ELECTRICAL WORKERS REGISTRATION BOARD

PRESCRIPTION FOR ELECTRICAL SERVICE TECHNICIAN "A" EXAMINATION

AND

TEACHING GUIDELINES FOR ELECTRICAL SERVICE TECHNICIAN "A" PRACTICAL ASSESSMENTS

Issued by:
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Registrar
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Contents

1. Introduction

The Electricity Act 1992 requires the Electrical Workers Registration Board to ensure the competency of all persons applying for electrical registration. To become registered as an electrical service technician, an individual must satisfy the requirements set out in section 74 of the Electricity Act 1992; and regulation 4(2) and schedule 2 of the Electricity Regulations 1997.

These 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 230 volt plug-in electrical appliances.

The subject matter is complied on the basis that students have only a minimum of prior electrical training and come from widely varying trade or non-trade backgrounds. Therefore, the tuition provided must cover **ALL** of the subject matter.

Practical and theoretical tuition is expected to take at least 70 hours. However, where all students in a class have had a similar depth of prior electrical training, the duration of the courses can be reduced accordingly.

While the guidelines aim to be a 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.6 limitation. That is:

- The maintenance (testing, servicing and repair) of electrical appliances rated up to 230 volts supplied via plug and flexible cord.
- The replacement of fuse links rated up to and including 230 volts.
- The construction repair and replacement of flexible cord sets rated up to and including 230 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

Suitable practical tuition and practical exercises must be given to students to reinforce such topics as Ohm's law, circuit and electrical appliance testing, operation of appliances and components, alternating and direct current comparisons, circuit and electrical appliance protection and safety devices etc.

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 the content of the practical assessment exercises are 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:

- New Zealand Standard (NZS)
- a joint Australian/New Zealand Standard (AS/NZS)
- a British Standard (BS)
- an International Electrotechnical Commission Standard (IEC)

Section

- 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 the1992 version reprinted 19 August 2005).
The Electricity Regulations (presently the 1997 version reprinted 5 September 2005).

8.2 Standards

AS/NZS 3000	Wiring Rules
AS/NZS 3008.1.2	Electrical installations – Selection of cables
AS/NZS 3760	In-service safety inspection and testing of electrical equipment

AS/NZS 3820	Electrical installations – Essential safety requirements for low voltage electrical equipment
AS/NZS 3832	Cold cathode illumination systems
AS/NZS 4701	Requirements for domestic electrical appliances for reconditioning or parts recycling
AS/NZS 60479-1	Effects of current in human beings and livestock - Part 1:General aspects
NZS 3019	Electrical installations – In-service testing
AS 60529	Degree of protection provided by enclosures for electrical equipment (IP Code)

8.3 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.

A. Basic Theory

A1.1 Theory **Level A 1,2**
Electrical and energy concepts **Level B 3**

1. Understand and explain the following terms:

Voltage (Volt)	Continuity	Earthed situation
Electromotive force	Neutral conductor	Exposed metalwork
Potential difference	Protective earthing conductor	Earthed metal
Voltage drop	Active conductor (Phase, Line conductor)	Earth free situation
Current flow (Ampere)	Earthing lead	Closed circuit
Resistance (Ohm, Ω, Mohm, MΩ)	Short circuit (between conductors and to earth)	Electrical fault
Power (Watt)	Open circuit	Efficiency
Energy (Watt-hour)	Low Voltage	kVA (kilovolt amp)
Insulation resistance	Extra Low Voltage	pF (power factor)
Main earthing conductor		

Convert between the multiples and sub-multiples of the above where applicable

2. Understand electrical terms, symbols and values including:

Voltage (V, E, U)	Current (I)	Resistance (R)
Power (W, P)	Voltage drop	

3. Understand the terms:

- RMS Value
- Frequency
- Cycle
- Maximum or peak value
- Sine wave

A2.2 Theory - Effects of current **Level A**

1. State why peak voltages are important in respect to electric shock and insulation resistance.

2 Understand the danger of being in contact with active (phase) and neutral or active (phase) and earth conductors simultaneously.

3. Understand the effects that various values of voltages, current, contact duration or other conditions (wet skin, etc.) will have on the victim of an electric shock.

