Electrical Workers Registration Board

Teaching Guidelines for Associated Tradesperson (Plumber, Gasfitter and Plumber/Gasfitter)

Written Examination Prescription

and

Practical Skill Assessments

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Contents

1 Introduction

Under the Electricity Amendment Act 2006 the Electrical Workers Registration Board (the Board) has a responsibility to set the registration criterion and ensure that all persons applying for electrical registration are competent.

As part of the competency requirements sixty-six (66) essential capabilities incorporating 31 critical items have been agreed between the Board and Australian licensing authorities.

Essential capabilities relevant to training an associated tradesperson to registration level under the "Rules of the Board" have been selected:

- to cover the examination subject matter detailed in these Teaching Guidelines; and
- for incorporation into any competency-based training system developed for an Associated Tradesperson National Certificate for Board approval.

To be eligible for registration as an associated tradesperson, an applicant must comply with the Board's minimum requirements and satisfy the Board that they are competent.

The written examination prescription and practical skill assessments in these Teaching Guidelines are structured around essential capabilities for the maintenance and replacement of fittings and equipment rated at not more than 250V and 16 amperes. These guidelines have been prepared to assist tutors in the development and delivery of courses for trainees who need to complete the following to be eligible to apply for associated tradesperson registration:

- capstone testing, that is, pass the written examination; and
- the practical skills assessment programme.

Tuition courses provided for the associated tradesperson registration must include theory, Regulations and Standards and cover **all** of the subject matter in relevant parts of this document and:

- practical skill assessments must cover all core skill tasks plus:
  - for plumbers, the additional skills listed for plumbers;
  - for gasfitters, the additional skills listed for gasfitters;
  - note: plumber/gasfitters must complete all skills.

While these prescriptions and 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.

2 Scope

The Written Examination Prescription is for capstone purposes and covers essential capabilities and critical items that are considered relevant to maintenance and replacement of fittings permitted by the "limits of work".

For the purposes of the Board's registration classes "servicing" means:

> "any prescribed electrical work that involves the dismantling, repair, adjustment, reassembly and replacement of electrical fittings, other than the installation of permanently wired conductors, of works or electrical installations intended for the generation, conversion, transformation, conveyance, or control of electrical supplies".

Therefore, a candidate undergoing tuition in accordance with these prescriptions should receive the full range of theory, regulations tuition and practical skills training that incorporate the appropriate relevant capabilities by:

- completion of a Board-approved competency-based training system for the issue of an Associated Tradesperson National Certificate; or
- alternatively, under an experience training pathway in New Zealand approved by the Board; or
- in an overseas jurisdiction that is recognised by the Board or the Board accepts as a satisfactory alternative;
- practical skills assessment that covers the requirements under the "Rules of the Board".

Practical skill assessments apply to those candidates who have not satisfactorily completed a Board-approved competency-based training system or candidates that have been trained in overseas jurisdictions recognised by the Board (or as required by the Board to be eligible to apply for registration).

Note: The subject matter in these Prescriptions and Guidelines reflect what a trainee or candidate is expected to achieve from tuition courses provided.

3 Associated Tradesperson Registration Requirements

To be eligible for registration as an associated tradesperson, under the "Rules of the Board" an applicant must provide evidence to the Board that they have:

(a) registration issued by the Plumbers, Gasfitters and Drainlayers Board as a **plumber or gasfitter or a plumber/gasfitter**; and

(b) satisfactorily completed a formal training course or courses of study for an associated tradesperson accredited by the Board or that the Board accepts is equivalent; and

(c) passed the associated tradesperson written capstone examination as required by the Board; and

(d) passed practical skill assessments, **or** a practical examination prescribed by the Board, **or** satisfactory completion of competency-based assessments that the Board accepts is equivalent; and

(e) satisfactorily completed instruction in safe working practices, testing, basic first aid and cardiac-pulmonary resuscitation as approved by the Board.

4 Limits of Work under the "Rules of the Board"

Associated tradesperson (plumber)

(a) The maintenance and replacement of fittings that have an electrical rating of not more than 250 volts and 16 amperes which are one of the following:
   (i) storage water heater elements;
   (ii) storage water heater thermostats.

(b) The disconnection and connection of fittings from or to a power supply, other than by means of a plug or pin inserted into a socket, or an appliance coupler inserted into an appliance inlet; where those fittings have an electrical rating of not more than 250 volts and 16 amperes and are one of the following:
   (i) waste disposal units;
   (ii) electronic water control units;
   (iii) water pressure devices;
   (iv) storage water heaters.

(c) The testing of work described in paragraphs (a) and (b) above.

(d) The certification of work described in paragraphs (a) and (b) above.

(e) The supervision of any work described in paragraphs (a) to (d) above.

Associated tradesperson (gasfitter)

(f) The maintenance and replacement of fittings that have an electrical rating of not more than 250 volts and 16 amperes which form part of gas fired equipment.

