



ELECTRICAL WORKERS REGISTRATION BOARD

**PRESCRIPTION FOR ELECTRICAL SERVICE TECHNICIAN “B”
EXAMINATION**

AND

**TEACHING GUIDELINES ELECTRICAL SERVICE TECHNICIAN “B”
PRACTICAL ASSESSMENTS**

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1. Introduction

The Electricity Act 1992 requires the Electrical Workers Registration Board to ensure the competency of all persons applying for electrical registration. The Electrical Service Technician B (ESTB) Teaching Guidelines have been prepared to assist tutors in the development of courses for students who need to complete the tuition, examination and practical assessment requirements for registration as an electrical service technician limited to work on single-phase and three-phase electrical appliances and fittings rated up to 460 volts.

The subject matter is compiled on the basis that each candidate has completed the Electrical Service Technician A tuition course. Therefore, the tuition provided must cover **ALL** of the subject matter

While the guidelines aim to be as detailed as possible, they do not cover every detail. For example, it should not be inferred that a particular subject is limited to the examples listed.

Please note that the release of this document is consistent with section 74 of the Electricity Act 1992 and does not reflect any decisions the Board may make in relation to future categories of registration as required by the Electricity Amendment Act 2006.

2. Structure of Guidelines and Prescriptions

All Guidelines and Prescriptions have the same structure and numbering system. The system is based around the 66 essential capabilities for electricians agreed between the Board and Australian Licensing Authorities. These capabilities have been placed in the following groups:

A	Basic Theory	I	Switchboards
B	d.c. Theory	J	Damp and Wet Areas
C	a.c. Theory	K	Testing, Certification and Inspection
D	System Theory	L	Safety, Safe Working Practices, Basic First Aid and CPR
E	Three-phase Motors, Generators and Starters	M	Semi Conductor Devices and Circuits
F	Single-phase motors and starters	N	d.c. Motors
G	Transformers	O	Lighting
H	Circuit and Cable Installation and Protection	P	Legislation

Example H1a.27, H1b.28, H1c.31

These 3 topics relate to protection and control. For "H1b.28"

- "H" relates to the group
- "1" denotes the first topic (or set of related topics) in the group
- "b" denotes that this is the 2nd topic in the set
- "28" is the core capability

Therefore, subject matter for the Guidelines or Prescriptions - other than for electricians - is "aligned" to the equivalent electrician core capability. Also some groups and capabilities do not apply to particular guidelines. For example, capabilities relating to certification of prescribed electrical work do not apply to Electrical Service Technician Guidelines.

3. Scope

The scope of the subject matter in these guidelines relates to the range of prescribed electrical work that can be carried out under an Electrical Service Technician registration with a No.1 limitation. That is:

- The maintenance (testing, servicing and repair) of single-phase and polyphase electrical appliances rated up to 460 volts.
- The maintenance and replacement of fittings (other than the installation of conductors) rated up to 460 volts.
- The connection and reconnection of permanently connected electrical appliances rated up to and including 460 volts
- The replacement of fuse links rated up to and including 460 volts.
- The construction repair and replacement of flexible cord sets rated up to and including 460 volts.

4. Safety

At all times the safety aspect must be emphasised to students in both classroom tuition and in carrying out practical exercises. Safety, not only for themselves, but for others who may later depend on the standard of their workmanship.

5. Practical Tuition

Wherever possible, students must be given the opportunity to gain confidence in the recognition, handling and use of electrical equipment. Students must use meters and test equipment in particular as frequently as possible in order that they can competently use and rely on such aids for personal safety.

6. Examinations

Student must be advised that:

- (a) The content of the practical assessment exercises are also examinable in the written examination.
- (b) The content of the Electrical Service Technician "A" course is also examinable in the written examination.

7. Definitions

Unless the context otherwise requires, within these guidelines:

Act	means the Electricity Act
Code or ECP	means New Zealand Electrical Code of Practice issued under Part IV of the Act.
Regulation	means the Electricity Regulations
Standard	means any of the following: <ul style="list-style-type: none">• New Zealand Standard (NZS)• a joint Australian/New Zealand Standard (AS/NZS)• a British Standard (BS)• an International Electrotechnical Commission Standard (IEC)
Section	<ul style="list-style-type: none">• means a section of the Electricity Act

All other terms are as defined in the Electricity Act, Electricity Regulations and AS/NZS 3000

8. Reference Texts

Training providers must use the applicable parts of the reference texts detailed in this part when providing tuition in accordance with these Guidelines. Providers:

1. Must use the most recent edition of a reference text and the current amendments.
2. May also need to use the edition of a reference text that was issued prior to the most recent edition. This may occur where a newer edition has been published after the one cited in regulations.
3. Select the course material and reference texts to be provided by students.
4. May use any other material they consider relevant to the course they are providing.

