

TMK CONSULTING ENGINEERS

SPECIFICATION 1710168 EE_A

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SPECIFICATION FOR ELECTRICAL SERVICES

**PROPOSED RESIDENTIAL DEVELOPMENT
419 REGENCY ROAD, PROSPECT**

FOR: NIATRON 10 PTY LTD



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0171 GENERAL REQUIREMENTS

1.1 General

1.1.1 Responsibilities

Performance

Structural: If required, provide structures, installations and components as follows:

- Fixed accessways: To AS 1657.
- Structural design actions: To AS/NZS 1170.0 and the **Structural design actions schedule**.

Design

Design by contractor: If the contractor provides design, use only appropriately qualified persons and conform to all statutory requirements.

Conflict with the documents: If it is believed that a conflict exists between statutory requirements and the documents, notify the contract administrator immediately and provide a recommendation to resolve the conflict.

Noise levels

General: Install systems in conformance with the **Noise level schedule** and within the limits of the contract design and documented equipment performance.

1.1.2 Precedence

General

Worksections and referenced documents:

- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of the worksections override conflicting requirements of their referenced documents.
- The requirements of the referenced documents are minimum requirements.

1.1.3 Cross references

General

Requirement: Conform to the following worksection(s):

- *Demolition*.
- *Service trenching*.

Common requirements

Requirement: Conform to the following:

- *Adhesives, sealants and fasteners*.
- *Fire-stopping*.
- *Metals and prefinishes*.
- *Termite management*.
- *Timber products, finishes and treatment*.
- *Building IT components*.

Cross referencing styles

Within the text:

- Worksection titles are indicated by *Italicised* text.
- Subsection titles are indicated by **BOLD** text.
- Clause titles are indicated by **Bold** text.



1.1.4 Referenced documents

Contractual relationships

General: Responsibilities and duties of the principal, contractor and contract administrator are not altered by requirements in the documents referenced in this specification.

Current editions

General: Use referenced documents which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.

1.1.5 Interpretation

Abbreviations

General: For the purposes of this specification the following abbreviations apply:

- AS: Australian Standard.
- BCA: National Construction Code Series Volume One: Building Code of Australia Class 2 to 9 Buildings.
- EMC: Electromagnetic compatibility.
- MSDS: Material safety data sheets.
- NATA: National Association of Testing Authorities.
- NCC: National Construction Code.
- NZS: New Zealand Standard.
- PCA: National Construction Code Series Volume 3: Plumbing Code of Australia.
- PVC: Polyvinyl Chloride.
- VOC: Volatile organic compound.

Definitions

General: For the purposes of this specification, the following definitions apply:

- Attendance: Attendance, provide attendance and similar expressions mean give assistance for examination and testing.
- Contractor: Contractor has the same meaning as builder and is the person or organisation bound to carry out and complete the work under the contract.
- Contract administrator: Contract administrator has the same meaning as architect or superintendent and is the person appointed by the owner or principal under the contract.
- Default: Specified value, product or installation method which is to be provided unless otherwise documented.
- Design life: The period of time for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
- Documented: Documented, as documented and similar terms mean contained in the contract documents.
- Economic life: The period of time from the acquisition of an asset to when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
- Electricity distributor: Any person or organisation that provides electricity from an electricity distribution system to one or more electrical installations. Includes distributor, supply authority, network operator, local network service provider, electricity retailer or electricity entity, as may be appropriate in the relevant jurisdiction.
- Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- Give notice: Give notice, submit, advise, inform and similar expressions mean give notice (submit, advise, inform) in writing to the contract administrator.
- High level interface: Systems transfer information in a digital format using an open system interface.
- Hot-dip galvanized: Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680 Table 1.
- IP: IP, IP code, IP rating and similar expression have the same meaning as IP Code in AS 60529.



- Joints:
 - . Construction joint: A joint with continuous reinforcement provided to suit construction sequence.
 - . Control joint: An unreinforced joint between or within discrete elements of construction which allows for relative movement of the elements.
 - . Contraction joint: An opening control joint with a bond breaking coating separating the joint surfaces to allow independent and controlled contraction of different parts or components, induced by shrinkage, temperature changes or other causes. It may include unbound dowels to assist vertical deflection control.
 - . Expansion joint: A closing control joint with the joint surfaces separated by a compressible filler to allow axial movement due to thermal expansion or contraction with changes in temperature or creep. It may include unbound dowels to assist vertical deflection control.
 - . Isolation joint: A joint between elements of a structure designed to isolate structural movement while permitting horizontal and/or vertical movement between abutting elements.
 - . Weakened plane joint: A contraction joint created by forming a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
 - . Structural control joint: A control joints (contraction, expansion and isolation) in structural elements when used with applied material and finishes.
 - . Substrate joint: A joint in the substrate which includes construction joints and joints between different materials.
 - . Sealant joint: A joint filled with a flexible synthetic compound which adheres to surfaces within the joint to prevent the passage of dust, moisture and gases.
- Local government authority: A body established for the purposes of local government by or under a law applying in a state or territory.
- Low level interface: Systems transfer information via terminals and voltage free contacts.
- Manufacturer's recommendations: Recommendations, instructions, requirements, specifications (and similar expressions) provided in written or other form by the manufacturer and/or supplier relating to the suitability, use, installation, storage and/or handling of a product.
- Metallic-coated: Steel coated with zinc or aluminium-zinc alloy as follows:
 - . Metallic-coated steel sheet: To AS 1397. Metal thicknesses specified are base metal thicknesses.
 - . Ferrous open sections zinc coated by an in-line process: To AS/NZS 4791.
 - . Ferrous hollow sections zinc coated by a continuous or specialised process: To AS/NZS 4792.
- Network Utility Operator: A person who undertakes the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or a stormwater system.
- Obtain: Obtain, seek and similar expressions mean obtain (seek) in writing from the contract administrator.
- Practical completion or Defects free completion: The requirements for these stages of completion are defined in the relevant building contract for the project.
- Pipe: Includes pipe and tube.
- Principal: Principal has the same meaning as owner, client and proprietor and is the party to whom the contractor is legally bound to construct the works.
- Professional engineer: As defined by the BCA.
- Proprietary: Proprietary means identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: Provide and similar expressions mean supply and install and include development of the design beyond that documented.
- Readily accessible: To AS/NZS 3000.
- Record drawings: Record drawings has the same meaning as as-installed drawings, as-built drawings and work-as-executed drawings.
- Registered testing authority:
 - . An organisation registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or



- . An organisation outside Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
- . An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- Required: Means required by the documents, the local council or statutory authorities.
- If required: A conditional specification term for work which may be shown in the documents or is a legislative requirement.
- Samples: Includes samples, prototypes and sample panels.
- Statutory authority: A public sector entity created by a specific law of the Commonwealth State of Territory.
- Supply: Supply, furnish and similar expressions mean supply only.
- Tests:
 - . Pre-completion tests: Tests carried out before completion tests.
 - * Type tests: Tests carried out on an item identical with a production item, before delivery to the site.
 - * Production tests: Tests carried out on a purchased item, before delivery to the site.
 - * Progressive tests: Tests carried out during installation to demonstrate performance in according with this specification.
 - * Site tests: Tests carried out on the site.
 - . Completion tests: Tests carried out on completed installations or systems and fully resolved before the date for , to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The contract administrator may direct that completion tests be carried out after the date for practical completion.
- Tolerance: The permitted difference between the upper limit and the lower limit of dimension, value or quantity.
- Verification: Provision of evidence or proof that a performance requirement has been met or a default exists.

1.1.6 Contract documents

Services diagrammatic layouts

General: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.

Before commencing work:

- Obtain measurements and other necessary information.
- Coordinate the design and installation in conjunction with all trades.

Levels

General: Spot levels take precedence over contour lines and ground profile lines.

Drawings and manuals for existing services

Warranty: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services.

1.1.7 Inspection

Notice

Concealment: If notice of inspection is required in respect of parts of the works that are to be concealed, advise when the inspection can be made before concealment.

Tests: Give notice of the time and place of documented tests.

Minimum notice for inspections to be made and for witnessing of tests: Conform to the **Notices schedule**.

Light level requirements: to AS/NZS 1680.2.4.

Attendance

General: Provide attendance for documented inspections and tests.



1.1.8 Submissions

General

Submit to: Principal

Default timing: Make submissions at least 5 working days before ordering products for, or starting installation of, the respective portion of the works.

Program: Allow in the construction program for at least the following times for response to submissions:

Shop drawings: 10 working days (minimum)

Samples and prototypes: 10 working days (minimum)

Manufacturers' or suppliers' recommendations: 10 working days (minimum)

Product data: 10 working days (minimum)

Product/design substitution or modification: 15 working days (minimum)

Proposed products schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

Identification

General: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements and product certification.

Non-compliance: Identify proposals for non-compliance with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

Errors

General: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

Submissions - electronic copies

File format: Current version of AUTO CAD

Transmission medium: email or CDs for any files larger than 5MB

Submissions - hard copy

Quantity: 3

- Loose documents larger than A3: One transparency on heavyweight plastic film the same size as the standard contract drawings.
- Loose documents up to and including A3: One copy.

Standard contract drawing size: A1 or B1

Authorities

Authorities' approvals: Submit documents showing approval by the authorities whose requirements apply to the work.

Correspondence: Submit copies of correspondence and notes of meetings with authorities whose requirements apply to the work.

Building penetrations

General: If it is proposed to penetrate or fix to the following, submit details of the methods proposed to maintain the required structural, fire and other properties:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.

Certification

General: Submit certification that the plant and equipment submitted meets all requirements of the contract documents.

Execution details

General: Before starting the installation of building services, submit the following:

- Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.



- Fixing of services: Typical details of locations, types and methods of fixing services to the building structure.
- Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

Inspection and testing

General: Submit an inspection and testing plan which is consistent with the construction program. Include particulars of test stages and procedures.

Test reports: Submit written reports on nominated tests.

Marking and labelling

General: Before marking and labelling submit:

- Samples of the proposed labels.
- A schedule showing, for each item or type of item:
 - . A description of the item or type of item sufficient to identify it.
 - . The proposed text of the marking or label
 - . The proposed location of the marking or label.

Materials and components

Product certification: If products must conform to product certification schemes, submit evidence of conformance.

Product data: For proprietary equipment, submit the manufacturer's product data as follows:

- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.
- Recommendations for installation and maintenance.

Substitutions

Identified proprietary items: Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:

- Evidence that the performance is equal to or greater than that specified.
- Evidence of conformity to a cited standard.
- Samples.
- Essential technical information, in English.
- Reasons for the proposed substitutions.
- Statement of the extent of revisions to the contract documents.
- Statement of the extent of revisions to the construction program.
- Statement of cost implications including costs outside the contract.
- Statement of consequent alterations to other parts of the works.

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:

- Is of net enhanced value to the principal.
- Is consistent with the contract documents and is as effective as the identified item, detail or method.

Samples

Submission: Submit nominated samples.

Incorporation of samples: If it is intended to incorporate samples into the works, submit proposals. Incorporate samples in the works which have been endorsed for inclusion. Do not incorporate other samples.

Retention of samples: Keep endorsed samples in good condition on site, until the date of practical completion.



Shop drawings

General: Include dimensioned drawings showing details of the fabrication and installation of structural elements, building components, services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

Diagrammatic layouts: Coordinate work shown diagrammatically in the contract documents, and submit dimensioned set-out drawings.

Record drawings: Submit all documented shop drawings amended to include changes made during the progress of the work and up to the end of the defects liability period.

Services coordination: Coordinate with other building and service elements. Show adjusted positions on the shop drawings.

Space requirements: Check space requirements of equipment and services indicated diagrammatically in the contract documents.

Checking: Make sure that the drawings have been checked before submission.

Building work drawings for building services: Submit detailed dimensioned drawings showing all:

- Access doors and panels.
- Conduits to be cast in slabs.
- Holding down bolts and other anchorage and/or fixings required complete with loads to be imposed on the structure during installation and operation.
- Openings, penetrations and block-outs.
- Sleeves.
- Plinths, kerbs and bases.
- Required external openings.

1.2 Products

1.2.1 General

Manufacturers' or suppliers' recommendations

General: Provide and select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use the manufactured items in conformance with the current written recommendations and instructions of the manufacturer or supplier.

Proprietary items/systems/assemblies: Assemble, install or fix to substrate in conformance with the current written recommendations and instructions of the manufacturer or supplier.

Project modifications: Advise of activities that supplement, or are contrary to, manufacturers' or suppliers' written recommendations and instructions.

Sealed containers

General: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

Prohibited materials

Do not provide the following:

- Materials listed in the Safe Work Australia Hazardous Substances Information System (HSIS).
- Materials that use chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) in the manufacturing process.

1.2.2 Tests

Attendance

General: Provide attendance on tests.

Testing authorities

General: Except for site tests, have tests carried out by a Registered testing authority and submit test reports.

- Reports: Submit copies of test reports, including certificates for type tests, showing the observations and results of tests and conformance or non-conformance with requirements.
- Site tests: Use instruments calibrated by authorities accredited by a Registered testing authority.

1.2.3 Materials and components

Consistency

General: For each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

Corrosion resistance

General: Conform to the following atmospheric corrosivity category as defined in AS/NZS 2312.

Galvanizing

Severe conditions: Galvanize mild steel components (including fasteners) to AS 1214 or AS/NZS 4680 as appropriate, if:

- Exposed to weather.
- Embedded in masonry.
- Exposed to or in air spaces behind the external leaf of masonry walls.
- In contact with chemically treated timber, other than copper chrome arsenate (CCA).

1.3 Execution

1.3.1 Off-site disposal

Removal of material

General: Dispose of building waste material off site to the requirements of the relevant authorities.

1.3.2 Wall chasing

Holes and chases

General: If holes and chases are required in masonry walls, provide proposals to demonstrate that the structural integrity of the wall is maintained. Do not chase walls nominated as fire or acoustic rated. Parallel chases or recesses on opposite faces of a wall: Not closer than 600 mm to each other.