(g) The disconnection and connection of fittings from or to a power supply, other than by means of a plug or pin inserted into a socket, or an appliance coupler inserted into an appliance inlet; where those fittings have an electrical rating of not more than 250 volts and 16 amperes and form part of gas fired equipment.

(h) The testing of work described in paragraphs (f) and (g) above.

(i) The certification of work described in paragraphs (f) to (g) above.

(j) The supervision of any work described in paragraphs (f) to (i) above.

Associated Tradesperson (Plumber/Gasfitter)

(k) All of the work described in paragraphs (a) to (j) above.

5 Written Examination

Every effort has been made in this document to provide clear guidance for the Written Prescription. In specific instances essential subject matter will be derived from the Electricity (Safety) Regulations 2010 or Electrical Standards.

Written examinations will cover any of the aspects in this Prescription. This examination includes electrical theory, referencing the Electricity Regulations and relevant Standards where those information sources are expected to be known by the candidate.

For example, minimum insulation resistance values for an electrical installation or electrical equipment (requirements from AS/NZS 3000 and AS/NZS3760) will be incorporated into examination questions relating to insulation resistance testing.

6 Safety

Safety must be emphasised at all times, whether it be classroom tuition, carrying out practical exercises or practical skill assessments. Safety, not only of tutors, assessors and candidates, but also others who may in future depend on the candidate's standard of workmanship and competency.

7 Definitions

Unless the context otherwise requires, within these guidelines:

Act means the Electricity Act 1992

Code or ECP means New Zealand Electrical Code of Practice issued under Part IV of the Act

Regulation means the Electricity (Safety) Regulations 2010

Standard means any of the following:

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

Section means a section of the Electricity Act 1992.

Other terms and interpretations are defined in the Electricity Act 1992, The Electricity Amendment Act 2006, Electricity (Safety) Regulations 2010, AS/NZS 3000 and the Companion Standards as prescribed in Schedule 2 of the Regulations.

8 Reference Texts

The applicable parts of following texts must be used when providing tuition in accordance with these Guidelines. Note that:

1. the most recent edition of the reference texts together with the latest amendments must be used
2. for Standards and Codes, the most recent edition and the edition prior may have to be used. This may occur where a newer edition has been published after the one cited in regulations
3. the reference texts cited **include** those that may be used by candidates in an examination. Reference texts permitted in the associated tradesperson examination will be notified by the Board and also published on the EWRB website
4. EWRB Supervision Guidelines for "Trainees" – supervision principles are also relevant to associated tradespersons.

Training providers, however, may use any other material they consider relevant to the tuition course but this material will not be permitted in the examination.

8.1 Legislation

The Electricity Act 1992 reprint dated 1 April 2010 and the Electricity (Safety) Regulations 2010.

Standards – Electricity (Safety) Regulations 2010
Schedule 2 Standards

Abbreviations used in regulations	Full title
AS 4777.1	AS 4777.1:2005 Grid connection of energy systems via inverters – Installation requirements.
AS/NZS 1677.2	AS/NZS 1677.2:1998 Refrigeration systems – Safety requirements for fixed applications: including Amendment 2.
AS/NZS 2500	AS/NZS 2500:2004 Guide to safe use of electricity in patient care.
AS/NZS 3000	**AS/NZS 3000:2007 Electrical Installations (known as the Australian/New Zealand Wiring Rules) including Amendment 1.**
AS/NZS 3001	AS/NZS 3001:2008 Electrical Installations – Transportable structures and vehicles including their site supplies: including Amendment A.
AS/NZS 3002	AS/NZS 3002:2008 Electrical Installations – Shows and carnivals, subject to variation that references to AS/NZS 3439.4 must be read as AS/NZS 3439.4:2009.
AS/NZS 3003	AS/NZS 3003:2003 Electrical Installations – Patient areas of hospitals, medical and dental practices and dialysing locations.
AS/NZS 3004.1	AS/NZS 3004.1:2008 Electrical Installations – Marinas and recreational boats – marinas.

