Australian Government

Department of Education, Employment and Workplace Relations

TDMMB3907A MANAGE THE TESTING, DETECTION OF FAULTS, MAINTENANCE AND RESTORATION OF ELECTRICAL MACHINERY AND 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 electrical 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).

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 a vessel unlimited propulsion power operating in international waters.

Pre-Requisites

Not applicable.

Employability Skills Information

Not applicable.

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

ELEMENT	PERFORMANCE CRITERIA
.	.
1 Manage the detection, identification and investigation of electrical machinery equipment malfunctions and faults	a The detection, identification and investigation of malfunctions and faults in shipboard electrical machinery equipment is correctly coordinated and managed b The operation of shipboard electrical machinery equipment is monitored as per 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 d Advanced diagnostic techniques are used to investigate poor performance and faults and appropriate action is initiated to

ELEMENT	PERFORMANCE CRITERIA
	rectify problems identified in accordance with the scope of responsibilities of a Chief Engineer e Appropriate action is taken to prevent damage/failure as per planned procedures marine practice, safety regulations and manufacturer's instructions

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ELEMENT	PERFORMANCE CRITERIA
1 Manage the detection, identification and investigation of electrical machinery equipment malfunctions and faults (continued)	f Faulty equipment and components are identified and are reported and action is initiated as required for isolation, tagging and repair or replacement 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 electrical machinery equipment	a The identification of faults in shipboard electrical equipment is managed in accordance with company procedures b Malfunctioning or faulty electrical 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 electrical equipment is reassembled in accordance with manufacturer's instructions and established marine engineering practice e Repaired electrical equipment is tested and adjusted in accordance with vessel's procedures and manufacturer's instructions and in consultation with relevant personnel f Repaired electrical 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 electrical equipment is recommissioned in accordance with vessel's procedures and established marine electrical practice

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ELEMENT	PERFORMANCE CRITERIA
3 Complete maintenance and repair documentation	a Correct records are kept concerning 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 electrical 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 electrical equipment failure or emergency to isolate and secure the electrical equipment and the vessel and maintain the safety of the vessel and persons involved f Ensure that shipboard emergency and contingency plans are followed in the event of an electrical 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 electrical 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 electrical equipment, systems and equipment

4 Operational characteristics and performance specifications for the different types of shipboard electrical equipment usually found on a vessel of unlimited propulsion power

5 Advanced diagnostic techniques for carrying out testing, troubleshooting and repair of shipboard electrical 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 electrical equipment, including responsibilities and requirements covered by various forms of vessel survey

7 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

8 Advanced diagnostic and repair techniques for carrying out shipboard electrical

REQUIRED KNOWLEDGE

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

9 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

10 Theory, calculations, practical characteristics and applications of shipboard electrical machines at the level as required by a Chief Engineer, 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

e three phase synchronous motors

f three phase alternators operating singly and in parallel

g three phase transformers

REQUIRED KNOWLEDGE

11 An understanding of the power distribution and control circuits typically used on board a vessel of unlimited propulsion power and their associated operational electrical equipment

12 Concepts of unmanned machinery spaces (UMS) and automated monitoring and control of machinery

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13 Principles and techniques for finding faults in shipboard control systems

14 Procedures for the calibration and adjustment of transmitters and controllers in control systems

15 Elementary programming and program modification for programmable logic controllers (PLCs), including principles and applications

16 Common active devices and their application in power 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

17 Principles and procedures for electrical measurement, including the use of oscilloscopes and multimeters and insulation resistance measurement using a Megger

18 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

13 Principles and techniques for finding faults in shipboard control systems

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 theory and calculations of AC and DC machines and related electrical equipment

e cabling, distribution and lighting systems

f control and switch gear

g deck electrical equipment

h process control theory

i instruments, calibration and testing

j alarm systems, including fire and emergency alarm systems

k main and auxiliary electrical equipment control and UMS

13 Principles and techniques for finding faults in shipboard control systems

20 Maintenance and repair records that must be maintained on a vessel to meet the requirements of the company, survey requirements and regulatory authorities

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21 Maritime communication techniques needed during maintenance and repair operations

22 Maintenance and repair hazards and problems and appropriate preventative and remedial action and solutions during maintenance and repair of shipboard electrical equipment

23 Safety, environmental and hazard control precautions and procedures relevant to shipboard electrical equipment inspection and maintenance operations

24 Safe procedures for the use of hand and power tools and maintenance equipment and for the handling heavy electrical equipment and component parts during maintenance and repair of electrical 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 electrical equipment

2 Interpret and follow procedures for the testing and maintenance of electrical 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 electrical equipment specifications, equipment drawings, operational manuals, and electrical circuit diagrams.

