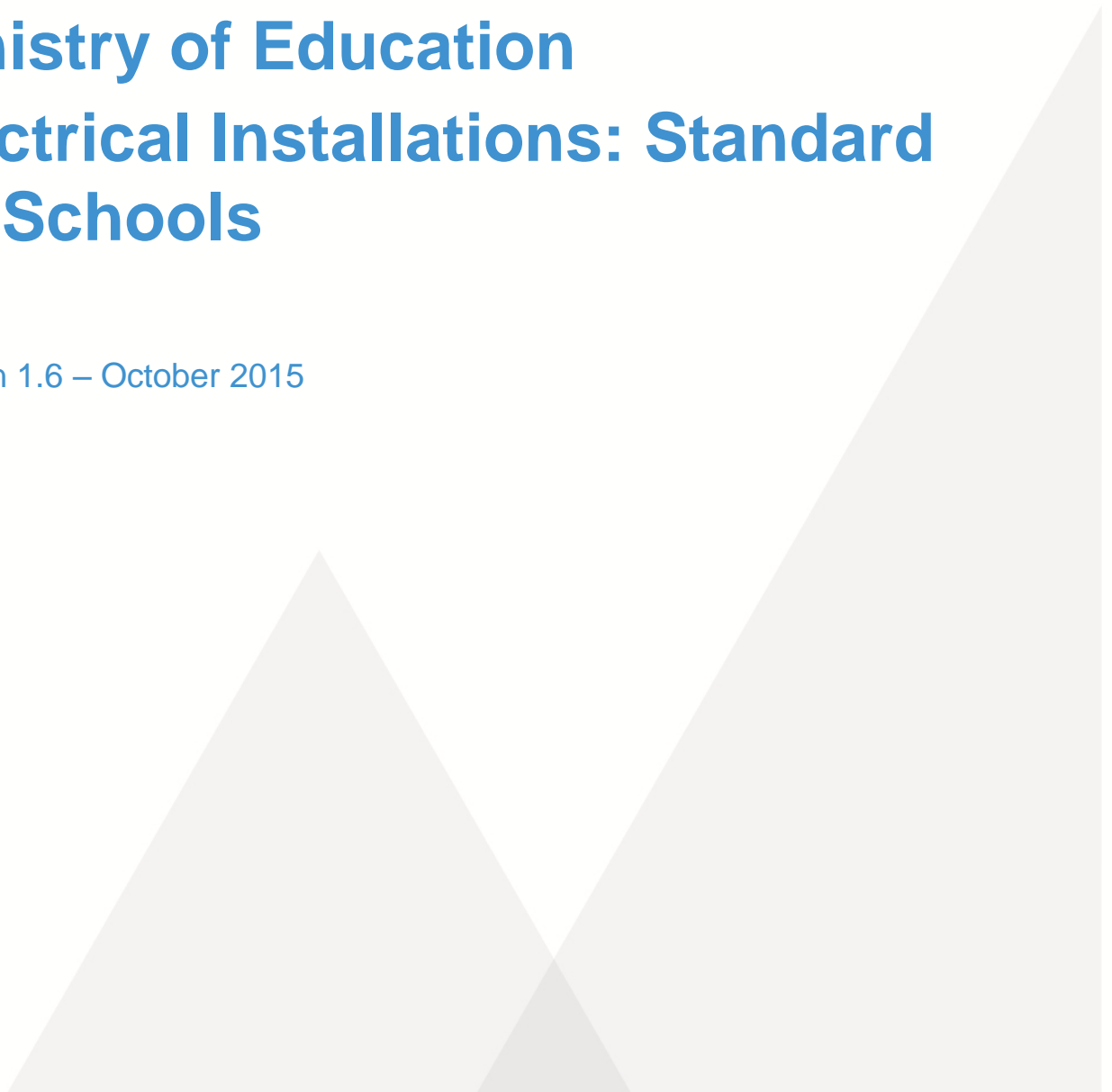




# Ministry of Education

# Electrical Installations: Standard for Schools

Version 1.6 – October 2015



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Table 1: Acceptable sound levels ..... **Error! Bookmark not defined.**

## REFERENCED DOCUMENTS

Reference is made in this document to the following:

### NEW ZEALAND REGULATIONS

Electricity (Safety) Regulations	Electricity (Safety) Regulations 2010
New Zealand Building Code	<hr/> Compliance document for New Zealand Building Code – Clause C Protection from Fire (including amendments 2 and 3) Compliance document for New Zealand Building Code – Clause E2 External Moisture (Third edition, including amendment 6) Compliance document for New Zealand Building Code – Clause G9 Electricity (including amendment 6) <hr/>

### NEW ZEALAND STANDARDS

NZS 3604:2011	Timber framed buildings
NZS 4121:2001	Design for access and mobility: Buildings and associated facilities
NZS 4219:2009	Seismic performance of engineering systems
NZS 4243.2:2007	Energy efficiency - Large buildings - Lighting
NZS 6115:2006 including Amendment 2	Electrical installations - Mobile medical facilities
NZS 6801:2008	Acoustics - Measurement of environmental sound
NZS 6802:2008	Acoustics - Environmental noise

### JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS ISO 717.1:2004	Acoustics – Rating of sound insulation in buildings and of
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AS/NZS 1680.1:2006	building elements-airborne sound insulation Interior and workplace lighting - Part 1: General principles and recommendations
AS/NZS 1680.2.4:1997 including Amendment 1 AS/NZS 2107:2000	Interior lighting - Part 2.4: Industrial tasks and processes
AS/NZS 3000:2007 including Amendment 3 AS/NZS 3123:2005	Acoustics – Recommended design sound levels and reverberation times for building interiors Electrical installations (known as the Australian/New Zealand Wiring Rules) Approval and test specification - Plugs, socket-outlets and couplers for general industrial application
AS/NZS 3439.1:2002	Low-voltage switchgear and controlgear assemblies - Type-tested and partially type-tested assemblies
AS/NZS 5033:2012	Installation and safety requirements for photovoltaic (PV) arrays
AS/NZS 60155:2000 (reconfirmed 2013)	Glow-starters for fluorescent lamps
AS/NZS 60598.2.1:2014	Luminaires - Part 2.1: Particular requirements - Fixed general purpose luminaires
AS/NZS 60598.2.2:2001 including Amendment 1	Luminaires - Particular requirements - Recessed luminaires

## AUSTRALIAN STANDARDS

AS 2293.1:2005	Emergency escape lighting and exit signs for buildings - System design, installation and operation ( <i>as amended by New Zealand Building Code F6/AS1, Appendix B</i> )
AS 4777.1:2005	Grid connection of energy systems via inverters – Part 1: Installation requirements
AS ISO 140.4:2006	Acoustics – Measurement of sound insulation in buildings and of building elements - Field measurements of airborne sound insulation between rooms

## OTHER PUBLICATIONS

IEC 60309-1 Ed. 4.2 b(2012)	Plugs, socket-outlets and couplers for industrial purposes – General requirements
IEC 60309-2 Ed. 4.2 b(2012)	Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories
IEC 60309-4 Ed. 1.1 b(2012)	Plugs, socket-outlets and couplers for industrial purposes – Part 4: Switched socket-outlets and connectors with or without interlock
Ministry of Education	Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools

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Lighting Design Guide for Schools and Boards of Trustees  
(BRANZ)  
Weather-tightness and durability requirements for school  
property

## **ADDITIONAL MATERIAL**

The following publications and websites are not referenced in this document, but provide additional information and guidance for designers and electricians.

### **OTHER PUBLICATIONS**

The Enviroschools Foundation      [http://www.enviroschools.org.nz/energy\\_efficient\\_schools\\_large.pdf](http://www.enviroschools.org.nz/energy_efficient_schools_large.pdf)

### **WEBSITES**

<http://www.legislation.govt.nz/>

<http://www.minedu.govt.nz/>

<http://rosboro.com/>

### **LATEST REVISIONS**

The users of this document should ensure that their copies of the above-mentioned New Zealand Standards are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on <http://www.standards.co.nz>.

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## FOREWORD

### 1.1 The goal of this document

The goal of this Ministry of Education document, *Electrical Installations: Standard for Schools v1.6* is to provide a reference document for the safe and cost effective design and construction of electrical infrastructure for all facilities in New Zealand Schools. It has been prepared to outline the minimum standards required to ensure safe and reliable electrical infrastructure systems for the protection of children, in addition to school and Ministry employees.

This document provides the technical standards and guidelines which are to be followed, for the design and technical performance of any electrical infrastructure in facilities owned by Ministry of Education schools, on how they will be installed, maintained, certified and managed. It is updated regularly as Standards, school requirements and Ministry policy change. Prior to using this document the user should confirm that they have the latest version. The latest version of the document may be obtained from [www.education.govt.nz/](http://www.education.govt.nz/)

### 1.2 Changes from previous version

The update from version 1 to version 1.6 was required to ensure the requirement that the use of RCD's in schools mirrored that required by AS/NZS 3000 in the domestic environment – this is now clarified in section 9.2. To confirm this requirement, RCD's are now required on all socket outlets in ICT cabinets.

Section 10.3.5 now recommends the use of socket mounted RCD's as the Ministry of Education's preferred way of providing earth leakage protection for all socket outlets.

Section 11.5 changes the recommendation of only two GPO's or RUPO's per 10mA RCD/RCBO to a requirement. And confirms that GPO or RUPO can be either single or dual outlet.

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## Purpose

The document shall be used by schools and other organisations which participate in the design and installation of electrical infrastructure for New Zealand schools. The document addresses all electrical work in schools, and is also to be applied to schools planning significant installations, or any upgrades and modifications to existing infrastructure.

This document provides guidance on minimum technical standards in the following areas:

- a) Technical requirements
- b) Product selection
- c) Design, installation and testing
- d) Labelling, administration and documentation.

## Document sponsor

This document has been developed and is controlled by the Ministry of Education. All queries, errors, omissions or suggestions are to be directed to:

The Director, Technology in Schools  
Education Infrastructure Services  
45-47 Pipitea St  
PO Box 1666  
Wellington 6140

## Acknowledgements

The Ministry of Education acknowledges with thanks the assistance and contribution of a number of organisations and parties in the preparation of this document. In particular the assistance of the following parties is acknowledged:

ECANZ	Lighting Council New Zealand
TorqueIP	WorkSafe NZ (Energy Safety)
Schneider Electric (NZ) Ltd	Opus International Consultants
Norman Disney & Young	Wellington Institute of Technology
Standards New Zealand	Pacific Consultants
7 Electrical Ltd	Lighting Management Consultants
Energy Efficiency and Conservation Authority	

## Outcome statement

By using this document, designers and electricians will successfully meet the Ministry of Education minimum standards for the safety, design, installation and support of electrical infrastructure, to maximise the value that electricity delivers for education purposes in environments that New Zealand schools manage and operate.

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## 2 USING THIS DOCUMENT

### 2.1 Interpretation of this document

#### 2.1.1 Interpretation

For the purposes of this document, the word 'shall' refers to requirements that are mandatory, while the word 'should' refers to practices that are advised or recommended.

#### 2.1.2 Scope of this document

This document addresses the following areas:

- a) Design
- b) Assembly
- c) Installation
- d) Commissioning of electrical installations
- e) Ongoing use
- f) Maintenance.

#### 2.1.3 Criteria for use

All new school electrical installations, repairs, upgrades, and maintenance work shall be in accordance with this document.

It is a requirement of the Ministry that all schools, designers and electricians shall use this document, in order to ensure the schools achieve a common standard, have correct and up to date documentation, and are safe.

In addition to this document, the designer and electrician should refer to other sources for detailed design and installation guidance, such as relevant mandatory legislation, publications outlined in this document, and manufacturer installation guidelines.

### 2.2 Application of this document

#### 2.2.1 Regulations, codes, and Standards

All electrical installations are to be carried out in accordance with the regulations, codes, and Standards listed at the beginning of this document. Compliance with the Electrical (Safety) Regulations and relevant New Zealand Codes of Practice is a mandatory requirement.

Where New Zealand and international Standards are referenced in this document the application of the Standard shall be, unless specifically stated elsewhere to the contrary, to the latest edition and amendments available on the date 30 calendar days prior to the issue of any request, quote, tender or proposal.

Where specifications or Standards, or any other references in this document refer in turn to other specifications, Standards or documents whether whole or in part, the strictest of those consequential references shall apply to this specification as if they were completely contained in the original reference.

### **2.2.2 Installation specific standards and requirements**

The designer and electrician shall conform to all the requirements of this Standard.

### **2.2.3 Variation from this document**

Compliance to the requirements of this document may, under some circumstances, not be practical, or cost effective, or an alternative solution may exist that better suits the conditions on site.