Abbreviations used in regulations	Full title
AS/NZS 3004.2	AS/NZS 3004.2:2008 Electrical Installations – Marinas and recreational boats – recreational boats installations.
AS/NZS 3009	AS/NZS 3009:1998 Electrical Installations – Emergency power supplies in hospitals.
AS/NZS 3010	AS/NZS 3010:2005 Electrical Installations – Generating sets.
AS/NZS 3012	AS/NZS 3012:2003 Electrical Installations – Construction and demolition sites, subject to variation that references to AS/NZS 3439.4 must be read as references to AS/NZS 3439.
AS/NZS 3014	AS/NZS 3014:2003 Electrical Installations – Electric fences including Amendment 1.
AS/NZS 3016	AS/NZS 3016:2002 Electrical Installations – Electric security fences including Amendment 1.
AS/NZS 3112	AS/NZS 3112:2004 Approval and test specification – Plugs and sockets including Amendment 1.
AS/NZS 3190	AS/NZS 3190:2009 Approval and test specification – Residual current devices (current-operated earth leakage devices).
AS/NZS 3439	AS/NZS 3439.4:2009 Low-voltage switchgear and control gear assemblies – Particular requirements for assemblies for construction sites (ACS).
AS/NZS 3551	AS/NZS 3551:2004 Technical management programmes for medical devices including Amendment 1.
AS/NZS 3760	**AS/NZS 3760:2003 In-service safety inspection and testing of electrical equipment including Amendment 1.**
AS/NZS 3820	AS/NZS 3820:2009 Essential safety requirements for electrical equipment.
AS/NZS 3823	AS/NZS 3823:1998 Electrical Installations – Cold-cathode illumination systems.
AS/NZS 4509.1	AS/NZS 4509.1:2009 Stand alone power systems – safety and installation.
AS/NZS 4701	**AS/NZS 4701:2000 Requirements for domestic electrical appliances and equipment for reconditioning or parts recycling.**
AS/NZS 5033	AS/NZS 5033:2005 Installation of photovoltaic (PV) arrays including Amendment 1.
AS/NZS 5761	**AS/NZS 5761:2005 In-service safety inspection and testing – Second-hand electrical equipment prior to sale.**
AS/NZS 5762	**AS/NZS 5762:2005 In-service safety inspection and testing – Repaired electrical equipment.**
AS/NZS 60079.14	AS/NZS 60079.14:2009 Explosive atmospheres – Electrical installations design, selection and erection.
AS/NZS 60079.17	AS/NZS 60079.17:2009 Explosive atmospheres – Electrical installations inspection and maintenance.

Abbreviations used in regulations	Full title
AS/NZS 60950	AS/NZS 60950.1:2003 Information technology equipment – Safety – General requirements including Amendments 1, 2 and 3.
AS/NZS 61000.3.2	AS/NZS 61000.3.2:2007 Electromagnetic compatibility (EMC) – Limits-Limits for harmonic current emissions (equipment input current less than or equal to 16 amperes per phase) including Amendment 1.
IEC 60050	IEC 60050: International Electrotechnical Vocabulary.
IEC/TS 60479-1	**IEC/TS 60479-1 Ed 4.0 Effects of current on human beings and livestock – Part 1: General aspects.**
IEC 61000-3-2	IEC 61000-3-2 Ed 3.2 Electromagnetic compatibility (EMC) – Limits – Limits for harmonic current emissions (equipment input current less than or equal to 16 amperes per phase) as amended by deviation in IEC 61000-3-2;2007 including Amendment 1.
IEC 61000-3-3	IEC 61000-3-3 Ed 2.0 Electromagnetic compatibility (EMC) – Part 3-3 Limits – Limits of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems with current less than or equal to 16 amperes per phase and not subject to conditional connection.
IEC 61000-3-4	IEC 61000-3-4 Ed 1.0 Electromagnetic compatibility (EMC) – Part 3-4 Limits – Limitation of emission of harmonic currents in low-voltage supply systems with rated current less greater than 16 amperes.
IEC 61000-3-5	IEC 61000-3-5 Ed 2.0 Electromagnetic compatibility (EMC) – Part 3-5 Limits – Limits of voltage fluctuations and flicker in low-voltage supply systems with rated current greater than 75 amperes.
IEC 61000-3-11	IEC 61000-3-11 Ed 1.0 Electromagnetic compatibility (EMC) – Part 3-11 Limits – Limits for harmonic currents produced by equipment connected to public low-voltage supply systems with input current greater than 16 amperes and less than or equal to 75 amperes per phase.
IEC 62128-1	IEC 62128-1 Ed 1.0 Railway applications – Fixed installation – Part 1 Protective provisions relating to electrical safety and earthing.
ISO/IEC 17050-1	ISO/IEC 17050-1 Conformity assessment – Supplier's declaration of conformity – Part 1 General requirements.
NZS 3003.1	NZS 3003.1: (2003) Electrical installations – Patient areas of hospitals and medical and dental practices – testing requirements.
NZS 6115	NZS 6115:2006 Electrical installations – Mobil electro-medical connectable installations: subject to variation that references in this standard to NZS3019 must read as references to AS/NZS3001.
NZS 6116	NZS 6116:2006 Safe application of electricity in meat processing industry.
NZS 7901	NZS 7901:2008 Electricity and gas industries – Safety management system for public safety.

8.2 Codes

NZECP 34 New Zealand Electrical Code of Practice for Electrical Safe Distances

NZECP 54 New Zealand Electrical Code of Practice for Electrical Installations of Recessed Luminaires and Auxiliary Equipment.

9 Associated Tradesperson Written Examination Prescription

Subject matter under the "Rules of the Board" has been extracted from 66 Essential Capabilities incorporating 31 critical items. Subject matter considered critical has been allocated A and B knowledge designations.

Letters "A", "B", "C" and "D" appearing in the right-hand margin represent levels of knowledge candidates are expected to attain by completing Board accredited or Board approved courses of study – these designations are as follows.

