

Title	Demonstrate knowledge of electrical theory for Electrical Service Technicians – A		
Level	3	Credits	4

Purpose	<p>'Electrical Service Technician – A' (EST – A) refers to a class of electrical registration for people who need to service electrical appliances and equipment designed to connect to a single-phase supply by flexible cord and plug, and rated at no more than 230 volts, 10 amps. Registration is the responsibility of the Electrical Workers Registration Board.</p> <p>People credited with this unit standard are able to demonstrate knowledge of:</p> <ul style="list-style-type: none"> – alternating current (a.c.) and direct current (d.c.) systems of supply; – the multiple-earthed neutral (MEN) system of supply and associated earthing requirements; – electrical fittings and components, and their uses; – electronic components; flexible cords; electrical appliances; and – electrical power, energy, and efficiency.
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Classification	Electrical Engineering > Core Electrical
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Available grade	Achieved
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Guidance Information

- 1 This unit standard has been developed for learning and assessment off-job.
- 2 This unit standard, together with Unit 10934, *Demonstrate knowledge of safety, protection, and testing for Electrical Service Technicians – A*; Unit 10935, *Demonstrate knowledge of regulations and codes of practice for Electrical Service Technicians – A*; and Unit 10936, *Demonstrate practical skills required for Electrical Service Technicians – A*, and their prerequisites, are designed to meet the *safety instruction, theory examination, and practical assessment* requirements for registration as an Electrical Service Technician 'A' (EST – A). For details of additional registration requirements, that is, work experience, candidates should contact the Electrical Workers Registration Board, PO Box 10156, Wellington, telephone: 0800 661 000.
- 3 Training courses designed to prepare candidates for credit in this unit standard must meet the requirements of the *Electricity Regulations 1997, Schedule 2*, and the *Teaching Guidelines for Electrical Service Technician 'A'*, issued by the Electrical Workers Registration Board.

- 4 Assessment against this unit standard must be in accordance with the associated Assessment Guide issued by The Skills Organisation.
- 5 Definition
Industry practice – practice used and recommended by organisations involved in the electrotechnology industry.
- 6 References
Electricity Act 1992;
Electricity Regulations 1997;
AS/NZS 3000:2007, *Electrical installations (known as the Australian/New Zealand Wiring Rules)* (AS/NZS 3000:2007);
Electrical Service Technician 'A' Handbook, Electrical Workers Registration Board; and all subsequent amendments and replacements.
- 7 Recommended: Unit 15843, *Demonstrate knowledge of magnetism and electricity*; Unit 15845, *Draw and explain simple electrical diagrams*; Unit 750, *Demonstrate knowledge of electrical test instruments and take measurements*; or demonstrate equivalent knowledge and skills.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of alternating current (a.c.) and direct current (d.c.) systems of supply.

Performance criteria

- 1.1 Demonstration includes essential differences between a.c. and d.c. supplies in terms of wave form, current direction, and relationship between current and voltage.
- 1.2 Demonstration includes comparison of advantages of a.c. supply systems over d.c. in accordance with industry practice.

Range	transmission, transformation; construction and operation of – motors, generators, alternators.
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- 1.3 Demonstration includes definition of a.c. terms according to industry practice.

Range	sine wave, frequency, cycle, root-mean-square (rms) value, maximum or peak value.
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- 1.4 Demonstration includes sketches of ring-main and radial-feed a.c. power distribution systems, according to the Electricity Regulations and industry practice.

Outcome 2

Demonstrate knowledge of the multiple-earthed neutral (MEN) system of supply and

associated earthing requirements.

Performance criteria

- 2.1 Demonstration includes a description of the MEN system of supply, with the aid of a diagram, according to the Electricity Regulations and industry practice.
- 2.2 Features of the MEN system of supply are explained in accordance with the Electricity Regulations and industry practice.
- Range ensuring high fault current flow, rapid and positive operation of circuit protection devices, the effect of the loss of the earth to neutral link.
- 2.3 Terms used in earthing systems are explained in accordance with Electricity Regulation 2 and AS/NZS 3000:2007.
- Range earthed, earthing system, electrical bonding, earth bonding, equipotential bonding.
- 2.4 Components of an earthing system are described in terms of their function, and with the aid of a wiring diagram, in accordance with Electricity Regulation 86 and AS/NZS 3000:2007.
- Range components – earth electrode, earthing lead, earth continuity conductor, neutral and earth busbars in switchboards;
diagram – busbars labelled, components labelled, conductors labelled and sizes stated.
- 2.5 Earthing and bonding requirements for particular situations are identified in accordance with Electricity Regulation 84 and AS/NZS 3000:2007.
- Range earthing – metalwork forming part of electrical installations, appliances, and fittings, fittings that must not, or need not, be earthed;
bonding – bathrooms, kitchens, laundries, boiler rooms, dry-cleaning premises, service stations, engineering machine shops.

Outcome 3

Demonstrate knowledge of electrical fittings and components, and their uses.