The designer and electrician are advised that, in the event that compliance to this document cannot be met, prior to undertaking the respective installation the designer or electrician or both is to obtain written approval for a variation from:

The Director, Technology in Schools  
Education Infrastructure Service  
45-47 Pipitea St  
PO Box 1666  
Wellington 6140

### **2.2.4 Conflicts**

If a conflict exists between the Standards or with the Scope of Works then the electrician shall notify the Project Manager or their representative of any conflicts and seek clarification prior to continuation.

In general the order of precedence shall be:

- a) Statutory Codes and Regulations and Standards cited by those documents
- b) The Ministry of Education publication *Electrical Infrastructure: Standards for Schools* (this document) except where its specifications exceed the cited Standards in the Codes and Regulations above
- c) Standards and specifications within the tender or contract
- d) Referenced New Zealand and International Standards.

In situations where tender specific Standards, specifications, or both, exceed Ministry requirements, these shall take precedence over the Ministry Standard.

Where reference is made to any other Standard or specification, the latest published editions of any such specification shall apply.

Conflicts in requirements or requests for variation from published documents that are identified by Schools, consultants, designers, tenderers, or electricians shall be notified in writing to:

The Director, Technology in Schools  
Education Infrastructure Service  
45-47 Pipitea St  
PO Box 1666  
Wellington 6140

Written confirmation from the Ministry is to be received before resolution.

## 2.3 Definitions and abbreviations

For the purposes of this document the following definitions and abbreviations shall apply.

### 2.3.1 Definitions

<b>Term</b>	<b>Definition</b>
<b>As-built</b>	Final set of drawings produced at the completion of a construction project, including all changes made to the original construction drawings
<b>Campus</b>	A school, and includes the buildings and grounds in which a cabling system is installed
<b>Designer</b>	A person who plans the look, or workings, or both, of something prior to it being made, by preparing drawings or plans
<b>DIN</b>	An electrical connector
<b>Electrician</b>	A person who is registered and licensed by the Electrical Workers Registration Board as being competent to install and maintain electrical equipment.
<b>Electrical Inspector</b>	A person who is registered and licensed by the Electrical Workers Registration Board as being experienced and competent to perform inspections of electrical installations
<b>Electrical installation</b>	Electrical cabling infrastructure and equipment installed for the purpose of conveyance, control, measurement and use of electricity
<b>Enclosure</b>	A housing for accommodation of equipment and cabling that includes mounting rails and protective panels
<b>Manufacturer</b>	A person or company that makes electrical goods for sale
<b>Photovoltaic (PV)</b>	A system for the purpose of converting solar energy into electricity
<b>Practicable</b>	Able to be done or put into practice successfully

<b>Term</b>	<b>Definition</b>
<b>Scope of Works</b>	A complete, detailed listing of the time and material costs for installation at a specific site, prepared by a contractor or other individual experienced in preparing contracts
<b>Site</b>	See <b>Campus</b>

### 2.3.2 Abbreviations

<b>CAD</b>	Computer Aided Design	<b>MEC</b>	Main Earth Conductor
<b>CCTV</b>	Closed-circuit TV	<b>MEPS</b>	Minimum energy performance standards
<b>CoC</b>	Certificate of Compliance	<b>NZBC</b>	New Zealand Building Code
<b>DB</b>	Electrical Distribution Board	<b>PVC</b>	Polyvinyl Chloride
<b>ECG</b>	Electronic Control Gears	<b>RCBO</b>	Residual Current Breaker (with overcurrent protection)
<b>EMC</b>	Electromagnetic Compatibility	<b>RCD</b>	Residual Current Device (No overcurrent protection)
<b>ESC</b>	Electrical Safety Certificate	<b>RoI</b>	Record of Inspection
<b>GPO</b>	General Purpose Electrical Outlet	<b>RUPO</b>	Restricted Use Power Outlet
<b>ICT</b>	Information and Communications Technology	<b>SCS</b>	Structured Cabling System
<b>IP</b>	Internet Protocol	<b>SPA</b>	School Property Advisor
<b>LAN</b>	Local Area Network	<b>SPD</b>	Surge Protection Device
<b>LED</b>	Light-emitting Diode	<b>TO</b>	Telecommunications outlet
<b>MAC</b>	Moves Adds Changes	<b>UPS</b>	Uninterruptible Power Supply
<b>MATV</b>	Master Antenna television	<b>uPVC</b>	Unplasticised polyvinyl chloride
<b>MCB</b>	Miniature Circuit Breaker	<b>WA</b>	Work Area
<b>MCG</b>	Magnetic Control Gear		



## **3 ELECTRICAL SYSTEMS: OVERVIEW**

### **3.1 Electrical systems background**

Electrical installations in schools play a crucial role in providing the physical connection between the sources and the users of the electricity supply.

An electrical installation may range in size from small and simple, for example installing a replacement socket outlet in an administration block, to large and complex, such as a new school build.

To facilitate the day-to-day operations of a normal school environment, an electrical installation must enable the users to make additions, moves and changes, wherever and whenever necessary. Furthermore, the electrical installation must also be flexible and provide the capacity to support a dynamic electricity demand.

Older electrical systems within schools are often inadequate for today's technology. Older classrooms frequently have extension cords and a variety of other cables around the sides of the room, and up and down walls to accommodate an abundance of projectors, computers and other teaching technology.

The use of wireless technology does eliminate some of the visible wiring, but it does not completely eliminate the significant increase in the electrical needs of a modern school.

As electrical products continue to evolve, greater demands are being placed on the electrical installations and their capacity to support the needs of these emerging technologies. Many teaching spaces now include a computer for the teacher, two or more computer workstations for student use, television monitors, media technology, multimedia projectors, device charging stations, and enhanced sound systems. Students often possess their own laptops, tablets, or mobile devices, all requiring electricity to charge or operate. The successful integration of these devices must be considered in electrical design.

### **3.2 Electrical infrastructure**

Electrical infrastructure covers cabling and associated products and equipment installed for the purpose of conveyance, control, measurement and use of electricity that are constructed according to standardised rules.

For the purpose of this document, cable pathways and spaces are considered as ancillary items.

### **3.3 General design requirements**

The safety of an electrical installation is the responsibility of the respective designers, electricians, the Ministry of Education, and the Board of Trustees under the Electricity Act, Electricity (Safety) Regulations, and Health and Safety in Employment Act.

For example, a meter board or electrical switchboard which is left unlocked or has missing blanking plates or live terminals exposed is considered hazardous. These are hazards that, in the worst case, could cause serious harm or death if touched.

School infrastructure is dynamic. It needs to be designed for change as classroom needs evolve. Energy conservation is also a critical issue affecting everyone, including schools. Government policy initiatives and evolving society awareness are changing energy-use patterns. This change is driven by supply, financial, and environmental factors.

Conservation of non-renewable resources is increasingly important to New Zealanders. Schools have the opportunity to address these issues by building energy conservation into their educational programmes.

## 4 GENERAL CONDITIONS

### 4.1 Ministry electrical requirements

In schools, all new or upgraded electrical installations shall:

- a) Be installed to comply with this Standard
- b) Have a minimum two (2) year installation warranty
- c) Have a minimum two (2) year systems and components warranty
- d) Have a minimum five (5) year electrical appliance warranty, where the appliance is supplied by the electrician
- e) Be installed or supervised by a registered electrician holding a current practising license
- f) Have all relevant documentation – for example, certification required by Regulation – submitted to the school, the regulator (where appropriate), and the Ministry.

The electrical contractor shall ensure that all electrical appliances that are not supplied as part of their contract are:

- g) Suitable and approved for use in New Zealand
- h) Have a 5 year electrical appliance warranty from the appliance supplier

If the 5 year electrical appliance warranty cannot be provided by the appliance supplier, then the electrical contractor shall notify the Ministry for an exemption or have this noted by the Project Manager or School, and included in their final documentation noting the reasons why the warranty could not be applied.

All electrical repairs and maintenance work shall be in accordance with this Standard. In the case of work undertaken to change or expand an existing electrical installation the following requirements shall be applied:

- i) All new electrical installations, alterations, or additions in a school shall be Certified Designs in accordance with the Electricity (Safety) Regulations
- j) The new installation, or equipment, or both shall be specified to ensure any existing warranties are maintained, full compliance with relevant Standards and Regulations is maintained, and that overall system performance is maintained or enhanced.
- k) The new equipment should be matched as closely as possible to the existing equipment unless a more up to date and cost effective solution is available or such matching would conflict with occupational health and safety requirements or mandatory standards

In the case of electrical installation for new buildings added to a school, the electrical installation shall comply with the requirements of this document unless such compliance would create compatibility or performance issues. Details of the incompatibility will be supplied in writing to the Ministry or its representative, and the school.

## 4.2 Ministry electrical installations

The scope of work for the provision of electricity or electrical systems in schools typically includes design, supply, installation, testing, commissioning, documentation, and maintenance.

It is important to note the Electricity Act and Electricity (Safety) Regulations, not the New Zealand Building Code, is the primary and relevant legislation for any electrical installation in a new building or renovation that the Ministry undertakes through schools.

When electrical installation is undertaken in schools the following shall apply:

- a) All electrical installation shall be carried out or supervised by a registered electrician holding a current practising license in accordance with the Electricity (Safety) Regulations and Compliance document for New Zealand Building Code – Clause G9 Electricity
- b) All new electrical installations, alterations, or additions in a school shall be Certified Designs in accordance with the Electricity (Safety) Regulations
- c) Certified Designs shall ensure compliance with all requirements of this document
- d) A special note should be taken for AS/NZS 3000 requiring the installation of 10mA RCD (Residual Current Device) protection for newly installed GPOs in some situations where Years 1 to 8 are in attendance. Guidance on compliance options regarding the installation of 10mA RCD (Residual Current Device) protection in schools is provided in 10.3
- e) A Certificate of Compliance (CoC), or an Electrical Safety Certificate (ESC), or both shall be issued in accordance with the Electricity (Safety) Regulations for all prescribed electrical work carried out on an installation, a part installation, or any fitting that supplies an installation or part installation. Refer to the requirements detailed within the Electricity (Safety) Regulations
- f) A Record of Inspection (RoI) shall be provided for all High Risk work in accordance with the Electricity (Safety) Regulations, or where it is required by this Standard
- g) Electrical testing results shall be recorded on the CoC
- h) Photographic evidence shall be collected for each completed installation. This shall include a time and date stamp, and form part of the completed handover documentation supplied to the Ministry of Education or its representative.
- i) Should the electrician identify any non-compliant electrical installation made by other trades or electricians they shall notify the school or its representatives of the non-compliance immediately in writing.

The installation of all electrical products and equipment shall be installed to the manufacturer's guidelines to the correct and relevant regulations and Standards by a registered and licensed electrician, or a trainee under the supervision of a registered and licensed electrician.

### 4.3 Standards and references

All electrical installations shall be carried out in accordance with the regulations, codes, and Standards referred to in the appropriate section of this document and the associated Scope of Works. In addition, all electrical installations involving product and equipment shall be carried out in accordance with the manufacturer's product guidelines, instruction sheets and specifications. See 2.2 for more information.

In all cases where Standards, documents and publications are referenced, the latest additions and amendments available at the time of release of the Scope of Works shall be used. Where reference is made to any other standard or specification, the latest published editions of any such specification shall apply. If a conflict exists between the standards or with the Scope of Works, the electrician shall notify the Ministry of Education or its representatives of any conflicts and seek clarification prior to continuation.

It is the electrician's responsibility to obtain the latest editions of and familiarise themselves with these documents and publications.

### 4.4 Responsibility of electrical contractors

Responsibility for safe electrical installation sits with the electrical company, not individual electricians employed by the company.

### 4.5 Security clearance and Police vetting

The Education Act requires that every electrician, employee of an electrician, or subcontractor engaged by an electrician who has, or is likely to have, unsupervised access to students at the school or children during normal school hours or service opening hours must be Police vetted.

Normal school hours are defined as the hours that the school is open for instruction.

Police vetting shall be obtained **before** a person who is required to be vetted has, or is likely to have, unsupervised access to students or children.

Once successfully vetted, the electrician or employee of an electrician will be cleared for employment for 12 months, upon which time an application must be resubmitted.

Many schools will also wish to induct visitors onto the site using the normal business practice of signing visitors into the school when they arrive and signing them out as they leave. Information typically required from visitors is:

Name

Company name

Purpose of visit

Time in and Time out

Electricians working at schools should wear an identification tag while in the school grounds, but at all times shall carry personal identification – for example, their current practicing license – and present it on request.

#### **4.6 Occupational Health and Safety (OSH)**

The electrician shall comply with all Acts and Regulations, Approved Codes of Practice, relevant Standards, WorkSafe New Zealand (previously Department of Labour) Guidelines, Occupational Health and Safety requirements, accepted codes of practice, manufacturer's instructions and any temporary rules and restrictions that may be in force at the time.

The electrician shall also comply with the school and Ministry of Education Health and Safety policy, guidelines and rules when engaged in work on Ministry of Education sites and equipment, and shall conform to all site specific requirements including safety requirements.