8.1 Legislation

The Electricity Act (presently the 1992 version reprinted 19 August 2005).
The Electricity Regulations (presently the 1997 version reprinted 5 September 2005).

8.2 Standards

AS/NZS 2430.3.1	Classification of Hazardous Areas – Examples of area classification - General
AS/NZS 2381.1	Electrical equipment for explosive atmospheres – Selection, installation, and maintenance – General requirements
AS/NZS 2500	Guide to the safe use of electricity in patient care
AS/NZS 3000	Wiring Rules
AS/NZS 3001	Electrical installations – Relocatable premises (including caravans and tents) and their site installations
AS/NZS 3002	Electrical installations – Shows and carnivals
AS/NZS 3003	Electrical installations – Patient treatment areas of hospitals and medical and dental practices
NZS 3003.1	Electrical installations – Patient treatment areas of hospitals and medical and dental practices – Testing requirements
AS/NZS 3004	Electrical installations – Marinas and pleasure craft at low voltage
AS/NZS 3008.1.2	Electrical installations – Selection of cables
AS/NZS 3012	Electrical installations – Construction and demolition sites
NZS 3019	Electrical installations – In-service testing
AS/NZS 3760	Inservice safety inspection and testing of electrical equipment
AS/NZS 3820	Electrical installations – Essential safety requirements for low voltage electrical equipment
AS/NZS 4701	Requirements for domestic electrical appliances for reconditioning or parts recycling
AS/NZS 4761.1	Competencies for working with electrical equipment for hazardous areas – Competency standards
AS/NZS 60479-1	Effects of current in human beings and livestock - Part 1:General aspects
AS 60529	Degree of protection provided by enclosures for electrical equipment (IP Code)

8.3 Codes

NZCEP 54	New Zealand Electrical Code of Practice for Electrical Installations of Recessed Luminaires and Auxiliary Equipment.
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8.4 Other Documents

ESTA Handbook
ESTB Handbook
Electrotechnology Principles and Practice (published by the Open Polytechnic of New Zealand.)

9. Theory/Regulations

THE SUBJECT MATTER FOR EACH TOPIC REFLECTS WHAT A STUDENT (OR CANDIDATE) IS REQUIRED TO ACHIEVE FROM THE TUITION PROVIDED. While the subject matter is as comprehensive as possible, it will not detail every single item that should be covered in a topic.

“Regulations” subject matter can generally be considered to be that which contains direct reference to the Act, Regulations, Standards or Code.

Each topic has a desired attainment level. The letters “A”, “B”, “C” and “D” represent the level of knowledge that should be attained by each student as the result of timetabled course tuition and private study. The letters mean:

- A Thorough knowledge
- B Good working knowledge
- C General knowledge
- D Basic understanding.

D System Theory

D1.12 System theory – 1 & 3 –phase systems

Level A 1,2
Level B 3,4

1. Single-phase Supply
 - (a) State the essential details.
 - One active (phase) conductor.
 - One neutral conductor.
 - One earth conductor.
 - (b) State the nominal voltages that exist between each of the conductors.
2. Three Phase supply:
 - (a) State the essential details.
 - Three active (phase) conductors.
 - One neutral conductor (if required).
 - One earth conductor.
 - (b) State the nominal voltages that exist between each of the conductors.
 - (c) Describe the circumstances in which the neutral conductor may not be present.
 - (d) Understand that a single or two-phase supply can be obtained from a three-phase source.

D4.22 System theory - MEN systems

Level B

1. State the essential details of the system. For example, earthing of neutral conductor at the distribution transformer, at main switchboard on every consumer's premises, and at many intermediate points.
2. Understand and explain the principal purpose of the MEN system, including:
 - The low neutral/earth parallel return circuit resistance to the distribution transformer.
 - Rapid disconnection of supply under fault conditions.
 - Ensuring voltage cannot rise above 230 volts to earth.
3. Understand and explain the essential differences between MEN switchboards and other types of switchboards.
4. Explain the importance of the neutral/earth link in an MEN switchboard.

