

Title	Demonstrate advanced knowledge of electrical power transformers		
Level	5	Credits	7

Purpose	<p>This unit standard is intended for use in the training and assessment of electricians beyond trade level. It covers theory of power transformers at a level more advanced than the requirements for the National Certificate in Electrical Engineering (Electrician for Registration) (Level 4) [Ref: 1195].</p> <p>People credited with this unit standard are able to demonstrate knowledge of:</p> <ul style="list-style-type: none"> – the construction of high voltage power transformers; – connections and phase displacements of three-phase transformers; – phasor diagrams applied to transformer performance; – transformer calculations; – the treatment of transformer insulating oil; – transformer cooling and accessories; and – power transformer tap changing.
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Classification	Electrical Engineering > Core Electrical
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Available grade	Achieved
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Guidance Information

- 1 Recommended skills and knowledge:
National Certificate in Electrical Engineering (Electrician for Registration) (Level 4) [Ref: 1195] or equivalent trade qualification for electricians.
- 2 This unit standard has been developed for learning and assessment off-job.
- 3 Definition
kVA – kilo volt amps.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of the construction of high voltage power transformers.

Performance criteria

1.1 Magnetic circuit is described for single-phase and three-phase transformers.

Range core type, shell type, two limb, three limb, five limb.

1.2 Winding construction and placement is described.

Range concentric winding; disc or sandwich winding; relative positions of higher voltage and lower voltage windings; tertiary winding for harmonic elimination.

Outcome 2

Demonstrate knowledge of connections and phase displacements of three-phase transformers.

Performance criteria

2.1 Terminals, phasor symbols, phase displacement, and winding connections are interpreted from the international codes for three-phase transformers.

Range codes – Yy0, Dd0, Yy6, Dd6, Dy1, Yd1, Dy11, Yd11; evidence of three is required, covering different phase displacements.

2.2 Conditions for parallel operation of transformers are stated in terms of phase sequence, phase shift, and secondary line voltage.

2.3 Industry-recommended relative values of regulation for parallel operation are stated.

Outcome 3

Demonstrate knowledge of phasor diagrams applied to transformer performance.

Performance criteria

3.1 Phasor diagrams are drawn for an ideal transformer, and a practical transformer at no-load and on-load.

Range load power factor of unity, load power factor lagging.

Outcome 4

Demonstrate knowledge of transformer calculations.

Performance criteria

4.1 Transformer efficiency and all-day efficiency are calculated from given data for different load conditions, and the conditions for maximum efficiency are determined.

Range given data – transformer kVA, iron loss, full load copper loss; load conditions – full load, partial load, unity power factor, power factor at less than unity.

4.2 Voltage regulation of a transformer is calculated from no-load and full load secondary voltages, and the impedance voltage from short circuit test data.

Range regulation – per unit, percentage.

4.3 Prospective short circuit current of a transformer is calculated from given data, assuming negligible short circuit impedance across the secondary.

Range given data – secondary full load current and voltage, no-load secondary voltage.

Outcome 5

Demonstrate knowledge of the treatment of transformer insulating oil.

Performance criteria

5.1 Common contaminants are stated with their effect on the insulating properties of the oil.

Range common contaminants – water, solid particles, acids, sludge.

5.2 Tests for quality of transformer insulating oil are described with reference to test principles and procedures.

Range common tests – acid test, electric strength test, crackle test.

5.3 Methods of reconditioning transformer insulating oil by filtration are identified with a brief description of the processes used.

Range methods – filter press, streamline filter.

Outcome 6

Demonstrate knowledge of transformer cooling and accessories.

Performance criteria

6.1 Principles and applications of transformer cooling methods are described.

Range methods – plain tank, tubed tank, finned radiators, air fans, oil pump.

6.2 Cooling methods are identified from letter symbols.

Range at least three different methods using four-letter combinations from – oil, air, natural, forced, directed.

6.3 The purpose and operating principles of power transformer accessories are explained.

Range accessories – conservator tank, Buchholz relay, relief or explosion vent, temperature gauges.

Outcome 7

Demonstrate knowledge of power transformer tap changing.

Performance criteria

7.1 Reasons for, and methods of, tap changing are explained.

Range methods – off-load, on-load.

7.2 The features and operation of an on-load tap changer are explained.

Range reason for location of tappings, selector switch, transition process from tapping to tapping.

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	26 February 2002	31 December 2013
Review	2	19 June 2009	31 December 2021
Rollover and Revision	3	15 March 2012	31 December 2021
Revision	4	15 January 2014	31 December 2021
Review	5	28 January 2021	31 December 2021

Consent and Moderation Requirements (CMR) reference	0003
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.