Chasing of blockwork: Only in core-filled hollow blocks or in solid blocks which are not designated as structural and to the **Concrete blockwork chasing table**.

Concrete blockwork chasing table

Block thickness (mm)	Depth of chase (maximum mm)
190	35
140	25
90	20

1.3.3 Fixing

General

Suitability: If equipment is not suitable for fixing to non-structural building elements, fix directly to structure and trim around penetrations in non-structural elements.

Fasteners

General: Use proprietary fasteners capable of transmitting the loads imposed, and sufficient for the rigidity of the assembly.

1.3.4 Services connections

Connections

General: Connect to network distributor services or service points. Excavate to locate and expose connection points. Reinstall the surfaces and facilities that have been disturbed.

Network distributors' requirements

General: If the network distributor elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the authorities.

1.3.5 Services installation

General

Fixing: If non-structural building elements are not suitable for fixing services to, fix directly to structure and trim around holes or penetrations in non-structural elements.



Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Concealment: Unless otherwise documented, conceal all cables, ducts, trays and pipes except where installed in plant spaces, ceiling spaces and riser cupboards. If possible, do not locate on external walls.

Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

Suspended ground floors: Keep all parts of services under suspended ground floors at least 150 mm clear of the ground surface. Make sure services do not impede access.

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.

Dissimilar metals

General: Join dissimilar metals with fittings of electrolytically compatible material.

Temporary capping

Pipe ends: During construction protect open ends of pipe with metal or plastic covers or caps.

Piping

General: Install piping in straight lines at uniform grades without sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Spacing: Provide at least 25 mm clear between pipes and between pipes and building elements, additional to insulation.

Changes of direction: Provide long radius elbows or bends and sets where practicable, and swept branch connections. Provide elbows or short radius bends where pipes are led up or along walls and then through to fixtures. Do not provide mitred fittings.

Vibration: Arrange and support piping so that it remains free from vibration whilst permitting necessary movements. Minimise the number of joints.

Embedded pipes: Do not embed pipes that operate under pressure in concrete or surfacing material.

Valve groupings: If possible, locate valves in groups.

Pressure testing precautions: Isolate items not rated for the test pressure. Restrain pipes and equipment to prevent movement during pressure testing.

Differential movement

- **General:** If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes or conduits are buried, provide control joints in the pipes or conduits, as follows:
- **Arrangement:** Arrange pipes and conduits to minimise the number of control joints.
- **Magnitude:** Accommodate the predicted movements.

1.3.6 Building penetrations

Penetrations

Fire rated building elements: Seal penetrations with a system conforming to AS 4072.1.

Non-fire rated building elements: Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

Sleeves

General: If piping or conduit penetrates building elements, provide metal or PVC sleeves formed from pipe sections as follows:

- **Movement:** Arrange to permit normal pipe or conduit movement.
- **Diameter (for non fire-rated building elements):** Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm.
- **Prime paint ferrous surfaces.**
- **Terminations:**
 - . If cover plates are fitted: Flush with the finished building surface.
 - . In fire-rated and acoustic-rated building elements: 50 mm beyond finished building surface.
 - . In floors draining to floor wastes: 50 mm above finished floor.



- . Elsewhere: 5 mm beyond finished building surface.
- . Termite management: To AS 3660.1.
- Thickness:
 - . Metal: ≥ 1 mm.
 - . PVC: ≥ 3 mm.

Sleeves for cables: For penetrations of cables not enclosed in conduit through ground floor slabs, beams and external walls provide sleeves formed from PVC pipe sections.

1.3.7 Concrete plinths

Construction

General: Provide concrete plinths as documented.

General: Provide plinths under all equipment located on concrete floor slabs as follows:

- Concrete: Grade N20.
- Finish: Steel float flush with the surround.
- Reinforcement: Single layer of F62 fabric.
- Surround: Provide galvanized steel surround at least 75 mm high and 1.6 mm thick. Fix to the floor with masonry anchors. Fill with concrete.

1.3.8 Support and structure

General

Requirement: Provide incidental supports and structures to suit the services.

1.3.9 Pipe supports

Support systems

General: Provide proprietary support systems of metallic-coated steel construction.

Vertical pipes: Provide anchors and guides to maintain long pipes in position, and supports to balance the mass of the pipe and its contents.

Saddles: Do not provide saddle type supports for pipes $> DN\ 25$.

Dissimilar metals: If pipe and support materials are dissimilar, provide industrial grade electrically non-conductive material securely bonded to the pipe to separate them. Provide fixings of electrolytically compatible material.

Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm.
- Spacer material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application.

Support spacing

Cold and heated water pipes: To AS/NZS 3500.1 Table 5.2. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Sanitary plumbing: To AS/NZS 3500.2 Table 9.1.

Fuel gas: To AS/NZS 5601.1 Table 5.5.

Other pipes: To AS/NZS 3500.1 Table 5.2.

Hangers

Conform to the **Hanger size table**.

Hanger size table

Nominal pipe size (DN)	Minimum hanger diameter (mm) for single hangers
≤ 50	9.5
65 to 90	12.7
100 to 125	15.8
150 to 200	19.0

1.3.10 Plant and equipment access

General

Services and equipment: Locate and arrange all services and equipment so that:

- They comply with the relevant requirements of the appropriate Work Health and Safety regulations.
- Failure of plant and equipment (including leaks) does not create a hazard for the building occupants.
- Failure of plant and equipment (including leaks) cause a minimum or no damage to the building, its finishes and contents including water sensitive equipment or finishes.
- Instruments, gauges and the like are located so they can be easily read.
- Safe tray and an overflow pipe are provided to each tank, hot water heater and storage vessel.
- Piping: Provide access and clearance at fittings which require maintenance or servicing, including control valves and joints intended to permit pipe removal. Arrange piping so that it does not interfere with the removal or servicing of associated equipment or valves or block access or ventilation openings.
- Services and equipment are readily accessible for inspection and maintenance and arranged so that inspection and maintenance can be carried out in a safe and efficient manner. Include the following:
 - . Minimise inconvenience and disruption to building occupants or damage to the building structure or finishes.
 - . Locate plant (including high level tanks) requiring regular inspection and maintenance so it is either safely and readily accessible from floor level or provide permanent access platforms and ladders.
 - . Conform to the relevant requirements of AS 1470, AS 1657, AS/NZS 1892.1, AS 2865 and AS/NZS 3666.1 for relevant requirements.
- In false ceilings, locate items of equipment that require inspection and maintenance above tiled parts. If not possible, provide access panels where located above set plaster or other inaccessible ceilings. Arrange services and plant locations to reduce the number of access panels. Coordinate with other trades to use common access panels where feasible.
- Modify manufacturer's standard equipment when necessary to provide the plant access in the contract documents.

1.3.11 Vibration suppression

Standard Rotating and reciprocating machinery noise and vibration: Vibration severity in Zone A to AS 2625.1 and AS 2625.4.

General

General: Minimise the transmission of vibration from rotating or reciprocating equipment to other building elements.

Speeds

General: If no maximum speed is prescribed do not exceed 1500 r/min for direct driven equipment.

Connections

General: Provide flexible connections to rotating machinery and assemblies containing rotating machinery. Isolate pipes by incorporating sufficient flexibility into the pipework or by use of proprietary flexible pipe connections installed so that no stress is placed on pipes due to end reaction.

Inertia bases

General: If necessary to achieve the required level of vibration isolation, provide inertia bases having appropriate mass and conforming as follows:

- Construction: Steel or steel-framed reinforced concrete. Position foundation bolts for equipment before pouring concrete.
- Supports: Support on vibration isolation mountings using height saving support brackets.

Vibration isolation mountings

General: Except for external equipment that is not connected to the structure of any building, support rotating or reciprocating equipment on mountings as follows:



- For static deflections < 15 mm: Single or double deflection neoprene in-shear mountings incorporating steel top and base plates and a tapped hole for bolting to equipment.
- For static deflections \geq 15 mm: Spring mountings.

Selection: Provide mountings selected to achieve 95% isolation efficiency at the normal operating speeds of the equipment.

Installation: Set and adjust vibration isolation mounting supports to give clearance for free movement of the supports.

Spring mountings: Provide freestanding laterally stable springs as follows:

- Clearances: \geq 12 mm between springs and other members such as bolts and housing.
- High frequency isolation: 5 mm neoprene acoustic isolation pads between baseplate and support.
- Levelling: Provide bolts and lock nuts.
- Minimum travel to solid: \geq 150% of the designated minimum static deflection.
- Ratio of mean coil diameter to compressed length at the designated minimum static deflection: \geq 0.8:1.
- Snubbing: Snub the springs to prevent bounce at start-up.
- Vertical resilient limit stops: To prevent spring extension when unloaded, to serve as blocking during erection and which remain out of contact during normal operation.

1.3.12 Seismic restraint of building services

Provisions

General: Arrange all components, other than service items exempted in AS 1170.4, to resist seismic loads determined in conformance with AS 1170.4. Securely fix all plant and equipment to the building structure. Do not rely on gravity and/or friction to resist seismic forces.

Anti-vibration mounts: Use horizontally restrained type.

Components: Do not use components that will be damaged by earthquake conditions. Protect systems against the adverse effects of components such as mercury switches that, although not damaged by earthquake, may malfunction.

1.3.13 Finishes to building services

General

General: If exposed to view (including in plant rooms), paint new building services and equipment. Surfaces painted or finished off-site: Conform to the *Metals and prefinishes* worksection.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish documented.

Standard

General: Conform to the recommendations of AS/NZS 2311 Sections 3, 6 and 7 or AS/NZS 2312 Sections 5, 8 and 10, as applicable.

Powder coating

Standard:

- Aluminium for architectural applications: To AS 3715.
- Other metals: To AS 4506.

Painting systems

New unpainted interior surfaces: To AS/NZS 2311 Table 5.1.

New unpainted exterior surfaces: To AS/NZS 2311 Table 5.2.

Paint application

Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Make sure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Combinations: Do not combine paints from different manufacturers in a paint system.

Protection: Remove fixtures before starting to paint and refix in position undamaged when painting is complete.



Underground metal piping

Corrosion protection: Provide corrosion protection for the following:

- Underground ferrous piping.
- Underground non-ferrous metal piping in corrosive environments.

Protection methods: Select from the following:

- Cathodic protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Conform to the recommendations of AS 2832.1.
- Continuous wrapping using proprietary petroleum taping material.
- Impermeable flexible plastic coating.
- Sealed polyethylene sleeve.

Low VOC emitting paints

Provide the following low odour/low environmental impact paint types with the following VOC limits:

- Primers and undercoats: < 65 g/litre.
- Low gloss white or light coloured latex paints for broadwall areas: < 16 g/litre.
- Coloured low gloss latex paints: < 16 g/litre.
- Gloss latex paints: < 75 g/litre.

1.3.14 Marking and labelling

General

General: Mark services and equipment to provide a ready means of identification and as follows:

- Locations exposed to weather: Provide durable materials.
- Pipes, conduits and ducts: Identify and label to AS 1345 throughout its length, including in concealed spaces.
- Cables: Label to indicate the origin and destination of the cable.

Consistency: Label and mark equipment using a consistent scheme across all services elements of the project.

Electrical accessories

General: Label isolating switches and outlets to identify circuit origin.

Equipment concealed in ceilings

Location: Provide a label on the ceiling indicating the location of each concealed item requiring access for routine inspection, maintenance and/or operation. In tiled ceilings locate the label on the ceiling grid closest to the item access point. In flush ceilings locate adjacent to closest access panel. Items to be labelled include but are not limited to:

- Fan coil units and terminal equipment (e.g. VAV boxes).
- Fire and smoke dampers.
- Isolating valves not directly connected to items otherwise labelled.
- Motorised dampers.
- Wall mounted equipment in occupied areas: Provide labels on wall mounted items in occupied areas including the following:
 - Services control switches.
 - Temperature and humidity sensors.

Points lists

Automatic control points: Provide plasticised, fade-free points lists for each automatic control panel. Store in a pocket on the door of the panel. Lists to include terminal numbers, point addresses, short and long descriptors.

Pressure vessels

General: Mount manufacturer's certificates in glazed frames on a wall next to the vessel.

Valves and pumps

General: Label to associate pumps with their starters and valves. Screw fix labels to body or attach label to valve handwheels with a key ring.



Underground services

Survey: Accurately record the routes of underground cables and pipes before backfilling. Include on the record drawings.

Records: Provide digital photographic records of underground cable and pipe routes before backfilling. Include in operation and maintenance manual.

Location marking: Accurately mark the location of underground cables and pipes with route markers consisting of a marker plate set flush in a concrete base, engraved to show the direction of the line and the name of the service.

Markers: Place markers at ground level at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

Marker bases: 200 mm diameter x 200 mm deep, minimum concrete.

Direction marking: Show the direction of the cable and pipe run by means of direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, aluminium or stainless steel with black filled engraved lettering, minimum size 75 x 75 x 1 mm thick.

Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.

Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.

Marker tape: Where electric bricks or covers are not provided over underground wiring, provide a 150 mm wide yellow or orange marker tape bearing the words WARNING – electric cable buried below, laid in the trench 150 mm below ground level.

Labels and notices

Materials: Select from the following:

- Cast metal.
- For indoor applications only, engraved two-colour laminated plastic.
- Proprietary pre-printed self-adhesive flexible plastic labels with machine printed black lettering.
- Stainless steel or brass ≥ 1 mm thick with black filled engraved lettering.

Emergency functions: To AS 1319.

Colours: Generally to AS 1345 as appropriate, otherwise black lettering on white background except as follows:

- Danger, warning labels: White lettering on red background.
- Main switch and caution labels: Red lettering on white background.

Edges: If labels exceed 1.5 mm thickness, radius or bevel the edges.

Fixing: Fix labels securely using screws, rivets, proprietary self-adhesive labels or double-sided adhesive tape and as follows:

- If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions.
- Use aluminium or monel rivets for aluminium labels.

