



Australian Government

Department of Education, Employment and Workplace Relations

TDMMR1307B OPERATE ELECTRICAL MACHINERY AND ELECTRONIC CONTROL EQUIPMENT ON VESSELS OVER 750 KW PROPULSION POWER

Release: 1

TDMMR1307B OPERATE ELECTRICAL MACHINERY AND ELECTRONIC CONTROL EQUIPMENT ON VESSELS OVER 750KW PROPULSION POWER

Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required to operate electrical machinery and electronic control equipment 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

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. the 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, describing requirements for a Chief Engineer on a ocean-going vessel between 750 kW and 3,000 kW propulsion power.
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Pre-Requisites

Not applicable.

Employability Skills Information

Not applicable.

Elements and Performance Criteria Pre-Content

Not applicable.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1 Manage and coordinate the operation of electrical machinery and electronic control equipment	- a The operation of shipboard electrical machinery and electronic control equipment is coordinated and managed as per established procedures - b Shipboard electrical machinery and electronic control equipment is managed and operated within the specified limits of performance in accordance with procedures and manufacturer's instructions and specifications - c The performance of shipboard electrical machinery and electronic control equipment is managed and monitored in accordance with vessel's survey requirements and manufacturer's instructions

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ELEMENT	PERFORMANCE CRITERIA
1 Manage and coordinate the operation of electrical machinery and electronic control equipment (continued)	d Advanced diagnostic techniques are used to investigate poor performance and faults and appropriate action is initiated to rectify the identified problems in accordance with the responsibilities of an Engineer Class 1 e Records of performance are maintained in accordance with vessel's procedures
2 Follow safety and hazard control procedures	a Safety, hazard minimisation and pollution control procedures and regulations are followed at all times during the operation of electrical machinery and electrical and electronic control equipment b Operational 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 Appropriate action is taken in the event of an electrical and/or electronic equipment failure or emergency to isolate and secure the equipment and the vessel and maintain the safety of the vessel and persons involved e Shipboard emergency and contingency are followed in the event of an electrical and 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 maritime regulations, IMO Conventions and Codes applicable to the operation of electrical and electronic control equipment on vessels between 750 kW and 3,000 kW propulsion power
- 2 Relevant OH&S legislation, policies and procedures
- 3 Established engineering practice for the operation of marine electrical machinery and electronic control equipment, systems and equipment
- 4 Operational characteristics and performance specifications for the different types of shipboard electrical and electronic control equipment typically found on a vessel of between 750 kW and 3,000 kW propulsion power
- 5 The nature and causes of typical shipboard electrical and electronic control equipment operational problems and the appropriate preventative and remedial action to be taken in each case
- 6 The power distribution and control circuits typically used on board a vessel of between 750 kW and 3,000 kW propulsion power and their associated operational electrical and electronic control equipment
- 7 Principles and procedures for electrical and electronic measurement, including the use of oscilloscopes and multimeters and insulation resistance measurement using a Megger
- 8 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 electric circuit
 - d theory and calculations of AC and DC machines and related electrical and

REQUIRED KNOWLEDGE

- electronic control equipment
- e cabling, distribution and lighting systems
- f control and switch gear
- g deck electrical and electronic equipment
- h principles, calculations and diagnostics for shipboard electronic components and systems, including:
 - i electronics principles
 - ii integrated circuits, microprocessors and PLCs
 - iii process control theory
 - iv instruments, calibration and testing
 - v electronic control, surveillance, measurement and recording systems
 - vi telemetering devices
 - vii alarm systems, including fire and emergency alarm systems
 - viii main and auxiliary electrical and electronic equipment control and UMS
- i theory and setting/tuning of 2 and 3 term controllers, including microprocessors

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- 9 Concepts of unmanned machinery spaces (UMS) and automated monitoring and control of machinery
- 10 Theory, calculations, practical characteristics and applications of shipboard electrical machines, including:
 - a AC and DC motors
 - b AC generators, including requirements for the parallel operation and the process of synchronisation