6 Work collaboratively with other shipboard personnel when managing the testing and maintenance of electrical equipment and systems

21 Maritime communication techniques needed during maintenance and repair operations

7 Solve problems that can occur when managing the testing and maintenance of electrical equipment and systems and take appropriate remedial action and solutions

8 Carry out calculations required when managing the testing and maintenance of electrical equipment

9 Adapt to differing types of electrical machinery, equipment and systems from one vessel to another and when equipment and systems are changed

10 Select and use tools and equipment required for the testing and maintenance of electrical equipment and systems

Evidence Guide

Evidence Guide

TDMMB3907A MANAGE THE TESTING, DETECTION OF FAULTS, MAINTENANCE AND RESTORATION OF ELECTRICAL MACHINERY AND EQUIPMENT TO OPERATING CONDITION ON VESSELS OF UNLIMITEDPROPULSION 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.

1 Critical aspects of evidence required to demonstrate competency in this unit	Assessment must confirm appropriate knowledge and skills to: a Manage maintenance activities at the level of responsibility of a Chief Engineer b Manage the monitoring of performance of shipboard electrical equipment against specifications on a vessel of unlimited propulsion power c Manage the monitoring of identification of malfunctioning and faulty electrical equipment and components d Apply advanced diagnostic techniques to the troubleshooting of malfunctioning and faulty electrical equipment and carry out required repairs in accordance with established marine engineering practice and at the level of responsibility

	e Ensure all required safety, environmental and hazard control precautions and procedures are taken when overseeing the operation, maintenance and repair of shipboard electrical equipment f Identify typical electrical equipment maintenance and repair problems and hazards and take appropriate action 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
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 managing maintenance activities of shipboard electrical equipment 2 managing the monitoring of performance of shipboard electrical equipment against specifications on a vessel of unlimited propulsion power 3 managing the identification of faulty electrical equipment and components 4 managing, training and controlling personnel involved in repairing shipboard electrical equipment 5 identifying and evaluating electrical equipment maintenance and repair problems and determining appropriate courses of action 6 identifying and implementing improvements to electrical equipment checking, maintenance and repair procedures 7 ensuring the application of all required safety precautions

Evidence Guide (**continued**)

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2 Evidence required for demonstration of consistent performance (**continued**)	8 completing maintenance and repair documentation and records c Shows evidence of application of relevant workplace procedures, including 1 relevant sections of maritime regulations 2 OH&S regulations and hazard prevention policies and procedures 3 ISM Code safety management system procedures and work instructions 4 on-board housekeeping processes 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 and company procedures 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
4Specific 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 manage the checking and repair electrical equipment typically found on a vessel of unlimited propulsion power, including identifying an appropriate range of possible electrical equipment malfunctions and carrying out related maintenance and repair solutions; and/or b manage the checking and related repairs of shipboard electrical 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 electrical 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 electrical 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 electrical 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 electrical 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 electrical 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 electrical equipment may be carried out: (**continued**)	5 while anchored or moored 6 in dry dock
c Types of electrical equipment may include:	1 AC generators 2 AC and DC motors, including: three phase induction motors such as squirrel cage, double cage, wound rotor and slip ring, TEFC, splashproof and submersible 3 three phase synchronous motors 4 three phase alternators 5 three phase transformers 6 power supply circuits 7 main switchboard and shipboard power distribution systems, including: i distribution circuits and wiring ii protection devices iii circuit breakers 12 emergency supply systems, including emergency generators, emergency switchboard and battery banks

	13 electronic governors 14 deck electrical machinery
d Testing and repair equipment may include:	1 CRO and computer displays of performance parameters 2 hand tools, such as soldering irons, pliers, cutters, wire strippers, spanners, wrenches, screwdrivers, hacksaws, etc. 3 electric and pneumatic power tools, such as grinders, lathes, drills, etc. 4 block and tackle 5 portable and manual lifting equipment and hydraulic jacks 6 material safety data sheets 7 protective clothing and equipment such as:

Range Statement (**continued**)

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d Testing and repair equipment may include: (**continued**)	i eye and ear protection ii safety boots iii dust and fume masks iv boilersuit/overalls v 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 4 unsecured electrical equipment, components or repair

	equipment
5	sharp tools and implements
6	power tools
7	moving and rotating electrical 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
18	poor housekeeping procedures
19	non-compliance with safe working procedures
20	electrical wiring and systems
21	hot pipes and valves (steam, fuel oil, lubricating oil)
22	cold pipes and valves (refrigeration and liquefied gas cargoes)
23	working at heights
24	overspeed of electrical machinery, emergency trips
25	noxious and dangerous cargoes

Range Statement (**continued**)

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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 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 7 vessel's safety and emergency contingency plans and procedures 8 electrical equipment and vessel manufacturer's

	specifications, instructions and recommended procedures 9 relevant sections of national and international regulations, and classification society rules dealing with shipboard electrical equipment maintenance and repair 10 instructions of relevant maritime authorities and classification societies concerning shipboard electrical equipment maintenance and repair
h Applicable legislation, regulations and codes may include:	1 sections of national and international regulations and classification society rules related to shipboard electrical 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 electrical 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.