Prior to the commencement of any design or construction work on school property involving access to grounds or buildings the electrician shall ensure they have received:

- a) A copy of the school safety plan, including the location of school safety and first-aid equipment
- b) A school vehicle access plan including safe access and parking for contractor and delivery vehicles
- c) The school hazards and asbestos register.

The electrician shall ensure that all their personnel working on Ministry of Education sites or working on Ministry of Education networks have undertaken appropriate training and have a recognised site safety accreditation for both the site and work to be undertaken.

No open pits, holes, trenches, or access areas, are to be left unattended at any time. All are to be clearly marked and secured in accordance with OSH regulations and all ground or structural disturbances are to be secured and/or removed at the end of each day's work in accordance with OSH regulations.

#### **4.7 Advice**

The electrician shall advise the school and gain approval before undertaking any work that may or will result in electrical service disruption. Any work that may result in electrical service down time will require scheduling with school representatives.

## **4.8 Site conditions**

The electrician shall familiarise themselves with the site conditions prior to undertaking or providing quote or estimate prices for any work. Specific conditions to be observed include school and Ministry of Education site access and entry requirements, Ministry of Education OSH requirements, qualification and identification of personnel and onsite legacy equipment and configurations.

Electricians are required to undertake all necessary investigations to fully inform themselves of the site conditions and other factors that could impact the cost and execution of installation.

This includes but is not restricted to:

- a) Hazards that may be present at the school (such as asbestos)
- b) Heritage registration of buildings
- c) Environmental conditions including special precautions for the protection of flora and fauna
- d) Local site conditions including weather hazards and cultural significance
- e) Easements
- f) Safety of students and staff with respect to pit covers and location
- g) Existing and projected underground services, note that site maps may not be complete or available

## **4.9 Contractual obligations**

The electrician shall complete all installations in a manner consistent with the Ministry of Education objectives and requirements, and consistent with the detail contained in this specification and the Scope of Works for any work to be undertaken and detailed drawings and specification documentation that accompanies the Scope of Works. The electrician shall also conform to all regulatory requirements applicable to the work being undertaken.

## **4.10 Existing sites floor plans**

For existing buildings, floor plans shall be provided by the Ministry, the school, or its representative for mark up by the electrician. The electrician shall mark up the drawings to reflect locations, numbering, and so on, and return them to the Ministry, the school, or its representative. Any identified additions or deletions to the plans will be required to be supplied to scale.

## **4.11 Design by the electrician**

When the electrician is required by the Scope of Works to develop the Certified Design shown on the contract drawings and detailed in the Scope of Works into a fully detailed final design, the electrician shall coordinate with the Ministry of

Education, the school, or its representatives, and with other contractors to prepare design documents for construction purposes.

The electrician should take into account and supply written comment on the electricity demand of the school, the performance of the proposed electrical system, the maximum demand per circuit, and the maximum number of outlets per circuit.

The electrician shall submit the Certified Design and documents to the school or the Ministry or its representatives for review and approval before work is undertaken. See 4.2 for additional information.

#### **4.12 Equipment locations**

Equipment and cable pathways shall be installed in accordance with approved drawings and plans.

When deciding on a suitable location for equipment all factors in EQUIPMENT SPACES should be considered.

Additions or modifications to installed plant shall not be made without the written approval of the school. Such additions or modifications shall be detailed on drawings and plans.

#### **4.13 Contract drawings**

When contract drawings are diagrammatic or indicative only, they are not intended for construction purposes. In conjunction with the design requirements described in this specification, the contract drawings are used to show the general layout of the system and to describe the performance requirements.

The quantity and specification of the equipment shown in diagrammatic contract drawings and the associated schedules are typically the minimum requirements only.

#### **4.14 Fit for purpose**

The electrician must provide all equipment that is required for a complete and working installation to attain the specified performance.

All cable and equipment shall be new and selected to ensure satisfactory operation under the environmental conditions present at the site.

All equipment shall be delivered in the original packaging except where pre-installation commissioning, run-up and configuration may require equipment to be worked on off-site.

All minor materials and fittings or any work which is necessary for the satisfactory installation and operation and efficient functioning of the installation, or which is generally provided in accordance with accepted trade practices shall be provided or



carried out as part of the installation even though such material or work may not be explicitly mentioned in this document, the installation specification, or shown on construction drawings.

#### **4.15 Replacement of existing fixtures, fittings or accessories**

All identified replacement of existing componentry – that is fixtures, fittings, cabling or accessories – within a Scope of Works shall be with a new item intended to serve the same purpose except in the following instances:

- a) Circuits shall be upgraded to include RCDs if none are present. RCDs are best installed at sockets for easy test, reset, and access. See 10.3 and 10.4 for more information
- b) RCDs shall be installed as per the requirements of AS/NZS 3000
- c) Where more modern componentry would greatly improve safety, for example in a damp zone or workshop, it shall be installed.

In all instances any replacement must be agreed to and signed by the Ministry, the school, or its representative.

#### **4.16 Requirement for inspection**

All work that involves the Main Earth Conductor (MEC), sub-main earth conductor, earth electrode(s), MEN connection, or mains shall be inspected and requires an ROI to be completed.

#### **4.17 Final design approval**

The design and proposals for any electrical work shall be carried out only by persons holding recognised industry certification, with a minimum of 3 years relevant electrical experience, prior to final signoff by the Ministry of Education or its representatives.

#### **4.18 Computer Aided Design (CAD) drawings**

All drawings shall comply with the requirements using recognised symbols and graphics as identified in AS/NZS 1102 and be in Revit, AutoCAD RL2004 (or later version) .dwg with attribute blocks. All drawings will be to a scale that will be legible and easy to follow when reproduced on A3 paper. Drawings shall be supplied uncompressed and unprotected.

#### **4.19 Shop drawings**

For new installations, shop drawings shall be provided to the Ministry or its representative for written approval prior to commencement of site work. As a minimum the shop drawings shall provide the following:

- a) System type, manufacturer and warranty details
- b) Proposed site, building and floor location of all switchboards, distribution boards and cabinets
- c) Proposed cabinet layouts showing dimensioned location of all new and existing MCB's and RCDs
- d) Proposed site pathway plan showing locations for all pit, pipe, cable tray and catenary systems
- e) Floor plans showing proposed location and numbering of all switchboards, distribution boards, control rooms, pathways and outlets
- f) Any proposed changes to the electrical systems and switchboards.

All shop drawings shall be provided and scaled to present the information within the drawing in a clear and easily viewable layout in .pdf, and either Revit, or AutoCAD format. That is, a drawing with a high density of GPOs and RUPOs shall be presented in a scale that allows for all information on each GPO or RUPO to be read easily without the need to zoom in on the electronic version of the drawing.

#### **4.20 Time elapsed**

Due to the time elapsing between the release of new build tender specifications and the installation and construction works for the electrical systems, it is anticipated that some of the equipment proposed may be superseded by later models by construction time.

The electrician is to review products and confirm the models of all equipment and products proposed with the project manager one month prior to the procurement and installation of the equipment including but not restricted to all electrical system components.

#### **4.21 Construction documentation**

Installation shall be in accordance with approved construction drawings.

Construction documentation will typically include:

- a) Scaled site and building/floor location plans showing the location and size of pathways and the cables to be installed therein, cable routes and pit locations.. Drawings will be to a reasonable accuracy
- b) Location, sizes and types of mains and sub-mains cables
- c) Location of mains and sub-mains distribution boards
- d) Location of transformers
- e) Utility room layouts
- f) Physical enclosure layouts
- g) Physical layout drawings of data and power outlet positions and identification numbers
- h) Itemised lists detailing the type, make and model of all equipment to be installed. This includes circuit protection, fittings and outlets. Position, size, ratings and

dimensions shall also be provided where appropriate. Equipment positions should be shown on a floor layout

- i) Maximum demand calculations per circuit incorporating all proposed componentry, cable types and lengths
- j) Identification of cable pathway routes and labelling.

For all new work, floor plans with GPOs and RUPO locations and numbering shall be provided to the school and its representatives and agents in .pdf, and either Revit, or AutoCAD format.

For upgrades of mains or sub-mains cabling and related switchboards, maximum demand calculations shall be updated and provided to verify the correct sizing or respective cabling and associated switchboard equipment, for example the main switch, and so on.

Where historic calculations have not been completed, or are not available, maximum demand shall be determined for the distribution board, or sub-distribution board, that installation is to be carried out on. If none are present, maximum demand shall be determined by calculation method as per AS/NZS 3000, and calculations shall be updated when an electrical installation is upgraded.

#### **4.22 Coordination with other services**

Where the electrician is the primary contractor, they shall be responsible for coordination with Ministry of Education personnel and representatives and with other works and trades including civil, building, structured cabling, mechanical and security where electrical installation is dependent upon or carried out in conjunction with these works.

This includes but is not restricted to:

- a) Use of site and facilities
- b) Closure or restriction of access to site and facilities
- c) Scheduling of works and resources
- d) Segregation of services
- e) Site reinstatement.

#### **4.23 Out of hours work**

Periodically, electricians will be engaged to work at Ministry schools and facilities out of normal school hours. If out of hours work is required by the school, then the school and the electrician shall agree on how site access is to be managed when school representatives are not present.

#### **4.24 Site reinstatement**

For work undertaken as a refit or extension to existing installations, including all connections to existing electrical infrastructure, all sites shall be reinstated to their original condition to the satisfaction of the Ministry of Education staff or their representatives. This shall be carried out as soon as practicable after works have been completed.

Site reinstatement shall be considered part of the installation and shall include the removal of all packaging materials and waste, the painting and plastering of wall surfaces damaged during installation, and the reinstatement to original condition of any ground surfaces damaged during earth works.

#### **4.25 Cleaning**

The electrician shall maintain a clean working environment minimising disruption to the school staff and students, and remove all packaging materials, off-cuts and materials left over from the installation of its product and leave the area clean on completion of all work.

#### **4.26 Removal of redundant materials**

When refit, renovation, variation or Moves/Adds/Changes (MAC) work is required, the electrician shall identify and remove any electrical fixtures, fittings or accessories made redundant as a result of the work being undertaken.

Electrical fixtures, fittings or accessories that are unused may be left in place if it is determined that they may be used at a later stage, or if removal of the fixtures, fittings or accessories may damage other services, or where removal is prohibitive. Written approval from the school or its representatives shall be obtained prior to the decision to retain any fixtures, fittings or accessories can be made.

Cabling left in place shall be tagged and labelled for future use and as-built documentation updated to show retained cabling and associated pathways. Any items left on site shall have written permission from the school.

#### **4.27 Practical completion**

The stage, in the execution of the installation under the contract, where the Contract Works are complete.

#### **4.28 Audits and inspections**

Audits of installations may be initiated by the Ministry of Education or its representatives from time to time to confirm compliance with Ministry Standards, the specifications, and construction drawings.

These audits and inspections will include, but not be limited to, written reviews of:

- a) Compliance with the Ministry of Education publication *Electrical Installations: Standard for Schools* (this document) and AS/NZS 3000
- b) Installation practices to current regulatory requirements
- c) Installation techniques and OSH guidelines, for the safety of site users and installation staff
- d) Police vetting
- e) Test results
- f) Site reinstatement
  - i. All work completed is to the former condition and the school representative's satisfaction
  - ii. All work completed as soon as practicable after the installation is complete
- g) Required project documentation and warranties
- h) Required electrical certifications.

#### **4.29 As-built drawings**

These drawings shall include the following information:

- a) Scaled site and building/floor location plans showing the location and size of pathways and the cables installed, cable routes and pit locations. Schematic diagrams detailing the Location of mains and sub-mains cables
- b) Location of mains and sub-mains distribution boards
- c) Location of transformers
- d) Utility room layouts
- e) Physical enclosure layouts
- f) Locations and circuit identification of all power socket outlets (GPOs and RUPOs)
- g) Locations of all protective devices (RCDs, MCBs, and so on)
- h) Physical layout drawings of data and power outlet positions and identification numbers
- i) Description of the labelling system used
- j) Equipment lists detailing the installed equipment (type/make/model) including racks, enclosures, and outlets, as well as position, maximum demand, size, and length where appropriate. Floor layout with all luminaires, GPOs and RUPOs labelled
- k) Test reports detailing procedures, equipment configuration, and test results
- l) A copy of maximum demand calculations.

#### **4.30 Warranties**

Warranties, Certificate of Compliance, Defect Periods and Guarantees shall be required as part of the Scope of Works for installation, maintenance and refit of facilities.

Warranty periods shall commence at practical completion or, if not concurrent with practical completion, at acceptance of installation.

The project will not be considered completed until all warranty documentation has been received by the Ministry of Education or its representative, and the school.

Three types of warranties apply to electrical installations:

- a) Installation warranty (Defect Liability Period)
- b) Electrical systems and components product Warranty (where applicable)
- c) Electrical appliance product warranty (where applicable).