A3.3 Theory - Resistance **Level A 1-4**
Level B 5
Level C 6

1. Understand the relationship between current, voltage, and resistance in terms of Ohm's law.

2. (a) State the formula

$$I = \frac{V}{R}$$

(b) Transpose the formula and perform simple calculations to obtain an unknown value

3. Calculate voltage drop using Ohm's law.

4. State the importance of "insulation resistance" as an indicator of an insulator's condition.

5. (a) State the purposes for which insulating materials are used, e.g.:

    - Protection against accidental personnel contact with live conductors.
    - Protection against short circuiting between conductors.
    - Protection against leakage to earth.

    (b) Identify suitable insulators for various practical purposes.

6. (a) Describe the properties of an ideal insulator for:

    - Use on a flexible cord conductor or as a sheathing.
    - Rigid use, e.g.:
        - supports for electrical elements.
        - framework for portable electrical appliances.
        - separation barriers between live and earthed components.

    (b) Compare the practical advantages and disadvantages of commonly used insulators when exposed to heat, moisture, corrosive materials, dusts, gases, tension, compression and vibration, e.g.:

    - Glass.
    - Mica.
    - Oils.
    - Ceramics.
    - Rubber.
    - Plastics (various).

A5.5 Theory - Simple circuits **Level B 1-4**
Level C 5-7

1. Describe the elements of an electric circuit:

    (a) Source (battery, generator, a.c. mains, etc.).

    (b) Conductors (positive, negative, active (phase), neutral, earth).

    (c) Insulation (to contain the conductors within defined limits)

    (d) Control (switches, thermostats, energy regulators, etc.).

    (e) Protection (fuses, circuit breakers, etc.).

    (f) Metering (voltmeter, ammeter, watt-hour meter, etc.).

    (g) Load (current using devices).

2. (a) Describe a series circuit.

   (b) State the characteristics of a series circuit.

   (c) Draw and label series circuit diagrams incorporating commonly used components

3. (a) Describe a parallel circuit.

   (b) State the characteristics of a parallel circuit.

4. (a) Draw and label diagrams of simple parallel and series-parallel circuits incorporating commonly used components.

   (b) Indicate on the diagrams the correct connections for the voltmeter, ammeter and ohmmeter.

5. Recognise and use the standard symbols for circuit components.

6. Understand and explain why electrical appliances are normally parallel connected rather than series connected.

7. Describe the essential differences between a.c. and d.c. current.

C a.c. Theory

C2.11 a.c. – Measurements **Level A 1-3**
V, A, P, pF **Level B 4**

1. Understand the relationship between:

   - Voltage, current and power
   - Voltage, current, time and energy

2. State the units in which power, energy, voltage, current and resistance are measured.

3. (a) Understand and apply the formulae and calculations involving V, I, R, W and V drop.

   (b) Transpose the formulae and perform simple calculations to obtain an unknown value.

4. Convert horsepower to watts and vice versa.

D System Theory

D1.12 System theory – single-phase systems **Level B**

Understand how the M.E.N. system of supply operates for single-phase 230V applications.

D3.21 System theory - Earthing of installations fittings and appliances **Level A 1-5 Level B 6**

1. State why it is usually necessary to earth the exposed metalwork of electrical appliances, e.g., electric shock hazard or fire risk.

2. Understand and explain how a portable metal clad electrical appliance is connected to earth and why it is necessary to ensure the lowest possible resistance in this circuit.

3. Understand the need for clean, tight earthing connections with no cut or loose strands of the flexible conductor.

4. Understand that as the protective earthing conductor's resistance increases it will adversely effect the operating time of the protective device.

5. Apply the requirements of the Regulations and AS/NZS 3760 in relation to the functional and protective earthing of electrical appliances.

6. Understand that protective earthing is expressed in terms of the resistance to exposed metal and that this must not exceed the values stated in AS/NZS 3760.

