Title	**Demonstrate knowledge of alternating current machines for electromechanical maintenance and repair**		
Level	**4**	**Credits**	**15**

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: – terms and specifications of AC machines; – single-phase asynchronous AC motors; – special single-phase AC motors; – three-phase synchronous AC motors; – three-phase asynchronous AC motors; and – maintenance and troubleshooting of AC machines.

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 *AC motors – Single-Phase Motors, Capacitor Motors, Repulsion Motors, Universal Motors, Special Motors, Motor Installation, Motor Maintenance, Induction Motors, Synchronous Motors, Multispeed Motors, Troubleshooting AC Motors*.

2 Definitions
AC – alternating current.
DC – direct current.
KVA – kilo voltage ampere.
NEMA – National Electrical Manufacturers Association.
RPM – revolutions per minute.

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 activities and 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 terms and specifications of AC machines.

Performance criteria

1.1 Explain terms used when describing AC machines.

Range may include but is not limited to – synchronous, asynchronous, electrical degrees, split phase, rotor, stator, induction motors, breakdown torque, full load toque, slip speed, locked rotor torque, shaft power, locked rotor torque, squirrel cage, centrifugal switch.

1.2 Describe NEMA motor standard for electrical machines nameplates.

Range may include but is not limited to – motor enclosures, phase, hertz, serial number, RPM, frame size, insulation class, shaft power, KVA, motor model, manufacturer, amps on full load, supply voltage, power factor.

Outcome 2

Demonstrate knowledge of single-phase asynchronous AC motors.

Performance criteria

2.1 Describe the construction and operation of a single-phase asynchronous induction motor.

Range may include but is not limited to – split phase, capacitor start, capacitor start capacitor run, reversible capacitor run, two speed capacitor run, centrifugal switched start winding.

2.2 Describe methods of single-phase motor configurations with the aid of circuit schematic sketches.

Range self-excited shunt, separately excited, compound, output voltage control.

2.3 Explain how a single-phase asynchronous induction motor can be reconfigured for reverse shaft rotation.

2.4 Describe and compare with the aid of sketches the speed, supply current and torque characteristics of single-phase asynchronous induction motors.

Range may include but is not limited to – split phase, capacitor start, capacitor run, reversible capacitor run, two speed capacitor run, centrifugal switched start winding, slip.

Outcome 3

Demonstrate knowledge of special single-phase AC motors.

Performance criteria

3.1 Describe the construction and operation of special single-phase induction motors.

Range may include but is not limited to – repulsion, universal, shaded pole, synchronous, wound rotor.

3.2 Explain the methods used to control shaft speed and shaft direction.

Range may include but is not limited to – repulsion, universal, shaded pole.

Outcome 4

Demonstrate knowledge of three-phase synchronous AC motors.

Performance criteria

4.1 Describe the construction and operation of three-phase synchronous induction motors.

Range may include but is not limited to – permanent magnet rotor, electromagnet rotor, salient pole rotor, stator, amortisseur winding, DC and brushless excitation.

4.2 Describe methods of starting synchronous induction motors.

4.3 Explain how shaft torque is developed and power factor can be controlled at synchronous speed.

Range may include but is not limited to – pull in and pull out torque, torque angle, over exciting, under exciting.

Outcome 5

Demonstrate knowledge of three-phase asynchronous AC motors.

Performance criteria

5.1 Describe the construction and operation of three-phase asynchronous induction motors.

Range may include but is not limited to – squirrel cage rotor, stator coils, pole-phase relationship, pole arrangement torque, rotor speed-frequency, speed-torque-slip-load current characteristics, delta-star winding configurations, dual voltages, multiple poles, stator winding methods.

5.2 Describe methods of starting three-phase asynchronous induction motors.

5.3 Explain how shaft torque is developed and shaft direction can be controlled in three-phase asynchronous induction motor.

5.4 Describe the relationship between rotor resistance, rotor reactance, power factor and rotor speed from zero to full load.

Outcome 6

Demonstrate knowledge of maintenance and troubleshooting of AC machines.

Performance criteria

6.1 Describe preventative maintenance requirements for AC machines.

6.2 Explain non-invasive maintenance testing procedure for AC machines.

Range may include but is not limited to – visual, observation no-load-on load operation, sound, vibration, oil and dust, starting current, shaft speed on no load and on load.

6.3 Explain fault locating in AC machines.

Range may include but is not limited to – testing stator windings, winding insulation, DC resistance of windings, high temperature, capacitor testing, centrifugal switches, bearings, armature open circuits, armature short circuits, brush tension, commutator wear, brush sparking, electrical and mechanical vibration, overheating, lack of torque.

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.