E. Three-phase Motors, Generators and Starters

E1.15 3ph-Motor/Alternators Theory

Level A.....1
Level B 2,3
Level 3 4

1. Understand the basic principles of operation of three-phase motors.
2. Understand and explain, with the aid of fully labelled diagrams, how Star and Delta motor connections are achieved.
3. Understand and explain, with the aid of fully labelled diagrams, how motors with their winding terminations on six individual terminals can be Star or Delta connected.
4. Develop a rotating field using three rotating phasors

E2.16 3ph-Motor/Alternators Selection, starting, protection

Level A...1,2
Level B 3,4

1. Understand and explain, with the aid of fully labelled diagrams, how the direction of rotation can be reversed in a three-phase motor.
2. Understand and apply the requirements of AS/NZS 3000 in relation to the protection and control of motors.
3. Draw a fully labelled diagram of the wiring to a 400V motor including control wiring, stop-start station and remote stop-start station.
4. Understand the need for and purpose of overload and back-up protection on electric motors and starters.

E4.18 3ph-Motor/Alternators Fault diagnosis

Level A

Understand and describe the various faults that can occur with three phase motors and starters. For example:

- Mechanical overload.
- Loss of one active (phase).
- Wrong direction of rotation for a specific load

F. Single-phase motors and starters

F1.19 1ph-Motors - Theory

Level A 1,2
Level B 3

1. Understand and explain with the aid of a fully labelled diagram how the winding connections can be changed to reverse the direction of rotation for the following types of motors:
 - Universal motor.
 - Split-phase (resistance start) motors.
 - Capacitor start.
 - Permanently split capacitor
 - Capacitor start/Capacitor run.
2. Understand the basic principles of operation for the following types of motors:
 - Universal motor.
 - Split-phase (resistance start) motors.
 - Capacitor start.
 - Permanently split capacitor
 - Capacitor start/Capacitor run.
3. Draw a fully labelled diagram of the wiring to a 230V motor including control wiring.

F2.20 1ph-Motors - Selection, and fault finding

Level A 1-3
Level B 4

1. Understand and apply the requirements of AS/NZS 3000 in relation to the protection and control of single-phase motors
2. Understand and describe the various faults that can occur with single phase motors and starters. For example:
 - Mechanical overload.
 - Open star winding circuit
3. State typical uses for the following types of motors:
 - Universal motor.
 - Split-phase (resistance start) motors.
 - Capacitor start.
 - Permanently split capacitor
 - Capacitor start/Capacitor run.
4. State the advantages and disadvantages for the following types of motors by using a comparison table:
 - Universal motor.
 - Split-phase (resistance start) motors.
 - Capacitor start.
 - Permanently split capacitor
 - Capacitor start/Capacitor run.

H. Circuit and Cable Installation and Protection

H1a.27 Protection and Control Protection characteristics

Level A 1-3
Level B 4-6
Level C 7

1. State the reasons why circuit protection is important.
2. Understand the category of duty relates to prospective short circuit current and the ability to safely interrupt and disconnect the faulty circuit.
3. Understand and apply the general requirements of the Regulations and AS/NZS 3000 in relation to the protective devices
4. Understand and explain the operation of the following circuit protective devices:
 - Rewirable fuses.
 - HRC fuses.
 - Thermal circuit breakers.
 - Magnetic circuit breakers.
 - Magnetic/Thermal circuit breakers.
5. Describe the various types of fault or combinations of faults that can lead to the operation of circuit protection devices.
6. Understand and explain how each of the following conditions could cause a protective device to operate:
 - Underrated fuse.
 - Over-rated fuse.
 - Overloaded circuit.
 - Short circuit in fixed wiring or appliance.
 - Short circuit to earth in wiring or appliance.
7. Understand that circuit protective devices will not prevent an electrical fault, but will assist in averting or decreasing the chance of electric shock, damage or fire resulting from the fault.

H1b.28 Protection and Control RCD characteristics

Level A

1. Understand and apply the safety principles in AS/NZS 3000 for RCDs in relation to personal safety and the protection of property.
2. Understand and describe with the aid of fully labelled diagrams the principles of operation of an RCD.

3. Understand how RCDs are classified including:

- method of operation
- type of operation
- number of poles and current paths
- protection against external influence
- method of mounting
- method of connection

4. Understand the characteristics of an RCD installed for personal protection

H1c.31 Protection and Control

Selection of control and protection equipment

Level A 1-5
Level B 6,7
Level C 8

1. Understand the importance of the protective device being in a safe, accessible point for circuit isolation, as well as providing fault protection.

