



Australian Government

MEM18102 Fault-find, test and rectify single and three-phase transformers

Release: 3

MEM18102 Fault-find, test and rectify single and three-phase transformers

Modification History

Release 3. Prerequisite units updated

Release 2. Minor adjustments to reflect ERAC requirements for electrician licensing and revision of Essential Performance Capabilities

Release 1. New unit

Application

This unit of competency has been developed for Engineering Tradesperson – industrial electrician apprenticeship training and the recognition of trade-level skills in fault finding and rectifying single and three-phase transformers.

It includes the operating principles of transformers, their construction and open circuit and full load characteristics; types of transformers used in transmission and distribution systems, appliances and welding machines; hazards associated with step and touch voltages, induced voltages and stored energy particularly with high voltages; earthing requirements to limit the rise of touch voltage; safe working procedures for connecting and testing and fault finding transformers.

This unit covers the skills and knowledge required to meet the Electrical Regulatory Authorities Council (ERAC).

Essential Performance Capabilities (EPCs):

- EPC 18 – Describe the basic construction, principles of operation, and typical applications of the main types of transformers.

And

Essential Performance Capabilities (EPCs) classified as ‘critical’:

- EPC 19 – List the key safety issues of various types of transformers, including AS/NZS 3000 requirements.
- EPC 48 – Demonstrate knowledge and understanding of the significant dangers of High Voltage equipment and distribution systems.

Some jurisdictions require the holder of this unit to be licensed or certified and users should check with the relevant authorities.

Band: A

Unit Weight: 4

Pre-requisite Unit

MEM10016	Terminate and test electrical wiring and accessories
MEM10018	Select cable types and sizes to suit loads and electrical installation environment
MEM10019	Select circuit protection devices by type and rating, fit to switchboards and install earthing
MEM12023	Perform engineering measurements
MEM18001	Use hand tools
MEM18104	Dismantle, replace and assemble electrical components and equipment

Competency Field

Maintenance and diagnostics

Elements and Performance Criteria

Elements describe the essential outcomes.		Performance criteria describe the performance needed to demonstrate achievement of the element.	
1. Determine job requirements	1.1	Follow standard operating procedures (SOPs)	
	1.2	Comply with work health and safety (WHS) requirements at all times, including appropriate risk control measures	
	1.3	Use appropriate personal protective equipment (PPE) in accordance with SOPs	
	1.4	Research the nature of the fault through checking of documentation and/or consultation with appropriate person	
2. Prepare to fault find single and three-phase transformers and associated circuits	2.1	Obtain all necessary tools, equipment and testing instruments needed to conduct fault diagnosis of single and three-phase transformers and circuits	
	2.2	Isolate and tag circuits and equipment in accordance with procedures	

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

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| 3. | Fault find single and three-phase transformers and associated circuits | 3.1 | Apply diagnostic techniques to fault find single and three-phase transformers and associated circuits using appropriate test equipment |
| | | 3.2 | Remove/repair/replace faulty components/circuits in accordance with manufacturer specifications and regulatory requirements |
| | | 3.3 | Test single and three-phase transformers associated circuits to ensure functionality in accordance with specifications |
| | | 3.4 | Carry out routine maintenance on transformers, including oil testing, silica gel change and bushing repairs, where applicable |
| | | 3.5 | Document all necessary repairs in accordance with SOPs |

Foundation Skills

This section describes those required skills (reading, writing, oral communication and numeracy) that are essential to workplace performance in this unit of competency.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

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| Transformers include two (2) or more of the following: | <ul style="list-style-type: none">• instrument• current• voltage• oil filled transformers• high voltage (HV) power transformers• low voltage (LV) power transformers• neutral• distribution:<ul style="list-style-type: none">• step up• step down |
| Regulatory requirements include: | <ul style="list-style-type: none">• AS/NZS 3000:2007 Electrical installations (known as the Australian/New Zealand Wiring Rules) |
| Safe working practices include: | <ul style="list-style-type: none">• demonstration of safe working practices and installation in accordance with industry established safe and sound practices |

Unit Mapping Information

Release 2. Equivalent. Minor adjustments to reflect ERAC requirements for electrician licensing and revision of Essential Performance Capabilities.

