



Australian Government

MARL6015A Demonstrate intermediate knowledge of marine electrical systems

Release 1

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Modification History

Release 1

This is the first release of this unit.

Unit Descriptor

This unit involves the skills and knowledge required to analyse complex switchboards, perform fault finding on electrical circuits, maintain circuit breakers, synchronise alternators and maintain emergency battery systems to ensure supply of shipboard electrical power on board a commercial vessel.

Application of the Unit

This unit applies to the work of a Marine Engineer Class 2 on commercial vessels greater than 3000 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Class 2 issued by the Australian Maritime Safety Authority (AMSA).

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

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

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| 1 Analyse common faults in shipboard electrical machinery | <ul style="list-style-type: none">1.1 Effects and ways of detecting earth on 3-wire insulated and 4-wire earthed neutral systems are explained1.2 Effects of short circuits and operation of discrimination protection are explained1.3 Symptoms and effects of 'light' and 'heavy' short circuits on components and circuits are compared1.4 Effects of open circuits on <i>systems and components</i> transformers are analysed1.5 Causes and effects of 'hot spots' in circuits are identified1.6 Cause and effects of static electricity on shafting and when cleaning tanks are identified |
| 2 Perform fault-finding on electrical circuits | <ul style="list-style-type: none">2.1 Safe procedure for determining insulation resistance of a 3-phase motor or alternator including protection of solid-state components and selection of suitable minimum insulation for the component is applied2.2 Procedure for safely drying out an electrical machine with a low IR is outlined2.3 Open circuit in a 3-phase motor is safely tested2.4 Procedure for testing internal short circuit in a 3-phase motor is clarified |
| 3 Analyse complex shipboard switchboard layouts | <ul style="list-style-type: none">3.1 <i>Switchboard layouts</i> are interpreted3.2 Effects and indications of earths on the system including intermittent and multi earths are explained3.3 Safe procedure for locating earths on main and low voltage circuits including 24 V system is outlined3.4 Operation of preferential tripping arrangements for overload protection is explained3.5 Relationship between main and emergency switchboards is explained3.6 Different methods of start up after black outs are outlined |

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| 4 Explain electrical safety procedures for ship and shore personnel | <ul style="list-style-type: none">4.1 Potential problems associated with shore maintenance personnel working on ship electrical equipment are identified4.2 Safe procedure of isolating electrical machinery for repair or maintenance is applied4.3 Safe method of working on live electrical circuitry for purpose of repair or maintenance is explained4.4 Problems associated with shipboard electrical fires are explained4.5 Safe procedures for fighting shipboard electrical fires including fires in switchboards are clarified |
| 5 Synchronise, parallel and load share alternators on manual and auto modes | <ul style="list-style-type: none">5.1 Process of manually synchronising alternator and sharing kW and kVAR loading under all loading conditions is explained5.2 Process of starting, testing and where applicable, of transferring emergency generator power on to main board, is explained5.3 Operation of synchronising lights, synchroscope and all meters associated with synchronising is outlined5.4 Operation of AVR and prime mover governor with respect to synchronising is outlined and how these can be adjusted at set points is explained |
| 6 Examine operation, construction and maintenance of circuit breakers | <ul style="list-style-type: none">6.1 Features and applications of different types of circuit breakers are differentiated6.2 Closing and opening systems of circuit breakers are explained6.3 Arc extinguishing systems are explained6.4 Method for accessing an air circuit breaker for inspection is analysed6.5 Function and operation of protection devices associated with air circuit breaker and molded case circuit breaker are examined |
| 7 Analyse function of emergency battery systems | <ul style="list-style-type: none">7.1 Different types and characteristics of batteries used for emergency supplies are identified7.2 Methods of battery charging and ways in which charge condition of the battery can be determined are explained7.3 Requirements of emergency supply and how transfer can occur without adversely affecting solid state components are explained7.4 Safety hazards associated with batteries, and procedures to be adopted to minimise explosion and short circuits are appraised |