See 4.1 for more information.

#### **4.30.1 Installation warranty**

The electrician shall provide a Defect Liability Period warranty on their own work and workmanship for a minimum period of two (2) years. This includes any remedial work done to bring existing electrical infrastructure up to the required Standard.

#### **4.30.2 Systems and components warranty**

The electrician shall provide product warranty for replacement or repair of systems or components, including labour, which fail to meet the specified performance standards with a minimum period of two (2) years.

#### **4.30.3 Product warranty**

An electrical appliance product warranty for replacement or repair of electrical appliances supplied by the electrician, including labour, which fail to meet the specified performance standards with a minimum of a five (5) year validity period, is a mandatory requirement.

In the event that the product warranties contradict those within this document, the electrician is to bring those contradictions to the attention of the Ministry immediately.

Any additional cabling installed at the warranted premises must not compromise any existing and valid warranty.

### **4.31 Records and retention**

All records, warranties, test results, guarantees and drawings relating to installation and maintenance work undertaken by the electrician shall be maintained by the electrician for a minimum period of one (1) year after the end of the warranty or guarantee period.

Copies of all warranties, test results, guarantees and other records relating to installation or maintenance and upgrade work are to be provided to the Ministry of Education or its representative within two weeks of practical completion.

### **4.32 Intellectual property**

All submissions, drawings, schematics, policies and procedures related to the Ministry of Education infrastructure and its premises are the property of the Ministry of Education.

### **4.33 Confidentiality**

All drawings, specifications and other information, samples, models, patterns, and the like supplied by either the Ministry of Education, or by the designer or electrician are regarded as confidential.

The designer or electrician shall not disclose any such information to a third party without the written consent of the Ministry.

### **4.34 Training**

The electrician shall supply safety instructions and operational manuals in hard copy and electronic format to the school, and provide operator training where required for Ministry of Education and school personnel.

Training shall be carried out not later than one week after and not earlier than 4 hours before practical completion.

## 5 DESIGN CRITERIA



### 5.1 Criteria for use

See 2.1.3. The designer and electrician should refer to sources and publications outlined at the beginning of this document for general design guidance.

### 5.2 Alternative supply arrangements

All new schools, or schools that are designated as a Civil Defence Centre, shall have an external coupler and internal switching (or other arrangement) suitable for the safe supply of electricity to the school from an external generator when the grid supply is interrupted.

If an external coupler is not currently installed in an existing school, then any electrical upgrade, repair, or maintenance work should, within the scope of work, should include consideration of installation for an external coupler and internal switching (or other arrangement) suitable for the safe supply of electricity to the school from an external generator when the grid supply is interrupted.

The size of coupler required should be determined by the size of the load (or the areas of the school required to be made operational) when the grid supply is interrupted.

### 5.3 Necessity of installation

The designer (who may be the electrician) should consider the necessity for electricity in each environment. If electricity is not necessary, it should not be installed.

### 5.4 Associated systems and components – new installation

The following systems and peripheral components should be considered in conjunction with the design and implementation of a new electrical installation:

- a) Fire, CCTV and security network systems
- b) School bell and intercom systems
- c) Data systems
- d) IP telephone systems
- e) Video conferencing
- f) MATV
- g) False floor in server/communications rooms to facilitate cable routing to floor mounted racks and cabinets
- h) Temperature control by forced ventilation or air conditioning in server and communications rooms
- i) Alternatives to fire sprinklers in server and communications rooms
- j) Smoke detection in server and communications rooms
- k) UPS system capacity requirements, accommodation, battery maintenance and life span



- l) Wireless access points
- m) IP cameras using existing switching (not on separate security network)
- n) Network for Learning (N4L) terminations and associated equipment.

## 5.5 Design exclusions

### 5.5.1 Existing cabling

There is no requirement to modify existing electrical cabling, fittings, switchboards, and so on prior to the commencement of any new installation, except where necessary to achieve a successful merger of new electrical installation with an existing one, or to bring the electrical installation up to related electrical standards. Note the requirements of 4.15.

Electrical components and cabling that has been installed in accordance with earlier Standards will generally be retained in service unless there is sufficient justification for replacement of the components and cabling as part of an upgrade or redevelopment, or if deemed unsafe.

## 5.6 Aesthetic design

In all cases any electrical installation shall be designed and installed in a manner that is suitable for the building and not in conflict with the environment at the particular school.

### 5.6.1 Heritage buildings

Many schools contain buildings that have significant historical or cultural significance. Modification on work within these buildings may be difficult and the amount and nature of any refurbishment may be subject to specific controls and restrictions. Designers and electricians are required to ensure that in the proposed construction activities do not compromise the restrictions imposed in these buildings.

See APPENDIX A – HERITAGE SITES for more information.

### 5.6.2 Exposed cabling

The designer is expected to minimise the use of exposed conduit and capping and overhead connections. Where possible all cabling and cable pathways, including pits and external conduits, should be placed as unobtrusively as possible so as to be hidden from view and not attract attention. It is expected that where service pathways are provided in a school campus (walkway cavities are a perfect example), they will be used to distribute electrical cabling infrastructure around that campus – If for any reason this may not be practicable, then written agreement from **BOTH** the School's authorised representative and the School SPA will be needed.

When it is not possible to completely hide the cable pathways including overhead, conduits and capping, electricians shall use materials and products that are the least obtrusive to view.

Cable pathways in buildings can be exposed if:

- a) The quality of workmanship is acceptable for display; and
- b) It can allow cable pathways to be used as a feature for learning; or

- c) Physical access to the pathways is restricted to installers that require access for maintenance.

## **5.7 ICT infrastructure**

ICT infrastructure in schools is a crucial asset for the Ministry. There are specific requirements that govern how ICT infrastructure in schools should be managed. See the Ministry of Education document, *Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools* for more information.

Any new ICT work in schools shall utilise products and services from the approved contractor list provided in APPENDIX B – APPROVED ICT CONTRACTORS LIST.

## **5.8 Dimensioning**

The electrical requirements and configuration in any given area or classroom is to be determined and confirmed by the school. Sufficient GPOs and RUPOs shall be installed in all areas to meet the Ministry design guidelines as per the specific scope documents and tender documents.

## **5.9 Salt spray and corrosive environments**

Particular care shall be taken for installations in coastal regions to minimise the exposure of equipment to salt. Equipment enclosures should not be installed in open areas. If this is unavoidable, switchboards or pillar boxes shall be appropriately rated for the environment they are installed, meeting all requirements of AS NZS 3000.

Utility room vents shall be fitted with filters to minimise salt spray ingress. See NZS 3604 for additional information.

## **5.10 Chemical corrosion**

### **5.10.1 Utility rooms**

Utility rooms shall not be located near to corrosive atmospheric or environmental conditions.

### **5.10.2 Storage areas**

Cleaning solvents and other chemical products shall not share any space used to house electrical equipment and shall not be adjacent to utility rooms or utility room vents.

### **5.10.3 Damp zones**

Where possible, electrical equipment should not be installed in damp zones, wet areas, or rooms containing hot water cylinders, cleaner's equipment, sinks or basins.

If installation in a damp zone is unavoidable, the requirements of AS/NZS 3000 shall be achieved and approval must be received in writing from the Ministry and the school prior to commencement of installation.

## 5.11 Noise

Equipment enclosure locations shall be selected such that noise levels in work and learning areas arising from the enclosed equipment, when combined with other sources of work area noise, shall be maintained within the limits specified by AS/NZS 2107.

Recommended design sound levels for different areas of occupancy in buildings are given in Table 1 of AS/NZS 2107, from which the following design details are extracted and may also be reproduced with permission granted by Standards New Zealand under licence 001075.

Type of Occupancy / Activity	Design sound Level ( $L_{Aeq}$ dBA)		Reverberation Time (s)
	Satisfactory	Maximum	
Art / Craft Studio	40	45	0.6 – 0.8
Computer Room – Teaching	40	45	0.4 – 0.6
Duplicating Rooms / Stores	45	50	0.6 – 0.8
Library – General Area	40	50	0.4 – 0.6
Library – Reading Area	40	45	0.4 – 0.6
Teaching Areas – Primary	35	45	0.4 – 0.5
Teaching Areas – Secondary	35	45	0.5 – 0.6

**Table 1: Acceptable sound levels**

Where noise produced by electrical equipment contains a distinctive tonal or impulsive character, as defined in NZS 6802, noise levels to be achieved shall be 5dBA less than the satisfactory levels stipulated in Table 1.

Further information on acoustics can be found in NZS 6801, NZS 6802, AS ISO 140.4, and AS/NZS ISO 717.1.

## 5.12 Pre-existing cabling

When substantial amounts of cabling is being replaced or altered in a space used to reticulate cabling (for example, underfloor and ceiling spaces), any remaining pre-existing electrical cabling, for example not properly secured and laying on the ground, that is being retained shall be rectified.

### 5.12.1 Cable removal

All pre-existing or redundant cabling, where its installation does not meet the required Standard, should be removed from site prior to any new installation where practical.

Consideration should be given to service continuity and ensuring a minimal service disruption period during installation. This includes associated pathways and the repair of any building structures as a result of the removal.

## 5.13 External building penetrations

External building penetrations shall be in accordance with the Ministry's published guidelines. These exceed the minimum standards required in the NZBC.

Proposed alternative solutions must be submitted and agreed to in writing by the Ministry of Education, or its representative.

The guidelines, *Weather-tightness and durability requirements for school property*, are located on the Ministry's website <http://www.minedu.govt.nz>.

## 5.14 Fire rating

All penetrations made through fire rated walls must maintain fire ratings where wiring goes through fire rated elements. This includes (but is not limited to):

- a) All penetrations, vertical and horizontal must be sealed utilising a system or product, or both, that adheres to all requirements of the relevant specific building design, Standard, Ministry, Local Authority, and New Zealand Building Code regulations
- b) All materials utilised for the sealing of the necessary fire rated risers and walls must be suitable for the purpose and comply with any Fire Safety Feature Reports that are issued and with all Local Authority regulations
- c) Where fire rated walls are penetrated a suitable fire rated sleeve shall be utilised to reticulate the electrical cabling through the opening and protrude either side of the penetration
- d) Vertical Risers and penetrations shall be sealed horizontally and utilise an easily removable solution that allows for future expansion and meets with necessary regulations

- e) Photographic evidence shall be collected for each completed fire rated penetration. This shall include a time and date stamp, and form part of the completed handover documentation supplied to the Ministry of Education or its representative
- f) If the electrician identifies non-compliant firewall penetrations made by other trades or electricians they shall notify the school or its representatives of the non-compliance immediately in writing to the Ministry of Education.

### **5.15 Electromagnetic compatibility**

There are presently no EMC regulations covering cabling installations and systems. Refer to the requirements of the Ministry of Education document, *Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools* for more information.

## **6 PATHWAYS AND SPACES**

### **6.1 Pathways and spaces – General requirements**

The requirements of the Ministry of Education document, *Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools* for the design and installation of pathways and spaces shall be read in conjunction with this chapter.

All pathways shall be installed with the expectation that they will be reused during the lifetime of the school. While it is accepted that pathways inside walls are more difficult to reuse, they can be made more accessible by ensuring cable is run vertically rather than horizontally.

The electrician shall ensure all installed fixtures, fittings or accessories avoid health and safety issues, for example sharp edges, or pathway and access obstruction, and NZBC violations. All continuous metal cable pathways shall be bonded or otherwise protected.

Prior to installation work beginning, the electrician will supply the Ministry, the school, or its representative:

- a) The proposed grouping of cables on all branches of the cable route
- b) Areas of possible conflict with other services
- c) Preliminary drawings or information on the sizing of switchboards, mains and sub mains cabling.

Guidance on electrical pathways through joists and framing is found in 17.3.

### **6.2 Cable support systems**

The electrician shall ensure that no conflict will occur with other services before installation commences. See 10.6 for cable segregation requirements.

Cable support material shall be manufactured, fit for purpose, and chosen to suit the conditions in order to minimise corrosion. See 4.14.

### **6.2.1 Cable Tray and Ladder Systems**

Cables shall be pulled along the installation route using rollers in order to avoid rubbing on other cables.

## **6.3 Conduits**

All electrical cabling shall be installed without crosses and twists in a way that does not cause damage to the cabling.

Where practical, conduits should be a minimum size of 50mm, or sized to allow spare capacity for future addition, to the following:

- a) For conduits containing cables of 2.5mm diameter or less, spare capacity of 30% minimum shall be available
- b) For conduits containing large conductors, for example neutral screen cables, a spare capacity of 20% shall be available
- c) Conduits embedded in concrete shall be no greater than 50% occupied
- d) Underground conduits shall be no greater than 50% occupied
- e) Pathways shall be fully formed to allow easy re-use for future services
- f) Draw wire shall be installed
- g) Where water can potentially access the underground duct, T-dux or similar product shall be used to seal the conduit.