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

Assessment Requirements for MEM18102 Fault-find, test and rectify single and three-phase transformers

Modification History

Release 3. Prerequisite units updated

Release 2. Minor adjustments to reflect ERAC requirements for electrician licensing and revision of Essential Performance Capabilities

Release 1. New unit

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria on at least two (2) occasions and include:

- following work instructions, standard operating procedures (SOPs) and safe work practices
- identifying and interpreting circuits, drawings and specifications relevant to the work to be undertaken
- determining the electrical and non-electrical isolation requirements to prevent the creation of hazards linked from the loss of machine/system/process control according to established procedures
- using lock out tag procedures with appropriate tags/signs
- proving electrical isolation and following established safety rules prior to working on electrical equipment or wiring
- ensuring all electrical equipment and tools are tested and tagged and up to date
- observing work health and safety (WHS) precautions and considerations when dealing with instrument transformers especially current transformers and high voltage equipment
- applying fault finding and diagnostic techniques on at least two (2) or more of the following single and three-phase transformers and their associated control circuits:
 - instrument
 - current
 - voltage
 - oil filled transformers
 - high voltage power transformers
 - low voltage power transformers
 - neutral
 - distribution:
 - step up
 - step down
- complying with the Australian/New Zealand Wiring Rules for the installation and safety requirements of transformers, including limiting the rise of touch voltages

- performing the following tests in accordance with specifications and regulatory requirements:
 - basic insulation resistance, continuity and winding identification tests
 - open and short circuit tests
- carrying out routine maintenance on transformers
- documenting all necessary repairs in accordance with SOPs.

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- safe work practices and procedures and use of personal protective equipment (PPE)
- operating principles of transformers, including:
 - principles of mutual induction and how it relates to a transformer
 - phasor diagram for a transformer on no-load and the voltage and current components
 - factors that determine the value of induced voltage in a transformer winding
 - transformers ratios both voltage and current
 - calculate the value of output voltage given the input voltage and turns ratio of a transformer
- transformer losses, including:
 - eddy current losses and the use of laminations to reduce this effect
 - hysteresis losses and core materials to reduce this effect
 - copper losses also referred to as primary/secondary losses or I²R losses
 - transformer efficiency and the effect flux leakage has on it and its related formula, i.e.

$$\text{transformer efficiency} = \frac{\text{output}}{\text{output} + \text{losses}}$$

- voltage regulation as applicable to a transformer and its related formula, i.e.

$$\text{voltage regulation} = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100\%$$

- power in a transformer, i.e. power in = power out
- impedance ratio and reflected impedance
- percentage impedance as applied to transformers and how its value affects the value of the available short-circuit current
- calculating the percentage impedance of a transformer and determine the percentage impedance of a transformer from test results
- transformer construction, including:
 - single and three-phase transformer cores and winding arrangements
 - transformer ratings, i.e. in kVA
 - relationship between transformer cooling and rating
 - methods used for natural and forced cooling of transformers
 - properties and tests that are conducted on transformer oil
 - winding polarities and polarity identification of single and three-phase transformers

- four common methods of connecting the primary and secondary windings of a three-phase transformer, i.e. star-star, delta-delta, delta-star and star-delta
- three-phase tertiary windings and the purpose they perform
- changing transformer ratios, i.e. off-load and on-load changing
- transformer auxiliary equipment and their function (bushings, surge-diverters, tap-changers, hot oil and winding indicators, breather, Buchholz relay and conservator)
- application of transformers, including welders
- paralleling of single-phase transformers, including:
 - ensuring their voltages are equal
 - instantaneous polarities are identical
 - consequences of incorrectly phased transformers
- paralleling of three-phase transformers, including:
 - the need for paralleling
 - ensuring they are of equal voltages, same phase sequence and phase voltages are in step and the consequences if they are not
- testing of transformers, including:
 - performing basic insulation resistance, continuity and winding identification tests
 - testing of final connections, i.e. in star, delta and open-delta configurations and transformer ratio
 - safe working procedures when connecting and testing transformers
 - open and short circuit tests
 - dielectric tests
- special transformers, including:
 - potential and current transformers and the reason why they are used
 - construction and application of potential and current transformers
 - work health and safety (WHS) hazards associated with instrument transformers especially current transformers where the secondary must never be open-circuited under any circumstances as it will cause a potentially dangerous voltage to be present at the secondary terminals
 - instrument transformer load or burden ratings
 - safe working procedures of potential and current transformers
 - commissioning and testing instrument transformers
 - transformers with multiple secondaries and tapped windings
 - advantages and disadvantages of auto-transformers
 - calculate the voltage and current in the windings of an auto-transformer
 - high-reactance or leakage transformers
 - applications of auto-transformers and instrument transformers
- Australian/New Zealand Wiring Rules installation and safety requirements for transformers
- dangers of high voltage equipment and distribution systems, including:

- step and induced voltages
- sources of induced voltage and stored energy
- creepage and clearance requirements
- application of safe working procedures in the vicinity of high voltage equipment.

Assessment Conditions

- Assessors must:
 - have vocational competency in fault finding, testing and rectifying single and three-phase transformers at least to the level being assessed with relevant industry knowledge and experience
 - satisfy the assessor requirements in the *Standards for Registered Training Organisations 2015* and comply with the *National Vocational Education and Training Regulator Act 2011* or equivalent legislation covering VET regulation in a non-referring State as the case requires.
- Where possible assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions. This must cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- Conditions for assessment must include access to all tools, equipment, materials and documentation required, including relevant workplace procedures, product and manufacturing specifications.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Links

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