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

9.1 Basic electrical theory

(a) Describe the elements of an electric circuit, ie: **B**

- source (battery, generator, a.c. mains, etc)
- conductors (positive, negative, phase, neutral, earth)
- insulation (to contain the conductors within defined limits)
- control (switches, thermostats, energy regulators, etc)
- protection (fuses, circuit breakers, etc)
- metering (voltmeter, ammeter, watt-hour meter, etc)
- load (current using devices).

(b) Demonstrate how energy is converted through heat, chemical, magnetic and mechanical processes. **C**

(c) Demonstrate knowledge of ohms law, material resistivity, resistor parameters, and introduction to measuring methods. **C**

(d) Demonstrate knowledge of how electrical energy is produced from various forms of energy. **C**

(e) Explain the operation of a simple practical circuit including current path, circuit control, load, EMF source and conductors. **C**

(f) Determine the resistance, voltage and power in any part of a d.c. series and/or parallel circuit using practical knowledge and safe use of measuring instruments. **C**

(g)	Understand that the total opposition to current flow in an a.c. circuit is impedance (Z).	**B**
(h)	State the formula Z = V/I and perform simple calculations to obtain a value for current (I) when the supply voltage and impedance values are known.	**B**

9.2 Electrical circuits

(a)	Describe a series circuit.	**B**
(b)	State the characteristics of a series circuit.	**B**
(c)	Draw and label series circuit diagrams incorporating commonly used components.	**B**
(d)	Recognise and use the correct standard symbols for circuit components.	**C**
(e)	Describe a parallel circuit.	**B**
(f)	State the characteristics of a parallel circuit.	**B**
(g)	Draw and label diagrams of simple parallel and series-parallel circuits incorporating commonly used components.	**B**
(h)	Indicate on the diagrams the correct connections for the voltmeter, ammeter and ohmmeter.	**B**
(i)	Explain why electrical appliances are normally parallel connected rather than series connected.	**B**
(j)	Describe the essential differences between ac and dc current.	**C**

9.3 Power and energy

(a)	Understand the relationship between voltage, current and power.	**A**
(b)	State the units in which power is measured.	**A**
(c)	State the formulae for power where: $P=V^2/R$, $P=I^2R$, $P=VxI$.	**B**
(d)	Transpose the Power formulae and perform simple calculations to obtain an unknown value.	**B**
(e)	Understand the relationship between voltage, current, time and energy.	**A**
(f)	State the units in which energy is measured.	**A**

9.4 Electrical conductors

(a) Describe the properties of commonly used conductors for: **C**

- use in flexible cord or flexible cable
- rigid use, eg:
  - contacts
  - terminals
  - heating elements
  - lamp filaments.

(b) Compare the practical advantages and disadvantages of commonly used conductors when exposed to heat, moisture, corrosive materials, dust, gases, tension, compression and vibration, eg: **C**

- copper
- silver
- aluminium
- tungsten
- carbon
- nichrome
- brass
- bi-metals.

(c) Understand the importance of secure, well made connections in prolonging the service life of a conductor. **B**

(d) Identify suitable conductors for various practical applications. **B**

9.5 Electrical insulators

(a) State the purpose for which insulating materials are used, eg: **B**

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

(b) Describe the properties of an ideal insulator for: **C**

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

(c) Compare the practical advantages and disadvantages of commonly used insulators when exposed to heat, moisture, corrosive materials, dusts, gases, tension, compression and vibration, eg: **C**

- glass
- mica
- oils
- ceramics
- rubber
- plastics (various).

(d) State the importance of "insulation resistance" as an indicator of an insulator's condition. **A**

(e) Identify suitable insulators for various practical purposes. **B**

9.6 Flexible cords and cables

(a) Describe commonly used types of flexible cord and list typical applications for each, eg: **B**

- twin and three core
- twisted, parallel and circular construction
- TRS and TPS sheathing
- PCP, HO-FR and PVC sheathings for oil and petrol contact.

(b) State the types of sheathing suitable for use in high temperature environments and give typical applications for each type. **B**

(c) State the New Zealand approved distinguishing colours by which each core in a flexible cord and cable may be identified. **A**

(d) Explain the effects of conductor length, cross sectional area and ambient temperature on the current carrying capacity of flexible cords. **B**

(e) Understand and explain the effects that oils, petrol, excessive weight or strain, and extremes of temperature have on the insulation and sheathing of commonly used flexible cords. **B**

(f) Understand and explain that the selection of a flexible cord for an electrical appliance may be dependent on environmental conditions prevailing at cord entry point and temperature within the electrical appliance where the conductors are terminated. **B**

(g) Demonstrate the use of Cable Manufactures' Tables and AS/NZS3008.1.2 relating to current ratings, voltage drop and temperature rating factors for various sizes and types of: **B**

- flexible cables; and
- flexible cords.