Label locations: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Labelling text and marking: To correspond to terminology and identifying number of the respective item as shown on the record drawings and documents and in operating and maintenance manuals.

Lettering heights:

- Danger, warning and caution notices: ≥ 10 mm for main heading, ≥ 5 mm for remainder.
- Equipment labels within cabinets: ≥ 3.5 mm.
- Equipment nameplates: ≥ 40 mm.
- Identifying labels on outside of cabinets: ≥ 5 mm.
- Isolating switches: ≥ 5 mm.
- Switchboards, main assembly designation: ≥ 25 mm.
- Switchboards, outgoing functional units: ≥ 8 mm.
- Switchboards, sub assembly designations: ≥ 15 mm.
- Valves: ≥ 20 mm.



- Self-adhesive flexible plastic labels :
- Labels < 2000 mm above floor: 3 mm on 6 mm wide tape.
 - . Labels ≥ 2000 mm above floor: 8 mm on 12 mm wide tape.
 - . Other locations: ≥ 3 mm.

Operable devices: Mark to provide a ready means of identification. Include the following:

- Controls.
- Indicators, gauges, meters.
- Isolating switches.

Vapour barriers: Do not penetrate vapour barriers.

1.3.15 Software

General

General: Provide the software required for the operation and management of building services systems and equipment.

1.3.16 Warranties

General

General: If a warranty is documented or if a manufacturer's standard warranty extends beyond the end of the defects liability period, name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Commencement: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

1.3.17 Record drawings

General

General: Submit record drawings showing the following:

- Installed locations of building elements, services, plant and equipment.
- Off-the-grid dimensions and depth if applicable.
- Any provisions for the future.

Recording, format and submission

Progress recording: Keep one set of drawings on site at all times, expressly for the purpose of marking changes made during the progress of the works.

Drawing layout: Use the same borders and title block as the contract drawings.

Quantity and format: Conform to **SUBMISSIONS**.

Endorsement: Sign and date all record drawings.

Accuracy: If errors in, or omissions from, the record drawings are found, amend the drawings and re-issue in the quantity and format documented for **RECORD DRAWINGS**.

Date for submission: Not later than 2 weeks after the date for practical completion.

Services record drawings

General: Submit record drawings of services to **General** and **Recording, format and submission** and the following:

- Extensions and/or changes to existing: If a drawing shows extensions and/or alterations to existing installations, include sufficient of the existing installation to make the drawing comprehensible without reference to drawings of the original installation.
- Detention: If on-site detention tanks or pondage are provided, include the volume required on the drawing and the permitted flow rate to the connected system.
- Domestic cold water or fire mains: Show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works.
- Stormwater: If storm water pipes are shown, include the pipe size and pipe grade together with the maximum acceptable flow and the actual design flow.



Diagrams: Provide diagrammatic drawings of each system including the following:

- Controls.
- Piping including all valves and valve identification tags.
- Principal items of equipment.
- Single line wiring diagrams.
- Acoustic and thermal insulation.
- Access provisions.
- Fixings.
- Fixtures.
- Switchgear and controlgear assembly circuit schedules including electrical service characteristics, controls and communications.
- Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

1.3.18 Operation and maintenance manuals

General

General: Submit operation and maintenance manuals for the whole of the work.

Authors and compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Referenced documents: If referenced documents or technical worksections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Subdivision: By installation or system, depending on project size.

Contents

General: Include the following:

- Table of contents: For each volume. Title to match cover.
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, subconsultants, contractor, subcontractors and names of responsible parties.
- Record drawings: Complete set of record drawings, full size.
- Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.
- Installation description: General description of the installation.
- Systems descriptions and performance: Technical description of the systems installed and mode of operation, presented in a clear and concise format readily understandable by the principal's staff. Identify function, normal operating characteristics, and limiting conditions.
- Equipment descriptions:
 - . Name, address, email address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
 - . Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.
 - . Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
 - . Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Certificates:
 - . Certificates from authorities.
 - . Copies of manufacturers' warranties.
 - . Product certification.
 - . Test certificates for each service installation and all equipment.
 - . Test reports

- . Balancing reports for mechanical installations.
- . Control system testing and commissioning results.
- 7 day record of all trends at commissioning.
- Operation procedures:
 - . Manufacturers' technical literature as appropriate.
 - . Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
 - . Control sequences and flow diagrams for systems installed.
 - . Legend for colour-codes services.
 - . Schedules of fixed and variable equipment settings established during commissioning and maintenance.
 - . Procedures for seasonal changeovers.
 - . If the installation includes cooling towers, a water efficiency management plan.
- Maintenance procedures:
 - . Detailed recommendations for preventative maintenance and procedures, including schedule of maintenance work including frequency and manufacturers' recommended tests.
 - . Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
 - . Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.
 - . Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.
 - . Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40 000 hours. Include lubrication schedules for equipment.
 - . Schedules for recording recommissioning data to enable changes in the system over time can be identified.
 - . Instructions for use of tools and testing equipment.
 - . Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.
 - . Material safety data sheets (MSDS).
- Maintenance records:
 - . Prototype periodic maintenance and performance report to AS 1851, AS/NZS 3666.2 and AS/NZS 3666.3 as appropriate, prepared to include project specific details.
- Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.
- Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

Format – electronic copies

Printing: Except for drawings required in the **RECORD DRAWINGS** clause provide material that can be legibly printed on A4 size paper.

Scope: Provide the same material as documented for hardcopy in electronic format.

Quantity and format: Conform to **Submissions – electronic copies**.

Format – hard copy

General: A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:

- Cover: Identify each binder with typed or printed title *OPERATION AND MAINTENANCE MANUAL*, to spine. Identify title of project, volume number, volume subject matter, and date of issue.



- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs.
- Drawings: Fold drawings to A4 size with title visible, insert in plastic sleeves (one per drawing) and accommodate them in the binders.
- Pagination: Number pages.
- Ring size: 50 mm maximum, with compressor bars.
- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

Number of copies: 3.

Date for submission

Date for draft submission: The earlier of the following:

- 2 weeks before the date for practical completion.
- Commencement of training on services equipment.

Date for final submission: Within 2 weeks after practical completion.

1.3.19 Tools and spare parts

Spare parts

General: Provide spare parts listed in the appropriate worksections.

Tools and spare parts schedule

General: At least 8 weeks before the date for practical completion, submit a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer's current price. Include the following in the prices:

- Checking receipt, marking and numbering in conformance with the spare parts schedule.
- Packaging and delivery to site.
- Painting, greasing and packing to prevent deterioration during storage.
- Referencing equipment schedules in the operation and maintenance manuals.
- Suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

Replacement: Replace spare parts used during the maintenance period.

1.3.20 Commissioning and completion tests

Reports

General: Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

Notice

Inspection: Give sufficient notice for inspection to be made of the commissioning and completion testing of the installation.

Controls

General: Calibrate, set and adjust control instruments, control systems and safety controls.

Samples

General: Remove unincorporated samples on completion.

Circuit protection

General: Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

Completion tests

General: Test the works under the contract to demonstrate compliance with the documented performance requirements of the installation.

Functional checks: Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

Proprietary equipment: Submit type test reports confirming compliance of proprietary equipment.

Sound pressure level measurements: Conform to the following:

- Correction for background noise: To AS/NZS 2107 Table B1.
- External: To AS 1055.1.



- Internal: To AS/NZS 2107.
- Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.
- Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.
- Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

Test instruments: Use instruments calibrated by a Registered testing authority.

Certification

General: On satisfactory completion of the installation and before the date of practical completion, submit certificates stating that each installation is operating correctly.

1.3.21 Training

General

Duration: Instruction to be available for the whole of the commissioning and running-in periods.

Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.

Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with the principal's staff.

Certification: Provide written certification of attendance and participation in training for each attendee. Provide register of certificates issued.

Demonstrators

General: Use only qualified manufacturer's representatives who are knowledgeable about the installations.

Maintenance

General: Explain and demonstrate to the principal's staff the purpose, function and maintenance of the installations.

Operation

General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

Seasonal operation

General: For equipment requiring seasonal operation, demonstrate during the appropriate season and within 6 months.

1.3.22 Cleaning

Final cleaning

General: Before practical completion, clean throughout, including all exterior and interior surfaces except those totally and permanently concealed from view.

Labels: Remove all labels not required for maintenance.

1.3.23 Periodic maintenance of services

General

General: During the maintenance period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.

Emergencies: Attend emergency calls promptly.

Annual maintenance: Carry out recommended annual maintenance procedures before the end of the maintenance period.

Maintenance period: The greater of the defects liability period and the period nominated in the **Maintenance requirements schedule**. Provide minimum 6 months maintenance visits after practical completion.

Maintenance program

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.



Maintenance records

General: Record in binders provided with operation and maintenance manuals.

Referenced documents: If referenced documents or technical worksections require that log books or records be submitted, include this material in the maintenance records.

Service visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of the principal's designated representative.

Site control

General: Report to the principal's designated representative on arriving at and before leaving the site.

1.3.24Post-construction mandatory inspections and maintenance

General

General: For the duration of the defects liability period, provide inspections and maintenance of safety measures required by the following:

- The Building Code of Australia.
- AS 1851.
- Other statutory requirements applicable to the work.

Records: Provide mandatory records.

Certification: Certify that mandatory inspections and maintenance have been carried out and that the respective items conform to statutory requirements. Submit certification.

Annual inspection: Provide an annual inspection and maintenance immediately prior to the end of the defects liability period.

0901 ELECTRICAL SYSTEMS

1.4 General

1.4.1 Responsibilities

General

The following specification details the electrical services proposal .

The Contract Conditions, this Specification, Preliminaries and the Drawings form a part of the contract.

The work includes, but is not limited to, the supply and installation, testing and commissioning of the following:

Contractor to maintain all existing services and allow for temporary services & all associated works as required during construction. All works on site are to be carried out with no disruption to all existing services during normal office hours.

1.4.2 POWER

- SAPN connection
- Coordinate and allow for de-energisation of existing SAPN stobie poles low voltage cables for construction works.



- Low voltage systems
- Underground conduit - Location to be set-out on site to avoid clashing with existing services. Utilise common service trench as applicable.
- Coordinate and provide power supply and connection to all associated power supply including mechanical equipment and hydraulic equipment.
- Provision of new main site switch board, main distribution board, landlord distribution boards, tenancy distribution boards and apartment load centres.
- Allow to supply and install all meters as shown.
- Low voltage systems not limiting but including power outlets and isolators.



- Supply and install fire rated cable to lift.
- Power supply to security panel.
- Power to hydraulic.
- Power to FIP.
- Power connection to range hood, cook top, oven, dishwasher, air-conditioning etc.
- Carry out all associated works to enable turn-key operation.

1.4.3 LIGHTING

- General lighting – Internal and External
- Areas nominated to have motion activated lights to have an override switch with 3 modes (ON, OFF, Motion detection active);
- Provide time clock and PE cells for external lighting as denoted on drawings.
- Provide facility to isolate all non-essential, non-emergency, and non-exit general lighting on activation of security system. Normally closed contactor to be installed for the above, whereupon activation of the security system, the contactor shall open and all general lighting.
- Ensure compliance with the provisions of the BCA generally, and Part J6 – Artificial Lighting and Power;
- No exposed conduit unless otherwise specified.
- Exit and Emergency lighting.

1.4.4 SECURITY

- Provide facility to isolate all non essential.non emergency and non exit general internal lighting on activation of security system. When security system disarm allow to turn on general areas and corridor lighting;
- Security panel to be hardwired;
- Card readers to be weather proof and complete with vandal when external;
- New security cabling to be run in underground conduit, in common service trench. Location to be set-out on site to avoid clashing with existing services.
- Lift controller connected to security panel.
- Gate controller connected to security panel.
- Induction loop for cars to exit car park connected to gate controller.
- Infra red remote sensor for car entry. Allow for the provision of 30 off remote controls for car entry into apartment building.
- Card reader at gate to come complete with infra read sensor for remote control to gates.
- Provision of 30 programmed fobs.
- Carry out all associated works to enable turn-key operation.

1.4.5 COMMUNICATION

- Allow to liaise with NBN and pay all associated authorities fees for additional incoming cables.
- Allow to coordinate, design and submit to NBN.
- Allow for power outlets to FTD,CTL,and NTD.
- New communications infrastructure includes conduits for backbone communication cabling and horizontal cabling.
- New data cabling to be run in underground conduit, in common service trench. Location to be set-out on site to avoid clashing with existing services.
- Horizontal communication cabling within apartments from NTD shall be via category 6 cable terminating to telecommunication outlets in apartments.
- Carry out all associated works to enable turn-key operation.

1.4.6 MATV AND PAYTV

- Design, supply and install a MATV and PAYTV system (Infrastructure cabling only) complete with TV outlets and PAYTV and FTA digital antennas (mounted on rooftop).

- MATV and PATV Specialist to determine final location on roof top to ensure good TV signal. Final location of satellite dish and FTA antenna shall be required to be approved by architect.
- For PayTV is required as per schematic. Allow to design supply and install a cabling solution for a PAYTV system to apartments.

1.4.7 INTERCOM SYSTEM

- Design, supply and install an Video Door Phone System, including engineering, components, installation and commissioning to external door and apartments as documented.
- Master intercom system to be connected next to security panel and located at Store area.
- Intercom system shall be Aiphone Multi Tenant Colour Video.
- Intercom system shall be integrated to the security system to facilitate the door operation and lift operation.
- Carry out all associated works to enable turn-key operation.

1.4.8 SITE INFRASTRUCTURE WORKS - GENERAL

- Confirm all trenching routes and allow for all associated trenching, reinstatement of open trenches and make good to match surrounding surfaces to existing condition.
- Installation of underground conduits traffic pits external UV resistant sparrow surface mounted wall conduit.
- Where new equipment/devices are documented or specified to be connected to an existing system on site, the contractor is to check during tender all existing system/equipment for compatibility with and connection of all new equipment/devices. Contractor to allow for all upgrade works on existing systems/equipment as required.