D4.22 System theory - MEN systems **Level B**

Understand and explain the principal purpose of the MEN system, that is:

- Ensures high fault current flow
- Rapid disconnection of supply under fault conditions.
- Keeps the appliance frame at earth potential under fault conditions
- Ensures maximum voltage to earth is 230 volts

F. Single-phase motors and starters

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

1. Understand the principles of operation of single-phase electric motors including:

   - Connections
   - Reversal of rotation
   - Universal (series) motors
   - Shaded pole motors
   - Split-phase (resistance start) motors.
   - Capacitor-start motors
   - Capacitor-start, capacitor run motors

2. Understand the operation of single-phase motor starters including control circuitry and locating faults.

G. Transformers

G2.24 Transformers **Level A**
Operating principles

Describe the basic operating principle of an isolating transformer

G4.26 Transformers **Level B**
Application and safety issues

1. Understand and explain why it is necessary, when two or more electrical appliances are connected simultaneously to one isolating transformer, their earth continuity conductors are connected together at the transformer but must not be earthed.

2. Understand and explain why the isolating transformer provides maximum safety when used with only one electrical appliance connected.

3. Understand that the isolating transformer may be used in conjunction with other approved safeguards for extra protection where considered desirable.

H. Circuit and Cable Installation and Protection

H1a.27 Protection and Control — **Level A…1,2**
Protection characteristics — **Level B… 3**

1. Understand and explain the meaning of the following terms:

   - Rated current.
   - Fusing current.
   - Utilisation category (fusing factor) in relation to fuses
   - Rupturing capacity.

2. Understand the general requirements of the Regulations and AS/NZS 3000 in relation to the protective devices for circuits supplying single-phase-plug in appliances

3. Describe the principle of operation of:

   - Rewirable fuses.
   - HRC fuses.
   - Circuit breakers (types B, C and D).
   - Glass cartridge fuses

H1b.28 Protection and Control — **Level A 1-5**
RCD characteristics — **Level B 6**
Level D 7

1. Describe the basic operating principle of a residual current device (RCD).

2. Understand that RCDs provide supplementary protection for the users of electrical appliances and equipment

3. Know the maximum tripping current and operating times of RCDs as per AS/NZS 3760.

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

   (a) RCDs functionally independent of line voltage (used in residential type switchboards and SRCDs)

   (b) RCDs functionally dependent on line or auxiliary voltage (used in PRCDs)

   (c) Understand why Type A RCDs are mandated for use in New Zealand

5. Understand and apply the general requirements of the Regulations and AS/NZS 3000 and AS/NZS 3760 in relation to the RCDs used for single-phase plug-in appliances

6. Understand and explain why the residual current device must be operationally tested regularly.

7. Understand that the residual current device may permit a current to pass from active (phase) to earth through a person's body (in certain circumstances) and that the time duration is such that personal harm is avoided.

H1c.31 Protection and Control — **Level A 1,2**
Selection of control and protection equipment — **Level B 3-5**

1. State the reasons for using the tortuous path provided by the manufacturer when rewiring a rewirable fuse, and understand the danger of leaving ends of fuse wire exposed to touch outside the fuse carrier of a rewirable fuse.

2 Understand that protective devices must be of the correct rating and in correct working order.

3. Understand the current rating of tinned copper wire of various diameters used for rewiring fuses.

4. Understand and explain the need to replace HRC fuse cartridges with items of the same type or comparable type and rating as the "blown" cartridge.

5. Understand and explain why a "blown" HRC fuse must not be repaired or replaced with fuse wire, e.g.:

- Danger of arcing if blown again.
- Utilisation category may no longer be appropriate.

H3d.41 Cables and Cords — **Level A 1**
Specifications — **Level B 2-4**
Level C 5

1. Understand and apply the requirements of the Regulations, AS/NZS 3000, AS/NZS 3008.1.2 and ASNZS 3760 in relation to the colour coding and typical application of flexible cords

2. Describe commonly used types of flexible cords, e.g,

- Twin and three core.
- Twisted, parallel and circular construction.
- TRS and TPS sheathing.
- PCP, HO-FR and PVC sheathings for oil and petrol contact.
- PVC not suitable for low temperature environments

3. State the types of sheathings used for high temperatures.

4. Understand the use of tables relating to current ratings, voltage drop and temperature rating factors for various sizes and types of flexible cord.

H3e.42 Cables and Cords — **Level A 1**
Termination of cords — **Level B 2-4**

1. Understand and apply the requirements of the Regulations, AS/NZS 3000 and ASNZS 3760 in relation to the termination of flexible cords

2. Understand the importance of secure, well made connections in prolonging the service life of a conductor.

3. State the reason why it is recommended that, when connecting a flexible cord to an electrical appliance or accessory, the earth continuity conductor should be made longer than the associated active (phase) and neutral conductors.

