing the operation, maintenance and repair of shipboard electrical</li></ol>
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	<p>equipment</p> <p>e Identify typical electrical equipment maintenance and repair problems and hazards and take appropriate action</p> <p>f Communicate effectively with others during maintenance and repair operations, including effective use of internal communication systems</p>
<p><b>2 Evidence required for demonstration of consistent performance</b></p>	<p>a Performance is demonstrated consistently over a period of time and in a suitable range of contexts</p> <p>b Consistently applies underpinning knowledge and skills when:</p> <ol style="list-style-type: none"> <li>1 assessing operational performance of electrical machinery equipment and identifying malfunctions and faulty plant and equipment</li> <li>2 taking action to minimise any damage and safety risk that could be caused by electrical equipment malfunctions</li> <li>3 managing, training and controlling personnel and carrying out repairs of shipboard electrical equipment</li> <li>4 identifying and evaluating electrical equipment maintenance and repair problems and determining appropriate courses of action</li> <li>5 identifying and implementing improvements to electrical equipment checking, maintenance and repair procedures</li> <li>6 applying safety precautions relevant to electrical equipment maintenance and repair operations</li> <li>7 completing maintenance and repair documentation and records</li> </ol> <p>c Shows evidence of application of relevant workplace procedures, including:</p> <ol style="list-style-type: none"> <li>1 relevant sections of maritime regulations</li> </ol>

**Evidence Guide (continued)**

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<p><b>2 Evidence required for demonstration of consistent performance (continued)</b></p>	<ul style="list-style-type: none"> <li>2 OH&amp;S regulations and hazard prevention policies and procedures</li> <li>3 ISM Code safety management system procedures, quality procedures and work instructions on the checking and repair of shipboard electrical equipment, including electrical equipment specifications and directions on equipment capability and limitations</li> <li>4 following on-board housekeeping processes</li> <li>d Action is taken promptly to report and/or rectify electrical equipment malfunctions, non-conformities, accidents, hazardous occurrences and safety incidents in accordance with statutory requirements, procedures and the ISM Code</li> <li>e Work is managed, controlled and completed systematically with required attention to detail</li> <li>f Recognises and adapts appropriately to cultural differences in the workplace, including modes of behaviour and interactions among crew and others</li> </ul>
<p><b>3 Context of assessment</b></p>	<ul style="list-style-type: none"> <li>a Assessment of competency must comply with the assessment requirements of the relevant maritime regulations</li> <li>b Assessment of this unit must be undertaken within relevant marine authority approved and audited arrangements by a registered training organisation:             <ul style="list-style-type: none"> <li>1 As a minimum, assessment of knowledge must be conducted through appropriate written/oral examinations, and</li> <li>2 Appropriate practical assessment must occur:                 <ul style="list-style-type: none"> <li>i at the registered training organisation; and/or</li> </ul> </li> </ul> </li> </ul>

	ii on an appropriate working or training vessel
<b>4 Specific resources required for assessment</b>	<p>Access is required to opportunities to:</p> <p>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 electrical equipment typically found on vessels of typically 750 kW propulsion power and more; and/or</p> <p>b complete checks and related repairs of shipboard electrical equipment in a range of operational situations on a commercial or training vessel of 750 kW propulsion power or more</p>

## Range Statement

### Range Statement

**TDMMB4107A TEST, DETECT FAULTS AND MAINTAIN AND RESTORE ELECTRICAL EQUIPMENT TO OPERATING CONDITION ON VESSELS OVER 750 KW PROPULSION POWER**

*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

<b>a. Work must be carried out:</b>	<p>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</p>
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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.*

<b>b. Work is performed:</b>	1 relatively independently under broad operational requirements, with accountability and responsibility for self and others in achieving the prescribed outcomes
<b>c. Work involves:</b>	1 the application of basic fault finding techniques to the repair of electrical machinery 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 electrical and equipment is required and accountability and responsibility for self and others in achieving the outcomes is involved
<b>d. Work requires:</b>	1 significant judgement in planning, engineering and leadership functions related to electrical equipment repair operations and procedures. This includes hazard minimisation, analysis of situations and decision making

## 2. WORKSITE ENVIRONMENT

<b>a Shipboard electrical equipment may include:</b>	1 that typically found on any Australian or international commercial vessel of 750 kW propulsion power or more
<b>b Performance monitoring and repair of shipboard electrical equipment may be carried out:</b>	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)**

**TDMMB4107A TEST, DETECT FAULTS AND MAINTAIN AND RESTORE ELECTRICAL EQUIPMENT TO OPERATING CONDITION ON VESSELS OVER 750 KW PROPULSION POWER**