1.4.9 GENERAL/OTHERS

- Penetrations at walls and access for cabling.
- Where items are of dissimilar metals, they shall be separated by suitable material.
- Preparation of co-ordinated shop and as constructed drawings.
- Operating and Maintenance manuals.
- Testing and commissioning of all installed systems.
- Twelve months maintenance, warranty and defects liability for the entire installation.
- The provision of all hoisting and scaffolding required for the installation of the above systems.
- **IN ALL OF THE ABOVE WORKS, THE CONTRACTOR SHALL ALLOW FOR ALL ASSOCIATED WORKS AS REQUIRED.**

All technical questions regarding this contract shall be directed to TMK Consulting Engineers on phone 8238 4100, facsimile 8410 1405 (Level 6, 100 Pirie Street, Adelaide, SA).

All work shall be carried out under the terms of this Specification and shall conform to all relevant Statutory Authorities, relevant Australian Standards, Building Code of Australia and Government requirements.

The extent of the work stated above is not a complete list of each component, action or work to be undertaken in this Contract. It is up to the tenderer to obtain information as required allow for all work required to complete the project to the satisfaction of the Superintendent.

The positions of machines, appliances and equipment shown on drawings is approximate only. The Contractor is responsible to determine exact locations by means of architectural drawings and allow for/include all associated works.

The Contractor shall review all tender documents and ensure that the tender includes all work, insurances, etc. required to complete the tender.

Electrical performance

Supply system: 400 V, 3-phase, 4-wire, 50 Hz.

Performance criteria: Meet the performance criteria, as documented.

Fault level protection: To withstand the prospective fault level of the incoming supply at the equipment location.

Site electricity supply

Responsibilities: Provide site electricity supplies as documented. Connect project electrical facilities to the network distributor's external site electricity supply.

Low voltage supplies

Low voltage transformer output supply: To AS/NZS 3000 and the network distributor's requirements.

Low voltage protection: Provide low voltage short circuit and overload protection at the transformer secondary supply using fault current limiting circuit breakers with adjustable overload and short circuit current setting features. Alternatively, if approved by the network distributor, where no secondary output protection is provided, provide appropriate sized high voltage protection on the incoming supply to transformers.

Low voltage circuit breakers: Include full discrimination and cascade protection and grade with the incoming transformer supply protection system and the downstream site protection devices.

Switchboards

Responsibilities: Provide main switchboard(s) and local distribution boards as documented and to the requirements of the following worksections:

- *Switchboards – proprietary.*
- *Switchboards – custom-built.*

Electrical protection equipment: Include all necessary electrical protection equipment, electrical components and the local network distributor's tariff metering equipment to the requirements of the *Switchboard components* worksection.

Large switchboards: Manufacture switchboards of module sizes to allow access and manoeuvrability through the project site and into switchrooms.

Overload and fault protection on all submains: Provide circuit breaker protection equipment coordinated to allow cascade and discrimination protection between upstream and downstream cable protection devices to AS/NZS 3000.

Electricity distributor's low voltage service protective device: To AS/NZS 3000, the network distributor's requirements and the supply authority Service and Installation rules.

For service protective devices > 100 A: Provide fault current limiting circuit breakers with adjustable overload and short circuit current facilities and full discrimination and cascade protection between the incoming supply protection systems and the downstream protection systems, if required.

Electrical cable systems

Responsibilities: Provide the following cabling systems:

- Power cables: Provide cable systems as documented and to the requirements of the *Low voltage power systems* worksection.
- Communications cables: Provide cable systems as documented and to the requirements of Australian Communications and Media Authority (ACMA) and the *Telecommunications cabling* worksection.

Provide separate cable systems for communications and sound systems. Do not use any part of the power system cable support systems.

Lighting

Responsibilities: Provide lighting systems as documented and to the requirements of the following worksections:

- *Lighting.*
- *Emergency evacuation lighting.*

Proprietary equipment: If proprietary equipment is selected by the contractor, the requirements of this specification override the specifications inherent in the selection of a particular make and model of accessory.



Communications systems

Responsibilities: Provide communication systems as documented and to the requirements of the *Telecommunications cabling* worksection.

Security systems

Responsibilities: Provide security systems as documented and to the requirements of the *Electronic security* worksection.

1.4.10 Precedence

General

Worksections and referenced documents:

- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of the worksections override conflicting requirements of their referenced documents.
- The requirements of the referenced documents are minimum requirements.

1.4.11 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Demolition.*
- *Cable support and duct systems.*
- *Low voltage power systems.*
- *Switchboards – proprietary.*
- *Switchboards – custom-built.*
- *Telecommunications cabling.*
- *Lighting.*
- *Emergency evacuation lighting.*
- *Electronic security.*

1.4.12 Referenced documents

General

Requirement: Conform to the *General requirements* worksection.

1.4.13 Standards

General

Electrical services: To AS/NZS 3000 unless otherwise documented.

Electrical installations

Designing to the win: To SAA HB 301.

Selection of cables: To AS/NZS 3008.1.1.

Degrees of protection (IP code): To AS 60529.

EMC: To AS/NZS 61000.

Rotating and reciprocating machinery noise and vibration: Vibration severity in Zone A to AS 2625.1 and AS 2625.4.

Telecommunications systems: To AS/ACIF S008, AS/ACIF S009, AS/NZS 3080, SAA HB 243 and SAA HB 29.

1.4.14 Contract documents

General

Requirement: Conform to the *General requirements* worksection.

1.4.15 Inspection

General

Requirement: Conform to the *General requirements* worksection.



Notice

Inspection: Give 14 days' minimum advance notice to Principal prior to any service disruptions.

1.4.16 Submissions

General

Requirement: Conform to the *General requirements* worksection.

Technical data

Submissions: Submit technical data for all items of plant and equipment.

Data to be submitted: Include at least the following information in technical submissions:

- Assumptions.
- Calculations.
- Model name, designation and number.
- Capacity of all system elements.
- Country of origin and manufacture.
- Materials used in the construction.
- Size, including required clearances for installation.
- Certification of compliance with the applicable code or standard.
- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.
- Manufacturers' technical literature.
- Type-test reports.

1.5 Products

1.5.1 General

General

Requirement: Conform to the *General requirements* worksection.

1.5.2 Electrical accessories

General

Responsibilities: Provide accessories as documented and to the requirements of the *Low voltage power systems* worksection.

Proprietary equipment: If proprietary equipment is selected by the contractor, the requirements of this specification over-ride the specifications inherent in the selection of a particular make and model of accessory.

Uniformity: Provide all accessories and outlets located in close proximity of the same manufacture, size, finish and material.

Default finish: Select from the manufacturers standard range.

1.6 Execution

1.6.1 General

General

Requirement: Conform to the *General requirements* worksection.

1.6.2 Work on existing systems

Demolition

General: Decommission, isolate, demolish and remove from the site all existing redundant equipment including minor associated components that become redundant as a result of the demolition.

Breaking down: Disassemble or cut up equipment where necessary to allow removal.



Recovered materials: Recover all components associated with the listed items. Minimise damage during removal and deliver to the locations documented.

Existing electrical systems

Condition of existing systems:

- If the existing condition does not conform to the requirements in the contract documents, submit proposals to rectify the deficiencies with related costing, time and other impacts.
- Subject to the rectification works on existing systems, achieve the performance in the contract documents.

1.6.3 Switchboards

General

Fixing wall mounted switchboards: Fix direct to wall framing for framed wall constructed walls and to masonry or concrete walls.

Fixing floor/wall mounted switchboards: Fix to floor plinths and direct wall framing for framed wall constructed walls and to masonry or concrete walls by suitable fasteners.

Fixing floor mounted island switchboards: Fix switchboard to floors plinths by suitable fasteners able to withstand seismic events nominated in the project documents.

Seismic sensitive projects

Fixing wall and wall/floor mounted switchboards: Fix only to building structural elements or to steel framing fixed to structural elements. Do not fix to masonry infill panels.

1.6.4 Support of plant and equipment

Support of roof mounted plant and equipment

Platforms: If a horizontal platform is required, or the area of the plant and equipment is extensive, obtain the advice of a professional engineer for the documentation of a suitable platform.

Balustrades: If balustrades or screening are required, obtain the advice of a registered architect.

Roof level support: If any of the following apply to roof level support, obtain the advice of a professional engineer:

- The total load from any unit of plant or equipment exceeds 500 kg.
- The load from a unit of plant or equipment to any single support point exceeds 100 kg.
- The average loading of plant and equipment over the area extending 1 m on all sides beyond the plant and equipment exceeds 25 kg/m².

Sloping roofs:

- Roof slope $\geq 10^\circ$: Adopt the roof material manufacturer's documented installation procedures, or seek the advice of a professional engineer.
- Roof slope $< 10^\circ$: Provide appropriate continuous supporting members, compatible with the roof material, laid parallel to the span of the roof sheeting. Extend the continuous support members in both directions to the first purlin or joist that is > 1 m from the face of the plant or equipment it supports.

Support of ground level plant and equipment

Ground level:

- If the ground slope is $\geq 15^\circ$, or the area of the plant and equipment is extensive, obtain the advice of a professional engineer for the documentation of a suitable slab or platform.
- In all other cases, provide proprietary plastic or concrete supports installed with falls that achieve a raised, impervious and water shedding bearing surface.

Balustrades: If balustrades or screening are required, obtain the advice of a registered architect.



0911 CABLE SUPPORT AND DUCT SYSTEMS

1.7 General

1.7.1 Responsibilities

General

General: Provide cable support, trunking and duct systems as documented and for all major cabling runs.

1.7.2 Interpretation

Definitions

General: For the purposes of this worksection the following definitions apply:

- Cable support: Cable tray, cable ladder and cable mesh cable support systems.

1.7.3 Submissions

Certification

General: Submit structural engineer's certification for the following:

- Fabricated columns.
- Flange assemblies at the base of columns.
- Footings for columns.
- Rag bolt assemblies for column support.

Shop drawings

General: Submit shop drawings showing the following:

- Cable tray and trunking routes.
- Layout of cable supports and enclosures on the current architectural background coordinated with the structure and other services.
- Layout of underground conduits, pits and drainage trenches.
- Invert levels for underground conduits.
- Depth of burial for cables and conduits.
- In situ pits.
- Provision for expansion and ground movement.

Technical data

General: Submit technical data for the following:

- Ducted wiring enclosure systems.
- Cable support systems.
- Proprietary pits.
- Proprietary columns.
- Load calculations for aerial cable supports.

1.8 Products

1.8.1 Conduits

General

Standards: AS/NZS 2053.1, AS/NZS 2053.2, AS/NZS 2053.3, AS/NZS 2053.4, AS/NZS 2053.5, AS/NZS 2053.6, AS/NZS 2053.7 and AS/NZS 2053.8.

Type

General: Rigid.

Sizes

Conduits: ≥ 20 mm.

Underground: ≥ 25 mm.



Conduits for telecommunications: ≥ 25 mm.

Fixings

Surface mounted: Double sided fixed.

In concrete slabs: Tie to structural steel.

Colour

Conduits generally: Light orange.

Telecommunications systems conduits: White.

Galvanized water pipe

Medium or heavy: To AS 1074.

1.8.2 Metallic conduits and fittings

General

Standards: To AS/NZS 2053.7 or AS/NZS 2053.8.

Type

General: Steel conduit with medium protection outside and inside to AS/NZS 2053.7.

Exposed to dampness or moisture: Steel conduit with high protection outside and inside to AS/NZS 2053.7.

Laid underground: Steel water pipe with protection outside and inside to AS/NZS 2053.7.

Joining

Steel conduit: Screwed joints and ends.

Fixings

Saddles: Conform to the following:

- Internal: Zinc plated.
- External: Hot-dipped galvanized.

Corrosion protection

Steel conduits: Paint ends and joint threads with zinc rich organic primer to AS/NZS 3750.9.

1.8.3 Non-metallic conduits and fittings

General

Standards: Non-metallic conduits and fittings: AS/NZS 2053.2, AS/NZS 2053.3, AS/NZS 2053.4, AS/NZS 2053.5 or AS/NZS 2053.6.

Solar radiation protection: Required for conduits and fittings exposed to sunlight.

Flexible conduit

General: Provide flexible conduit to connect with equipment and plant subjected to vibration. If required, provide for adjustment or ease of maintenance. Provide the minimum possible length.

Associated fittings

Type: Provide associated fittings of the same type and material as the conduit.

Wall boxes on UPVC conduits: Provide prefabricated earthed metal boxes, for special size wall boxes not available in UPVC.

Inspection fittings

General: Provide inspection-type fittings only in accessible locations and where exposed to view.

Joints

Type: Cemented or snap-on joints.

1.8.4 Cable duct/trunking

General

Standards: To AS/NZS 4296.

Cable duct

Material: Metal.

Material finish: Metallic-coated to AS 1397 Grade G2, Coating Class Z275.

Construction: Solid.

Covers for accessible locations: Screw-fixed or clip-on type removable only with the use of tools.



Accessories: Purpose-made to match the duct system.

Cable support: Except for horizontal runs where the covers are on top, support wiring with retaining clips at intervals of not more than 1000 mm.

Proprietary trunking systems

General: Provide proprietary skirting duct, wall duct, floor duct and service column systems, incorporating segregation, if used for multiple services. Provide rigid supports. Round off sharp edges and provide bushed or proprietary cable entries into metallic trunking.

Accessories: Provide proprietary fixings and mountings facilities for accessories and outlets.

Covers: Screw-fixed or clip-on type, removable only with the use of tools.

1.8.5 Cable support systems

General

System: Provide a complete cable support system consisting of the cable supports, brackets, fixings and accessories.

Standard: To NEMA VE-1.

Type tests: To NEMA VE-1.

Manufacture: Provide proprietary cable support, fittings and accessories from a single manufacturer for the same support system.

Selection: Select cable supports in conjunction with support system installation to achieve the loading and deflection requirements.

Spare capacity: $\geq 50\%$.