Performance criteria

- 3.1 The term 'electrical fitting' is defined, and examples of fittings used with electrical appliances are stated, in accordance with the Electricity Regulations and industry practice.
- 3.2 Demonstration includes a description of limitations on the use of fittings and components in accordance with the Electricity Regulations.

Range current limits, voltage limits, ingress protection (IP) ratings, unsuitability of some ac switches for use in dc circuits, unsuitability of certain switches for purposes of circuit isolation, position of switches in circuits, unsuitability of lampholder adaptors to connect electrical appliances to the supply.

3.3 Demonstration includes the interpretation of simple lighting and control circuit diagrams.

Range lighting – one-way, two-way (two-strap), two-way (three-strap); control – pressure switches, limit, time, single and double pole, single and double throw, three-heat, simmerstat, thermostat.

Outcome 4

Demonstrate knowledge of electronic components.

Performance criteria

4.1 Electronic components are identified by name and type, and an application for each is stated, in accordance with industry practice.

Range resistors – fixed-linear and variable, carbon, film, wire-wound, light dependent resistor (LDR), voltage dependent resistor (VDR), temperature dependent resistor (TDR), positive temperature coefficient (PTC), negative temperature coefficient (NTC); capacitors – air, paper, plastic, mica, ceramic, electrolytic, solid dielectric, fixed, variable, pre-set variable; chokes and inductors – iron or ferrite-core, air-core; transformers – power, inter-stage, output, centre-tapped; for assessment purposes, identification could be from manufacturer's catalogues and data sheets, pictorial displays, physical displays, recall.

4.2 Demonstration includes restrictions on the use of capacitors for radio and television suppression in accordance with the Electricity Regulations.

Range capacitance connected to exposed metalwork not to exceed 0.005 μ F (microfarads), interference suppression devices may not be connected in the earth continuity conductor, replacement suppression capacitors for use in 230 volt appliances must be rated at least at twice the voltage.

Outcome 5

Demonstrate knowledge of flexible cords.

Performance criteria

5.1 Demonstration includes description of flexible cords in terms of their construction, and at least one application for each, in accordance with manufacturer's specifications and AS/NZS 3000:2007.

Range flexible cords – twin and three core, twisted, parallel, and circular, tough rubber sheath (TRS), tough plastic sheath (TPS), polychloroprene compound (PCP), heat and oil resisting and flame retardant (HO-FR), polyvinyl chloride (PVC).

5.2 Demonstration includes description of the effects of oil, petrol, excessive weight, and extremes of temperature both within and without an electrical appliance, on the insulation and sheathing of flexible cords, in accordance with industry practice.

Range flexible cords – tough rubber sheath (TRS), tough plastic sheath (TPS), polychloroprene compound (PCP), heat and oil resisting and flame retardant (HO-FR), polyvinyl chloride (PVC).

5.3 Demonstration includes description of the effects of conductor length, cross-sectional area, and ambient temperature on the current-carrying capacity of flexible cords, in accordance with AS/NZS 3000:2007.

5.4 Demonstration includes conductor names, abbreviations, and colour codes of single-phase flexible cords, without error, in accordance with AS/NZS 3000:2007.

5.5 Demonstration includes the selection of a flexible cord to match a practical application from cable data, in accordance with AS/NZS 3000:2007.

Outcome 6

Demonstrate knowledge of electrical appliances.

Performance criteria

6.1 The term 'electrical appliance' is defined in accordance with the Electricity Regulations.

6.2 Demonstration includes an explanation of the general operating principles of appliances in terms of input, control and power circuits, protection, and output.

Range heating appliance, cooking appliance, appliance incorporating electric motors.

6.3 Demonstration includes a description of the features and applications of single phase motors, in accordance with industry practice.

Range motors – universal, standard split-phase, capacitor-start, capacitor-start-and-run, permanently split, shaded pole; features – starting method, operating principle, internal connections, terminal identification, method of reversal; one application should be stated for each motor type.

Outcome 7

Demonstrate knowledge of electrical power, energy, and efficiency.

Performance criteria

- 7.1 Electrical power is calculated from voltage and current, from voltage and resistance, and from current and resistance.
- 7.2 Demonstration includes transpositions of the formulae $P=V^2/R$, $P=I^2R$, and $P=IR$, to calculate values of voltage, current, and resistance.
- 7.3 Demonstration includes description of the relationship between energy, power, voltage, current, and time, in terms of the formulae $W = Pt = VIt$.
- 7.4 Efficiency of an appliance is calculated from output and input powers.
- 7.5 Demonstration includes identification of units of energy and power, and conversions between them.

Range units of power – watts (W), kilowatts (kW), horsepower (hp);
units of energy – joules (J), kilowatt-hours (kWh);
conversions – 1 hp = 746 watts, 1kWh = 3.6MJ.

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	25 June 1997	31 December 2022
Revision	2	3 April 2001	31 December 2022
Revision	3	14 August 2002	31 December 2022
Rollover and Revision	4	25 February 2008	31 December 2022
Review	5	28 January 2021	31 December 2022

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>.