Title	**Demonstrate knowledge of single-phase and three-phase transformers**		
Level	**3**	**Credits**	**3**

Purpose	This unit standard is for people in the electrical and related trades and covers the theory of single-phase and three-phase transformers. People credited with this unit standard are able to: – demonstrate knowledge of construction and operating principles of single-phase transformers; – determine single-phase transformer characteristics by measurement; – demonstrate knowledge of single-phase transformer applications; – demonstrate knowledge of instrument transformers; – describe the construction of three-phase power transformers; – describe three-phase transformer applications; and – demonstrate knowledge of single-phase and three-phase transformer safety requirements.

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 25072, 29445 and 29470 together meet the assessment requirements of ERAC EPC 7.
This unit standard meets the assessment requirements of ERAC EPC 9.
This unit standard and unit standards 1204, 2016 and 29477 together meet the assessment requirements of ERAC CEPC 16.
This unit standard and unit standards 15848 and 29445 together meet the assessment requirements of ERAC EPC 18.
This unit standard and unit standard 29445 together meet the assessment requirements of ERAC CEPC 19.

3 Definitions
a.c. – alternating current.
CEPC – Critical Essential Performance Capabilities.
EPC – Essential Performance Capabilities.
ERAC – Electrical Regulatory Authorities Council.

EWRB – Electrical Workers Registration Board.
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 may refer to current legislation and Standards during assessment.
- b Demonstration of safe working practices and installation in accordance with *safe and sound practice* are essential components of assessment of this unit standard.
- c 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 construction and operating principles of single-phase transformers.

Range double-wound transformer, auto-transformer.

Performance criteria

1.1 Describe transformer construction with the aid of a sketch and with reference to cores and windings.

1.2 Describe operating principle and regulation using tap changing of mutual induction transformers and self-induction transformers.

1.3 Describe the purpose of single-phase transformers used in the domestic, commercial, industrial, and electricity supply industries.

Outcome 2

Determine single-phase transformer characteristics by measurement.

Range isolating transformer, step-down double-wound transformer, auto-transformer.

Performance criteria

2.1 Measure and record voltages across and currents through a resistive load connected to each type of transformer.

2.2 Explain variations between measured and nameplate values in terms of supply variations, transformer losses, and measurement error.

2.3 Explain the difference between volt-amps and watts with reference to reactive and resistive loads.

Outcome 3

Demonstrate knowledge of single-phase transformer applications.

Performance criteria

3.1 Compare double-wound and auto-transformers.

Range physical size, cost and complexity for similar volt-amp, operating voltage ranges, response to load changes (regulation), ambient temperature, ease of cooling, operational requirements.

3.2 State common transformer applications.

Range double-wound transformer – step up and step down of voltage and current, safety isolation, safety extra-low-voltage source, instrumentation;
auto-transformer – reduced-voltage motor starters, voltage regulation, variable-voltage supplies.

3.3 State requirements of current regulations and Standards with respect to transformers.

Range extra-low voltage circuits, electric toys, medical and dental apparatus, high-voltage discharge lamps, restrictions for auto-transformers.

3.4 Describe the purpose of single-phase transformers in terms of domestic, commercial, industrial and electricity supply application and give reasons for the selection.

Outcome 4

Demonstrate knowledge of instrument transformers.

Performance criteria

4.1 Describe voltage transformers with reference to typical connections, standard voltage ranges, and burden.

4.2 Describe current transformers in terms of principle of operation, typical connections, standard current ranges, burden, and safety precautions.

Range current transformer types – bar, wound primary, measurement and protection types.

4.3 Describe reasons for using instrument transformers in terms of measurement convenience, and personal and property safety.

Range isolation, reduction of voltage and current, remote measurement, metering, indication.

Outcome 5

Describe the construction of three-phase power transformers.

Performance criteria

5.1 Describe core assembly for shell and core type transformers.

Range material, shape, limbs, yokes.

5.2 State position of high and low voltage windings on the core with the reasons for the choice in terms of heat dissipation and maximum insulation for the high voltage winding.

5.3 Describe star and delta winding connection methods and draw diagrams to show all possible configurations for primary and secondary windings.

5.4 Describe cooling arrangements for three-phase power transformers.

Range dry, oil-filled, plain radiator, forced air radiator.

5.5 Describe alarm and protection devices.

Range temperature, oil level, over current relay, Buchholz relay.

Outcome 6

Describe three-phase transformer applications.

Performance criteria

6.1 Describe the purpose of three-phase transformers in terms of domestic, commercial, industrial and electricity supply applications and give reasons for the selection.

Outcome 7

Demonstrate knowledge of single-phase and three-phase transformer safety requirements.

Performance criteria

7.1 Explain potential hazards associated with transformers.

7.2 Explain precautions to be observed when working with transformers.

Replacement information	This unit standard and unit standard 29445 replaced unit standard 15850 and unit standard 15857.

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
Revision	2	16 March 2017	31 December 2027
Review	3	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.