2. Understand and explain the use of the following circuit protective devices:

- Rewireable fuses
- HRC fuses.
- Thermal circuit breakers.
- Magnetic circuit breakers.
- Magnetic/Thermal circuit breakers.
- Residual current devices.

3. Understand the operational characteristics of RCDs and how different types of the available RCDs operate including:

- Residual current-operated circuit breakers (RCCB)
- Residual current-operated circuit breakers with overcurrent protection (RCBO)
- Socket-residual current protection devices (SRCD)
- Portable residual current protection devices (PRCD)
- RCDs functionally independent of line voltage (used in residential type switchboards and SRCDs)
- RCDs functionally dependent on line or auxiliary voltage (used in PRCDs)

4. Understand and apply the requirements of the Regulations and AS/NZS 3000 in relation to the selection and installation of protection and control equipment

5. Apply the requirements of the Regulations and AS/NZS 3000 in relation to the selection, installation and use of RCDs.

6. Understand that three-phase devices may consist of three separate single-phase devices or one unit incorporating three devices.

7. Understand the meaning and the importance of the label information shown or stamped on fuse carriers, fuse cartridges, circuit breakers and other circuit protective devices:
 - Rated current.
 - Rated voltage.
 - Category of duty.
 - Breaking or rupturing capacity.
 - Type of device.
 - Class of protection and Utilisation Categories gG, gL, gM plus other symbols
 - The importance of considering Prospective Short Circuit Current (PSCC) at various points in an installation when choosing protective equipment.
 - Types of circuit breakers
8. Understand the essential differences between single-phase and three-phase circuit protective devices.

**H3d.41 Cables and Cords
 Specifications**

Level A 1,2
Level B 3-5

1. Understand and apply the colour coding of conductors used in New Zealand including:
 - Fixed wiring and flexible cords and cables
 - Two three, four and five conductor configurations.
 - The requirements of AS/NZS 3000 and AS/NZS 3760
2. Understand and apply the requirements of AS/NZS 3000, AS 3008.1.2 and AS/NZS 3760 in relation to the construction, colour coding and typical application of cables and flexible cords
3. Understand that flexible cords are for conductors of cross sectional area up to and including 4 mm²
4. Understand that conductors having a greater cross sectional than 4 mm² are classed as flexible cables.
5. Understand and explain the construction of the following flexible cables, flexible cords, and cables listed below:
 - TPS and TRS cables.
 - Neutral screened cables.
 - MIMS cables.
 - Flexible cables and cords.
 - cables in metal and plastic conduit.
 - PVC. cables in flexible conduit.
 - Copper braided sheath flexible cords and cables

2. Describe procedures for reconnecting conductors at an electrical appliance or at a fixed wiring terminating point including:
 - Checking safety tags that are in place.
 - Checking isolation is still effective ("Prove - Test - Prove").
 - Reconnecting conductors to terminals.
 - Ensuring correct direction of rotation of motors.
 - Ensuring correct phase sequence of polyphase appliances,.
 - Carrying out prescribed tests including earthing, polarity and insulation resistance, and where appropriate, the insulation resistance between the motor windings
 - Replacing all covers, screens and guards.
3. Understand the importance of connecting three-phase motors to preserve correct rotational direction.
4. Understand the precautions that must be taken when disconnecting and reconnecting cables and their enclosures including:
 - TPS and TRS cables.
 - Neutral screened cables.
 - MIMS cables.
 - Flexible cables and cords.
 - Cables in metal and plastic conduit.
 - PVC. cables in flexible conduit.
 - Copper braided sheath flexible cords and cables.
5. Understand and explain the importance of ensuring all conductors are correctly terminated to maintain the correct polarity.
6. Understand and explain what would occur if the following were accidentally interchanged on the supply to a single-phase 230 volt induction motor:
 - The active (phase) and neutral conductors.
 - The neutral and earth conductors.
 - The active (phase) and earth conductors.

J. Damp and Wet Areas

J.33 Damp and wet areas

Level A 1-3
Level B 4

1. Apply the requirements of the Regulations, AS/NZS 3000 and AS 60529 in relation to damp and wet areas.
2. Understand IP ratings and what the respective numbers represent, i.e. the first and second digits.
3. Understand that when an electrical appliance is repaired or components replaced, it is important that the correct components are used to ensure the appliance retains the correct safety standard.
4. Define a Damp Situation.