(h) Understand that flexible cords are conductors up to and including 4 mm^2 cross sectional area. **C**

(i) Understand that flexible cables are conductors having a cross sectional area greater the 4 mm^2 cross sectional area. **C**

9.7 Cables

Understand and apply the general requirements of AS/NZS 3000 in relation to the termination of cables. **A**

Understand and explain the construction of the following flexible cables, flexible cords, and cables listed below: **B**

- TPS and TRS cables
- neutral screened cables
- MIMS cables
- steel-wired armoured cables
- cables installed in metal and plastic conduit
- PVC cables installed in flexible conduit
- copper braided sheath flexible cords and cables.

Provide typical applications where each of the following types of cables are likely to be encountered: **C**

- TPS and TRS cables
- neutral screened cables
- MIMS cables
- flexible cables and cords
- cables installed in metal and plastic conduit
- PVC cables installed in flexible conduit
- copper braided sheath flexible cords and cables.

9.8 Cable and cords termination methods

Understand and explain the methods by which electrical equipment and fittings may be connected to the fixed wired supply including: **B**

- by flexible cord using various approved plugs and sockets
- by flexible cord from a ceiling rose
- by flexible cord or flexible cable from a permanent connection unit
- by flexible cord or flexible cable using suitable connectors housed in an approved box, switch or terminal unit
- by direct connection of the fixed wiring cables to the electrical appliance at its terminal box
- installation couplers complying with AS/NZS 61535.

Understand and explain connection methods listed in above and offer reasons for the selection of one or another in the following circumstances: **C**

- portability of the electrical appliance
- effects of moisture or vibration
- special tariff circuits
- loading involved
- multi-phase requirements.

9.9 Systems of supply

New Zealand electrical supply system

(a)	Illustrate with labelled diagrams the New Zealand electrical supply system showing the generation, transmission and distribution systems.	**A**
(b)	State the typical voltages involved in each of the above supply areas.	**B**
(c)	Draw and label the three-phase four-wire New Zealand distribution system to show how it can be used to supply: • a three-phase consumer • a two-phase consumer • a single-phase consumer.	**A**
(d)	State the advantages of balancing the load over the three phases.	**A**

9.10 Multiple earth neutral system

(a)	Explain how the MEN system of supply in New Zealand is configured.	**A**
(b)	Explain reasons why the neutral is earthed at multiple points in the supply system.	**B**
(c)	Understand and explain the principle purpose of the multiple earth neutral (MEN) system used in New Zealand including: • maintaining a low neutral/earth parallel return circuit impedance to the distribution transformer • rapid disconnection of the supply under fault conditions • ensuring that the voltage cannot rise above 230V to earth.	**B**
(d)	Understand and explain the importance of maintaining reliable low resistance earth circuit values for both protective earth and bonding conductors.	**A**
(e)	Understand and explain the danger high resistance protective earth conductor or bonding conductor connections would present under fault conditions.	**A**
(f)	Explain the implications of a missing MEN link in an installation during fault conditions in respect to; line voltage to earth, fault current path, earth loop impedance and operation of protective devices.	**B**
(g)	Distribution type system – explain the circumstances in which an alternative system (eg, distribution system) can be connected down stream of an MEN system.	**B**

9.11 Protection

(a)	State what is meant by the terms rated current and excess current protection.	**A**
(b)	Describe the danger of excess current to cables and equipment.	**A**
(c)	State forms of excess current protection: • close excess current protection • coarse excess current protection.	**A**

(d) Explain the following terms applicable to sub-circuit protection: **A**

- voltage rating
- current rating
- utilisation categories – that replace fusing factors
- breaking capacity and kVA rating.

(e) Describe, with the aid of labelled diagrams the construction, operation principles and applications of the following protective devices: **A**

- semi-enclosed rewirable fuses (installed in existing installations)
- HRC fuses labelling in accordance with BS88:1998, IEC and AS/NZS 60269
- miniature circuit breakers
- HRC fuse cartridge fuses
- fusible links
- magnetic overload relays
- thermal overload relays.

(f) Understand and explain the following terms as related to protective devices: **A**

- current rating
- voltage rating
- fusing current
- utilisation category
- tripping factor
- cut-off characteristic
- time verses current characteristic
- category of duty
- discrimination
- back-up protection
- rupturing capacity
- prospective short-circuit current
- earth-fault loop impedance.

9.12 Electrical safety of personnel

Effects of current

(a) Demonstrate knowledge of the physiological effects of electricity on humans. **A**

(b) Explain: **A**

- why peak voltages are an important consideration in respect to insulation resistance values providing protection from exposure to electric shock
- the danger of simultaneously contacting active (phase) and neutral or active (phase) and earth conductors
- the effects that varying values of voltages, current, duration of contact and other conditions (wet or punctured skin, etc) have on the severity of electric shock received by the victim.