4. Understand and apply the techniques for fitting and terminating various types of flexible cords to electrical appliances and fittings including the need for accurate and tidy work.

H3f.44 Cables and Cords — **Level A 1**
Install and terminate cables — **Level B 2-7**
Level C 8

1. Describe the step by step procedure for connecting flexible cords to plugs, cord extension sockets, appliance connectors, lampholders and adaptors (bayonet cap and Edison screw types).

2. Identify suitable conductors for various practical applications.

3. List typical applications for commonly used types of flexible cords, e.g.:

   - Twin and three core.
   - Twisted, parallel and circular construction.
   - TRS and TPS sheathing.

   - PCP, HO-FR and PVC sheathings for oil and petrol contact.

4. Give typical applications for the types of sheathings used for high and very low temperatures

5. Understand and explain the effects of conductor length, cross sectional area and ambient temperature on the current carrying capacity of flexible cords.

6. Understand and explain the effects of oils, petrol, excessive weight or strain, and extremes of temperature on the insulation and sheathing of commonly used flexible cords.

7. Understand that the selection of a flexible cord for use with an electrical appliance may be dependent upon the temperature or other conditions prevailing at the point of entry and connection within the electrical appliance.

8. Compare the practical advantages and disadvantages of commonly used conductors when exposed to heat, moisture, corrosive materials, dust, gases, tension, compression and vibration, e.g.:

    - Copper.
    - Silver.
    - Aluminium.
    - Tungsten.
    - Carbon.
    - Nichrome.
    - Brass.
    - Bi-metals.

H6.43 Selection of fittings and Appliances **Level A 1-4 Level B 5-11 Level C 12-15**

1. Understand and explain why all single pole switches must be connected in the active (phase) conductor of electrical appliance wiring.

2. Correctly identify the pin polarity of three pin accessories and the earthing facility on electrical appliance connectors.

3. Understand and explain the importance of replacing internal wiring of portable electrical appliances, when required, with similar or equivalent alternative conductors by considering:

    - Current carrying capacity.
    - Quality of insulation to suit the electrical appliance operating voltage.
    - Operating temperature.
    - Need for flexibility or rigidity as required.

4. Understand the requirements of the Regulations, AS/NZS 3000 and AS/NZS 3760 in relation to the selection, installation and mechanical and electrical protection of fittings and electrical appliances.

5. Describe the types and purpose of "internal" protection devices commonly used within electrical appliances, e.g.

    - Fuses (including miniature glass cartridge type).
    - Fusible links.
    - Overload relays (magnetic and thermal).
    - Tilt switches
    - Micro-temps and thermo-temps

6. Radio and television interference suppression:

   (a) Identify the principal components used, i.e.:

   - The capacitor.
   - The inductor (choke)

   (b) Explain why the total capacitance connected to the exposed metalwork of any electrical appliance must not exceed 0.005 microfarad.

   (c) Explain why interference suppression devices must not be connected in the earth continuity conductor of any electrical appliance.

   (d) Understand why replacement suppression capacitors for use with 230 volt electrical appliances must be rated for voltage considerably in excess of 230 volts.

7. State the reason why the earthing pin on the three-pin plug is longer than the active (phase) and neutral pins.

8. Recognise the limitations that may apply to the use of electrical fittings, e.g.:

   - Current limits.
   - Voltage limits.
   - Environmental restrictions.

9. Understand why most a.c. switches are not suitable for d.c. applications.

10. Define the term "electrical appliance" and describe the difference between earthed and double insulated electrical appliances. Explain how each provides safety from electric shock.

11. Understand the operating principles and typical uses of the following types of control devices:

    - Energy regulator (simmerstat).
    - Thermostats of various types.
    - Pressure switch.
    - Limit switch.
    - Time switch.
    - Single and double pole switches.
    - Single and double throw (centre "off") switches.
    - Two way control switching.
    - Three-heat switching (for two section resistive load).

12. Define the term "electrical fitting" and list examples of those used with electrical appliances and flexible cords. Identify light or heavy-duty electrical fittings where applicable.

13. List the reasons why the use of lampholder adaptors to connect electrical appliances to the electrical supply are illegal, e.g.:

    - No guarantee of polarity (bayonet and Edison screw types).
    - No earthing facility.
    - Current limitations (bayonet and Edison screw types).