Support

Power cables: Conform to the following:

- Overhead suspension: Trapeze or centre rail structure.
- Wall supported: Wall bracket with full access from one side of the cable support.

Communications cables: Conform to the following:

- Overhead suspension: Single sided.
- Wall supported: Wall bracket with full access from one side of the cable support.

Dimensions: To the preferred dimensions nominated in NEMA VE-1.

Material finish: Metallic-coated to AS 1397, Grade G2, Coating Class Z275.

Covers: Provide ventilated flat covers to cable support systems installed in accessible locations.

1.8.6 Catenary systems

General

Catenary systems: May be used within suspended ceiling spaces in lieu of cable tray and ladder systems.

Wire: Provide stainless steel or coated galvanized cable and couplings for catenary systems.

1.8.7 Cable pits

General

Cable draw-in pits: Provide cable draw-in pits as documented. Sizes given are internal dimensions.

Proprietary cable pits

Pits $\leq 1200 \times 1200$ mm: Provide proprietary concrete or polymer moulded pits.

In situ construction

Pits $> 1200 \times 1200$ mm: Provide either:

- Proprietary cable pits.
- Construct walls and bottoms from rendered brickwork or 75 mm thick reinforced concrete. Incorporate a waterproofing agent in the render or concrete.

Pit covers

General: Provide pit covers to suit external loads. Fit flush with the top of the pit.

Standard: To AS 3996.

Weight: < 40 kg for any section of the cover.



Lifting handles: Provide a lifting handle for each size of cover section.

Drainage

General: Provide drainage from the bottom of cable pits, either to absorption trenches filled with rubble or to the stormwater drainage system.

Absorption trenches: Minimum size 300 x 300 x 2000 mm.

1.9 Execution

1.9.1 General

Fire isolation

General: Provide fire stop sealing where electrical services pass through fire-rated walls, floors or ceilings.

Wall boxes in fire rated walls: Provide fire-rated barriers behind wall boxes in fire-rated walls if the integrity of the fire rating has been altered.

1.9.2 Unsheathed cables – installation

General

General: Provide permanently fixed enclosure systems, assembled before installing wiring.

Draw wires: Provide draw wires to pull in conductor groups from outlet to outlet, or provide ducts with removable covers.

1.9.3 Conduit systems – installation

Inspection fittings

Location: Locate in accessible positions.

Draw cords

General: Provide 5 mm² polypropylene draw cords in conduits not in use.

Draw-in boxes

General: For conduits in accessible locations provide draw-in boxes as follows:

- In straight runs at > 30 m: Spacing ≤ 30 m.
- At changes of level or direction.

Underground draw-in boxes: Provide gasketed covers and seal against moisture. Install in accessible pits.

Expansion

General: Allow for thermal expansion/contraction of conduits and fittings due to changes in ambient temperature conditions. Provide expansion couplings as required.

Rigid conduits

General: Provide straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings.

Routes

Set out: If exposed to view, install conduits in parallel runs with right angle changes of direction.

Bends: Install conduits with no more than 2 right angled bends per cable draw-in run.

Concealed conduits: Run conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations directly between points of termination, minimising the number of sets. Do not provide inspection fittings. Use large radius bends or elbows.

Overhead conduits in mechanical plant rooms: If overhead conduits service mechanical equipment installed on plinths in plant rooms, provide support and protection. Alternatively use cable support system.

Painting

Conduits exposed to view: Paint to match surrounds as documented.

Conduits in concrete slabs

Route: Do not run in concrete toppings. Do not run within pretensioning cable zones. Cross pretensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location.

Parallel conduit spacing: ≥ 50 mm apart.



Conduits in mechanical plant room slabs: Avoid installation of conduits in plant room slabs (boiler rooms, mechanical plant rooms and tank rooms) if conduits and cables are likely to experience high temperatures, be subject to core hole drilling, drilling of large anchor bolt points or where exact plant locations are unknown at time slab is poured.

Minimum cover: The greater of the conduit diameter and 20 mm.

Construction joints: Provide sleeving over conduit to allow movement of the conduit across the joint due to any slab movement.

Fixing: Fix directly to the top of the bottom layer of reinforcing.

Conduits in hollow-block floors

Location: Locate conduits in the core-filled sections of precast hollow-block type floors.

Conduits in columns

Number and size of conduits in columns: As determined by the structural engineer.

Bends: Enter columns with ≥ 150 mm radius sweep bends. Do not use elbows.

Chasing: Do not chase columns.

1.9.4 Cable support systems – installation

General

Standard: To NEMA VE-2.

Design: Support cable support systems as follows:

- Horizontal runs:
 - . Concealed cable support system: Provide supports at spacing which is less than length of cable support section.
 - . Visible cable support: Loaded deflection $\leq \text{span}/200$.
- Vertical runs: Support to manufacturer's recommendation, taking into account the weight of cables installed.

Fixing to building structure

General: Fix supports to the building structure or fabric with ≥ 8 mm threaded rod hangers attached to hot-dipped galvanized U-brackets, or by means of proprietary brackets.

Cable fixing

General: Provide strapping or saddles suitable for fixing cable ties.

Bend radius

General: Provide bends with an inside radius at least 12 times the outside diameter of the largest diameter cable carried.

Cable protection

General: Provide rounded support surfaces under cables where they leave trays or ladders.

Clearances

Access: Provide at least 150 mm free space above and at least 600 mm free space on at least one side of cable tray and ladders.

From hot water pipes: > 200 mm.

From boilers or furnaces: > 500 mm.

Electromagnetic interference (EMI): Locate support systems for electrical power cabling and communication cabling to minimise electromagnetic interference.

1.9.5 Catenary systems – installation

General

Anchoring: Anchor catenary systems to the structure. Do not fix to any part of a suspended ceiling system.

Design loads: Provide catenary systems designed to support the proposed load of the cables with a spare capacity of 50% loading.

Fixing: Fix cables to the catenary system so that no cable is under stress due to tension or compression. Use proprietary fixings that allow cables to be added or removed without destroying the integrity of the system.



1.9.6 Cables in trenches – installation

Sand bed and surround

General: Conform to the *Service trenching* worksection.

Sand bed and surrounds: Provide at least 150 mm clean sharp sand around cables and conduits installed underground.

Sealing ducts and conduits

General: Seal buried entries to ducts and conduits with waterproof seals as follows:

- Spare ducts and conduits: Immediately after installation.
- Other ducts and conduits: After cable installation.

0921 LOW VOLTAGE POWER SYSTEMS

1.10 General

1.10.1 Responsibilities

General

General: Provide low voltage power systems, as documented.

1.10.2 System description

Network supply

General: Liaise with the electricity distributor and provide network connection, as documented.

Programme: Schedule the works and statutory inspections to suit the construction programme.

Prospective fault current: Determine, from the electricity distributor, the prospective fault current and fault protection requirements.

Distribution system

General: Provide power distribution system elements, as documented.

Metering

Retail: Provide metering to the requirements of the principal, the selected electricity retailer and the electricity distributor.

Design

Design responsibilities: Conform to the definition of provide in **INTERPRETATIONS, Definitions** of the *General requirements* worksection.

Design parameters: As documented.

Fault protection: Automatic disconnection to AS/NZS 3000 clause 2.4.

Maximum demand: Calculation method to AS/NZS 3000 Appendix C.

1.10.3 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Electrical systems.*
- *Cable support and duct systems.*

1.10.4 Standards

General

General: To SAA HB 301.

Electrical equipment: To AS/NZS 3100.

Fire and mechanical performance classification: To AS/NZS 3013.

Selection of cables: To AS/NZS 3008.1.1.

Distribution cables: To AS/NZS 4961.

South Australia Power Network (SAPN) Regulations and Standards

Testing

Standard: To AS/NZS 3017.

1.10.5 Interpretations

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- RCD: Residual current device.

Low voltage: Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

1.10.6 Submissions

Samples

General: Submit samples of all visible accessories and equipment.

Cabling accessories: Switched socket outlets, light switch plates and other accessories.

Shop drawings

General: Submit shop drawings of the following:

- Cable routes.
- Busduct systems including routes, dimensions and connection details.

Technical data

General: Submit the following information for each main, submain and final subcircuit for which calculation is the responsibility of the contractor:

- Single line diagram.
- Fault levels at switchboards.
- Maximum demand calculations.
- Cable and conductor cross sectional area and insulation type.
- Cable operating temperature at design load conditions.
- Voltage drop calculations at design load conditions.
- Protective device characteristics.
- Discrimination and grading of protective devices.
- Prospective short circuit current automatic disconnection times.
- Earth fault loop impedance calculations for testing and verification.
- Certification of conformance to AS/NZS 3000, for electrical services.
- Stringing calculations for aerial cables.

Final subcircuits: May be treated as typical for common route lengths, loads and cable sizes.

Tests

On-site tests: Submit results as follows:

- Installation: To AS/NZS 3000 Section 8 using the methods outlined in AS/NZS 3017.
- Connections to electricity networks: To AS 4741.

1.11 Products

1.11.1 Site Electricity Supply

General

Selection: Provide site electricity supplies, as documented.

LV supplies from dedicated substations

LV transformer output supply: To AS/NZS 3000 and the electricity distributor's Service and Installation Rules.

Requirements: Provide short circuit and overload protection at the transformer secondary supply using fault current limiting circuit breakers with adjustable overload and short circuit current setting features, if secondary output supply protection is required.

Circuit breakers: Include full discrimination and cascade protection and grade with the electricity distributor's incoming supply protection system and the downstream site protection devices.

Consumers Mains

Selection: Provide consumers mains, associated services and all necessary fault and overload current protection equipment to AS/NZS 3000 Section 3, the local electricity distributor's standards, the local Service and Installation Rules and as documented.

Protected consumers mains: Provide short circuit and overload protection, where required by the electricity distributor.

1.11.2 Wiring systems

Selection: Provide wiring and site cable reticulation systems appropriate to the installation conditions and the function of the load. Include the following:

- Underground services.
- Above-ground services.
- In-building services.

Type: Re-wireable system.

Neutral Conductors: Same size as the corresponding active conductors. Rate the neutral conductor size for the maximum harmonic currents.

Cable support system: Conform to the *Cable support and duct systems* worksection.

1.11.3 Power cables

Standards

Polymeric insulated cables: To AS/NZS 5000.1.

Aerial cables: To AS 1746.

Cable

General: Select multi-stranded copper cable generally.

Default insulation: V-75.

Default sheathing: 4V-75.

Minimum size: Conform to the following:

- Lighting sub-circuits: 1.5 mm².
- Power sub-circuits: 2.5 mm².
- Sub-mains: 6 mm².

Voltage drop: Select final subcircuit cables within the voltage drop parameters dictated by the route length and load.

Fault loop impedance: Select final subcircuit cables selected to satisfy the requirements for automatic disconnection under short circuit and earth fault/touch voltage conditions.

Underground residential distribution (URD) systems: Select cables conforming to AS/NZS 4026.

Distribution cables: To AS/NZS 4961.

Colours

Cables: For fixed wiring, provide coloured conductor insulation. If this is not practicable, slide at least 150 mm of close fitting coloured sleeving on to each conductor at the termination points.

Active conductors in single phase circuits: Red.

Active conductors in polyphase circuits:

- A phase: Red.
- B phase: White.
- C phase: Blue.

Sheath: White.

1.11.4 Busducts

Systems

Type: Proprietary type-tested systems made up of integral lengths and fittings containing solid busbar conductors and housings, assembled in sections to form complete fully enclosed and insulated low impedance power distribution systems.

Standard: To AS/NZS 3439.2.

Selection

Ratings: Provide busduct selected to meet nominated current ratings and, if used as consumer's mains, to match the statutory authority's substation equipment.

Degree of protection: For complete assembly, at least the following:

- Indoor use: IP40.
- Weatherproof (partial exposure): IP54.



- Outdoor use: IP55.

Indoor system accessories

For current ratings ≤ 400 A: Provide fuse, fuse switch or circuit breaker type plug-in connection boxes. Provide interlocks to enable plug-in boxes to be safely installed or removed on an energised system. Provide plug-in boxes whereby earthing to the busduct housing is achieved before connection of active conductors.

For current ratings > 400 A: Provide bolt on accessible T-off boxes.

Expansion joints: Provide expansion joints, to allow for thermal expansion and contraction of the busduct system.

End caps: Provide end caps or covers to fully enclose ends of busducts not connected to equipment.

1.11.5 Electrical accessories

General

Selections: Provide accessories, as documented.

Style: Provide accessories of the same style and from the same manufacture.

Socket outlets

Standards:

- General: To AS/NZS 3112.
- Industrial: To AS/NZS 3123.

Plastic switched socket outlets

Type: Integral switched socket outlet.

Material: High impact plastic.

Size: Standard single gang.

Colour: White electrical.

Current rating: 10 A.

Pin arrangement: Mount outlets with the earth pins at the 6 o'clock position.

Mounting configuration: Horizontal.

Ironclad socket outlets

Type: Integral switched socket outlet.

Material: Diecast metal or cast iron.

Size: Standard single gang.

Colour: Grey.

Current rating: 10 A.

Pin arrangement: Mount outlets with the earth pins, at the 6 o'clock position.

Weatherproof socket outlets

Type: Integral switched socket outlet.

Material: High impact plastic.

Size: Standard single gang.

Colour: Grey.

Current rating: 10 A.

Pin arrangement: Mount outlets with the earth pins, at the 6 o'clock position.

Combined RCD switched socket outlets

Type: Integral RCD unit with double switched socket outlet.

Material: High impact plastic.

Size: Standard single gang.

Colour: White electrical.

Current rating: 10 A.

RCD trip current: 30 mA Type II to AS/NZS 3190 . Alternatively provide 10 mA Type I to AS/NZS 3190 as documented in the project documents.

Pin arrangement: Mount outlets with the earth pins, at the 6 o'clock position.



Multi-switch socket outlets on grid mounted panels

Type: Separate switch and socket outlets grid mounted on propriety or custom designed panels.

