

<b>Title</b>	<b>Demonstrate knowledge of three-phase transformers</b>		
<b>Level</b>	<b>4</b>	<b>Credits</b>	<b>3</b>

<b>Purpose</b>	<p>This unit standard covers the theory and measurement of three-phase transformers for people in the electrical and related trades.</p> <p>People credited with this unit standard are able to:</p> <ul style="list-style-type: none"> <li>– describe the construction of three-phase power transformers;</li> <li>– demonstrate knowledge of transformer losses;</li> <li>– demonstrate knowledge of three-phase transformer theory; and</li> <li>– make and verify three-phase transformer measurements.</li> </ul>
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<b>Classification</b>	Electrical Engineering > Core Electrical
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<b>Available grade</b>	Achieved
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**Explanatory notes**

- 1 This unit standard has been developed for learning and assessment off-job.
- 2 For assessment purposes
  - a Candidates shall 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 International (SI) units, including multiples and sub-multiples (pico, nano, micro, milli, kilo, mega, etc) and be able to convert between them.

**Outcomes and evidence requirements**

**Outcome 1**

Describe the construction of three-phase power transformers.

**Evidence requirements**

- 1.1 Core assembly is described for shell and core type transformers.
 

Range material, shape, limbs, yokes.
- 1.2 Position of high and low voltage windings on the core is stated with the reasons for the choice in terms of heat dissipation and maximum insulation for the high voltage winding.

1.3 Star and delta winding connection methods are described, and diagrams are drawn to show all possible configurations for primary and secondary windings.

1.4 Cooling arrangements are described for three-phase power transformers.

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

1.5 Alarm and protection devices are described.

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

## Outcome 2

Demonstrate knowledge of transformer losses.

### Evidence requirements

2.1 Variable transformer losses are explained in terms of load current, winding resistance, and variation with load.

Range copper loss ( $I^2R$  loss),  $\propto I^2$ .

2.2 Constant transformer losses are explained, and methods of reduction are stated in terms of material selection during transformer manufacture.

Range constant transformer losses – hysteresis loss, eddy-current loss.

## Outcome 3

Demonstrate knowledge of three-phase transformer theory.

### Evidence requirements

3.1 The relationship between line and phase values of voltage, current, and volt-amps (VA) are stated for star and delta winding configurations.

3.2 Transformer values are calculated from given data for different winding configurations.

Range values – primary and secondary voltage and current, turns ratio, VA rating; configurations – star-star, delta-delta, star-delta, delta-star.

3.3 The effect of load current on the secondary terminal voltage of a transformer is illustrated with the aid of calculations, and the use of tap changing to overcome this effect is described.

3.4 Transformer efficiencies are calculated from given data for different values of secondary load.

**Outcome 4**

Make and verify three-phase transformer measurements.

Range transformers – star-star, delta-delta, star-delta, delta-star;  
values – primary and secondary turns, voltage, current, VA.

**Evidence requirements**

- 4.1 Measurements are made according to industry practice.
- 4.2 Results are compared with nameplate values, and variations explained in terms of supply variations, non-linear components, transformer losses, and instrument and measurement errors.

<b>Replacement information</b>	This unit standard replaced unit standard 1703. This unit standard and unit standard 15850 have been replaced by unit standard 29473 and unit standard 29445.
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**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	10 February 1999	31 December 2013
Review	2	26 May 2005	31 December 2021
Rollover and Revision	3	15 March 2012	31 December 2021
Revision	4	15 January 2014	31 December 2021
Review	5	21 July 2016	31 December 2021

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

**Please note**

Providers must be granted consent to assess against standards (accredited) by NZQA, before they can report credits from assessment against unit standards or deliver courses of study leading to that assessment.

Industry Training Organisations must be granted consent to assess against standards by NZQA before they can register credits from assessment against unit standards.

Providers and Industry Training Organisations, which have been granted consent and which are assessing against unit standards must engage with the moderation system that applies to those standards.

Requirements for consent to assess and an outline of the moderation system that applies to this standard are outlined in the Consent and Moderation Requirements (CMR). The CMR also includes useful information about special requirements for organisations wishing to develop education and training programmes, such as minimum qualifications for tutors and assessors, and special resource requirements.

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