14. Briefly describe the general operating principles of the following types of electrical appliances:

    - Heating appliance.
    - Cooking appliance.
    - Appliance incorporating electric motors.

15. Draw the internationally recognised symbol for a double insulated electrical appliance.

H10.66 Fault diagnosis **Level A 1**
Level C 2

1. Describe the steps required to:
    - Identify a "blown" fuse.
    - Isolate the fuse base from both supply and load.
    - Rewire the fuse carrier or replace the cartridge.
    - Replace the fuse carrier in its fuse base.

2 Describe suitable means of preventing further use of a defective or hazardous electrical appliance, including the use of appropriate safety tags

J. Damp and Wet Areas

J.33 Damp and wet areas **Level C**

Understand and apply the requirements of the Regulations, AS/NZS 3000, and AS 60529 as they relate to electrical appliances in damp and wet areas.

K. Testing, Certification and Inspection

K2.38 Statutory testing and inspection requirements — Level A

1 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.

2. Testing of portable RCDs used for personal protection

(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.

(c) Understand the method of verifying RCDs suitable for personal protection in accordance with NZS 3019 as an alternative to testing.

3. Testing of Isolating Transformers

(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.

K4.46 Testing and inspection methods — Level A

1. (a) Identify the appropriate instrument for testing an electrical appliance for:

- Circuit continuity
- Insulation resistance
- Polarity
- Protective earthing continuity
- Effectiveness of controls and safety facilities.

(b) Describe methods of carrying out tests listed in (a) and state minimum and maximum results (where appropriate) that are considered satisfactory.

(c) Understand the reasons for each of the tests listed in (a).

(d) 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.

(e) Understand that the instrument used to measure the resistance of a protective earthing conductor must be able to accurately read values of less than 1 ohm

2 (a) Identify the correct instrument to measure:

- Voltage.
- Current.
- Resistance.
- Insulation resistance.
- Protective earthing continuity.
- Power.

(b) 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.

3. (a) Describe the correct method of connecting indicating instruments in a circuit to obtain meaningful results, e.g.:

    - Connect a voltmeter across the circuit or component.
    - Connect an ammeter in series with the circuit or component
    - Use of a clip-on ammeter as an alternative to using an ammeter.
    - Connect an insulation resistance tester between open circuited conductors and from each conductor and earth.
    - Connect an ohmmeter to form a closed series circuit with its associated power source, zeroing resistance and the resistance to be measured.

    (b) 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.

    (c) Understand that an ohmmeter, if of the analogue type, must be calibrated (zeroed) with its power source before use. Explain how this is carried out and why it is necessary.

    (d) List the usual functions available in a multimeter and understand the relationship existing between different ranges of the same function.

    (e) List the limitations of the multi-meter and insulation resistance tester when used for testing insulation resistance and protective earth conductor continuity.

    (f) Ensure correct instrument polarity when working with moving coil analogue type meters on direct current circuits.

    (g) State the likely results of using test instruments connected in circuit incorrectly or, where a multimeter is used, switched to incorrect functions or inappropriate ranges.

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 1-5 Level B 6**

1. State the factors that contribute to safety in the workplace, e.g.:

    - The wearing of suitable clothing for the job.
    - Ensuring working conditions are safe.
    - Safe use of ladders and lifting gear.
    - Safety relating to noxious materials, acids, gasses, fumes, dust, etc.
    - The correct use of machine tools.
    - The promotion of good workshop behaviour.

2. Understand the danger represented by exposed live parts and conductors with respect to:

    - Components or conductors operating at different potentials.
    - Earth potential.
    - Connecting any electrical appliance or apparatus that may become an electrical hazard.
    - The need to suitably label any such electrical appliance and remove it from the work area if possible.
    - The need to ensure that all covers, screens and guards provided with portable electrical appliances are in good order and are firmly fixed in their correct positions at the completion of any work carried out on the appliance.
    - The need to always test work before connecting it to the supply.

3. Nominate appropriate procedures that will assist in preventing contact with live components, e.g. disconnect from the supply before working on electrical equipment.