Material: As documented.

Colour: As documented.

Panel finishes: As documented.

Current rating: 10 A.

Plugs – 230 volt

General: Provide plugs with integral pins of the insulated type to AS/NZS 3112.

230 volt combination switch and permanently connected cord outlet

Type: Three terminal flush mounted switch and flex-lock insert assembly.

Material: High impact plastic.

Size: Standard single gang.

Colour: White electrical.

Current rating: 10 A.

Neon Indicator: Provide neon indicator, where nominated in the project documents.

Flex-lock assembly: Match and securely grip the size and type of flexible cable to be used.

Mounting configuration: Horizontal.

Installation couplers

Standard: to AS/NZS 61535.

Permanently connected equipment

General: Provide final subcircuit to permanently connected equipment, as documented.

Isolation: Provide isolating switch adjacent to equipment.

Coordination: Coordinate with equipment supplier.

Wall/ceiling mounted equipment: Conceal final cable connection to equipment.

Isolating switches

Standard: To AS/NZS 3133.

Emergency stop switches

Standard: To IEC 60947-5.5.

3-phase outlets

Standard: To AS/NZS 3123.

Type: Surface mounted Integral switched socket outlet with flap lid on the outlet.

Material: High impact plastic.

Size: To suit current rating and pin configuration nominated in the project documents.

Colour: Grey.

Current rating: 5 pin, 20 A, 400 V a.c.

Pin arrangement: Five round pins mounted with earth pins at the 6 o'clock position, neutral pins in the centre and the red, white and blue phases in a clockwise sequence when viewed from the front of the outlet.

Plug: Provide a matching plug top for each outlet.

Appliances

General: Provide appliances, as documented.

Connection: Shorten lead to minimum length for plug connections.

Isolating Switches: Provide as required by AS/NZS 3000.

1.12 Execution

1.12.1 Site electricity supply

General

- Electrical systems: Connect to the electricity distributor's supply, as documented and provide all equipment necessary to meet the electricity distributor's requirements.



Electrical contractor to liaise with SAPN, connect to proposed site power and pay all fees to SAPN as needed.

1.12.2 Earthing

Earthing systems

Standard: Provide a protective earthing system with a multiple earth neutral (MEN) connection to AS/NZS 3000 and as documented.

Earth electrodes

General: Provide electrodes to AS/NZS 3000 clause 5.3.6.

Bonding

General: Provide equipotential bonding to AS/NZS 3000 clause 5.6.

Earth and bonding clamps

General: Provide proprietary earthing and bonding clamps.

Standard: To AS 1882.

1.12.3 Power cables

General

Standard: Classifications to AS/NZS 3013.

Handling cables: Report damage to cable insulation, serving or sheathing.

Stress: Make sure that installation methods do not exceed the cable's pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures.

Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

Cable joints: Locate in accessible positions in junction boxes and/or in pits.

Extra-low voltage circuits: Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

Tagging

General: Identify multicore cables and trefoil groups at each end with stamped non-ferrous tags clipped around each cable or trefoil group.

Marking

General: Identify the origin of all wiring by legible indelible marking.

Submains and final sub-circuits

Installation: Provide the following:

- Cables with diameter less than 13 mm: Run in conduit, cable ducts or support on cable trays or ladders.
- Cables for lighting systems: Run in conduit, cable ducts, suspend on catenary systems or support on cable trays or ladders.
- Inaccessible concealed spaces: Install cable in UPVC conduit.
- In roof spaces: Install cable below heat insulation and sarking. If not protected by thermal insulation, derate the cables, to AS/NZS 3000, for an assumed ambient temperature of 55°C.
- In accessible ceiling voids: Support and enclose cables on ceiling surfaces or ceiling suspension systems.
- In walls filled with bulk thermal insulation: Install cables in PVC conduit.
- In metal stud framed walls: Install cable using TPS cable allowing rewirability. Bush all knock-outs in steel framing to prevent cable damage. Earth metal stud frames to the electrical earthing system.
- On horizontal cable trays or ladders: Fix cables using propriety nylon cable ties or straps, cable saddles or clips at 2000 mm intervals.
- In vertical cable risers: Fix cables using propriety nylon cable ties or straps, cable saddles or clips at 1000 mm intervals.
- Plant rooms: Install cable in heavy duty UPVC conduit or on tray, cable ladder or in duct.

1.12.4 Fire-rated cables

Protection

General: If exposed to mechanical damage, provide protection to AS/NZS 3013.

1.12.5 Copper conductor terminations

General

General: Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, with compression-type lugs of the correct size for the conductor. Compress using the correct tool or solder.

Within assemblies and equipment

General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Alternative: Run cables in UPVC cable duct with fitted cover.

Identification: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

1.12.6 Aluminium conductor terminations

General

Conductor surface preparation: Remove oxide as follows:

- Wire brushing surfaces to be connected.
- Immediately applying oxidation inhibiting abrasive grease containing zinc or similar particles. Thoroughly cover the surfaces and work the grease between the strands of stranded conductors.

Fittings: Unless joint contact surfaces are factory tinned or factory pre-filled with oxidation inhibiting abrasive grease, prepare as for conductors.

Aluminium-to-aluminium jointing

Compression method: Conform to the following:

- Provide aluminium or aluminium alloy crimp lugs or ferrules to suit the size and shape of the conductors.
- Use compression dies selected to suit lugs or ferrules, with hexagonal dies for stranded conductors and indent dies for solid conductors.
- Fill lugs or ferrules with oxidation inhibiting abrasive grease.
- Insert conductors into lugs or ferrules, driving out excess grease.
- Apply dies to provide at least 2 indentations at each joint or termination.

Termination of electro-tinned aluminium lug: Bolt the palm of the lug to terminals using a stainless steel bolt and nut with a large diameter stainless steel flat washer and two Belleville spring cup washers.

Bolted joints: Tighten to the Belleville spring cup manufacturer's recommended tension requirements. Do not over tension or destroy the ability of the cup washers to maintain the correct tension of the joint. Allow for thermal expansion of the joint.

Fusion weld method: Make joints by fusion welding with aluminium lugs. Protect cable insulation from heat by fixing substantial heat sinks to the cable near the joint. After completion of the weld, wire brush the joint and file sharp projections smooth.

Aluminium-to-copper jointing

Method: Use compression method, as for **Aluminium-to-aluminium jointing**.

Connector types: Select from the following:

- Bi-metal: Lug or pin type with cast copper palm or pin, friction welded to an aluminium barrel section, subsequently factory filled with oxidation inhibiting abrasive grease.
- Termination of electro-tinned aluminium lug: Bolt the palm of the lug to the copper busbar or terminal by means of a stainless steel bolt and nut with a large diameter stainless steel flat washer and two Belleville spring cup washers.



Bolted joints: Tighten to the Belleville spring cup manufacturer's recommended tension requirements. Do not over tension or destroy the ability of the cup washers to maintain the correct tension of the joint. Allow for thermal expansion of the joint.

1.12.7 Aerial cables – power

Aerial cables

Tension: String and tension cables to meet the project specific design criteria.

Aerial connection – poles

For change of direction $< 5^\circ$: Pin insulators mounted on horizontal cross arms.

For change of direction $> 5^\circ$ and $< 30^\circ$: Shackle insulators secured by hooks on single cross arm and bolts on cross arms or elsewhere.

For termination or change in direction $> 30^\circ$: Use separate cross arm.

Bundled conductors: To AS 3766.

Aerial connection – building attachment

General: Provide proprietary up-stands, as required to achieve required clearances.

Attachment: Shackle insulators and supports securely bolted to building structure.

Building entry: Angle conduit upwards at a minimum angle of 45° .

1.12.8 Busduct installation

General

Standard: To AS/NZS 3439.2.

Horizontal runs: Support busducts at maximum intervals of 2 m, with adjustable hangers and steel angle supports. Provide runs that are straight and level. Install hangers at least 300 mm from joint centres. Secure busducts to angle supports with proprietary clamps.

Vertical runs: Support with a combination of fixed and spring type hangers to allow for expansion and contraction of the busduct system.

Fittings: Provide elbows, offsets and junctions for changes in direction. If necessary, provide weatherproof covers and gaskets.

1.12.9 Accessories

General: Install accessories and conceal cabling in walls in conformance with the following:

- Rendered masonry partition: Flush wall box, with conduit chased into wall.
- Double sided face brick partition: Vertically mounted flush wall box, with conduit concealed in cut bricks.
- Face brick external cavity wall: Flush wall box, with thermoplastic insulated cables in conduit run in cavity and tied against inner brick surface, or thermoplastic sheathed cables run in cavity.
- Stud partition: Flush plate secured to proprietary support bracket or wall box.
- Fire walls: Flush wall box, with conduit built into wall. Provide additional fire protection around wall boxes, where necessary to maintain fire rating.

Location: Confirm final location of all outlets and equipment on site, before installation.

Spacing from adjacent horizontal surface: ≥ 75 mm to the centre of accessory socket.

Default mounting heights to centre of accessory plate:

- Outlets: 300 mm.
- Switches and controls: 1100 mm.

Flush mounting: Provide flush mounted accessories, except in plant rooms.

Common face plates: Mount adjacent flush mounted accessories under a common faceplate.

Restricted location: Do not install wall boxes across junctions of wall finishes.

Surface mounting: Proprietary mounting blocks.

Ceiling mounted accessories

Connections for appliances: Provide flush mounted outlets on the ceiling next to support brackets.

Mounting: Mount appliances independent of ceiling tiles and suspended ceiling suspension system.

Fix directly to concrete slab or to roof structure above ceiling.

Connections for fixed equipment: Provide concealed permanent connections.



Fixing: For equipment and appliances heavier than 30kg, provide support through the suspended ceiling to the building structure. Brace appliances that have excessive bending moments, are heavy or vibrate, to prevent horizontal movement, e.g. operating theatre shadowless lights.

Installation couplers

Standard: To AS/NZS 3000 and AS/NZS 61535.

Location: Accessible.

1.12.10 Completion tests

Site tests

Inspection: Visually inspect the installation to AS/NZS 3000 before testing. Submit record on a checklist.

Ventilation: Test and verify the installation to AS/NZS 3000 Section 8 using the methods outlined in AS/NZS 3017.

Electricity networks: Test and verify the connections to electricity networks to AS 4741. Record and submit the results of all tests.

Dummy load tests

General: If electrical tests are required and the actual load is not available, provide a dummy load equal to at least 75% of the design load.

1.12.11 Spare parts

General

Spare parts: As documented.



0941 SWITCHBOARDS – PROPRIETARY

1.13 General

1.13.1 Responsibilities

General

General: Provide switchboards, as documented.

1.13.2 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Electrical systems.*
- *Low voltage power systems.*
- *Switchboard components.*

1.13.3 Standards

General

Standards: To AS/NZS 3000 and AS/NZS 3439.3.

1.13.4 Interpretation

Definitions

General: For the purposes of this worksection the following definitions apply:

- Proprietary assemblies: Low voltage switchgear and control gear assemblies available as a catalogue item, consisting of manufacturer's standard layouts and equipment.
- Fault current limiters: Circuit opening devices designed or selected to limit the instantaneous fault current.
- Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.
- Rated short-circuit currents: Maximum prospective symmetrical root mean square (r.m.s.) current values at rated operational voltage, at each assembly incoming supply terminal.

1.13.5 Inspection

Notice

Inspection: Give sufficient notice so inspection may be made of the following:

- Factory assembly completed, with busbars exposed and functional units in place.
- Assembly ready for routine testing.
- Assembly installed before connection.
- Assembly installed and connected.

1.13.6 Submissions

Product data for proprietary assemblies

General: Submit the following:

- Makes, types and model numbers of items of equipment.
- Type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data
- Overall dimensions.
- Fault level.
- IP rating.
- Rated current of components.
- Number of poles and spare capacity.



- Mounting details.
- Door swings.
- Paint colours and finishes.
- Access details.
- Schedule of labels.

Tests

General: To AS/NZS 3439.1.

Type tests: Submit results, as follows:

- Type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data.
- Testing facility: Accredited by a NATA registered testing authority.

Routine tests: Submit results, as follows:

- Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment.
- Dielectric testing: 2.5 kV r.m.s. for 15 s.

1.14 Products

1.14.1 General

Enclosure

Default material: Metallic-coated sheet steel.

Separation

Default: Form 1.

Metering

Requirement: To the *Low voltage power systems* worksection.

Busbars

General: Incorporate proprietary insulated busbar systems for the interconnection of isolators, circuit breakers and other circuit protective devices.

Spare capacity

Default spare poles: $\geq 20\%$.

Surge diversion

General: Provide surge diversion as documented.

Earthing

General: Make provision for the connection of the communications earth terminal (CET) at switchboard earth bar to AS/ACIF S009.

Doors

General: Provide lockable doors with a circuit card holder unless enclosed in cupboards or in an area which is not readily accessible to the public.

IP rating

Default rating: IP42 minimum.

Weatherproof: IP56 minimum.

Finishes

Interior: Orange X15 or the manufacturer's standard colour.

- Installed in cupboards, switchrooms and plant rooms: Manufacturer's standard powder coated finish Colour to be nominated by architect..
- Installed elsewhere: power coated finish Colour to be nominated by Architect.

Supporting structure

Assemblies:

- Wall mounted: $\leq 2 \text{ m}^2$.
- Floor mounted: $> 2 \text{ m}^2$.



Ventilation

General: Required to maintain design operating temperatures at full load.

1.15 Execution

1.15.1 General

Fixing

General: Before making inter-panel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

Cable entries

General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables: Pass separately through non-ferrous gland plates. Do not provide ferrous metal saddles.

Cable enclosures

Cable enclosures: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports

Cable supports: Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

1.15.2 Maintenance

General

Standard: To AS 2467.



SWITCHBOARDS – CUSTOM-BUILT

1.16 General

1.16.1 Responsibilities

General

General: Provide switchboards as documented.