### **6.3.1 Flexible conduit**

Flexible conduit shall not be used except where a conduit is terminated at an appliance or accessory that may be subject to movement and/or vibration.

In addition, the flexible conduit:

- a) Adapters shall be impact resistant plastic type and screwed to the conduit
- b) Bending radius shall not be less than twice the minimum-bending radius
- c) Shall be supported to prevent mechanical damage or sagging
- d) Shall, if used externally, be heavy duty exhibiting the appropriate UV resistance, for example solar rated uPVC.

### **6.3.2 Embedded conduit**

Embedded conduit shall be fitted in solid straight lengths and shall be:

- a) Covered not less than 40mm in concrete or 5mm in plaster
- b) Positioned and located as close as possible to the centre of concrete slabs or columns
- c) Braced to prevent movement when concrete is poured.

## **6.4 Backfilling and reinstatement**

Backfilling shall be carried out in accordance with AS/NZS 3000 and its requirements of underground wiring systems.

The surface finish shall be reinstated to match the original surface.

## **6.5 Route identification**

Markers shall be permanent material with the statement in red lettering 'LIVE CABLES UNDERGROUND', and a vertical arrow on a white background nominal size 75mm wide by 100mm high.

Cable end markers shall be:

- a) Fitted over the ends of all runs giving voltages and depth of cables
- b) Fitted at all entries and exits of cables at buildings.

Flush concrete markers shall be laid over each cable route at:

- c) 100m spacing
- d) Each change of direction
- e) Each end of a roadway crossing
- f) Over each joint.

Marker wording shall be impressed in the concrete in 100mm letters indicating whether cabling is HV CABLE, LV CABLE, TELEPHONE or JOINT, as appropriate.

## 7 CABLING

### 7.1 General requirements

The requirements of the Ministry of Education document, *Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools* for the design and installation of pathways and spaces shall be read in conjunction with this chapter.

See 10.6 for additional requirements.

### 7.2 Terminations

All terminations shall be fit for purpose and follow the manufacturer's instructions.

### 7.3 Cable support system

All cabling shall be supported by either a pathway as per PATHWAYS AND SPACES, or by some form of proprietary cable support system.

Cable shall not be run directly on:

- a) The ground
- b) A suspended ceiling
- c) The floor of a ceiling space.

The cable support system shall be fit for purpose, and installed as per manufacturer's instructions.

### 7.4 Access to other services

All cabling installed in schools shall be installed so as to allow safe access for all other trades.



## **8 EQUIPMENT SPACES**

### **8.1 General requirements**

The requirements of the Ministry of Education document, *Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools* for the design and installation of equipment spaces shall be read in conjunction with this chapter.

### **8.2 Equipment spaces – Protective devices**

When installing a new electrical sub-distribution board within a space housing the main/server cabinet(s), this board shall only contain miniature circuit breakers (MCBs) and RCD's protecting the socket outlets allocated to the respective cabinet(s).

Circuit protection for RUPOs outside this room may not be supplied from this sub distribution board.

Surge protection devices (SPD) shall be installed at the switchboard to protect the entire phase supplying any dedicated communications cabinet circuits.

A dedicated circuit breaker shall be installed to protect the SPD in accordance with AS NZS 3000 and the SPD manufacturer's requirements. This circuit breaker shall not be used to protect any other sub circuits.

All MCBs are to be clearly and permanently labelled at the distribution board, clearly referencing the circuit they are protecting.

### **8.3 Labelling**

See APPENDIX C – LABELLING CONVENTION for more information.

## 9 WORK AREAS (WA)

### 9.1 General requirements

The requirements of the Ministry of Education document, *Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools* for the design and installation of work areas shall be adhered to.

## 10 GENERAL ARRANGEMENT, CONTROL AND PROTECTION

### 10.1 Electrical installation – General requirements

The requirements of AS/NZS 3000 for general arrangement, control and protection in electrical installations shall be read in conjunction with this chapter.

### 10.2 Requirement for RCD's in all schools

To align schools to the domestic requirements of **clause 2.6.3.1** AS/NZS 3000 - All socket outlets and all lighting circuits in schools must have 30mA earth leakage protection unless another sensitivity of earth leakage protection is otherwise mandated.

### 10.3 Guidance for installation of 10mA RCD protection in schools

RCDs are to be installed in accordance with the requirements of AS/NZS 3000.

#### 10.3.1 Types of schools covered by 10mA RCD requirements

RCDs with a maximum rated residual current of 10mA shall be provided for socket-outlets in areas within a building primarily for the purpose of teaching or caring for children in:

- a) Kindergartens
- b) Day care centres for preschool children
- c) Schools for children up to and including school year eight.

For avoidance of doubt the Ministry has interpreted the requirement to include:

***Any rooms and areas that is normally accessible by pupils up to and including the educational age of year eight (8).***

The regulation therefore does not apply to secondary schools, excepting for areas normally designated to accommodate year eight or below pupils, as in some composite schools where areas are regularly shared.

#### 10.3.2 Areas in schools that require 10mA RCD protection

Based on the standard and relating this to a typical school construction, the following areas would be considered as “areas normally accessible by children”:

- a) Classrooms and areas where it is intended to teach children
- b) Workrooms where children are allowed to work
- c) Technology classrooms (except ICT suites)
- d) Music rooms.

## 10.4 Electrical installation – Protective devices

Socket outlets, installed in locations other than those referenced in 10.3, and intended to be used for the connection of electrical equipment that may represent an increased risk of electric shock to the user, shall be protected by RCDs.

RCD protection may be at circuit or socket level, with the preference being socket level particularly in situations where increased risk exists. This allows for resetting and testing of the RCD without the need to leave the teaching environment.

10mA RCDs or RCBOs are not required for the following:

- a) GPOs mounted above 1.8m
- b) RUPOs specifically installed for the supply of electricity to IT equipment and cleaning equipment, that are clearly marked to indicate the restricted purpose of the socket-outlet and that 10mA RCD protection is not provided
- c) GPOs in corridors, halls, gymnasiums and similar areas where portable electrical appliances are not likely to be used by children
- d) Where other methods of protection are applied, for example a separated supply in accordance with AS/NZS 3000
- e) Where specific provisions for RCD protection exist through the application of other Standards, for example AS/NZS 3001, AS/NZS 3002, AS/NZS 3003, AS/NZS 3004, or AS/NZS 3012, and this is agreed to in writing by the Ministry
- f) To the special situations referred to in Sections 6 and 7 of AS/NZS 3000 that require RCD protection, which shall be provided in accordance with the relevant clause.

In designated computer labs or computer pods as detailed on the drawings, the electrician shall either install:

- g) A local electrical sub-distribution board to feed the RUPOs in these areas, at a maximum of 6 dual RUPOs per 20A MCB. These shall have 30mA RCDs on each circuit
- h) 30mA RCDs on each RUPO.

This rule also applies to any floor boxes that are to be installed and 30mA RCDs shall be fitted at the sub-board per circuit. The use of 30mA RCBOs is permissible.

When deployed, horizontal RCD sockets shall not be mounted vertically.

A maximum of two dual GPOs downstream of an RCD or socket based RCD is required for all areas requiring 10mA RCD protection. For existing GPOs requiring this level of protection, this shall be achieved by utilising socket based RCDs.

In technical learning spaces and cooking and kitchen spaces there may be a requirement for some form of central emergency isolation function to remove power to hand held devices and rotating machinery.

## 10.5 Electrical products and equipment

The installation of all electrical products and equipment shall be installed to the manufacturer's guidelines to the correct and relevant regulations and Standards, by a licensed and registered electrician or a trainee under the supervision of a registered and licensed electrician, and, where required by regulations, inspected by a licensed and registered electrical inspector.

## 10.6 Electrical cable segregation

Cable pathways and cable shall be installed to achieve a minimum 50mm physical separation between extra-low voltage cabling and low voltage services as per AS/NZS 3000. Where this cannot be achieved, a durable plastic or earthed metal barrier shall be provided to achieve physical separation.

**Designer and Electrical contractor note:**

*This is a safety requirement and not a performance issue.*

Where specific manufacturer requirements require greater separation than required by AS/NZS 3000, the greater distance shall be observed.

## 10.7 Switchboards – General requirements

Electrical switchboards shall be clear and free of obstructions for at least 0.6m at all times.

The electrician is to ensure that all electrical switchboard loads are balanced at the completion of their installation, providing current readings to the Ministry or its representative to confirm this.

Additional circuit protection added to switchboards containing old circuit protection shall be carried out in full compliance with AS NZS 3000 and be aligned with current best practice and utilising compliant components, including RCDs.

New or upgraded switchboards shall be fitted with maximum demand meters and load meters.

## 10.8 Switchboard wiring

Internal wired connections shall be PVC insulated and shall be:

- a) Suitably identified to indicate their function
- b) Supported adequately using plastic ties or PVC trunking
- c) Terminated in DIN rail mounted terminal blocks where shown on the drawings
- d) Provide separate terminals for every outgoing connection.

Cable entries for external cables shall be provided as follows:

- e) TPS - bushed holes (sealed)
- f) NS - compression type glands
- g) PLYSS - sealing box and brass wiping gland
- h) PLSWAS - sealing box and armour clamping gland
- i) XLPE/HT-PVC - compression type glands.

### **10.8.1 Busbars**

The following applies:

- a) Busbars shall be high conductivity copper and shall be colour identified red, white, blue on phases and black for neutral for three phase systems
- b) Busbar links shall be the same carrying capacity as the bar and shall be secured at each end by at least two bolts
- c) All busbars shall be of high conductivity copper adequately supported to withstand fault currents and shall link all fuses or miniature circuit breakers
- d) Busbar connection points for both supply tails and outgoing circuits shall be bolted using bolts and nuts with locking washers
- e) No live metal shall be exposed to touch or accessible to tools under normal conditions when the panel or cubicle door is open.

### **10.8.2 Switchboard Diagrams**

The switchboard power system single line diagram shall:

- a) Be printed in black on stiff white material, using a non-fading process
- b) Be mounted in a clear 1.5 mm thick plastic envelope or laminated
- c) Be fixed on a wall adjacent to the switchboard if in a utility room, otherwise attached inside the switchboard door if in an unsecured environment.

When upgrading switchboards, all existing circuits not adequately labelled shall be identified and clearly labelled on a new schedule of circuits and equipment.

### **10.8.3 Protective device – circuit ways**

Where all of the circuit protection on a switchboard is replaced, additional protection by RCDs shall be provided for final lighting subcircuits supplied from that switchboard. All final subcircuits feeding socket outlets that do not incorporate earth leakage protection will require protecting by an RCD or RCBO.

Where space for future expansion is shown, the board shall be constructed so that no metal cutting or busbar extensions are required for the fitting of additional fuse ways or miniature circuit breakers.

Spare ways are to be left with blank legs. A minimum of 25% spare ways shall be provided in each distribution board

### **10.8.4 Circuit identification charts**

Circuit identification charts for all distribution boards shall:

- a) Give full circuit information and identification
- b) Show a reduced floor plan (A4 size)
- c) Be printed in black on stiff white material, using a non-fading process
- d) Be mounted in a clear 1.5 mm thick plastic envelope
- e) Be fixed to the inside of the cabinet door.

### **10.8.5 Equipment layout**

Power and data separation shall be maintained at all times.

Equipment layouts shall be:

- a) Symmetrical
- b) Allow a minimum of 25% space for future additions
- c) Ensure that sufficient space is provided to allow all internal components such that they are mounted to their manufacturer's requirements.

### **10.8.6 Equipment mountings**

The mounting of equipment, inside the cubicle, shall be on either mild steel panels or standard DIN mounting rails.

Panel mounted equipment and mounting panels shall be fixed by screws into captive nuts using rust resistant screws.

Self-tapping screws are not acceptable.

### **10.8.7 ICT specific wall mounted cabinet protection requirements**

Each wall mounted cabinet (less than 1.0kW input) shall have 1 x 10A dual RUPO installed, supplied by a single dedicated circuit.

The dual RUPO shall be mounted 150-200mm above the base of the cabinet.

All MCBs protecting RUPOs, the MCB protecting the SPD and the SPD itself at the switchboard shall be labelled, clearly referencing which cabinet they are protecting.

### **10.8.8 ICT specific free standing cabinet requirements**

Each cabinet (server & free standing greater than 1.0kW input) shall have 1 x 15A dual RUPO & 1 x 10A dual RUPO installed, with each having a separate dedicated feed from the switchboard (on the same phase to mitigate 400v potential between RUPOs).

These RUPOs shall be mounted 300mm above the base of the cabinet (server, open frame or free standing).

A standard circuit breaker protection (20A MCB) shall be installed for each dedicated circuit to a cabinet RUPO.

All MCBs protecting RUPOs, the MCB protecting the SPD and the SPD itself at the switchboard shall be labelled, clearly referencing which cabinet they are protecting.