8 Explain hazards associated with marine high voltage installations

- 8.1 Functional and operational requirements for a marine high voltage system are outlined
- 8.2 High voltage marine installations are identified
- 8.3 Design features of high voltage installations are explained
- 8.4 Risks and safety procedures associated with working in high voltage environments are identified
- 8.5 Procedure for assisting suitably qualified personnel to carry out maintenance and repair of high voltage installation is outlined

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required Skills:

- Assess own work outcomes and maintain knowledge of current codes, standards, regulations and industry practices
- Explain intermediate principles of electrical circuits, switchboards, alternators and circuit breakers
- Identify and interpret numerical and graphical information in electrical diagrams and specifications for a commercial vessel
- Identify and suggest ways of rectifying electrical hazards and emergency situations on a vessel
- Identify methods, procedures and materials needed for testing marine electrical systems
- Impart knowledge and ideas through verbal, written and visual means
- Read and interpret written information related to electrical circuitry and components on commercial vessels
- Use electrical measuring and testing instruments

Required Knowledge:

- Alternating current (AC)/direct current (DC) voltage
- Alternators – construction, characteristics, synchronised operation
- Batteries
- Circuit breakers
- Circuits
- Earthing
- Electrical measuring and testing instruments
- Electrical safe working practices
- Electrical symbols, basic electrical diagrams/circuits
- Emergency battery systems
- Fault finding procedures
- Isolation procedures
- Phase angle, power factor and current flow
- Procedures for dealing with hazards and emergencies
- Regulations of relevant state/territory maritime and electrical licensing authorities
- Resistance, inductance and capacitance
- Risks and safety procedures associated with working in high voltage environments
- Safety, environmental and hazard control precautions and procedures relevant to marine electrical systems
- Switchboards and protection – purpose, testing and maintenance, equipment removal

- Work health and safety (WHS)/occupational health and safety (OHS) legislation and policies

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, the required skills and knowledge, the range statement and the Assessment Guidelines for the Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the Elements, Performance Criteria, Required Skills, Required Knowledge and include:

- providing accurate and reliable information
- providing appropriate level of detail in responses.

Context of and specific resources for assessment

Performance is demonstrated consistently over time and in a suitable range of contexts.

Resources for assessment include access to:

- industry-approved marine operations site where intermediate knowledge of marine electrical systems can be demonstrated
- technical reference library with current publications on marine electrical systems
- tools, equipment and personal protective equipment currently used in industry
- relevant regulatory and equipment documentation that impacts on work activities
- range of relevant exercises, case studies and/or other simulated practical and knowledge assessments
- appropriate range of relevant operational situations in the workplace.

In both real and simulated environments, access is required to:

- relevant and appropriate materials and equipment
- applicable documentation including workplace procedures, regulations, codes of practice and operation manuals.

Method of assessment

Practical assessment must occur in an:

- appropriately simulated workplace environment and/or
- appropriate range of situations in the workplace.

A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate to this unit:

- direct observation of the candidate demonstrating intermediate knowledge of marine electrical systems
- direct observation of the candidate applying relevant WHS/OHS requirements and work practices.

Guidance information for assessment

Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

In all cases where practical assessment is used it should be combined with targeted questioning to assess Required Knowledge.

Assessment processes and techniques must be appropriate to the language and literacy requirements of the work being performed and the capacity of the candidate.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below.

- Systems and components may include:
- Motors
 - Transformers
- Switchboard layouts may include:
- DC systems
 - Dedicated power supplies
 - Dual supply for steering gear
 - Feed back and feed forward arrangements
 - Interconnection with low voltage
- Problems may include:
- Electric shock
 - Enclosed space work
 - Noncompliance with safe working procedures
 - Unfamiliar with marine electrical systems
 - Using equipment beyond safe working limits
 - Working at heights

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering