Title	**Demonstrate knowledge of d.c. and a.c. machines used for small scale renewable energy systems**		
Level	**4**	**Credits**	**5**

Purpose	This unit standard is for people who work with renewable energy systems and covers knowledge of d.c. and a.c. machines for use with small scale renewable energy systems. People credited with this unit standard are able to demonstrate knowledge of the construction, operating characteristics, and application of: – d.c. motors and generators; and – single-phase and three-phase a.c. machines.

Classification	Renewable Energy Systems > Renewable Energy Systems - Generic

Available grade	Achieved

Guidance Information

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

2 References
All references to Australian Standards (AS) may be found at www.standards.org.au;
All Australian/New Zealand Standards (AS/NZS) may be found at http://www.standards.org.nz/;
AS/NZS 5139:2019, Electrical installations - Safety of battery systems for use with power conversion equipment;
AS/NZS 3000:2018, Electrical installations (known as the Australian/New Zealand Wiring Rules);
AS/NZS 3010:2017, Electrical installations - Generating sets;
AS/NZS 4509.1:2009, *Stand-alone power systems - Part 1: Safety and installation*;
AS/NZS 4509.2:2010 *Stand-alone power systems - Part 2: System design*;
Electricity (Safety) Regulations 2010;
Electricity Act 1992;
and all subsequent amendments and replacements.

3 Definitions
a.c. – alternating current.
Current regulations and standards – in this unit standard this term is used to refer to the requirements of the above references.
d.c. – direct current.

Enterprise policies and procedures – those practices and procedures that have been promulgated by the company or enterprise for use by their employees.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.

4 Range
- a All measurements are to be expressed in Système Internationale (SI) units, and where required, converted from Imperial units into SI units.
- b Candidates shall be supplied by the assessor with formulae involving more than three quantities.
- c Use of a calculator during assessment is permitted.
- d All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with legislation, enterprise policies and procedures, ethical code, current regulations and standards, industry practice; and where appropriate, manufacturers' instructions, specifications, and data sheets.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of the construction, operating characteristics, and application of d.c. motors and generators.

Performance criteria

1.1 Describe functions of the major components of d.c. motors and d.c. generators.

Range three functions.

1.2 Describe types of excitation used for d.c. motors and generators.

Range self excitation, separate excitation.

1.3 Describe methods of changing the rotation direction of d.c. motors.

Range two types of d.c. motors.

1.4 Calculate the energy conversion efficiency of a d.c. motor or d.c. generator from measured or nameplate data.

1.5 Outline maintenance required on d.c. motors and generators used in small scale renewable energy systems.

1.6 Identify common faults on d.c. motors and generators and outline remedial actions.

Range common faults include but are not limited to – failure to self excite.

1.7 Select d.c. motors and d.c. generators for given applications in small scale renewable energy systems.

Range two d.c. motors, two d.c. generators

Outcome 2

Demonstrate knowledge of the construction, operating characteristics, and application of single-phase and three-phase a.c. machines.

Performance criteria

2.1 Describe types of single-phase a.c. machines and their main features.

Range machines include – motor, generator.

2.2 Describe the functions of the major components of an a.c. generator and a squirrel cage induction motor.

Range three functions each for an a.c. generator and a squirrel cage induction motor.

2.3 Describe the method of voltage control on alternators with brushless excitation.

2.4 Explain the reason an induction machine does not operate at synchronous speed.

2.5 Calculate the synchronous speed of an a.c. machine.

2.6 Describe the starting characteristics of induction motors and their implication for running induction motors from stand-alone power systems.

2.7 Describe methods of changing the rotation direction of a.c. motors.

Range two types of a.c. motors.

2.8 Calculate the energy conversion efficiency of an a.c. motor or a.c. generator from measured or nameplate data.

2.9 Select a.c. motors and a.c. generators for given applications in small scale renewable energy systems.

Range two a.c. motors, two a.c generators.

Planned review date	31 December 2026

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	21 July 2011	31 December 2020
Review	2	24 October 2019	N/A
Rollover and Revision	3	27 March 2025	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 Waihanga Ara Rau Construction and Infrastructure Workforce Development Council qualifications@waihangaararau.nz if you wish to suggest changes to the content of this unit standard.