K. Testing, Certification and Inspection

K2.38 Statutory testing and inspection requirements

Level A

1. RCDs
 - (a) Know the maximum tripping current and operating times as stated in NZS 3019 or AS/NZS 3760.
 - (b) Understand the testing and verification requirements as detailed in NZS 3019 or AS/NZS 3760.
 - (c) Test an RCD to ensure it meets the requirements of NZS 3019 or AS/NZS 3760.
2. Testing– General
 - (a) Define the term “testing”.
 - (b) Describe how the tests for compliance are performed and state the values which are acceptable.
3. Testing of electrical installations
 - (a) Understand and explain the specific tests that are required by AS/NZS 3000 and state the types of test instruments required to perform those tests.
 - (b) Describe the methods of carrying out the tests referred to in AS/NZS 3000, stating the minimum and maximum values (where appropriate) that are acceptable.
4. Testing of electrical appliances:
 - (a) Understand and explain the specific tests that are required by AS/NZS 3760 and state the types of test instruments required to perform those tests.
 - (b) Describe the methods of carrying out the tests referred to in AS/NZS 3760, stating the minimum and maximum values (where appropriate) that are acceptable.
5. Testing of Isolating Transformers
 - (a) Understand and explain the specific tests that are required by NZS 3019 or AS/NZS 3760 and state the types of test instruments required to perform those tests.

- (b) Describe the methods of carrying out the tests referred to in NZS 3019 or AS/NZS 3760, stating the minimum and maximum values (where appropriate) that are acceptable.

K4.46 Testing and inspection methods

Level A

1. (a) Identify the appropriate instrument for the following tests:
 - Circuit continuity.
 - Insulation resistance.
 - Polarity.
 - Protective earthing continuity.
 - Effectiveness of controls and safety facilities.
 - (b) Understand the reasons for each of the tests listed in (a).
 - (c) (i) Understand and explain why it is necessary to carry out insulation resistance tests of electrical fittings at twice the normal applied voltage.
 - (ii) Understand and explain the alternative methods of testing the insulation integrity of an electrical appliance including:
 - Why an insulation resistance test is twice the normal applied voltage to earth – 500V d.c.
 - Why 250V d.c. test would be carried out.
 - The use of an earth leakage test as an alternative to an insulation resistance test.
 - (d). Describe methods of carrying out tests listed in (a) and state minimum and maximum results (where appropriate) that are considered satisfactory.
2. Describe operating precautions that must be observed when connecting a test instrument into a circuit, e.g.:
 - Use the correct instrument (or function if using a multi-meter).
 - Observe correct polarities where necessary.
 - Use the range appropriate for the expected result.
 - Check that connections are clean, tight and safe.
 3. Understand the necessary safety procedures when using instruments to test "live" circuits, e.g.:
 - Do not energise the circuit until appropriate instrument connections have been completed.
 - Maintain adequate insulation and clearances between instrument clips, probes or leads.
 - Avoid personal contact with either live conductors or earth when using instruments on live circuits.

4. Describe the various conditions, indications and defects that can be found by visual examination of an electrical appliance being checked for compliance with regulation requirements and for general electrical and mechanical safety.

L. Safety, Safe Working Practices, Basic First Aid and CPR

**L1.40/ 54 Isolation
Equipment and Personal safety**

Level A

1. Isolation – General Principles

- (a) Understand the difference between the actions of "switching an electrical appliance or circuit off" and "isolating an electrical appliance or circuit".
- (b) Understand that the electrical appliance, circuit or fitting to be worked on must first be proven to be "dead", i.e., using the Prove-Test-Prove method
- (c) Understand the importance of knowing the relevant isolation procedures and the position of and how to operate isolating and safety devices before commencing work
- (d) Understand that live conductors may be present in some electrical appliances and/or fittings when the switch is off, e.g.:
 - 4 plate ceiling rose.
 - Thermostat.
 - Control sensors.
 - Control wiring.This list is not exhaustive.
- (e) Understand that isolation must be checked and proven in case:
 - The wrong circuit is isolated.
 - The wrong switch, fuse, circuit breaker has been operated.
 - Any damaged insulation permits contact between conductors.
 - The appliance is supplied from two sources.
 - The isolation switch is not in the active (phase) conductor.
- (f) Understand the dangers of relying on equipment indicator lamps or similar devices to judge the "live" or "dead" state of circuit conductors, e.g.:
 - The indicator on a machine may state "non-operational"; or "off", but some machine circuits may still be alive.