- 9 Concepts of unmanned machinery spaces (UMS) and automated monitoring and control of machinery
 - 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
- 11 Common active devices and their application in power electronic and electronic circuits typically used on vessels of between 750 kW and 3,000 kW propulsion power, including:
 - a ability to identify the devices and their circuit symbols
 - b operating characteristics of common active devices
 - c applications of common active devices
- 12 Common integrated circuit devices and their application in shipboard electronic instrumentation and power supply circuits, including:
 - a operational amplifiers
 - b voltage regulators
 - c multivibrators
- 13 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
- 14 Procedures for diagnosing and repairing faults in 4 to 20 mA loops, including:
 - a open and short circuits
 - b earth faults

- 9 Concepts of unmanned machinery spaces (UMS) and automated monitoring and control of machinery
 - c high resistance joints
 - d power supply faults
 - e electronic component failure

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- 16 Elementary programming and program modification for programmable logic controllers (PLCs), including principles and applications
- 17 Operational records that must be maintained on a vessel to meet the requirements of the company, survey requirements and regulatory authorities
- 18 Maintenance hazards and hazard identification and prevention strategies
- 19 Maritime communication techniques needed when operating electrical and electronic equipment
- 20 Safety, environmental and hazard control precautions and procedures relevant to the operation of shipboard electrical and electronic equipment
- 21 Safe procedures for the use of hand and power tools and maintenance equipment

REQUIRED SKILLS

This describes the basic skills required for this unit.

- 1 Communicate effectively with other personnel when operating electrical machinery and electronic control equipment
- 2 Interpret and follow procedures for the operation of electrical machinery and electronic control equipment
- 3 Read and interpret electrical 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 operating electrical machinery and electronic control equipment
- 7 Identify problems that can occur when operating electrical machinery and electronic control equipment and take appropriate remedial action and solutions
- 8 Carry out calculations required when operating electrical machinery and

- 16 Elementary programming and program modification for programmable logic controllers (PLCs), including principles and applications
electronic control equipment
- 9 Adapt to differing types of electrical machinery and electronic control equipment from one vessel to another and when equipment and systems are changed
- 10 Select and use tools and equipment required for the operation of electrical machinery and electronic control equipment on a vessel

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 the operations of shipboard electrical and electronic control equipment - b Operate shipboard electrical and electronic control equipment against specifications on a vessel of between 750 kW and 3,000 kW propulsion power - c Identify malfunctioning and faulty electrical and electronic control equipment and components and initiate appropriate action for repair or replacement - d Exercise all required safety, environmental and hazard control precautions and procedures when operating electrical and electronic control equipment - e Identify electrical machinery and electronic control equipment operational problems and hazards and take appropriate action
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	- f Communicate effectively with others during operation of electrical and electronic control equipment, including effective use of internal communication systems - g Ensure adherence to relevant maritime and electrical wiring 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 operating shipboard electrical machinery and electronic equipment 2 assessing operational performance of electrical and electronic equipment 3 identifying operational problems with shipboard electrical machinery and electronic equipment and taking remedial action 4 taking action to minimise any damage and safety risk that could be caused by electrical machinery and electronic equipment malfunctions 5 identifying and implementing improvements to procedures for the operation of shipboard electrical machinery and electronic control equipment 6 applying safety precautions relevant to the operation of shipboard electrical machinery and electronic control equipment 7 completing operations documentation and records

Evidence Guide (continued)