VARIABLE	SCOPE
<p><b>b Performance monitoring and repair of shipboard electrical equipment may be carried out: (continued)</b></p>	<p>5 while anchored or moored</p> <p>6 in dry dock</p>
<p><b>c Types of electrical equipment may include:</b></p>	<p>1 programmable logic controllers (PLCs)</p> <p>2 signal transmission systems used for monitoring and control</p> <p>3 temperature and pressure sensors</p> <p>4 electrical equipment space monitoring alarm and control systems</p> <p>5 AC generators</p> <p>6 AC and DC motors, including:</p> <p style="padding-left: 20px;">i programmable logic controllers (PLCs)</p> <p style="padding-left: 20px;">ii signal transmission systems used for monitoring and control</p> <p>7 three phase alternators</p> <p>8 three phase transformers</p> <p>9 main switchboard and shipboard power distribution systems, including:</p> <p style="padding-left: 20px;">i distribution circuits and wiring</p>

VARIABLE	SCOPE
	<ul style="list-style-type: none"> <li>i protection devices</li> <li>iii circuit breakers</li> <li>iv emergency supply systems, including emergency generators, emergency switchboard and battery banks</li> <li>v electronic governors</li> <li>vi deck electrical machinery</li> </ul>
<p><b>d Testing and repair equipment may include:</b></p>	<ul style="list-style-type: none"> <li>1 electronic instrumentation meters and gauges, oxygen meter and gas detectors</li> <li>2 computer displays of performance parameters</li> <li>3 hand tools, such as soldering irons, pliers, cutters, wire strippers, spanners, wrenches, screwdrivers, hacksaws, etc.</li> <li>4 electric and pneumatic power tools, such as drills, etc.</li> <li>5 material safety data sheets</li> <li>6 block and tackle</li> <li>7 portable and manual lifting equipment and hydraulic jacks</li> </ul>

**Range Statement (continued)**

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VARIABLE	SCOPE
<p><b>d Testing and repair equipment may include: (continued)</b></p>	<ul style="list-style-type: none"> <li>8 material safety data sheets</li> <li>9 protective clothing and equipment such as:                             <ul style="list-style-type: none"> <li>i eye and ear protection</li> <li>ii safety boots</li> </ul> </li> </ul>

VARIABLE	SCOPE
	<ul style="list-style-type: none"> <li>iii dust and fume masks</li> <li>iv boilersuit/overalls</li> <li>v safety helmet</li> </ul>
<p><b>e Maintenance and repair hazards may include:</b></p>	<ul style="list-style-type: none"> <li>1 exposed live circuits</li> <li>2 faulty earth connections</li> <li>3 moving heavy loads using unsafe lifting procedures</li> <li>4 unsecured electrical equipment, components or repair equipment</li> <li>5 sharp tools and implements</li> <li>6 power tools</li> <li>7 moving and rotating electrical equipment</li> <li>8 faulty equipment, handling equipment and lifting gear</li> <li>9 using equipment beyond safe working limits</li> <li>10 poor housekeeping procedures</li> <li>11 non-compliance with safe working procedures</li> <li>12 electrical wiring and systems</li> <li>13 hot pipes and valves (steam, fuel oil, lubricating oil)</li> <li>14 cold pipes and valves (refrigeration and liquefied gas cargoes)</li> <li>15 working at heights</li> <li>16 overspeed of electrical machinery, emergency trips</li> <li>17 noxious and dangerous cargoes</li> </ul>

<b>VARIABLE</b>	<b>SCOPE</b>
<b>f Emergencies may include:</b>	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

**Range Statement (continued)**

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<b>VARIABLE</b>	<b>SCOPE</b>
<b>f Emergencies may include: (continued)</b>	6 failure of emergency alarm and control systems
	7 loss of refrigeration
	8 overloading of electrical systems
<b>g Documentation and records may include:</b>	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 electrical equipment and vessel manufacturer's specifications, instructions and recommended procedures
	4 electrical equipment maintenance log, running sheets and records
	5 computer database of running information and maintenance records
	6 vessel's survey procedures and instructions as they relate to shipboard electrical equipment

VARIABLE	SCOPE
	<p>7 vessel's safety and emergency contingency plans and procedures</p> <p>8 relevant sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and classification society rules dealing with shipboard electrical equipment maintenance and repair</p> <p>9 instructions of relevant maritime authorities and classification societies concerning shipboard electrical equipment maintenance and repair</p>
<p><b>h Applicable legislation, regulations and codes may include:</b></p>	<p>1 sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and classification society rules related to shipboard electrical equipment maintenance and repair</p> <p>2 relevant international, Commonwealth, State and Territory OH&amp;S legislation</p> <p>3 relevant international, Commonwealth, State and Territory electrical engineering practice standards</p>

## Unit Sector(s)

Not applicable.

## Field

Field B Equipment Checking and Maintenance

## Relationship to other units

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