### **10.8.9 Connections**

All wiring shall be terminated in either:

- a) Tunnel type terminals
- b) Crimped collets
- c) Spade type lugs.

Where several conductors terminate at a common terminal each conductor shall be removable without dislodging the remaining conductors.

All terminals and live metal shall be shrouded with clear plastic.

Plastic labelled ferrules are to be fitted on all wiring for control wiring. The coding system shall make it possible to identify the both ends of a length of wire where the circuit loops between several connection points.

External connections of non-earthed conductors shall be at rail-mounted terminals in compartments at the cable entry point.

Mount neutral and earth bars in the cable entry compartment.

Terminal compartments for external cables shall be located a minimum of 500mm above floor level.

#### **10.8.10 Installation main switch**

Installation and building main switches shall be:

- a) Fit for purpose
- b) Insulated type with auxiliary contacts as required
- c) Arranged to be lockable in the off position.

#### **10.8.11 Construction details**

Ensure the access requirements of AS/NZS 3000 are satisfied

Dimensions shall not exceed the maximum sizes specified on the drawings.

The following design guidance shall be followed:

- a) Layouts shall be symmetrical. All panel depths shall be the same in each switchboard or distribution board
- b) Panel mounted equipment shall be flush
- c) Stiffen where necessary to prevent panel deformation due to weight of equipment or stresses of switching operations
- d) Hinges on doors shall be concealed or semi-concealed type
- e) Door catches shall be of the flush lockable type and of the same combination for the complete installation
- f) Non-ferrous metal gland plates of the bolted removable type shall be used with single core cabling.

#### **10.8.12 Sub-distribution boards**

When installing and feeding an additional sub-distribution board from any existing switchboard:

- a) The existing connected load shall be evaluated, documented and used as a base value to confirm that additional electrical demand will not exceed the maximum current ratings of any section of the existing supply system
- b) Current (load) testing of the existing switchboard mains or sub mains supply shall be carried out and documented before and after the installation of the new sub board
- c) Current (load) of all phases supplying the new sub-distribution board shall be carried out and documented.



#### **10.8.13 Flush mounted panels**

Trim panel manufactured for the purpose shall be fitted to all flush distribution boards to cover the raw edge of wall linings.

#### **10.8.14 Finish**

Surfaces are to be painted to the manufacturer's standard finish and colour.

On completion all surfaces are to be cleaned and any internal or external paint damage or any other defect is to be repaired.

### **10.9 Switchboards - New**

Any new switchboards installed shall have the following requirements in addition to the previous clause requirements.

#### **10.9.1 Manufacture**

The manufacture of new switchboards shall be by a firm specialising in the type of work and shall be of the same manufacture throughout the installation.

New switchboards shall be fitted with maximum demand meters and load meters.

### 10.9.2 Design criteria

Criteria	Requirement
Standards	AS/NZS 3439.1 or approved equivalent if switchboard is based on European or American design standards and/or components
Supply system	400V ac 50Hz, three phase, earthed neutral
Service conditions	Indoor Standard Ambient temperatures -5°C to +35°C Max +40°C Humidity 10-85%
Environmental Rating	For example, Indoor IP 31 sprinklers
General arrangement	Flush front Modular Distribution Board Control panel
Enclosure type	Multi-cubicle
Fault level	For example, 10 kA
Mounting	
Access	Side Front Top Bottom
Extendable	No
Cable entry position	Top Bottom
Type test to AS/NZS 3439.1	
Seismic Coefficient	CP=1.7
Mechanical Controls	Provide a dedicated controls cabinet for the mechanical contractor to install their controls

Surge protective devices (SPD) shall be installed at the switchboard to protect the entire phase supplying any dedicated communications cabinet circuits. A dedicated circuit breaker shall be installed to protect the SPD, and this circuit breaker shall not be used to protect any other sub circuits.

## 11 Selection and installation of wiring systems

### 11.1 Selection and installation of wiring systems – General requirements

The requirements of AS/NZS 3000 for the design, selection and installation of wiring systems shall be read in conjunction with this chapter.

Photographs shall be provided of the electrical installation along with other sign off documentation. Photographs are to be provided of all newly installed:

- a) Switchboards
- b) Sub distribution boards
- c) Circuit breakers added to existing switchboards (showing circuit labelling)
- d) Circuit breakers and surge protective devices installed to protect new communications cabinet circuits
- e) Pathways.

### 11.2 Flush boxes and plates

Flush boxes and plates shall be:

- a) Mounted so that flush plates are true and square with the wall finish
- b) Earthed if metal type where metal foil is used in the wall construction
- c) Deep metal type in poured concrete.

#### 11.2.1 Fixings

One of the following fixing methods shall be used:

- a) Fix through the back by two screws, with a minimum penetration of 20mm, into a dwang or support
- b) By screws through the side to the stud.

Outlet label details shall include the circuit and distribution board numbers. See APPENDIX C – LABELLING CONVENTION for more information.

### 11.3 Switches, socket outlets and fixed outlets

#### 11.3.1 General

Switches, sockets and fixed outlets shall be:

- a) Flush type
- b) Standard manufactured type, commonly available with clip-on metal or plastic coloured over plates
- c) Standard manufactured type, commonly available plastic or polycarbonate colour coloured faceplates.

Light switches, data, fixed and socket outlet plates shall be of the same manufacture throughout the installation.

### 11.3.2 Surface Type

Surface type shall have:

- a) Enclosures of the impact resistant, corrosion resistant, surface mounted type, as per PATHWAYS AND SPACES
- b) Spare entries permanently plugged
- c) An earth connection if metal clad.

### 11.3.3 Damp/External Requirements

See 15.2

### 11.3.4 Light Switches

Light switches shall be rated at 10A minimum unless specified otherwise.

Adjacent light switches on different phases shall be housed in separate or approved partitioned enclosures.

Lighting switches shall be mounted at 1m above the floor level, and within 200mm of the doorframe on the handle side unless indicated otherwise.

### 11.3.5 Socket Outlets

Socket outlets shall be:

- a) Flat three-pin socket type incorporating a suitably rated switch for single- phase applications
- b) Round five-pin socket type incorporating a suitably rated switch for three phase applications.

Note the requirements of NZS 4121 which requires outlets to be mounted 500mm above the floor for disability access.

Switched socket outlets shall be located in relation to the equipment or appliance such that the isolation point is readily accessible.

It is highly recommended that earth leakage protection for all socket outlets is provided by RCD's incorporated into each socket outlet face plate, this ensures that:-

- If the RCD operates it can be reset by the teacher without leaving the classroom.
- The RCD can be tested on a regular basis to ensure correct operation.
- If the RCD operates it only affects that outlet and not others that may well be in another room.
- It reduces possible nuisance tripping from the aggregate earth leakage of many devices fed by that circuit.

All newly installed RUPOs installed in schools shall be labelled to indicate their purpose and that RCD protection is provided, for example '**ICT USE ONLY – RCD PROTECTION**' for ICT related RUPOs.

All socket outlets (RUPOs and GPOs) shall be labelled with switchboard and circuit identification.

Front cover plates shall be labelled with computer generated vinyl labels, this label shall also be replicated on the base plate using permanent marker.

### 11.3.6 Industrial Outlets

Single and poly-phase industrial socket outlets shall be:

- a) To AS/NZS 3123, or IEC 60309
- b) Supplied with matching plug
- c) Mounted 1000mm above floor level, unless indicated otherwise.

## 11.4 Fixed wiring outlets

Fixed wired outlets shall be located:

- a) Adjacent to the equipment or appliance such that the isolation point is readily accessible
- b) As near as practical to the point of entry to the appliance.

All fixed wired outlets shall have a switch incorporated.

Earthing shall be by means of a stud or terminal within the outlet.

High temperature grade wiring or flexible cords shall be used where equipment connection boxes operate in conditions above 60°C. Anchoring arrangements shall be provided for flexible cord within the outlet.

Phases and loading shall be confirmed with the specialist equipment supplier before installation.

## 11.5 GPOs and RUPOs

There shall be no more than six (6) GPOs installed for newly run circuits. There shall be no more than six (6) GPOs where new GPOs are added to an existing circuit. In this instance the GPO can be single or dual.

All new GPO circuits shall be protected by an RCD at circuit or socket level. Fuses that can be rewired or High Rupture Capacity (HRC) Fuses shall not be installed.

Due to issues with aggregate earth leakage there shall be no more than two (2) GPOs or RUPOs are to be protected by a 10mA RCD. If an RCD faceplate outlet is used this constitutes 1 GPO and only one other GPO can be protected by the 10mA RCD. In this instance the GPO or RUPO can be single or dual.

See 11.3.5 for additional information on RUPOs.

## 12 LUMINAIRES

### 12.1 Luminaries – Overview

Schools are required to deliver efficient well-lit learning and working environments for students and staff. Adequate lighting can increase student achievement, and designers and electricians should ensure properly illuminated classrooms, libraries and other educational spaces to allow for reading without eye strain, focused concentration, attentiveness, and student accomplishment.

Many older schools still use MCG fluorescent lamps. In newer or refurbished schools, it is more common and preferable to use modern ECG or LED luminaires. This change alone in a large school can save considerable amounts in operating costs.

While energy and cost resourcefulness are of decisive importance, the quality of lighting is fundamental in providing students with favourable learning spaces. A lighting consultant should be used to determine lighting requirements.

New high-efficiency light sources, multiple lighting levels, direct and indirect lighting, occupancy sensors and light monitoring sensors, and other devices can provide greater control and improved comfort in the classroom. The requirements of NZS 4243.2 shall apply.

For quality of light, the best fixtures are direct/indirect fixtures. These throw light on the ceiling as well as on task surfaces and the illumination is uniform and without glare.

### 12.2 Luminaries – Design and installation

For luminaire design, refer to the *Lighting Design Guide for Schools and Boards of Trustees (BRANZ)* document on the Ministry of Education website, AS/NZS 1680.2.4 in conjunction with AS/NZS 1680.1, and this chapter.

For luminaire installation, refer to AS/NZS 3000 for information and guidelines, and this chapter.

For the purpose of determining light source usage after practical completion it will be assumed that the Principal uses the lighting system for an average of ten hours per day, five days per week.

### 12.3 Luminaries – General requirements

#### 12.3.1 Power Factor Correction

Provide power factor correction to not less than 0.95 lagging in all luminaires where required.

#### 12.3.2 Damp situations

See 15.4.

## 12.4 Lighting dimmers

Where lighting dimmers for fluorescent or LED lighting loads are required, they shall be:

- a) Designed to suppress RFI and audible noise
- b) Mounted in a standard flush outlet box.

## 12.5 Recessed luminaires

Only recessed luminaires that meet the requirements of AS/NZS 60598.2.2 shall be installed in schools.

Recessed luminaires shall have:

- a) Air circulation sufficient to prevent abnormal working temperatures
- b) Mechanical attachments to the main elements of the ceiling system designed to carry the weight
- c) Independent support wires provided to the supporting structure to provide seismic restraints in accordance with NZS 4219.

## 12.6 Surface mounted luminaires

Only surface mounted luminaires that meet the requirements of AS/NZS 60598.2.1 shall be installed in schools.

Fixings for surface mounted channel type luminaires shall be capable of withstanding three times the weight of the luminaire and shall:

- a) Prevent flexing or twisting of the spine
- b) Use a minimum of two screws per luminaire each having a minimum diameter of 3.2 mm and penetrating at least 40 mm into timber. Alternative fixing methods proposed by the contractor may be considered.

## 12.7 Chain suspended luminaires

Chain suspended luminaires shall have the associated ceiling rose positioned adjacent to one of the suspension anchor points.

Suspension chains shall be:

- a) Solid link type
- b) Suitably plated for the conditions
- c) Fitted with safety hook or other approved securing method to provide the required seismic restraint
- d) Earthed by a core in the flexible cable.

## 12.8 Fluorescent lighting

Fluorescent lamps shall incorporate moisture and dust protection to:

- a) IP20 for general purpose luminaires intended for use in dry indoor applications
- b) IP56 for exterior luminaires that are mounted on the exterior of a building and IP65 for luminaires in school precincts mounted on bollards, columns or poles.

### 12.8.1 Fluorescent lamp accessories

Fluorescent lamp starters shall comply with AS/NZS 60155.

The metalwork finish shall be delivered by an approved baked enamel or equivalent process.

Components shall be fixed so that they can be replaced without:

- a) Gaining access to the back of the luminaire
- b) The use of rivets or self-tapping screws.

In addition, fluorescent lamps shall be:

- c) Individually removable from multi-tube luminaires without impairing the security of any other tube
- d) Tri-phosphor type
- e) To class Q or class R rating of MEPS
- f) Colour temperature between 3300K and 3900K – tubes to be T5 (preferably) or T8 type.

## 12.9 Exterior site lighting

### 12.9.1 Control switch

A photo sensitive daylight switch in a light industrial enclosure shall be provided.