9.13 Personal protection devices

Residual current devices (RCDs)

(a)	Understand that RCDs provide supplementary protection to users of electrical appliances and equipment.	**A**
(b)	Demonstrate knowledge of the maximum tripping current and operating times as stated in Regulation 20.	**A**
(c)	Explain the verifying and testing requirements in New Zealand to ensure that RCDs installed for protection against shock are **Type A**.	**A**
(d)	Explain with the aid of a labelled diagram the operating principles of an RCD use for personal protection.	**A**
(e)	Understand different types of RCDs include: • residual current-operated circuit breakers (RCCB) • residual current-operated circuit breakers with over current 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) • typical residual current ratings 10mA and 30mA • classification of RCDs according to the presence of dc components • load leakage currents.	**A**
(f)	Understand and apply the principles relating to protection for safety in AS/NZS 3000 and the role RCDs can play in protection for additional safety in damp situations.	**A**
(g)	Understand and apply the requirements regarding the use of RCDs with hand-held electrical appliances.	**A**
(h)	Understand the considerations of installing 10 mA RCD for protecting areas of increased risk and children against electric shock as detailed in Section 2.6.1 of AS/NZS3000.	**A**
(i)	Testing RCDs to ensure compliance with Regulation 20.	**A**

Isolating transformers

(a)	Describe the basic operating principle of an isolating transformer.	**B**
(b)	Explain why the isolating transformer provides maximum safety when used with only one electrical appliance connected.	**C**
(c)	Explain why it is necessary, when two or more electrical appliances are connected simultaneously to one isolating transformer, their earth continuity conductors are bonded together at the transformer but must not be earthed.	**B**
(d)	Understand that the isolating transformer may be used in conjunction with other approved safeguards for extra protection where considered desirable.	**C**

(e) Explain why transformers are rated in kVA and not watts. **C**

9.14 Safety tagging system

(a) Explain the safety tagging system. **A**

(b) State the benefits of using the safety tagging system to promote safety in the workplace. **A**

(c) Explain methods employed to isolate and "lock off" equipment. The importance of using danger tags when working on equipment which may become live. **A**

(d) Explain the importance of the prove–test–prove safety rule and, the benefits of testing before touch to prevent electric shock. **A**

(e) Explain the conditions covering the use of safety tags, their correct placement and removal procedures. **A**

(f) Detail written isolation procedures. **A**

Legislative requirements for workplace safety

(a) Understand that employers are required by legislation to provide and maintain equipment and PPE supplied for employees use in a safe condition. **B**

(b) Understand that employees must use the PPE supplied by the employer and also comply with all safety procedures established. **B**

9.15 Safe working practices

(a) Explain that it is essential to identify hazards and potential hazards and take appropriate steps to eliminate, isolate or minimise the hazard risk by observing safety measures at all times to ensure the safety of: **A**

- electrical workers or electrical trainees
- other workers in the area
- members of the public
- equipment and property.

(b) Explain that associated tradespersons are required to be conversant with the Electricity Safety Regulations to be competent. **A**

(c) Explain the importance of using the correct tools, clothing and equipment that is appropriate for the job and trained to competently use any specialised equipment required. **A**

(d) Explain the importance of preliminary safety checks and observing proven safety rules when working at height and when ladders and scaffolding are involved. **A**

(e) Understand that when good housekeeping and tidy work habits are practiced it promotes a safety culture in the workplace. **A**

(f) Explain that personal protective equipment (PPE) such as covers, mats, gloves, safety harnesses, insulated tools and glasses or goggles, etc, are required to be manufactured to an approved safety standard. **A**

(g)	Explain that regular checks are required to retain the integrity of the safety equipment.	**A**
(h)	Explain why it is necessary to use insulated tools of an approved type when working on electrical fittings.	**A**
(i)	Explain that when working in outdoor or damp situations it is important to supply electrical appliances from either an isolating transformer or from an RCD.	**A**
(j)	Detail the dangers when working with metal ladders, tape, tools and the like on or near electrical supplies or equipment.	**A**
(k)	Explain the dangers of working in explosive atmospheres and stress the importance of ensuring that all electrical equipment is correctly isolated before removing any covers, etc.	**A**
(l)	Explain the procedures when a fire is discovered	**A**
(m)	Explain the procedures for rescue of a person or persons in contact with live conductors or equipment.	
(n)	Detail the types of fire extinguishers that are suitable for use on electrical fires and explain how each type is used.	**A**
(o)	Detail the dangers/hazards involved when working on high voltage fittings.	**A**
(p)	Explain the precautions necessary when working on circuits which have capacitors connected or other sources of stored energy.	**A**
(q)	Detail the requirements and the need for the presence of a second competent person, in situations where a danger or a potential risk exists.	**A**
(r)	Explain the dangers and hazards associated with short circuits and where potentially high prospective short circuit currents could be present.	**A**
(t)	Explain that electrical arcing exposes the victims of electric shock to additional hazards such as: arc eye and serious burns.	**A**

9.16 Electrical testing and measuring instruments

(a) Identify the correct instrument to measure: **B**

- voltage
- current
- resistance
- insulation resistance
- earth continuity
- power.

(b) Explain the purpose and give typical applications of the following types of test instruments: **A**

- ohmmeter
- insulation resistance tester
- voltmeter
- ammeter
- earth loop impedance tester
- RCD tester.