- (g) Understand the consequences of failing to isolate correctly include:
- Electric shock through failure to isolate correct circuit.
 - Electric shock through failure to isolate all live conductors.
 - Disruption to equipment operation and possible injury through isolating wrong circuit.
 - Damage or injury through removing a fuse that is still alive and carrying current.
- (h) Understand that if complete isolation cannot be achieved the circuit must not be worked upon and assistance must be sought.

2. Isolation – Use of Test Instruments

- (a) Identify suitable instruments and test devices approved for checking isolation.
- (b) Understand that the correct type of instrument or tester must be used
- - Solenoid type such as:
 - Martindale.
 - Worthington.
 - Square D.
 - Duspol.
- This list is not exhaustive.
- (c) Understand the dangers of using non-proprietary test lamps of any type and discourage their use.
- (i) Recognise the danger that exists when using a test lamp for a test of circuit isolation. The use of Series test lamps must be discouraged because of their inherent dangers, e.g.:
- A broken lamp filament may give a false indication of safety.
- (ii) Explain the dangers associated with using neon pencil testers.
- (d) Understand that the test instrument must be rated for the operating voltage of the circuit or appliance being tested. That is, use a tester rated 500 volts or above for testing multi-phase circuits, appliances and fittings.
- (e) Understand that some test instruments have fused leads and they may indicate isolation if the fuse has operated.
- (f) Understand that there is the possibility of the test leads open circuiting or breaking and thereby giving a false indication of isolation.

3. Isolation – Procedures

- (a) Describe methods of isolating an electrical appliance.
- (b) Describe the following methods of ensuring continued isolation:
 - Withdrawal of fuses.
 - Warning notice on the isolating switch.
 - Locking of switch.
 - Removal of plug from socket plus warning notice or removal of the electrical appliance.
 - Tripping of circuit breaker plus warning notice.
- (c) Explain the purpose of "Prove-Test- Prove" testing procedure for checking the isolation of a circuit and describe how the procedure is carried out.
- (d) Understand that the "Prove - Test - Prove" procedures are to be followed, including:
 - Test each active (phase) to earth.
 - Test between each active (phase).
 - Visually check the isolation to ensure all the contacts have opened correctly.
- (e) Discuss methods of ensuring that circuits supplying an isolated fixed wired electrical appliance or fitting remains isolated as required, e.g.:
 - Apply a warning tag to the point of isolation.
 - Lock the isolating switch with personal lock.
 - Remove fuses from vicinity of switchboard.
 - Disconnection of circuit conductors by an appropriately registered person if the disconnection is to be for a long period.

4. The Safety Tag System – General

- (a) State that the general principles involved for one's own safety and the safety of others are, e.g.:
 - Any person may apply a tag.
 - It may be applied to all plant and equipment.
 - All persons must comply.
- (b) State that the two tags generally used are:
 - The Danger tag "Danger - Do not Operate".
 - The Out of Service tag "Out of Service - Not to be Operated".
- (c) Describe the purpose of each tag and describe how its use will increase safety in given circumstances.

- (d) Understand that the tags may be handmade if a proprietary item is not available.

5. Danger Tags

- (a) Describe or sketch the "Danger" tag and state the essential information required on one of its sides.

- (b) List circumstances in which the use of a danger tag would be essential to promote safety, e.g.:

- Working on electrical fittings.
- Working on faulty machinery.
- Working with steam, gas or dangerous liquids.

- (c) Indicate where a Danger Tag must be applied, e.g.:

- At the point of isolation.
- At any other point that, if actuated, may expose the worker to danger.

- (d) Explain why each person working on a machine or piece of equipment or circuit must put on their own Danger tag.

- (e) Nominate who may remove a Danger tag, e.g.:

- Only the person who placed the tag or the person in charge of the work party after personally checking for safety.

- (f) Explain what is required when a previously unnoticed danger is observed, e.g.:

- Apply the Danger tag.
- Isolate the danger if possible.
- Inform the Person in Charge immediately.

- (g) State the procedure required with respect to Danger tags when work in progress is unfinished at the end of the shift or day, e.g.:

- Each worker removes their own Danger tag.
- A senior person replaces their Danger tag with an Out of Service tag if a dangerous situation still exists.
- Person in charge must be informed of situation.