The switch shall be screened from direct sunlight and from any artificial lighting sources.

The ability to adjust the sensitivity of the daylight switch for dusk to dawn control shall be provided.

### 12.9.2 Installation of lighting columns

Install columns vertically with a cast in-situ concrete base or footings, and complete with neat concrete surround finished smooth and flush with final ground level.

## 12.10 Emergency lighting

Emergency lighting shall comply with AS 2293.1 and the NZBC.



### **12.10.1 Self contained single point systems**

Self contained single point systems shall include:

- a) Luminaires with sealed rechargeable battery cells of sufficient capacity for not less than half an hour of emergency lighting after mains failure
- b) Battery charger with full wave rectifier and automatic 2 rate output
- c) High frequency fluorescent ballast, and miniature fluorescent lamp or LED driver and LED module
- d) Devices to switch the lamp on when mains voltage fails and off when battery voltage fails
- e) LED lamp to indicate battery charge condition, and test push button to interrupt mains supply
- f) Alternatively one luminaire may incorporate battery cells of sufficient capacity to operate two luminaires with the second connected as a slave.

### **12.10.2 Testing Facility**

Provide a test facility on the front of each distribution board that supplies emergency lighting systems to AS 2293.1 to energise emergency lights and exit signs, then automatically reset after a pre-set time.

## 13 SELECTION AND INSTALLATION OF APPLIANCES AND ACCESSORIES

### 13.1 Appliances and accessories – General requirements

The requirements of AS/NZS 3000 for the selection and installation of appliances and accessories shall be read in conjunction with this chapter.

All equipment installed shall be fit for purpose and meet approved safety requirements for use in New Zealand. There shall be no adaptors, incorrect plugs, or products installed that do not meet the requirements of the Electricity (Safety) Regulations.

The following is a **non-exhaustive** list of common appliances supplied to schools and requirements for their installation.

### 13.2 Appliances and accessories - Connections

#### 13.2.1 Terminations

Terminations at appliances shall be:

- a) Terminated with fixed wiring at a junction box, isolator or outlet located adjacent to the appliance being served, such that the disconnection switch is readily accessible
- b) Connected with a PVC sheathed flexible cable
- c) Allow sufficient length of flexible cable to permit the removal of the appliance for checking, testing and disconnection.

#### 13.2.2 Domestic Appliances

When connecting into a removable appliance and that appliance covers the outlet, provide an engraved switch (labelled as to the function of the switch, adjacent or above the appliance).

This requirement applies to, but is not limited to:

- a) Dishwashers
- b) Refrigerators
- c) Microwaves
- d) Chiller/freezer cabinets
- e) Ovens
- f) Cook tops.

### 13.3 Hand driers

Hand driers shall:

- a) Be operated by movement of the hands in the general area of the air outlet.
- b) Incorporate brushless type motors
- c) Be wired via a 20A isolator switch mounted at high level.

### 13.4 Heat trace systems

Heat trace shall:

- a) Operate from a 230 volt power supply
- b) Terminate wiring at a switch located at a suitable level. The function of the switch shall be clearly labelled
- c) Allow to label the function of the protective device supplying these circuits
- d) Provide a monitoring system on the switchboard to monitor the current drawn by each trace heating element system
- e) Illuminate an indicator lamp when the current drawn by the element falls below the nominal minimum value.

On completion of the installation of the pipe work, trace heating element, and insulation, the element shall be connected to the power supply and the current monitored, using a suitable chart recorder for a minimum of 48 hours before the installation becomes operational. Allow for consultation and subsequent setting of an appropriate set point for the alarms.

#### 13.4.1 Waste Pipe Installations

Supply and install a trace heating system suitable for maintaining the waste pipes at a nominal temperature of 40°C.

#### 13.4.2 Condensate Pipe Lines

Supply and install a trace heating system suitable for maintaining the waste pipes at a nominal temperature of 4°C.

### 13.5 Sanitary disposal units

Sanitary disposal units shall:

- a) Be wired via a 20A isolator switch mounted at high level, then in concealed conduit directly into switched permanent outlets incorporating with red neon indicators
- b) Be connected with high temperature flexible cords for incinerator type.

### 13.6 Storage water heaters

Storage water heaters shall:

- a) Connect with flexible cord connections to the isolator outlet
- b) Be fitted with white connection cords unless specified otherwise
- c) Connect through flexible conduit with high temperature cable to the water heater terminal box.

### **13.7 Under bench water heaters**

Under bench water heaters shall:

- a) Connect with flexible cord connections to the isolator outlet
- b) Be fitted with white connection cords unless specified otherwise.

### **13.8 Water misers**

Water misers shall:

- a) Operate from a 230 volt single-phase power supply
- b) Be wired via a 4-pin outlet, located on a plastic mounting block within the ceiling void. Connect from the outlet to the solenoid valve
- c) Be wired via a single 10A switched outlet located on a plastic mounting block within the ceiling void. Connect from the unit to the solenoid valve.

### **13.9 Fire alarm transmitter device (LTX)**

A fire alarm transmitter device shall terminate in a switched single phase 10A socket outlet incorporating a clear cover over the socket connection point.

The protective device supplying this circuit shall be clearly labelled.

### **13.10 Fire indicator panel (FIP)**

A fire indicator panel shall terminate in a switched single phase 10A socket outlet incorporating a clear cover over the socket connection point.

The protective device supplying this circuit shall be clearly labelled and wired directly into the panel.

### **13.11 Panel heaters**

Panel heater elements shall be finned type.

The panel heater shall be:

- a) Constructed to allow air to circulate between the section containing the element and the back panel of the heater
- b) Fixed to the wall to allow air movement between the wall and the back panel of the heater
- c) Mounted above the skirting, but not less than 100mm minimum above the floor for free movement of supply air
- d) Connected by a short flex to an adjacent outlet.

### **13.12 Infrared heaters**

Infrared heaters shall be:

- a) Mounted on adjustable brackets, at 2400mm above floor level but not higher than 400mm below the ceiling

- b) Connected by a short flex to an adjacent outlet.

### **13.13 Storage heaters**

#### **13.13.1 Fan controlled output type**

Fan controlled output type shall be:

- a) Provided with blanked off fan control
- b) Initially set low speed and shall have:
  - i. Accessible charge control
  - ii. A written undertaking that the heater will accept a full 24 kWh charge.

#### **13.13.2 Fixed output type**

Fixed output type shall be:

- a) Charge acceptance of 20 kWh in eight hours
- b) Net storage capacity of 15 kWh.

#### **13.13.3 Connections**

Outlets shall have:

- a) Flexible cord connections from switched permanent outlets similar to and mounted at the same height above floor level as the socket outlets
- b) Two connections for the heaters – one for the fan and one for the element.

### **13.14 Window actuators**

Terminate in a switched single phase 10A socket outlet.

## 14 EARTHING AND TRANSIENT PROTECTION

### 14.1 Earthing and transient protection – General requirements

The requirements of AS/NZS 3000 and the Ministry of Education document, *Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools* shall be read in conjunction with this chapter.

### 14.2 Earthing

No more than 3 earth wires shall connect into any one (1) earth bar connection point.

Solder shall not be used as the primary connection method for earth connections.

### 14.3 Bonding of other services and metal work

All metallic ducts, pipe work, benches and sinks, taps and partitioning members shall be bonded to the earth bar at the local distribution board using a green PVC insulated copper conductor.

All new and existing ICT cabinets shall be electrically bonded in accordance with AS/NZS 3000 with a 6mm<sup>2</sup> wire run from the nearest switchboard.

If an earth lug is not provided in the free-issue ICT cabinet, then the electrician shall create a true mechanical bond securing the earth to the cabinet.

### 14.4 Communications Cabinets:

If an earth lug is not provided in the ICT cabinet, the electrician shall create a true electrical and mechanical bond securing the earth to the cabinet.

A nut and bolt arrangement should be utilised including a star washer.

Paint or powder coating shall be removed at the point of contact.

### 14.5 Metallic Cable Pathways:

All metallic electrical and ICT cabling pathways shall be bonded to earth utilising minimum conductor sizes as required by AS NZS 3000. This requirement extends to all cable trays, trunking, ladder racks and so on that are made from conductive metals.

### 14.6 Protective earthing conductors

Protective earthing conductors shall be provided as per AS/NZS 3000.

Conductors shall be installed with the wiring to all lighting, switch, power or other connection points.

The metal sheaths or armouring of PVC insulated cables, or both, shall be bonded to the metal parts of the equipment to which they are connected, utilising a proprietary brass earthing tag and brass nut and bolt.

When flexible conduit is used, ensure the protective conductor at the equipment end is made-off to the equipment earth terminal.

The protective conductor shall be installed within the conduit and suitably sized for the circuit or circuits passing through.

## 14.7 Equipotential bonding

Equipotential bonding shall not be part of the earth fault path of the protective conductor system.

Bond to earth all:

- a) Enclosures
- b) Equipment
- c) Exposed conductive parts
- d) Extraneous conductive parts
- e) Metallic trunking
- f) Metallic conduits
- g) Metallic cable trays
- h) Any other metalwork, other than any live part, forming protection or part of the electrical installation, including apparatus and appliances.

The electrician shall ensure that all main water pipes, main gas pipes other service pipes and ventilation ducting (including ductwork flexible connections, riser of heating and air conditioning systems), oil pipe services, storage tank, piped gas systems and the exposed metallic parts of the building structure are effectively connected to the main earthing terminal points.

The electrician shall ensure the installation has all incoming services bonded to earth at the point of entry. For the purposes of this clause a building is defined as a separate structure. Structures linked by a corridor, subway or bridge are considered to be separate structures.

The electrician shall bond together electrically conductive services entering or leaving plant rooms, boiler houses, calorifier rooms, bathrooms, kitchens and other wet-process areas, and bond to the electrical installation equipotential bonding conductor system.

Extraneous metalwork to be bonded includes:

- i) Metal ceiling grids by bonding each primary grid member using a 4mm sq. PVC insulated copper conductor
- j) Metallic ladders and companion ways
- k) Suspended metal floor systems including supports/frames. There shall be a minimum of two bonds per room plus one additional bond per fifty square metres.

All other exposed metallic parts and equipment permanently secured to or forming part of the building structure including exposed metalwork of hollow partitions and separate sections of duct/pipe work insulation metallic covering shall be bonded.

## 14.8 ICT earthing

The electrician shall connect dedicated ICT earth bars to the “highest level” distribution board in the building using a 6mm<sup>2</sup> earth cable.

The electrician shall install separate 6mm<sup>2</sup> earth wires from the ICT earth bar, to all ICT cable trays, metal trunking, cabinets and frames within the building.

All ICT earths shall be dedicated and not looped. There shall be no joints in any ICT earth cables and each cable shall be connected directly to the communications earth bar and shall be labelled accordingly.

## 14.9 Surge protection

Installation of surge protection devices (SPD) shall be according to manufacturer’s recommendations and as described in AS/NZS 3000.

The electrician shall provide:

- a) Labels indicating the location and nature of the surge protection provided
- b) Three spare modules of each type of surge protection with plug in modules, stored with the distribution board.



## **15 DAMP SITUATIONS**

### **15.1 Damp situations – General**

The requirements of AS/NZS 3000 for the selection and installation of appliances and accessories shall be read in conjunction with this chapter.

### **15.2 Damp zones**

Socket outlets shall not be installed in any damp zone or environment.

### **15.3 Switches, sockets outlets, and fixed outlets**

Components located in damp or external locations shall have:

- a) Enclosures rated to a minimum of IP56
- b) Fixings through external lugs
- c) Covers secured by brass screws into blind holes on the enclosures.

Moisture and dust protection shall be IP56 minimum for luminaires that are mounted on the exterior of a building and IP65 for luminaires in school precincts mounted on bollards, columns, or poles.

### **15.4 Luminaires**

All luminaire parts shall be suitably protected against corrosion, by being constructed from non-ferrous material, stainless steel, galvanised steel or impact resistant plastic materials.

Metals in contact shall not have a galvanic potential difference exceeding 0.25V.

Moisture and dust protection shall be IP56 minimum.

## *16 SPECIAL ELECTRICAL INSTALLATIONS*

### **16.1 Special electrical installations – General**

The requirements of AS/NZS 3000 for special electrical installations shall be read in conjunction with this chapter.

### **16.2 Photovoltaic (PV) installations**

Photovoltaic (PV) systems – commonly referred to as solar – in an installation are deemed high risk, as per the Electricity (Safety) Regulations. The requirements of AS/NZS 5033, AS 4777.1 and AS/NZS 5033 shall be met.

The record of all PV installations shall be entered into the High Risk Register, which is managed by Energy Safety (part of WorkSafe NZ).

In schools that are designated as Civil Defence Centres, any PV systems installed shall be arranged to ensure that the output from the PV system can be employed in a civil emergency, when the grid electric supply is interrupted. This arrangement may include the use of an external generator, in which case a suitable coupler and switching arrangement shall be provided for this purpose. See 5.2 for more information.