(c) Detail any specific precautions required when using the above instruments. **A**

(d) Explain how the above types of test instrument should be connected to test a circuit. **A**

(e) Explain the importance of ensuring that the correct connections, functions and range are selected on the test instrument before it is used to test a circuit. **A**

(f) List the usual functions available in a multi-meter and understand the relationship existing between different ranges of the same function. **C**

9.17 Electrical testing

(a) Identify the appropriate instrument for testing electrical equipment: **B**

- circuit continuity (to detect open or short circuits, dry or loose connections).
- insulation resistance (phase to earth and between phase and neutral if and when required)
- for verifying correct polarity (detect phase-neutral transposition or phase–earth reversal and switching of the neutral conductor)
- protective earth conductor resistance (identify open circuits, dry, loose or corroded connections)
- effectiveness of any controls and safety devices fitted.

(b) Describe methods of carrying out each test listed above and state minimum and maximum results (where appropriate) that are considered satisfactory. **A**

(c) Understand the reasons for each type of the tests listed in (a) above. **B**

(d) Explain why a multi-meter is not suitable for insulation resistance testing when used for testing insulation resistance and earth continuity. **B**

(e) State why insulation resistance testing of 230V ac equipment is carried at 500V dc and well above the normal single–phase supply voltage. **B**

(f) Describe the various conditions, indications and defects that can be identified by visually inspecting electrical fittings being checked for compliance, general electrical and mechanical safety. **A**

(g) Describe the precautions that must be observed when connecting a test instrument into a circuit, eg: **B**

- use the correct instrument (select function and range if using a multi-meter)
- observe correct polarity where necessary
- select appropriate range for the anticipated result (highest range first)
- ensure that connections are clean, tight and safe.

(h) Understand the essential safety procedures when using instruments to test "live" circuits, eg: **A**

- 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
- ensure that other persons will not be exposed to danger by the testing procedure.

9.18 Commissioning and decommission equipment

Describe procedures for disconnecting conductors at an electrical appliance or at a fixed wiring terminating point including: **A**

- isolation methods
- affixing safety tags
- checking supply to confirm isolation ("prove – test – prove")
- securing isolation (lock off – if facility is available)
- identification of conductors and terminal configurations as disconnection proceeds by ensuring that the correct polarity is observed and noted; protective earth conductor last
- ensuring that any exposed conductors are made safe
- ensuring that disconnected cable conductors are adequately protected against mechanical damage or interference.

Describe procedures for reconnecting conductors at an electrical appliance or fitting at a fixed wiring terminating point including: **A**

- checking safety tags that are in place
- checking that isolation is still effective ("prove – test – prove")
- reconnecting conductors to terminals – earth conductor first
- ensuring correct polarity is observed
- carrying out visual checks and prescribed tests including protective earthing, insulation resistance and polarity
- ensure all covers, screens and guards are in place
- removal of safety tagging and securing locks
- liven and check for correct operation.

Understand the precautions that must be taken when disconnecting and reconnecting conductors from enclosures including: **B**

- 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.

	Understand and explain the importance of ensuring all conductors are correctly identified and correctly terminated to maintain the correct polarity.	**A**
	Understand and explain what would occur if the following conductors were accidentally interchanged on the supply to class I single-phase 230 volt fittings or equipment: • the active (phase) and neutral conductors • the neutral and earth conductors • the active (phase) and earth conductors.	**A**

9.19 Damp situations and wet areas

(a)	Define a damp situation.	**A**
(b)	Apply the requirements of the Regulations, AS/NZS 3000 in relation to damp situations and wet areas.	**B**
(c)	Understand and explain international protection ratings (IP Code) in Appendix G of AS/NZS3000 and specifically what the respective numbers represent, ie, the first and second digits.	**A**
(d)	Understand that when an electrical equipment item is repaired or components are replaced, that the correct components are used to ensure the equipment retains the correct safety standard.	**C**

10 Practical Tasks and Skill Assessments

During the course of practical instruction and assessment stress the importance of understanding how practical skill tasks relate to “on the job” situations.

The candidate shall demonstrate an acceptable level of skill and competency in the practical skill tasks listed for an associated tradesperson.

Skill assessment grading

A consistent grading system has been introduced for all registration classes:

C = competent, and
NC = not competent.

Any skill that has not been assessed is to be awarded a NC result and the reason entered into the comments section on the practical assessment record form.

To pass the practical assessment all skills must be successfully completed with “C” entered into corresponding result column and initialled by a Board-approved skill assessor.

The Practical Assessment Skill Programme is essential to establish that the candidate can competently undertake all practical task skills involving maintenance and “servicing” of single-phase electrical equipment associated with plumbing or gasfitting work that includes but is not limited to:

- identifying components and fittings used on domestic and industrial equipment, stating their purpose and principal function;
- locating and safely isolating (at the switchboard) the electricity source of sub-circuits that are supplying directly connected **single phase** plumbing or gas appliances and/or electrical equipment. Carry out the isolating procedure for:
  - a switch, a fuse and a circuit breaker;
  - secure isolation by means of affixing appropriate safety tags and "personal" padlock (lock off where possible);
  - test for live conductors at an isolated appliance or item of equipment using instruments and applying the "prove – test – prove" rule.
- Disconnect, label and make safe conductors from directly connect plumbing or gas appliances and equipment using a range single-phase cords and cable types.
- Connect and terminate conductors to fixed wired fittings and equipment using a range single-phase cable types.
- Carry out instrument testing on fittings and equipment for safety and compliance.
- Restoration of supply and checking of fittings and/or equipment for correct and safe operation.