- (h) Understand that, having isolated a piece of equipment and fitted a Danger tag it is necessary to check the machine or circuit to prove that isolation has been effective, e.g.:

- "Test Before Touch".
- "Prove - Test - Prove".

- (i) Understand why some electrical switches etc are not acceptable as isolating switches, e.g.:
 - Standard control switches
 - Push button switches.
 - Switches on control stations.
 - Emergency stop buttons
 - (j) State that the procedure to be adopted by the Supervisor or person in charge when work requiring Danger tags to be used is being carried out by several workers is as follows:
 - Each person will place their own Danger tag or Out of Service tag as appropriate.
 - Each person will check the work and ensure safety before removing their own tag.
6. Out of Service Tags
- (a) Sketch and describe the "Out of Service" tag and state the essential information required on the recording side of the tag.
 - (b) List circumstances in which the Out of Service tag would be used to promote safety, e.g.:
 - If machinery or equipment is faulty or damaged and could cause more damage or injury if operated.
 - If equipment is faulty but not currently being worked on.
 - If an item that is serviceable is likely to be connected to faulty equipment.
 - (c) State who may remove an Out of Service tag or authorise the use of the equipment that is tagged, e.g.:
 - The person working on the equipment who placed the tag on it, when the repairs or maintenance have been completed, or
 - Only the person in charge may remove an Out of Service tag or authorise the use of the equipment and only after personally checking that the item is safe to use.
 - (d) Understand that, when a Danger tag has been applied to a machine or equipment already carrying an Out of Service tag, only the Person in Charge may authorise its operation for testing or other purposes after the Danger tag has been removed.
 - (e) State that, when about to work on a machine or circuit that already carries an Out of Service tag, a worker must also attach their own Danger tag to ensure their safety.
7. Understand and apply the requirements of the regulations, AS/NZS 3000 and AS/NZS 3760 in relation to public and personal safety

L2.53 Statutory safety requirements **Level A
H&S, Supervision**

1. Understand and explain Regulations 25 and 26 of the Regulations.
2. Understand the requirements of the Act and Regulations in relation to the supervision of trainees and non-competent persons
3. Understand the Guidelines for Supervision issued by the Electrical Workers Registration Board
4. Understand and explain the terms "Supervision" and "Supervisor of electrical work".

L4.56 Safe use of equipment **Level A**

Understand and apply the requirements of the Regulations in relation to safety equipment and PPE

L6b.61 Expert assistance **Level A
Electrical**

Understand the importance of engaging another registered person if the work intended to be carried out is outside the limits of work on an electrical service technician registration

P. Legislation

**P1.13 Legislation
Fundamental principles**

Level A

Understand the fundamental principles of the Regulations and section 1 of AS/NZS 3000

**P2.13 Legislation
Registration**

Level A

1. State that electrical work is subject to audit by the Electrical Workers Registration Board.
2. Understand that completing an ESTB tuition course and passing the ESTB examination and practical assessment does not entitle a person to carry out prescribed electrical work (unless under supervision) unless registered by the Board
3. Understand that the registration issued by the Board will be an Electrical Service Technician registration with a No.1 limitation that entitles the holder to carry out:
 - The maintenance (testing, servicing and repair) of single-phase and polyphase electrical appliances rated up to 460 volts.
 - The maintenance and replacement of fittings (other than the installation of conductors) rated up to 460 volts.
 - The connection and reconnection of permanently connected electrical appliances rated up to and including 460 volts
 - The replacement of fuse links rated up to and including 460 volts.
 - The construction repair and replacement of flexible cord sets rated up to and including 460 volts.
4. Understand that the Board may impose certain limits or restrictions on the work that may be undertaken or where or for whom the registered person may work.
5. Describe the responsibilities of persons carrying out prescribed electrical work including:
 - (a) The need to ensure compliance with the Electricity Act 1992, Electricity Regulations 1997, Standards and Codes and other legal requirements insofar as they apply to the work undertaken.
 - (b) The need to ensure a high standard of workmanship.
 - (c) The need to work safely.
 - (d) The limits and restrictions that apply to persons who may assist a registered Electrical Service Technician in carrying out prescribed electrical work.

