



Australian Government

MARL5001A Apply basic principles of marine electrotechnology

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 explain basic marine electrotechnology principles and to perform basic electrical calculations.

Application of the Unit

This unit applies to the work of Marine Engineering Watchkeepers on commercial vessels greater than 750 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Watchkeeper 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

- | | |
|---|--|
| 1 Explain how material properties affect resistance of electrical conductors | 1.1 Terms and symbols used in the formula for resistivity are used correctly
1.2 How resistance varies with changes in conductor length and cross sectional area is outlined
1.3 How resistance varies with temperature is outlined
1.4 Calculations are performed that illustrate how material properties affect resistance of electrical conductors |
| 2 Apply Ohm's Law to electrical circuits | 2.1 Main sources of EMF are identified
2.2 Terms and symbols used in Ohm's Law are used correctly
2.3 Calculations are performed using Ohm's Law to solve problems involving internal, external and variable resistances in both series and parallel circuits
2.4 Calculations are performed to determine power required and /or energy expended by electrical devices
2.5 Circuits for a wheatstone bridge and a slide wire bridge are sketched and their application on a ship is outlined
2.6 Calculations are performed dealing with resistances, currents and voltage drops in bridge circuits under null or balanced conditions |
| 3 Apply principles of electrolytic action to electrical cells | 3.1 How the theory of electrolytic disassociation when applied to common electrolytic solutions and electrode materials explains the generation of EMF from chemical sources, is outlined
3.2 Primary cells are distinguished from secondary cells
3.3 Calculations are performed to solve problems involving currents, voltage drops and terminal potential difference of cells connected to form batteries in series and in parallel
3.4 How capacity of a battery is measured is explained
3.5 Construction of typical batteries used in marine environments is outlined |
| 4 Apply principles of electromagnetism to EMF | 4.1 Form and properties of the magnetic fields surrounding single conductor and multi-turn solenoid coils when carrying an electrical current are compared and contrasted
4.2 Terms and symbols used in Faraday's and Lenz's laws of |

generation	electromagnetic induction are used correctly
	4.3 Calculations are performed using Faraday's and Lenz's laws of electromagnetic induction to solve problems related to electromagnetism and EMF generation
	4.4 Fleming's Right Hand Rule is outlined
5 Explain operation of direct current rotating machinery	5.1 Construction and methods of maintaining and repairing typical direct current (DC) machines are illustrated
	5.2 Principle wiring arrangements used with DC machines are outlined
	5.3 Action of the commutator in DC generators is outlined
	5.4 Significance of Back EMF (E_b) in the operation of DC motors is outlined
	5.5 Mathematical formula are applied to show relationships between <i>operational parameters of DC motors</i>
	5.6 Calculations are performed to solve simple problems relating to power output and efficiency in DC motors
6 Explain operation of AC rotating machinery	6.1 How three-phase AC may be developed out of simple single phase AC is explained
	6.2 Difference between Star and Delta connections is outlined
	6.3 How a three-phase supply can generate a rotating magnetic field is explained
	6.4 Construction of an AC synchronous generator is outlined
	6.5 Construction of an AC induction motor is outlined
	6.6 Calculations are performed to show how driving torque is produced in an induction motor
7 Explain parallel operation and load sharing of generator	7.1 Load/voltage curves of AC and DC generators are compared
	7.2 Main requirements for satisfactory power sharing between both AC and DC generators are outlined
	7.3 Sequences that occur when load changes on two DC generators working in parallel without an equaliser connection are outlined
	7.4 Effect of varying power factors on the load/voltage curve of an AC generator 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 basic principles of marine electrotechnology
- Identify and apply relevant mathematical formulas and techniques to solve basic problems related to marine electrotechnology
- Identify and interpret numerical and graphical information, and perform mathematical calculations such as resistance of electrical conductors, power output and efficiency in DC motors, and driving torque in induction motors
- Identify, collate and process information required to perform basic calculations related to marine electrotechnology
- Impart knowledge and ideas through verbal, written and visual means
- Read and interpret written information needed to perform basic electrical calculations
- Use calculators to perform mathematical calculations

Required Knowledge:

- AC:
 - rotating machinery
 - principles
- Basic electrical circuits
- Batteries
- DC:
 - rotating machinery
 - motors
- Difference between AC and DC
- Electrical:
 - current
 - power
 - safety
 - units of measurement
- Electromagnetic:
 - induction
 - force
- Ohm's Law
- Parallel circuits

- Principles of:
 - electromagnetism
 - electrolytic action
- Resistance
- Series circuits
- Work health and safety (WHS)/occupational health and safety (OHS) requirements and work practices

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:

- performing accurate and reliable calculations
- solving problems using appropriate laws and principles.

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 basic principles of marine electrotechnology can be applied
- electrical diagrams, specifications and other information required for performing basic electrical calculations
- technical reference library with current publications on basic marine electrotechnology
- 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 applying basic principles of marine electrotechnology
- 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.

Operational parameters of DC motors may include:

- current
- flux density
- torque
- voltage

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering