Title	**Demonstrate knowledge of electrical theory for electromechanical maintenance and repair**		
Level	**3**	**Credits**	**9**

Purpose	This unit standard covers electricity knowledge for people intending to qualify in the electrical industry in electromechanical maintenance and repair. It provides the underpinning knowledge for those people who have responsibility for the refurbishment of electric machines. This includes dismantling, stripping, rewinding, assembling and testing electric machines. People credited with this unit standard are able to demonstrate knowledge of: – methods for e.m.f. production and elimination of static electricity for electromechanical maintenance and repair; – electrochemistry for electromechanical maintenance and repair; – magnetism for electromechanical maintenance and repair; – DC circuit parameters for electromechanical maintenance and repair; – resistors, capacitors, and inductors used in electrical systems; and – AC circuits for electromechanical maintenance and repair.

Classification	Electrical Engineering > Electrical Machines

Available grade	Achieved

Guidance information

1 This unit standard has been developed for learning and assessment off-job and can be completed by passing the Electrical Apparatus Service Association (EASA) distance learning module *Electricity I – Static and Current Electricity, Magnetism, Current, Resistance, and Potential Difference, Electrical components, Conductors, DC circuits, AC circuits, Electronics, Series Circuits, Parallel Circuits, Series-Parallel Circuits*.

2 Definitions
AC – alternating current.
DC – direct current.
e.m.f. – electromotive force.

3 For assessment purposes:
- a Candidates will be supplied with formulae involving more than three quantities.
- b Use of a calculator during assessment is permitted.
- c Candidates are expected to express calculated values in the relevant Système Internationale (SI) units, including multiples and sub-multiples, for example: pico (p) 10^{-12}; nano (n) 10^{-9}; micro (μ) 10^{-6}; milli (m) 10^{-3}; kilo (k) 10^{3}; mega (M) 10^{6}; Giga (G) 10^{9}; and to be able to convert between them.
- d Conventional current flow direction (positive to negative) is implied. Trainees should be aware of the opposite direction of electron flow.

4 Range
All evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with industry best practice and the Electrical Apparatus Service Association (EASA) Technical Manual.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of methods for e.m.f. production and elimination of static electricity for electromechanical maintenance and repair.

Performance criteria

1.1 Describe methods of producing an e.m.f. in terms of how it is achieved, and the relative magnitude of the voltage produced.

Range friction (static), chemical, magnetic, piezoelectric, photoelectric, thermopile.

1.2 State an example of a common device using each method of producing an e.m.f from 1.1.

1.3 Explain methods of eliminating static electricity in electrical installations.

Range bonding, grounding, static combs, humidity, conducting materials.

Outcome 2

Demonstrate knowledge of electrochemistry for electromechanical maintenance and repair.

Performance criteria

2.1 Describe the construction and operation of a primary cell and of a lead-acid battery with the aid of labelled sketches.

Range the descriptions and diagrams should reflect an understanding of the terms – primary cell, secondary cell, battery, electrolyte, specific gravity, electrodes, cathode, anode, charging, discharging; details of chemical reactions are not required.

2.2 Define battery capacity in terms of current and time.

2.3 Outline precautions that ensure safe charging of secondary batteries.

Outcome 3

Demonstrate knowledge of magnetism for electromechanical maintenance and repair.

Performance criteria

3.1 Explain the molecular domain theory of magnetism and the earth's magnetic field.

3.2 Explain magnetic terms in relation to permanent magnets and electromagnets.

Range magnetic lines of force, magnetic poles, magnetic flux, magnetic flux density, magnetising force.

3.3 Describe the direction of the magnetic field surrounding a current-carrying wire using any common rule, with the aid of a sketch.

3.4 Describe the configuration of an electromagnet with the aid of a sketch, indicating current direction in coil and magnet polarity using right hand rule.

3.5 Describe the effect of a current-carrying conductor in a magnetic field.

3.6 Identify practical application of electromagnets in the electromechanical industry.

Range may include but is not limited to – solenoids, contactors, relays, loudspeakers, lifting magnets, electric bells, moving coil instruments, electric door locks.

Outcome 4

Demonstrate knowledge of DC circuit parameters for electromechanical maintenance and repair.

Performance criteria

4.1 Describe the nature of electric current flow in conductors and insulators in terms of their atomic structure.

4.2 Define Ohm's Law.

4.3 Describe the relationship between resistance, voltage, potential difference and current in terms of the effect that a change in any one value has on the others.

4.4 Calculate circuitry values for given DC circuits.

Range series and parallel resistor combination and potential divider; maximum of five resistors in combinations.

4.5 Explain with examples the term resistivity of conductors.

4.6 Explain the term DC power dissipation in components connected in a DC circuit using calculation examples.

4.7 Explain the concept of insulation resistance of a dielectric material.

4.8 State the properties and application of commonly used insulating materials.

Range tapes, dielectric strength, temperature rating, flexibility, mechanical strength, moisture resistance.

4.9 Explain Kirchhoff's (current and voltage) laws with practical examples.

Outcome 5

Demonstrate knowledge of resistors, capacitors, and inductors used in electromechanical systems.

Performance criteria

5.1 Describe the construction of resistors, units used, typical resistance range, practical uses, colour code or labelling, symbols and typical power ratings.

Range may include but not limited to – wirewound, film, tapped, variable resistors.

5.2 Describe the construction of fixed capacitors, units used, typical capacitance range, practical uses, and typical voltage ratings.

Range may include but not limited to – ceramic, polyester, electrolytic.

5.3 State the types of inductors, units used, typical inductances found in components used in the electromechanical industry.

Range solenoids, relays, motor windings.

Outcome 6

Demonstrate knowledge of AC circuits for electromechanical maintenance and repair.

Performance criteria

6.1 Explain the advantages of using AC instead of DC in the electricity system.

6.2 Describe the AC output of a two-pole alternator with the aid of sketches.

6.3 Describe the effect capacitors and inductors have on the current flow in an AC electric circuit.

Range inductive and capacitance reactance, impedance, phase relationship between supply voltage and current.

Planned review date	31 December 2023

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	26 April 2019	N/A

Consent and Moderation Requirements (CMR) reference	0003

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

Comments on this unit standard

Please contact The Skills Organisation reviewcomments@skills.org.nz if you wish to suggest changes to the content of this unit standard.