**P3.13 Legislation
 Practising licences** **Level A**

Understand the requirements of the Act and Regulations in relation to practising licences

**P4.13 Legislation
 Discipline** **Level A**

Understand the requirements of the Act and Regulations in relation to discipline including:

- Laying of complaints
- Types of disciplinary offences
- Types of disciplinary action that can be taken by the Board

**P5.13 Legislation
 Accidents** **Level A**

Understand the requirements of the Act and Regulations in relation to the defining and reporting of accidents

10. Practical Assessment

10.1 Assessment of practical ability

Each student shall demonstrate an acceptable level of skill and ability in the practical skills listed below. The level attained by each student shall be assessed and recorded progressively during practical periods undertaken throughout the course.

The candidate's performance and level of attainment must be entered on the Practical Assessment Work Record as detailed for skills 16 to 23 inclusive and submitted to the Board on completion of the course.

The assessment levels are:

- A Outstanding practical ability.
- B Average ability. Confident and competent.
- C Satisfactory. Expected to improve with experience.
- D Unsatisfactory. Requires further tuition.
- E Defective or unsafe work. Identify specific examples.
- NA Not assessed. Reason to be given.

10.2 Programme

During the course of practical instruction, stress the importance of understanding how the practical exercises relate to on-job situations and that this area is examinable in the theory examination paper.

The Practical Assessment Programme is an integral part of the "B" technical tuition and the students are required to carry out the range of practical exercises detailed in the skills list including being able to:

1. Identify the components found on domestic and small industrial switchboards mentioning their purpose and principal function.
2. Locate, identify and isolate (at the switchboard) the source of supply to nominated permanently connected single and three-phase electrical appliances. This includes being able to state the isolating practice required by each of the following:
 - A switch, a fuse and a circuit breaker.
 - Secure isolation by means of appropriate safety tags and "personal" padlock (where possible).
 - Test for live conductors at an isolated appliance using the "Prove - Test - Prove" method.

3. Disconnect and reconnect a range of fixed wired single and three-phase electrical appliances (including motors and direct-on-line starters) supplied by:
 - Flexible cords or flexible cables.
 - TPS and TRS cables.
 - Cables enclosed in metal and plastic conduit.
 - MIMS cables.
 - Neutral screened cables.
 - Copper braided sheath flexible cords and cables.

This exercise **must** include the use of methods designed to ensure (as applicable):

- Wiring is left electrically and mechanically sound after being disconnected.
 - Checking for continued safe isolation.
 - Checking for the existence of live conductors before commencing reconnection
4. Checking all earth continuity conductors electrically and mechanically
 5. Remove safety tags and/or padlock.
 - 6 . Restore power supply and check equipment for correct operation

10.3 Skills

E. Three-phase Motors, Generators and Starters

E2.16 3ph-Motor/Alternators Selection, starting, protection

Level A

Skill 17

Connect three-phase squirrel-cage induction motors and reverse rotation.

Skill 22

- (a) Connect three-phase direct-on-line motor starters.
- (b) Understand and describe the operation of protection devices used to protect motors against:
 - Overcurrent.
 - Phase failure.
 - Phase reversal.
 - Under voltage

F. Single-phase motors and starters

F2.20 1ph-Motors - Selection, and fault finding

Level A

Skill16

- (a)
 - (i) Connect the following types of single phase motors including – split phase, capacitor-start, capacitor run, and universal motors.
 - (ii) Demonstrate how to reverse the direction of rotation for each type of the above single phase motors.
- (b) Understand and describe the operation of protection devices used to protect electric motors against:
 - Overcurrent.
 - Under voltage

H. Circuit and Cable Installation and Protection

H1c.31 Protection and Control **Level A** **Selection of control and protection equipment**

Skill 4

1. Demonstrate the correct procedures for withdrawing, reloading and replacing fuse carriers at the switchboard. Exercises are to include rewirable and HRC cartridge types.
2. Be aware of such items as:
 - Current rating.
 - Category of duty.
 - Fusing factors.
 - Enclosure types.

H3e.42 Cables and Cords **Level A** **Termination of cords**

Skill 19

Connect flexible cords and cables to ceiling roses, permanent connection units, including soldering tags and lugs.

H3f.44 Cables and Cords **Level A** **Install and terminate cables**

Skill 5

Demonstrate the ability to satisfactorily connect:

- Solid and stranded cables to screw and washer terminals.
- Solid and stranded cables to pillar terminals.

H6.43 Selection of fittings and Appliances **Level A**

Skill 18

Connect three-phase plugs and cord connection sockets.

Skill 19

Demonstrate the ability to satisfactorily connect permanent connection units and fluorescent lighting