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2 Evidence required for demonstration of consistent performance (continued)	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 safety management system procedures and work instructions on the operation of electrical machinery and electronic control equipment 4 following on-board housekeeping processes d Action is taken promptly to report and/or rectify electrical machinery and electrical and 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 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 operational situations and other assessments that demonstrate the skills and knowledge to operate electrical and electronic equipment used on a vessel of between 750 kW and 3,000 kW propulsion power; and/or - b operate shipboard electrical machinery and electronic control equipment in a range of operational situations on a commercial or training vessel of between 750 kW and 3,000 kW 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 rules and regulations and IMO Conventions and Codes. Applicable codes, guidelines and standards recommended by IMO, the classification societies and industry organisations must be taken into account
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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. Work is performed:	1 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 to the operation of electrical machinery and electronic control equipment typically found on a vessel of between 750 kW and 3,000 kW propulsion power across a wide and often unpredictable variety of contexts. Contribution to the development and implementation of a broad plan or strategy for the operation of shipboard electrical and electronic control equipment is required
d. Work requires:	1 significant judgement in planning, engineering and leadership functions related to the operation of electrical and electronic control equipment. This includes management, training and control of personnel, hazard minimisation, analysis of situations and decision making

2. WORKSITE ENVIRONMENT

a Shipboard electrical machinery and electrical and electronic control equipment may include:	1 that used on an Australian or international commercial vessel of between 750 kW and 3,000 kW propulsion power
b Operation of shipboard electrical machinery and 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

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

be carried out: | 5 while anchored or moored

Range Statement (continued)

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VARIABLE	SCOPE
b Operation of shipboard electrical machinery and electronic control equipment may be carried out: (continued)	6 in dry dock 7 when bunkering 8 during cargo operations
c Types of electrical machinery and electronic control equipment may include but are not limited to:	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 electrical and electronic equipment space monitoring alarm and control systems 7 AC generators 8 AC and DC motors, including: i three phase induction motors such as squirrel cage, double cage, wound rotor and slip ring, TEFC, splash proof and submersible

VARIABLE

SCOPE

- ii three phase synchronous motors
- 9 three phase alternators and three phase transformers
- 10 electronic instrumentation and power supply circuits
- 11 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
- 15 radio, navigation and bridge equipment

Range Statement (continued)

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VARIABLE

SCOPE

d Operational hazards may include:

- 1 moving and rotating electrical and electronic equipment
- 2 using equipment beyond safe working limits
- 3 poor housekeeping procedures
- 4 non-compliance with safe working procedures
- 5 hot pipes and valves (steam, fuel oil, lubricating oil)
- 6 cold pipes and valves (refrigeration and liquefied gas cargoes)

VARIABLE	SCOPE
	7 working at heights 8 dangerous atmosphere 9 overspeed of electrical machinery, emergency trips 10 noxious and dangerous cargoes 11 electric shock
e 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 6 failure of emergency alarm and control systems 7 loss of refrigeration 8 overloading of electrical systems 9 electric shock 10 foundering/grounding of vessel
f Documentation and records may include:	1 safety management system plans, procedures, checklists and instructions 2 planned maintenance system, repair procedures and instructions 3 electrical and electronic equipment and vessel manufacturer's specifications, instructions and recommended procedures 4 electrical and electronic equipment running sheets, operations logs and other operational records and/or computer database of running information 5 vessel's survey procedures and instructions

VARIABLE	SCOPE
	6 vessel's safety and emergency contingency plans and procedures

Range Statement (continued)

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VARIABLE	SCOPE
f Documentation and records may include: (continued)	7 electrical and electronic equipment and vessel manufacturer's specifications, instructions and recommended procedures
	8 relevant sections of national and international regulations, IMO Conventions and Codes
	9 instructions of relevant maritime authorities and class societies concerning shipboard electrical and electronic control equipment operation
g Applicable legislation, regulations and codes may include:	1 sections of relevant maritime regulations related to electrical and electronic control equipment operation on vessels of between 750 kW and 3,000 kW propulsion power
	2 relevant international, Commonwealth, State and Territory OH&S legislation
	3 relevant international, Commonwealth, State and Territory electrical and electronic engineering practice standards

Unit Sector(s)

Not applicable.

Field

Field R Carry Out Operations on Equipment and Systems

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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