

<b>Title</b>	<b>Demonstrate knowledge of electrical theory for Electrical Service Technician – B</b>		
<b>Level</b>	<b>3</b>	<b>Credits</b>	<b>3</b>

<b>Purpose</b>	<p>'Electrical Service Technician – B' (EST – B) refers to a class of electrical registration for people who need to work on electrical appliances directly connected to fixed wiring, and rated at no more than 460 volts. 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"> <li>–electricity supply systems;</li> <li>–common cables and their termination requirements;</li> <li>–alternating current (a.c.) motors; and</li> <li>–direct-on-line motor starters.</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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<b>Prerequisites</b>	Unit 10933, <i>Demonstrate knowledge of electrical theory for Electrical Service Technicians – A</i> , or demonstrate equivalent knowledge and skills.
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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 10938, *Demonstrate knowledge of appliance isolation, connection, and testing procedures for EST – B*, Unit 10939, *Demonstrate knowledge of regulations and codes of practice for Electrical Service Technicians – B*, and Unit 10940, *Demonstrate practical skills required for Electrical Service Technicians – B*, and their prerequisites, are designed to meet the *safety instruction, theory examination, and practical assessment* requirements for registration as an Electrical Service Technician 'B' (EST – B). 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 'B'*, 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 4417.2:2001, *Marking of electrical products to indicate compliance with regulations – Specific requirements for electrical safety regulatory applications* (AS/NZS 4417.2:2001);  
AS/NZS 3000:2007, *Electrical installations (known as the Australian/New Zealand Wiring Rules)* (AS/NZS 3000:2007);  
AS/NZS 3008.1.2:1998, *Electrical installations – Selection of cables – Cables for alternating voltages up to and including 0.6/1 kV – Typical New Zealand installation conditions* (AS/NZS 3008.1.2:1998);  
*Electrical Service Technician 'A' Handbook*, Electrical Workers Registration Board; and all subsequent amendments and replacements.

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## Outcomes and performance criteria

### Outcome 1

Demonstrate knowledge of electricity supply systems.

#### Performance criteria

- 1.1 Systems of alternating current (a.c.) supply are described in terms of the number of conductors, and standard voltages between conductors.
- Range single, two, and three-phase alternating current (a.c.).
- 1.2 The derivation of single-phase and two-phase supplies from the New Zealand three-phase supply system is described with the aid of a labelled diagram, and in accordance with Electricity Regulations.
- 1.3 The colour codes for fixed wiring and flexible cords are described according to the Electricity Regulations and all relevant standards.
- Range two and three conductor configurations for single-phase supply, two, three, and four conductor configurations for two-phase supply, three, four, and five conductor configurations for three-phase supply.
- 1.4 Situations are identified where the neutral conductor may be omitted or may not be present, in accordance with the Electricity Regulations.

### Outcome 2

Demonstrate knowledge of common cables and their termination requirements.

**Range** tough plastic sheath (TPS), tough rubber sheath (TRS), neutral-screened, flexible cables and cords, metal insulated mineral cables (MIMS), cables in metal and plastic conduit, polyvinyl chloride (PVC) cables in flexible conduit, copper braided sheath flexible cords and cables.

### **Performance criteria**

2.1 Demonstration includes descriptions of construction, conductor types, and at least one application for each, in accordance with industry practice.

**Range** construction – single-core, multi-core, armoured, un-armoured, flexible;  
conductor types – copper, aluminium, solid, stranded, round, flat, shaped.

2.2 Termination methods and requirements are identified in accordance with AS/NZS 4417.2:2001, AS/NZS 3000:2007, AS/NZS 3008.1.1:1998, and Electricity Regulation 70.

**Range** termination methods – compression joints, soldered joints, mechanical clamping, cord anchorage;  
requirements – mechanical requirements, cleanliness of surfaces, insulation of joints, glands.

### **Outcome 3**

Demonstrate knowledge of alternating current (a.c.) motors.

### **Performance criteria**

3.1 Demonstration includes description of motor components in terms of their function.

**Range** casing – casing, end shields, shaft, bearings, mounting;  
rotor – yoke, core, winding, cage, double-cage, wound-rotor;  
stator – cage rotor, wound rotor;  
enclosure types – screen-protected, drip-proof, totally enclosed non-ventilated, totally enclosed fan-ventilated, flame-proof.

3.2 Demonstration includes a description of the operating principles of a.c. motors in terms of the rotating action of the field windings and the interaction of stator and rotor fluxes.

**Range** single-phase motors – universal, split-phase, capacitor-start, capacitor-start-and-run, permanently split, shaded pole motors;  
three-phase induction motors.

3.3 Demonstration includes comparison of relative advantages and disadvantages of ac motors in terms of smoothness of operation, operating environments, load characteristics, supply requirements, and starting requirements, with typical applications for each type.

Range single-phase motors – universal, split-phase, capacitor-start, capacitor-start-and-run, permanently split, shaded pole motors, three-phase induction motors.

3.4 Demonstration includes description, with the aid of a diagram, of motor winding connections to the electricity supply, and explanation of how the winding connections can be changed to reverse the direction of rotation.

Range single-phase capacitor-start motor, three-phase induction motor connected to six individual terminals for star and delta operation.

#### Outcome 4

Demonstrate knowledge of direct-on-line motor starters.

#### Performance criteria

4.1 Demonstration includes description of a single-phase direct-on-line motor starter, with the aid of a labelled circuit diagram, in accordance with industry practice.

Range circuit diagram must show – start and stop buttons, remote start-stop station, contactor, auxiliary contacts, overload protection for motor, overload protection for control circuit, electricity supply, motor internal windings, interconnection of all components.

4.2 Demonstration includes description of a three-phase direct-on-line motor starter, with the aid of a labelled circuit diagram, in accordance with industry practice.

Range circuit diagram must show – start and stop buttons, remote start-stop station, contactor, auxiliary contacts, overload protection for motor, overload protection for control circuit, electricity supply, motor internal windings, interconnection of all components.

**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

<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>.

This unit standard is expiring