



Australian Government

MARL010 Apply basic principles of marine electrotechnology

Release: 1

MARL010 Apply basic principles of marine electrotechnology

Modification History

Release 1. New unit of competency.

Application

This unit involves the skills and knowledge required to explain basic marine electrotechnology principles and to perform basic electrical calculations.

This unit applies to the work of Marine Engineering Watchkeepers on commercial vessels greater than 750 kW.

This unit forms part of the requirements for the Certificate of Competency Marine Engineer Watchkeeper issued by the Australian Maritime Safety Authority (AMSA).

Pre-requisite Unit

Not applicable.

Competency Field

L – Marine Engineering

Unit Sector

Not applicable.

Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

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

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| | 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 generation | |
| | 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 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 |

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| | 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 operational parameters of DC motors |
| | 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 |

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Operational parameters of DC motors must include:

- current
- flux density
- torque
- voltage

Unit Mapping Information

This unit replaces and is equivalent to MARL5001A Apply basic principles of marine electrotechnology.

Links

Companion Volume implementation guides are found in VETNet -
<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>

Assessment Requirements for MARL010 Apply basic principles of marine electrotechnology

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least one occasion and include:

- applying relevant work health and safety/occupational health and safety (WHS/OHS) requirements and work practices
- assessing own work outcomes and maintaining knowledge of current codes, standards, regulations and industry practices
- identifying and applying relevant mathematical formulas and techniques to solve basic problems related to marine electrotechnology
- identifying and interpreting numerical and graphical information, and performing mathematical calculations such as resistance of electrical conductors, power output and efficiency in DC motors, and driving torque in induction motors
- identifying, collating and processing information required to perform basic calculations related to marine electrotechnology
- performing accurate and reliable calculations
- reading and interpreting written information needed to perform basic electrical calculations
- solving problems using appropriate laws and principles.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- AC:
 - rotating machinery
 - principles
- basic electrical circuits
- basic principles of marine electrotechnology
- batteries
- DC:
 - rotating machinery

- motors
- difference between AC and DC
- electrical:
 - current
 - power
 - safety
 - units of measurement
- electromagnetic:
 - induction
 - force
- effective verbal, written and visual communication techniques
- Ohm's Law
- parallel circuits
- principles of electromagnetism and electrolytic action
- resistance
- series circuits
- WHS/OHS requirements and work practices.

Assessment Conditions

Assessors must satisfy National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) assessor requirements.

Assessment must satisfy the National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) standards.

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

Assessment must occur in workplace operational situations or where these are not available, in simulated workplace operational situations or an industry-approved marine operations site that replicates workplace conditions where basic principles of marine electrotechnology can be applied.

Resources for assessment include access to:

- electrical diagrams, specifications and other information required for performing basic electrical calculations
- relevant and appropriate tools, equipment and personal protective equipment currently used in industry
- relevant documentation including workplace procedures, regulations, codes of practice and operation manuals
- technical reference library with current publications on basic marine electrotechnology.

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

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