Title	**Demonstrate and apply knowledge of single-phase and three-phase rotating machines**		
Level	**3**	**Credits**	**4**

Purpose	This unit standard covers theory of single-phase rotating machines for electricians and related trades. People credited with this unit standard are able to: – demonstrate knowledge of single-phase and three-phase generation; – demonstrate knowledge of single-phase motors; – apply knowledge of single-phase motors; – diagnose single-phase motor faults; – demonstrate knowledge of three-phase induction motors; – apply knowledge of three-phase motors; and – diagnose a three-phase motor fault.

Classification	Electrical Engineering > Core Electrical

Available grade	Achieved

Guidance Information

1 This unit standard has been developed for learning and assessment off-job.

2 This unit standard and unit standards 29443 and 29444 together meet the assessment requirements of ERAC CEPC 13.
This unit standard and unit standards 29420, 29443, and 29444 meet the assessment requirements of ERAC EPC 15.
This unit standard and unit standards 15848, 29420, 29421, 29422, 29443, 29444, and 29481, 29557 meet the assessment requirements of ERAC CEPC 54.

3 Definitions
CEPC – Critical Essential Performance Capability.
d.c. – direct current.
EPC – Essential Performance Capability.
ERAC – Electrical Regulatory Authorities Council.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
Safe and sound practice – as it relates to the installation of electrical equipment is defined in AS/NZS 3000:2007, *Electrical Installations (known as the Australian/New Zealand Wiring Rules).*

4 Range
- a Candidates are to be supplied with formulae involving more than three quantities.
- b Standard symbols to be used for all assessments.
- c Use of a calculator during assessment is permitted.
- d Candidates are expected to express calculated values in the relevant Système International (SI) units, including multiples and sub-multiples (pico, nano, micro, milli, kilo, mega, etc) and be able to convert between them.
- e Candidates may refer to current legislation and Standards during assessment.
- f Demonstration of safe working practices and installation in accordance with *safe and sound practice* are essential components of assessment of this unit standard.
- g All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with:
  - i legislation;
  - ii policies and procedures;
  - iii ethical codes;
  - iv Standards – may include but are not limited to those listed in Schedule 2 of the Electricity (Safety) Regulations 2010;
  - v applicable site, enterprise, and industry practice; and,
  - vi where appropriate, manufacturers' instructions, specifications, and data sheets.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of single-phase and three-phase generation.

Performance criteria

1.1 With the aid of a sketch describe the construction and operating principles of generators.

1.2 Graph the alternator output through one revolution.

1.3 Carry out calculations involving the number of poles, speed, and frequency for single-phase generators from given data.

1.4 Define Watts and convert between Watts and horsepower for electric motors.

Outcome 2

Demonstrate knowledge of single-phase motors.

Range motors – universal, shaded-pole, standard split-phase induction, capacitor-start, permanently-split capacitor, capacitor start and run.

Performance criteria

2.1 Describe motor construction and identify all components with the aid of a diagram or from physical examples.

2.2 Identify types of motor enclosures and state the features of each.

2.3 Describe operating principles in terms of starting, production of rotating magnetic field, and production of torque.

2.4 Describe speed control methods, where achievable.

2.5 Describe method of reversal of rotation with the aid of a diagram.

2.6 State a typical application for each type of motor and give reasons for the suitability of the choice.

2.7 Identify types of motor enclosures and state the features of each.

Outcome 3

Apply knowledge of single-phase motors.

Performance criteria

3.1 Test motor to ensure safe operation.

Range visual, earth continuity, insulation resistance.

3.2 Connect three motors for safe operation.

Range may include but is not limited to – universal, shaded-pole, standard split-phase induction, capacitor-start, permanently-split capacitor, capacitor start and run.

3.3 Connect three motors to change direction.

Range may include but is not limited to – universal, shaded-pole, standard split-phase induction, capacitor-start, permanently-split capacitor, capacitor start and run.

Outcome 4

Diagnose single-phase motor faults.

Performance criteria

4.1 Diagnose a single-phase motor fault and identify potential remedies.

4.2 Identify potential remedies and establish viability of repair.

Outcome 5

Demonstrate knowledge of three-phase induction motors.

Performance criteria

5.1 With the aid of diagrams and with reference to components, describe the construction of three-phase induction motors.

5.2 Explain the operating principles of three-phase induction motors in terms of the action of the rotating magnetic fields, the interactions of stator and rotor fluxes, and methods of starting.

5.3 With the aid of a diagram describe methods of rotation reversal.

5.4 With the aid of a sketch describe star and delta motor connections.

5.5 Sketch and label speed versus torque curves that show starting torque, running torque, rated torque, pull-out speed, and rated speed.

Range motors – squirrel cage, wound rotor with slip-rings, double cage rotor.

5.6 State a typical motor application with reasons for the suitability of the choice.

Range motors – squirrel cage, wound rotor with slip-rings, double cage rotor.

Outcome 6

Apply knowledge of three-phase motors.

Performance criteria

6.1 Test motor to ensure safe operation.

Range visual, earth continuity, insulation resistance.

6.2 Connect an induction motor and a slip ring motor for safe operation.

Range star, delta.

6.3 Connect an induction motor and a slip ring motor to change direction.

Outcome 7

Diagnose a three-phase motor fault.

Performance criteria

7.1 Diagnose a three-phase motor fault and identify potential remedies.

7.2 Identify potential remedies and establish viability of repair.

This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	21 July 2016	31 December 2027
Review	2	25 May 2023	31 December 2027

Consent and Moderation Requirements (CMR) reference	0003

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