11. Practical Assessment Skills

Skills common to plumbers, gasfitters and plumber/gasfitters

Skill no.	Skill definitions and task requirements	Essential capability references
1	Cardiac Pulmonary Resuscitation (CPR) training in New Zealand Resuscitation Council approved methods.	57, 58
2	Basic first aid training – complete a course with St John or Red Cross.	57, 58
3	Electrical safety and safe working practices – observe/assess candidate's ability to competently use the appropriate tools for the job and apply safety principles whilst carrying out practical skill tasks.	40, 54
4	Identify at least ten (10) electrical fittings and accessories and state an application for each.	43
5	Identify at least ten (10) flexible cords and cable types, specify the current rating and a typical application for each type.	41
6	Locate correct protective devices at a functional switchboard and isolate sub-circuits supplying electrical equipment or fittings by: • with drawing a re-wireable fuse and testing sub-circuit for isolation. • with drawing a HRC fuse link and testing sub-circuit for isolation. • turning off and disabling a miniature circuit breaker (mcb) using lever/toggle lock off device and testing for isolation.	38, 40, 54, 62

Skill no.	Skill definitions and task requirements	Essential capability references
7	Locate correct protective devices at a functional switchboard and reliven single-phase sub-circuits supplying electrical equipment and fittings by: • reinserting a re-wireable fuse, to test and check for correct operation • reinserting a HRC fuse link, to test and check for correct operation • removing a lever/toggle lock off device and switching on a mcb to test and check for correct operation.	38, 62, 66
8	Terminate flexible cords, cables and stranded conductors in crimp lugs, at terminal posts under washers and locknut and, into screw terminals.	42, 44
9	Solder and de-solder components and flexible stranded conductors: • onto a printed circuit board • onto solder tags or solder terminals.	42, 44
10	Live test single-phase sub-circuits using appropriate test instruments to obtain voltage, current and earth fault loop impedance values.	6, 13, 38
11	Test two (2) Class I and one (1) Class II 230V electrical fittings or equipment items in accordance with requirements of AS/NZS3760.	34, 46
12	Connect Class I and Class II equipment connected by flexible cord into permanent connection units (PCUs).	43, 44, 47

Additional compulsory skills for plumbers

Skill no.	Skill definitions and task requirements	Essential capability references
13	Remove and install a replacement element in storage water heaters rated up to 250V 16 amperes. Tasks to include rating assessments of the wiring, isolating switch and sub-circuit protection device to ensure the replacement element will not overload the sub-circuit wiring or isolating switch.	44, 47
14	Remove and replace storage water heater thermostats with a rating up to 250V 16 amperes.	38, 42, 44
15	Test 230V plug-in plumbing fittings and equipment connected by flexible cord to the requirements of AS/NZS3760, eg, waste disposal units, electronic water control units, water pressure devices and sensors.	56

Skill no.	Skill definitions and task requirements	Essential capability references
16	Locate, identify, isolate, test, tag, disconnect and connect fittings to a power supply rated up to 250V 16 amperes wired in a range of cable methods and types for: • waste disposal units • electronic water control units • water pressure devices • storage water heater. This task can be a combination of: two disconnections and one connection or, alternatively one disconnection and two connections to a power supply.	40, 44, 62
17	Carry out testing in accordance with Section 8 of AS/NZ3000 following completion of the connection tasks for skill 16 above.	38

Additional compulsory skills for gasfitters

Skill no.	Skill definitions and task requirements	Essential capability references
18	Remove and replace fittings which form part of gas fired equipment rated up to 250V 16 amperes. At least three individual fittings from the range below: • flame failure sensors, solenoid valves, over temperature cut outs, igniters, temperature control sensors or thermostats, pressure switches or pressure sensors, fan motors, step down transformers supplying extra low voltage control circuits.	52, 56, 63
19	Locate, identify, isolate, test, safety tag, disconnect and connect fittings to a power supply rated up to 250V 16 amperes wired in a range of cable methods and types supplying gas fired equipment. Can be a combination of: • two disconnections and one connection, or • one disconnection and two connections to a power supply.	40, 62
20	Carry out testing in accordance with Section 8 of AS/NZ3000 following completion of the connection undertaken for skill 18 above.	38
21	Test 230V gas fired fittings and equipment connected by flexible cord and three pin plug to AS/NZS3760.	38, 56
22	Following repairs and replacement of 230V fittings test a plug-in gas fired appliance connected by plug and flexible cord for electrical safety to AS/NZS5762 (ER90).	62