1.16.2 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Electrical systems.*
- *Low voltage power systems.*
- *Switchboard components.*

1.16.3 Standard

General

Standards: To AS/NZS 3000 and AS/NZS 3439.1.

1.16.4 Interpretation

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- TTA: Type-tested assemblies.
- NTTA: Non type-tested assemblies.
- PTTA: Partially type-tested assemblies.

Definitions

General: For the purposes of this worksection the following definitions apply:

- Custom-built assemblies: Low voltage switchgear and controlgear assemblies manufactured to order and incorporating either purpose-built or proprietary components or purpose-built or proprietary busbar assemblies.
- Fault current limiters: Circuit opening devices designed or selected to limit the instantaneous fault current.
- Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.
- Rated short-circuit currents: Maximum prospective symmetrical root mean square (r.m.s.) current values at rated operational voltage, at each assembly incoming supply terminal.

1.16.5 Inspection

Notice

Inspection: Give sufficient notice so inspection may be made of the following:

- Fabrication and painting completed.
- Factory assembly completed, with busbars exposed and functional units in place.
- Assembly ready for routine testing.
- Assembly installed before connection.
- Assembly installed and connected.

1.16.6 Submissions

Calculations

General: Submit detailed certified calculations verifying design characteristics.

Standard: To AS 3865 and AS 60890.

Routine tests

Standard: To AS/NZS 3439.1.

General: Submit reports.

Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment.

Dielectric testing: NTTAs and PTTAs: 2.5 kV r.m.s. for 15 s.

Shop drawings

General: Submit shop drawings showing:

- Types, model numbers and ratings of assemblies.
- Component details, functional units and transient protection.
- Detailed dimensions.
- Shipping sections, general arrangement, plan view, front elevations and cross-section of each compartment.
- Projections from the assembly that may affect clearances or inadvertent operation, such as handles, knobs, arcing-fault venting flaps and withdrawable components.
- Fault level and rated short circuit capacity characteristics.
- IP rating.
- Fixing details for floor or wall mounting.
- Front and back equipment connections and top and bottom cable entries.
- Door swings.
- External and internal paint colours and paint systems.
- Quantity, brand name, type and rating of control and protection equipment.
- Construction and plinth details, ventilation openings, internal arcing-fault venting and gland plate details.
- Terminal block layouts and control circuit identification.
- Single line power and circuit diagrams for all new and modified switchboards.
- Details of mains and submain routes within assemblies.
- Busbar arrangements, links and supports, spacing between busbar phases and spacing between assemblies, the enclosure and other equipment and clearances to earthed metals.
- Dimensions of busbars and interconnecting cables in sufficient detail for calculations to be performed.
- Form of separation and details of shrouding of terminals.
- Labels and engraving schedules.

Technical data

Calculations: Submit design calculations of non-type-tested and non-proprietary busbar assemblies.

Type tests

Standard: To AS/NZS 3439.1.

General: Submit type test certificates for components, functional units and assemblies. Verify that type tests and internal arcing-fault tests, if any, were carried out at not less than the designated fault currents at rated operational voltage.

Alterations to TTAs: Submit records of alterations made to assemblies since the tests.

Testing facility: Accredited by a NATA registered testing authority.

1.17 Products

1.17.1 Custom-built switchboard construction

General

General: Provide custom-built switchboards as documented.

Switchboard manufacturer

General: Use only switchboard manufacturers employing experienced switchboard personnel with more than 5 years experience in the design of switchboards.

Separation

Default: Form 1.

Metering

General: Conform to the *Low voltage power systems* worksection.

Spare capacity

Default spare poles: $\geq 20\%$.

Surge diversion

General: Provide surge diversion as documented.

Earthing

General: Make provision for connection of communication systems CET at switchboard earth bar to AS/ACIF S009.

IP rating

Default rating: IP42 minimum.

Weatherproof: IP56 minimum.

Supporting structure

Assemblies:

- Wall mounted: $\leq 2 \text{ m}^2$.
- Floor mounted: $> 2 \text{ m}^2$.

Ventilation

General: Required to maintain design operating temperatures at full load.

Layout

General: Position equipment to provide safe and easy access for operation and maintenance. Group devices according to function.

Connection: Front connected.

Compartments: Separate shipping sections, subsections, cable and busbar zones, functional unit modules and low voltage equipment compartments by means of vertical and horizontal steel partitions which suit the layout and form of separation.

Form 1 enclosures: Separate into compartments with partitions at 1.8 m maximum centres.

Equipment on doors: Set out in functional unit groups and to provide access without the use of tools or keys.

Segregation

General: Segregate BCA emergency equipment from non-emergency equipment with metal partitions designed to prevent the spread of a fault from non-emergency equipment to emergency equipment.

Enclosure materials

General: Fabricate from sheet metal of rigid folded and welded construction. Obtain approval for non-welded forms of construction.

Material: Metallic-coated sheet steel to AS 1397.

Material thickness:

- Diagonal dimension:
 - . $< 900 \text{ mm}$: $\geq 1.6 \text{ mm}$.
 - . $\geq 900 \text{ mm}$: $\geq 2.0 \text{ mm}$.

Coating class:

- Indoor assemblies: Z200.
- Outdoor assemblies: Z450.

Insect proofing

General: Cover ventilation openings with non-combustible and corrosion resistant 1 mm mesh.

Equipment mounting panels

General: To support the weight of mounted equipment.

Metallic panels: Construct from $\geq 3 \text{ mm}$ thick metal with heavy metal angle supports or plates bolted or welded to enclosure sides.



Non-metallic panels: Provide non-metallic to support the weight of the mounted equipment and design the mounting structure for stability and stiffness.

Non-metallic boards: To IEC 60893-1.

Equipment fixing

Spacing: Provide 50 mm minimum clearance between busbars for the following:

- Lifts, fire services and building emergency services.
- General installation services busbars.
- Equipment.

Mounting: Bolts, set screws fitted into tapped holes in metal mounting panels, studs or proprietary attachment clips. Provide accessible equipment fixings which allow equipment changes after assembly commissioning.

Installation: For lightweight equipment, provide combination rails and proprietary clips.

Earth continuity

General: Strip painted surfaces and coat with corrosion resistant material immediately before bolting to the earth bar. Provide serrated washers under bolt heads and nuts at painted, structural metal-to-metal joints.

Construction

Lifting provisions: For assemblies with shipping dimensions exceeding 1800 mm high x 600 mm wide, provide fixings in the supporting structure and removable attachments for lifting.

Supporting structure: Provide concealed fixings or brackets to allow mounting and fixing of assemblies in position without removing equipment.

Floor-mounting: Provide mild steel channel plinth, galvanized to class Z600, with toe-out profile, nominal 75 mm high x 40 mm wide x 6 mm thick, for mounting complete assemblies on site. Drill M12 clearance holes in assembly and channel and bolt assemblies to channel. Prime drilled holes with zinc rich organic primer to AS/NZS 3750.9.

Ventilation: Provide ventilation to maintain design operating temperatures at full load.

1.17.2 Cable entries

General

General: Provide cable entry facilities within assembly cable zones for incoming and outgoing power and control cabling. Provide sufficient clear space within each enclosure next to cable entries to allow incoming and outgoing cables and wiring to be neatly run and terminated, without unnecessary bunching or sharp bends.

Cover and gland plates

Cover plates: Provide 150 mm maximum width cover plates butted together and covering the continuous cable entry slot.

Gland plates: Provide removable gland plates fitted with gaskets to maintain the degree of protection.

Materials: Conform to the following:

- Generally: 1.5 mm thick steel, 5 mm thick composite material or laminated phenolic.
- For MIMS cables and cable glands: 6 mm thick brass.

1.17.3 Bus trunking system entry

General

General: Provide entry plates with close tolerance cut-out to accommodate busbars, fitted with a flange bolted and sealed to assembly enclosure to maintain assembly IP rating. Earth the busway enclosure to the assembly protective earth conductor. Fit busway flanges at assembly manufacturer's premises and retain for transportation.

1.17.4 Doors and covers

General

Requirement: Provide lockable doors with a circuit card holder unless enclosed in cupboards.

Door layout

Maximum width: 900 mm.

Minimum swing: At least 90°.



Door stays: Provide stays to outdoor assembly doors.

Adjacent doors: Space adjacent doors to allow both to open to 90° at the same time.

Door construction

Protection: Provide single right angle return on all sides and fit suitable resilient sealing rubber to provide the documented IP rating and prevent damage to paintwork.

Hinges: Provide the following:

- Generally: Corrosion-resistant pintle hinges or integrally constructed hinges to support doors.
- For removable doors: Staggered pin lengths to achieve progressive engagement as doors are fitted.
- For doors higher than 1000 mm: 3 hinges.
- For non lift-off doors: Restraining devices and opposed hinges.

Door hardware: Provide the following:

- Corrosion resistant lever-type handles, operating a latching system with latching bar and guides strong enough to withstand explosive force resulting from fault conditions within the assembly.
- Dual, edge mounted, corrosion resistant T handles with provision for key locking cylinder.
- Captive, corrosion resistant knurled thumb screws as an alternative to handles.

Locking: Incorporate cylinder locks in the latching system. Key alike, 2 keys per assembly.

Door mounted equipment: Protect or shroud door mounted equipment and terminals to prevent inadvertent contact with live terminals, wiring, or both.

Earthing: Maintain earth continuity to door mounted indicating or control equipment with multi-stranded, flexible earth wire, or braid of equal cross-sectional area, bonded to the door.

Covers

Maximum dimensions: 900 mm wide and 1.2 m² surface area.

Fixing: Fix to frames with at least 4 fixings, using corrosion-resistant acorn nuts with serrated washers.

Rest cover edges on the cubicle body or on mullions. Do not provide interlocked covers.

Handles: Provide corrosion-resistant D type handles.

Escutcheons

General: For doors enclosing circuit breakers, provide escutcheon plates as barriers between operating mechanisms and live parts.

Escutcheon plates

General: Provide plates or removable covers with neat circuit breaker toggle cut-outs allowing interchangeability of 1, 2 and 3 pole circuit breakers. Provide corrosion-resistant lifting handles or knobs. Provide unused circuit breaker toggle cut-outs with blanking in-fill pole covers.

Maximum dimensions: 900 mm wide and 1.2 m² surface area.

1.17.5 Factory finishes

General

Standard: To AS 2700.

Extent: Apply protective coatings to internal and external metal surfaces of assembly cabinets including covers, except to stainless steel, galvanized, electroplated, or anodised surfaces and to ventilation mesh covers.

Finish coats: Thermoset powder coating to AS 4506 or two-pack liquid coating of AS/NZS 3750.13 primer and proprietary or epoxy acrylic full gloss spray finish to **Factory finishes schedule**.

Factory finishes schedule

Mounting structure (brackets)	To match enclosure
Enclosure - Indoor	Indoor assemblies: Orange X15 Assembly interior: Orange X15
Enclosure - Outdoor	Outdoor assemblies: Avocado green G34 Assembly interior: White
Escutcheons	Removable equipment panels: Internal assemblies: Orange X15



Mounting structure (brackets)	To match enclosure
	External assemblies: Off white Y35
Doors	To match enclosure
Plinths	Black

1.17.6 Busbars

General

General: Provide main circuit supply busbars within assemblies, extending from incoming supply terminals to the line side of protective equipment for outgoing functional units and for future functional units.

Standards: To AS 3768, AS 3865 and AS 60890.

Definitions

Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.

Main circuit supply busbars: Busbars connecting incoming functional unit terminals, or incoming busbars where no main switches are included, to outgoing functional unit terminals or outgoing functional unit tee-offs.

Tee-off busbars: Busbars connecting main busbars to incoming terminals of outgoing functional units.

Custom-built busbar construction

Material: Hard-drawn high-conductivity electrolytic tough pitched copper alloy bars, designation 110.

Temperature rise limits - active and neutral conductors:

- Maximum rated current temperature rise limits: $65 \pm 1.5^{\circ}\text{C}$ by type test or calculation to AS 3768 or AS 60890.
- Maximum short-circuit withstand current temperature rise limits: 160°C by calculation to AS 3865.

Cross section: Rectangular. Remove sharp edges of rectangular busbar by filing the edge or use radiused edges.

Supports: Sufficient to withstand thermal and magnetic stresses due to maximum prospective fault currents.

Support material: Non-hygroscopic insulation capable of holding busbars at 105°C .

Proprietary busbars

Type: Multi-pole proprietary insulated busbar assemblies or busbar systems, verified for short circuit capacity and temperature rise-limits by type tests.

Phase sequence

General: For main busbars and connections to switching devices, set-out phase sequence for phases A, B and C, from left-to-right, top-to-bottom and front-to-back when viewed from the front of the assembly.

Colour coding

General: Provide 25 mm minimum width colour bands permanently applied to busbars at 500 mm maximum intervals with at least one colour band for each busbar section within each compartment.

Active busbars: Red, white and blue respectively for the A, B and C phases.

Neutral busbar: Black.

MEN link: Green-yellow and black.

Protective earth busbar: Green-yellow.

Restrictions: Do not provide adhesive type colour bands.

Current carrying capacity

Active conductors: Take into account thermal stresses due to short circuit current, assuming magnetic material enclosures located indoors in well-ventilated rooms and 90°C final temperature.

Neutral conductors: Size to match incoming neutral conductor current carrying capacity.

Protective earth conductors: Size for at least 50% of the rated short circuit withstand current for 100% of the time duration.

Tee-off busbars current rating

For individual outgoing functional units: Equal to maximum frame size rating of the functional unit.

For multiple functional units: Equal to the diversity factors of AS/NZS 3439.1, based on frame size rating.

MEN links

MEN links > 10 mm² in cross-section: Bolted removable busbar links stamped MEN LINK, located in the incoming compartment, between neutral and earth busbars.

Amend to suit the supply authority or project specific requirements.

Fault current limiters

General: Rate busbars connected to fault current limiters to 100% of the indicated fault current limiter circuit breaker frame size or fuse base rating.