4. Understand the precautions necessary when working in hazardous locations and/or environments, and in damp situations.

5. Understand the requirements of the Regulations, AS/NZS 3000 and AS/NZS 3760 in relation to public and personal safety

6. Understand the precautions necessary when handling or working with capacitors that may retain a charge.

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 1-3**
Level B 4

1. Understand and explain, with the aid of fully labelled diagrams, the purpose and uses, of:

   - The isolating transformer.
   - Double insulation.
   - Residual current devices (RCDs).

2. (a) State, which types of fire extinguisher, must or must not be used on an electrical fire.

   (b) Understand that the power supply to the burning equipment must be turned "off" before attempting to extinguish the fire.

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

4. Understand the various "conditions of use" and "types of safeguard" approved for use with electrical appliances.

L5.57/ 58 CPR and basic first aid

Note: These aspects are covered elsewhere within the training system such as in on-job training or practical assessments or refresher courses. Assessment will occur in those areas and not in the examination.

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 of an electrical service technician registration

P. Legislation

P1.13 Legislation **Level A**
Fundamental principles

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

P2.13 Legislation **Level A**
Registration

1. State that electrical work is subject to audit by the Electrical Workers Registration Board.

2. Understand that completing an ESTA tuition course and passing the ESTA 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.6 limitation that entitles the holder to carry out:

   - The maintenance (testing, servicing and repair) of electrical appliances rated up to 230 volts supplied via plug and flexible cord.
   - The replacement of fuse links rated up to and including 230 volts.
   - The construction repair and replacement of flexible cord sets rated up to and including 230 volts.

4. Understand the requirements of the Act and Regulations for registration as an electrical service technician

5. 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.

6. Describe the responsibilities binding upon 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 **Level A**
Practising licences

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

P4.13 Legislation **Level A**
Discipline

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 **Level A**
Accidents

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 1 to 15 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 General

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

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

- Identify the components found on domestic and small industrial appliances mentioning their purpose and principal function.

- Locate, identify and isolate the source of supply, including the replacement of fuse links and resetting of circuit breakers.

- Carry out isolation practices, in relation to the following:

    - At socket outlets.
    - Securing isolation by means of appropriate safety tags (where possible).
    - Testing for live conductors at an isolated appliance.

- Checking all protective earthing conductors electrically and mechanically.

- Removal of safety tags.

- Restore power supply and check equipment for correct operation.

10.3 Skills

F. Single-phase motors and starters

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

Skill 14

Connect and test a single-phase motor.

H. Circuit and Cable Installation and Protection

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

Skill 4

Select and replace rewireable and HRC fuses including.

(a) Demonstrating the correct procedures for withdrawing, reloading and replacing fuse carriers at the switchboard. Exercises are to include rewirable and HRC cartridge types.

(b) Being aware of such items as:

- Current rating.
- Category of duty.
- Utilisation categories.
- Enclosure types.

H3d.41 Cables and Cords Specifications **Level A**

Skill 13

Identify electrical fittings, cables and flexible cords.

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

Skill 5

Terminate flexible cords including various crimp connector types.

Skill 6

Soldering

Demonstrate the ability and skill to satisfactorily:
- Connect stranded cables to screw and washer terminals.
- Connect stranded cables to pillar terminals.
- Solder tags and solder lugs.

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

Skill 3

Fit single-phase plugs and sockets (cord connectors).

Skill 7

Connect metal framed electrical appliances by flexible cord (insulation protection and earthing).

Skill 8

Fit Edison screw and bayonet cap lampholders.

Skill 10

Connect three heat switching and energy regulator controls.

Skill 13

Identify electrical fittings, cables and flexible cords.

H8.52A Design and connect switching circuits **Level A**

Skill 9

Connect 1 way, 2 way lamp circuits and control circuitry, including the use of double pole switches.

K. Testing, Certification and Inspection

K4.46 Testing and inspection methods **Level A**

Skill 11

Live voltage and current rating testing of 230 volt appliances.

Skill 12

Test three electrical appliances and the completion of an electrical appliance test sheet for each appliance including identifying and suitably labelling defective electrical appliances or circuits to prevent their further use or operation until repaired or replaced.

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

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

Skill 2

Demonstrate electrical safety and safe working practices during all of the practical assessment

L5.57/58 CPR and basic first aid **Level A**

Skill 1

Cardio Pulmonary Resuscitation instruction and practice in approved methods.

Skill 15

Basic 1st Aid course