### **16.3 Electro medical installations**

The requirements of the Electricity (Safety) Regulations and NZS 6115 shall be met for all external power points to connect mobile medical vehicles.

## *17 Electrical installation requirements in the New Zealand Building Code*

### **17.1 New Zealand Building Code – General requirements**

The requirements of AS/NZS 3000 Appendix E3, and information and guidelines on electrical installation requirements in the New Zealand Building Code shall be read in conjunction with this chapter.

### **17.2 Building penetrations**

See 0 for more information.

All penetrations shall be covered by an external weathershield. Silicon sealants shall only be used as a secondary method of protection.

### **17.3 Drilling of structural members**

The maximum sized holes and locations for penetrations through joists and framing are detailed in NZS 3604, in addition with the following restrictions.

#### **17.3.1 Pathways through underfloor joists**

See NZS 3604, Section 7.

Drilled holes shall be:

- a) No larger than 32mm
- b) Positioned closer to a supporting joist
- c) Positioned within the middle third of the joist width.

#### **17.3.2 Pathways through 70mm studs**

See NZS 3604, Section 8.

Drilled holes shall not be more than 19mm and slots shall not be more than 19mm in depth.

There shall be a 600mm minimum spacing vertically between slots.

#### **17.3.3 Pathways through 90mm studs**

See NZS 3604, Section 8.

Drilled holes shall not be more than 25mm and slots shall not be more than 25mm in depth.

There shall be a 600mm minimum spacing vertically between slots.

#### **17.3.4 Pathways through timber framing**

See AS/NZS 3000, Protection against mechanical damage.

### **17.3.5 Pathways through laminate wooden beams**

A structural engineer shall be consulted, their advice received in writing, and this information supplied to the Ministry, the school, or their representative for written approval before drilling any glulam or similar beams in schools.

See <http://rosboro.com/index.php?action=technical.glulam> for guidance on laminate wooden beams.

# 18 TESTING, VERIFICATION, CERTIFICATION AND DOCUMENTATION

## 18.1 Testing and verification, certification, and documentation

The requirements of AS/NZS 3000 for testing and verification, certification, and documentation shall be read in conjunction with this chapter.

### 18.1.1 Test records

The electrician shall provide test records for all cabling installed under the Scope of Works.

## 18.2 RCDs

All RCDs installed shall be tested. The electrician shall replace RCDs that failed the tests and repeat the tests on all of the new devices.

## 18.3 RCD – Distribution board test schedule

### 18.3.1 Test schedule

Include a copy of the test schedule in the distribution board.

<b>Routine Testing Instructions:</b>				
(a) Residual Current Device's (RCDs) must be tested at regular intervals of not more than three months.				
(b) The results of these tests must be recorded on this schedule.				
(c) Pressing the 'TEST' button on the RCD should cause the RCD to trip.				
(d) If an RCD fails to trip, switch off the circuit and call your electrician immediately.				
Do not use the outlets connected to the faulty device until the cause of the failure has been identified and the faulty RCD replaced.				
RCD Identification	Tested by	Date dd/mm/yy	P - Pass F - Fail	Comments

## 18.4 Warranty certification

Warranties and certification are a requirement for all new installations and for all MAC's in existing installations.

The project work is not considered complete until all warranty documentation is provided.

The electrician shall be responsible for ensuring supply of:

- a) A minimum two (2) year installation warranty
- b) A minimum two (2) year systems and components warranty
- c) A minimum five (5) year electrical appliance warranty, where the appliance is supplied by the electrician
- d) All relevant documentation – for example, certification required by Regulation – submitted to the school, the regulator (where appropriate), and the Ministry
- e) The original certificate confirming warranty, with an electronic copy forwarded to the Ministry and their representatives. Hard copies of all warranties are required
- f) Electronic copies of test results and certificates required by the Ministry or its representatives are stored for future reference.

The electrical contractor shall ensure that all electrical appliances that are not supplied as part of their contract are:

- l) Suitable and approved for use in New Zealand
- m) Have a 5 year electrical appliance warranty from the appliance supplier.

If the 5 year electrical appliance warranty cannot be provided by the appliance supplier, then the electrical contractor shall notify the Ministry for an exemption or have this noted by the Project Manager or School, and included in their final documentation noting the reasons why the warranty could not be applied.

Electronic records shall:

- g) Be provided on WORM (Write-Once/Read-Many) CD/DVD media
- h) Include scanned copies of all warranties.

Electronic records shall not be provided on USB stick, flash-cards or other types of removable read/write media.

## 18.5 Light level measurements

Measure horizontal light levels (lux) at 720mm AFL at least 30 minutes after sunset on a grid pattern, such that in larger rooms a minimum of nine readings are taken and in office areas a minimum of four readings are taken. Readings shall be taken not less than 500 mm from any wall and shall be evenly distributed around the room.

Fluorescent lamps must have been allowed to operate for a minimum of 48 hours before any readings are taken. LED luminaire light level measurements may be taken at any time after installation.

Room ID	Co-ordinates			
		Lux	Lux	Lux
		Lux	Lux	Lux
		Lux	Lux	Lux

Alternatively readings may be printed onto an as-built drawing.

Drawings to include:

- a) A basic floor plan
- b) Readings and a dot to indicate the reading point. Drawings may include:
- c) Furniture
- d) The location of luminaires
- e) The location of light switches.

Drawings must not include:

- f) Circuit details
- g) Switching details
- h) Any other details not specifically related to the lighting installation.

## 18.6 Commissioning procedures

Responsibility for the commissioning shall belong to the electrical installer who shall provide all labour, tools, and instruments as required.

Scope of the commissioning shall be to prove:

- a) Compliance with all statutory and design requirements, such as the Electricity (Safety) Regulations and Electrical Codes of Practice, and electrical Standards.
- b) Safe and proper working of the installation in all respects.

Commissioning procedures shall be in accordance with the following stages unless instructed otherwise by the Project Manager:

- c) Visual inspection at all construction stages
- d) Static tests of wiring and equipment
- e) Checking and setting of all protection devices and safety interlocks to design requirements
- f) Demonstrating that specific commissioning requirements details in the Electrical Services Sections of the Scope of Works have been complied with
- g) Setting installation to work, checking operations, taking readings, and recording results

- h) Comparing design figures against achieved results and adjusting where required
- i) Completing all test sheets and passing two copies of each to the engineer.

## **18.7 Acceptance**

Acceptance of the completed installation will not be considered until satisfactory completion of all testing and commissioning, submission of test and commissioning results that satisfy the requirements of the contract documents, including the draft Operating and Maintenance Manual.



## *APPENDIX A – HERITAGE SITES*

(Informative)

### **A1. General**

Many older sites have objects such as buildings or trees that may have a heritage status, or be deemed as protected by a local or regional council.

Information is often not easy to find and can be located in different places depending on the local or regional council. In addition to the heritage status and council designation the site may also be recognised as an archaeological site or one of significant Maori heritage.

Often schools and SPAs are not aware themselves of heritage status of some of their buildings. If a building is suspected of heritage status the following information can be used to determine the any details

### **A2. Historical Sites**

Historic sites are registered by Heritage New Zealand. Heritage New Zealand has a regulatory role regarding protected historic places, archaeological sites and sites of importance to Maori and may prosecute under the Heritage New Zealand Pouhere Taonga Act 2014.

There is likely to be historic significance if the school was built pre-1930s.

The auditor will need to search the register located at:

<http://www.heritage.org.nz/the-list>.

It's useful to search the suburb or town to ensure that all historic places in the area are captured. Care needs to be taken when dealing with suspected historic places. Confirmation from the school or SPA is not sufficient and if heritage significance is suspected, confirmation in writing from Heritage New Zealand must be received.

### **A3. Archaeological Sites**

An archaeological site is defined in the Heritage New Zealand Pouhere Taonga Act 2014. Any works that may affect an archaeological site must have written authority from Heritage New Zealand before work begins.

Archaeological sites may be listed in the Heritage New Zealand register or, in a council district plan or council database. If in doubt, contact Heritage New Zealand AND the relevant council.

### **A4. Maori Heritage**

Māori heritage can be divided into the physical/tangible, natural and intangible. Heritage New Zealand employs specialist Pouārahi (Māori Heritage Advisors) and other staff based in its offices in Kerikeri, Auckland, Tauranga, and Wellington.

If the site (or locations within the site) is suspected as of Maori Heritage then contact Heritage New Zealand for advice on proceeding further. This may be necessary around a Marae (particularly if it is a very old site), or if old carvings are present, and so on.

## **A5. Council Designation**

Heritage New Zealand does not manage all historic places and many of them are managed by the local or regional council.

Councils have responsibilities under various pieces of legislation for heritage management and protection, notably the Resource Management Act, Heritage New Zealand Pouhere Taonga Act, Building Act and Local Government Act.

Sites may be protected under a council designation and each council and region has a difference database and method of accessing that database. Some councils only have these listed in their district plan and other councils may not have digital records or a searchable database.

## *APPENDIX B – APPROVED ICT CONTRATORS LIST*

(Normative)

### **B1. Approved ICT contractors list**

The Ministry, schools, and their agents (such as project managers or designers) shall select suppliers from the Ministry's Approved ICT Contractors List for the following categories of ICT services and products:

- a) Structured cabling installation services
- b) Structured cabling product supply
- c) Wireless integration services.

This requirement is to be followed whether the ICT work is undertaken by any Ministry programme of work, or independently by a school.

Over time, the list is intended to be extended to include other types of ICT contractor.

The list of approved ICT contractors can be found at <http://www.minedu.govt.nz/>.

## APPENDIX C – LABELLING CONVENTION

(Normative)

### **C1. Approved cabling systems products**

#### **Labels**

- a) Material: Laminated plastic.
- b) Use line gill face lettering:
  - i. 10mm high for board identification and warning labels
  - ii. 6mm high for major items
  - iii. 3mm for minor items.
- c) Attach an identifying label to the outside of each cubicle.

Identify each internal item or component such that their function is easily identified.

Labels may be computer generated by the Brother labelling system or equivalent industrial standard (for example Dymo Industrial Labellers using vinyl tape). Use of felt tipped pen and the like is not acceptable for outlet front cover plates and the fronts of patch panels.

All cable ends at the rear of GPOs, RUPOs, and in the switchboards shall be labelled with permanent marker.

All retained cabling shall be labelled in a consistent manner to the new installation.

### **C2. Switchboards**

Each switchboard shall be labelled with a five character designation that is unique for the site.

The following shall apply:

- a) 'DB' should precede all specific labels.
- b) The first character shall be alphanumeric and signify the building (for example A for Administration, F for Block F, 1 for Block 1 and so on)
- c) The second character shall be alphanumeric and signify the level within the building (for example 1 for Level 1, G for Ground, B for Basement, and so on)
- d) The third character shall be a sequential numeral (1, 2, 3, and so on) signifying the particular enclosure on the respective level.

For example 'DB-F24' would signify the fourth switchboard on Level 2 of Block F.

The labels shall be 100mm x 50mm, self-adhesive multi-layered laminate engraved with 15mm upper case lettering. The labels shall be located on the front centre of each rack or enclosure, near the top.

### **C3. Underground ducts**

All underground ducts at the point of entering or exiting a building are to be labelled "Warning: Underground Electrical Duct" with an arrow pointing down.

The labels shall be 100mm x 50mm, Self-adhesive multi-layered laminate engraved with 10mm upper case lettering. They may also be riveted in place to offer additional mechanical bonding.

The labels shall be located on the front centre of each flashing, shroud or enclosure, approximately 300mm above the natural ground level.

#### **C4. Restricted use general power outlets**

All new RUPOs and GPOs shall be labelled on the front faceplate using an industrial grade labeller with vinyl tape e.g. 'Dymo' or 'P Touch'. Sockets must be labelled on the back plate using permanent marker pen. Labelling on the backplate must replicate labelling on the faceplate.

For newly installed power circuits: All RUPOs or GPOs or both of the respective circuit shall be marked with the applicable switchboard and circuit identification, for example DB F21-R2.

For new sockets looped off existing power circuits: All RUPOs or GPOs or both of the circuit, both new and existing, shall be marked with the applicable circuit identification as above.

Where applicable, all newly installed RUPOs installed shall be labelled to indicate their restricted use – for example, for an ICT related RUPO: 'ICT use only – 30mA RCD Protection'. Note that there will be a maximum of 6 x dual RUPOs per circuit.

For an ICT related installation, all existing RUPOs that are paired with a new TO need not be labelled "For ICT use only – 30mA RCD protection" but are retained as GPOs.

As-built drawings must have circuits marked on them, including the phase, circuit and distribution board they are fed from and an indication that it is RCD protected (if applicable). For example DB7-R17-RCD (Distribution Board 7, Red Phase, Circuit/Breaker 17, RCD Protected).



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