Busbar links

General: For current transformers, provide removable busbar links ≤ 450 mm long.

Cable connection flags

General: Provide and support busbar flags for equipment with main terminals too small for cable lugs. Provide flags sized to suit cable lug termination, with current rating of at least the maximum equipment frame size.

Phase isolation: Provide phase isolation or barriers between flags where the minimum clearance distances phase-to-phase and phase-to-earth are below the component terminal spacing.

Future extensions

General: Pre-drill the main circuit supply busbar for future extensions and extend busbar droppers into future functional unit locations.

Jointing

General: Use multiple bolted joints on all overlapping busbars with a minimum of two bolts per joint.

Type: High tensile steel bolts, washers and nuts, with lock nuts or spring washers. Do not use tapped holes and studs or the like for jointing current carrying sections.

Custom-built busbar insulation

Active and neutral busbars and joints: Select from the following:

- Polyethylene: At least 0.4 µm thick with dielectric strength of 2.5 kV r.m.s for 1 minute, applied by a fluidised bed process in which the material is phase coloured and directly cured onto the bars.
- Close fitting busbar insulation mouldings at least 1 mm thick.
- Heat shrink material: Only on rounded edge busbars.

Taped joints: Apply non-adhesive stop-off type tape, coloured to match adjacent insulation and half lapped to achieve a thickness at least that of the solid insulation.

Damaged insulation: Repair damaged insulation before energising.

1.17.7 Neutral links and earth bars

Terminals

General: Provide terminals for future circuits.

Links

Assembly capacity > 36 poles: Provide neutral links and earth bars at the top and bottom of the circuit breaker section.

Assembly capacity ≤ 36 poles: Provide links and bars at the point of entry of incoming supply cables.

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral links and earth bars.

Labels: Provide labels for neutral and earth terminals.

Cables > 10 mm²: Provide bolts or studs.

Communications earth: Make provision for connection of communications systems earth at switchboard earth bar to AS/ACIF S009.

1.17.8 Internal wiring

Wiring

General: Cable type: 0.6/1 kV copper cables. Provide V-90HT insulation where directly connected to active and neutral busbars.



Cable interconnections

General: For the main circuit supply, provide cable interconnections as follows:

- $\geq 1.5 \text{ mm}^2$ internal cables, with minimum V75 insulation rating with stranded copper conductors rated to AS/NZS 3008.1.1. Provide cables with current ratings suitable for the internal assembly ambient air temperature and for temperature rise limits of equipment within the assembly.
- Run cables clear of busbars and metal edges.
- Provide cables capable of withstanding maximum thermal and magnetic stresses associated with relevant fault level and duration.
- Run cables neatly. Provide slotted trunking sized for future cables or tie at 150 mm maximum intervals with ties strong enough to withstand magnetic stresses created at the specified fault current. Do not provide adhesive supports.
- Provide for installation of wiring for future equipment without removal of existing equipment.
- Identify power and control cables at both ends with neat fitting ring type ferrules agreeing with record circuit diagrams. Mark to AS/NZS 4383.
- Terminate control cables and motor control circuits in tunnel terminals or, if necessary, provide suitable palm type lugs and correct crimp tool.
- For equipment mounted on hinged doors run cables on the hinge side to avoid restricting the door opening. Bundle cables with spiral wrap PVC and secure to door.
- If recommended by device manufacturers, provide shielded wiring.

Adjacent circuit breakers: If suitable proprietary multi-pole busbar assemblies are available to link adjacent circuit breakers, do not provide cable interconnections.

Cables $> 6 \text{ mm}^2$

Terminations:

- Tunnel terminals: Single cables.
- Other connection points or terminals: ≤ 2 cables.

Doors: Do not run cables to hinged doors or removable panels.

Supports:

- Spacing at enclosure: $\leq 200 \text{ mm}$ from a termination.
- Spacing generally: $\leq 400 \text{ mm}$.
- Strength: Capable of withstanding forces exerted during fault conditions.

Single core cables rated $\geq 300 \text{ A}$: Do not provide ferrous type metal cable saddles.

Terminals marked: Terminate marked cables for connection to external controls in correspondingly marked terminals within the assembly.

Control and indication circuits

General: Provide conductors sized to suit the current carrying capacity of the particular circuit.

Minimum size: 1 mm^2 with 32/0.2 stranding.

Cable colours

General: Colour code wiring as follows:

- A phase: Red.
- B phase: White.
- C phase: Blue.
- Neutral: Black.
- Earthing: Green-yellow.

1.17.9 Terminations

Submains, light and power circuits

General: Connect direct to the control equipment terminals.

Shipping breaks: Provide terminal blocks for interconnecting wiring on each side of shipping breaks.



1.18 Execution

1.18.1 Assembly installation

Fixing

General: Before making inter-panel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

1.18.2 Assembly entries

Cable entries

General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables rated > 300 A: Pass separately through non-ferrous gland plates. Do not use ferrous metal saddles.

Cable enclosures

General: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports

General: Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

Bus trunking system entry

General: Provide entry plates with close tolerance cut-out to accommodate busbars, fitted with a flange bolted and sealed to assembly enclosure to maintain assembly IP rating. Earth the busway enclosure to the assembly protective earth conductor. Fit busway flanges at assembly manufacturer's premises and retain for transportation.

1.18.3 Marking and labelling

General

- General: Label the switchboard assembly in conformance with AS/NZS 3439.1 including the following:
- Size and type of all incoming and outgoing mains and submains.
- Emergency operating procedures.

1.18.4 Completion

Maintenance

Standard: To AS 2467.

General: Carry out the following:

- Rectify faults, make adjustments and replace consumable and faulty materials and equipment within 24 hours of notification.
- Monthly inspections and maintenance work to maintain the assembly, including battery systems.

0943 SWITCHBOARD COMPONENTS

1.19 General

1.19.1 Responsibilities

General

General: Provide switchboard components as follows and as documented.

1.19.2 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Switchboards – proprietary.*
- *Switchboards – custom-built.*

1.19.3 Design

Statutory authority's equipment

General: Liaise with the electricity distributor about the installation and coordinate with their protective and control equipment.

1.19.4 Submissions

Technical data

General: Submit technical data for all components.

1.19.5 Interpretation

Abbreviations

General: For the purposes of this specification the following abbreviation applies:

- ATS: Auto-transfer
- MSB: Main switchboard
- SPD: Surge protection device.

1.20 Products

1.20.1 General

General

Selection: Conform to the requirements of AS/NZS 3000 clause 1.7 and AS/NZS 3000 Section 2.

Rated duty: Uninterrupted.

Rated making capacity (peak): $\geq 2.1 \times$ fault level (r.m.s.) at assembly incoming terminals.

Utilisation category: To AS 60947.1 clause 4.4 and the recommendations of Annex A.

- Circuits consisting of motors or other highly inductive loads: At least AC-23.
- Other circuits: At least AC-22.

Coordination: Select and adjust protective devices to discriminate under overload, fault current, and earth fault conditions.

Enclosure: IP4X minimum.

1.20.2 Switch-isolator

General

Standard: To AS 60947.1 and AS/NZS 3947.3.

Poles: 3.

Operation: Independent manual operation including positive ON/OFF indicator.

Shrouding: Effective over range of switch positions.

Fault make/fault break switch-isolators

Rated breaking capacity: To AS/NZS 3947.3 Table 3.

Rated short-time withstand current: To AS 60947.1 clause 4.3.6 and the manufacturer's recommendation to meet the prospective fault current conditions applying.

Rated short-circuit making capacity: To AS 60947.1 clause 4.3.6 and the manufacturer's recommendation to meet the prospective fault current conditions applying.

Rated short-circuit breaking capacity: To AS 60947.1 clause 4.3.6 and the manufacturer's recommendation to meet the prospective fault current conditions applying.

Load make/load break switch-isolators

Rated breaking capacity: To AS/NZS 3947.3 Table 3.

Rated short-time withstand current: To AS 60947.1 clause 4.3.5 and the manufacturer's recommendation to meet the current conditions applying.

Rated making capacity: To AS 60947.1 clause 4.3.5 and the manufacturer's recommendation to meet the current conditions applying.

Rated breaking capacity: To AS 60947.1 clause 4.3.5 and the manufacturer's recommendation to meet the current conditions applying.

1.20.3 Overload and fault protection generally

General

Requirement: Provide overload and fault protection devices including full discrimination and cascade protection and grade with the electricity distributor's incoming supply protection system and the downstream site protection devices.

1.20.4 Fuse-switch units

General

Operation: Provide an extendable operating handle.

Fuse links: Isolate when switch contacts are open. Provide 3 phase sets of high rupturing capacity (HRC) fuse links.

1.20.5 Moulded case and miniature circuit breakers

General

Moulded case breakers: To AS 60947.1, AS 2184 and AS 60947.2.

Miniature circuit breakers: Interrupting capacity classification to AS/NZS 60898.1 or AS/NZS 3111.

- For general building services: Type C.
- For motor protection: Type D.

Operation: Independent manual operation including positive ON/OFF indicator.

Trip type: Conform to the following:

- Moulded case breakers: Adjustable thermal, fixed magnetic.
- Miniature circuit breakers: Fixed thermal and fixed magnetic.

Isolation facility: Required.

Mounting: Mount circuit breakers so that the ON/OFF and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.

Utilisation category: Moulded case breakers:

- Final subcircuits category: Category A.
- Mains and submains: Category B.

Trip settings: Set as documented, seal, and label.

Interchangeable trip units: Connect trip units so that trip units are not live when circuit breaker contacts are open.

Fault current limiting circuit breakers: Select breaker frame sizes from one manufacturer's tested range of breakers to give cascade and discrimination protection within the switchboard and downstream switchboards as required.



1.20.6 Electricity distributor's service protective devices

General

Requirement: Provide low voltage service protective devices to AS/NZS 3000, the network distributor's requirements and the supply authority Service and Installation rules.

For service protective devices > 100 A: Provide fault current limiting circuit breakers with adjustable overload and short circuit current facilities with full discrimination and cascade protection between the incoming supply protection systems and the downstream protection systems.

1.20.7 Residual current operated circuit breakers (RCBO)

General

Standard: To AS/NZS 3190.

Integral non-overload protection type: To AS/NZS 61008.1.

Integral overload protection type: To AS/NZS 61009.1.

Modular type: To AS 60947.2.

Type: Type II.

Default tripping current: 30 mA.

1.20.8 Air circuit breakers

General

Standard: To AS 60947.1 and AS 60947.2.

Type: Open construction, withdrawable 3 pole, front connected.

Utilisation category: Category B.

Closing operation: Provide independent manual operation with trip free closing mechanisms and positive mechanically operated ON and OFF indication.

Opening operation: Provide independent manually operated release for opening.

Auxiliary switch contacts: Provide contacts with minimum rated operational current of 6 A at 240 V, 50 Hz. Provide at least one spare normally-open and one spare normally-closed contacts. Provide shunt trip release coil circuits with an early-make/late-break series connected auxiliary contact.

Protection system: Provide a fully adjustable solid state protection system integral to the circuit breaker and incorporating a solid state protection relay.

Locking: Provide for locking of circuit breakers in either the open or closed position.

Operating mechanism charging: Manual.

Electrical interlock: Control circuitry of functional units with normally-opened and normally-closed auxiliary contacts.

Mechanical Interlock: Provide cable or bar interlocks.

Interlock keys: Provide captive type coded key with squared face and alphabetical or numerical coded operating face to operate the electrical and mechanical interlocks as required.

Door interlock: Except for compartment doors that serve only as covers, provide interlocks to prevent compartment doors being open if the circuit breakers are closed.

Abnormal operations: Provide circuit breakers which preclude the following operations:

- Slow closing or opening of contacts.
- Manual independent hand closure, if springs fail.
- Release of charged springs while contacts are closed.

Maintenance: Provide for slow closing of the circuit breaker mechanism during disconnected maintenance.

Withdrawable type

Mounting: Mount circuit breaker on a withdrawable carriage for racking in or withdrawing, and for positively fixing the unit into any of the 3 following positions:

- Connected.
- Test/isolated.
- Disconnected.



Auxiliary contacts: Provide contacts which are disconnected in the isolated position and connected in the test position.

Interlocking: Provide interlocking which prevents the circuit breaker being racked in or withdrawn unless it is in a tripped condition and prevents the circuit breaker being closed unless located in either the connected or test/isolated position. Provide stored energy devices which are automatically discharged by any racking operation.

Shutters: Provide automatic shutters, which can be locked, covering busbar and incoming/outgoing circuit connections and labelled BUSBARS and CIRCUIT respectively.

Earthing: Provide earthing connection between withdrawable carriage and assembly earth busbar which makes before, and breaks after, other contacts on the circuit breaker carriage.

1.20.9 Fuses with enclosed fuse links

General

Standards: To AS 60269.1, AS 60269.2.0 and AS 60269.2.1.

Fuses with fuse-links for the protection of semiconductor devices: To AS 60269.4.0.

Fuses with fuse-links used as fault current limiters: Co-ordinate fuse type and rating with the protection switchgear manufacturer's recommendation if used downstream of the fault current limiters. Provide labels adjacent to the fuse holder stating FAULT CURRENT LIMITER and fuse size.

Fuse links: Enclosed, high rupturing capacity type mounted in a fuse carrier.

Breaking range and utilisation category:

- Distribution/general purpose: gG.
- Motors: gM.

Fuse-holders: Mount fuse-holders so that fuse carriers may be withdrawn directly towards the operator and away from live parts. Provide fixed insulation which shrouds live metal when the fuse carrier is withdrawn.

Barriers: Provide barriers on both sides of each fuse link, preventing inadvertent electrical contact between phases by the insertion of screwdriver.

Spare fuse links: Provide 3 spare fuse links for each rating of fuse link on each assembly. Mount spares on clips within the spares cabinet.

Spare fuse holder carriers: Provide 3 spare fuse holder carriers for each size of fuse holder carrier on each assembly. Mount spares on clips within the spares cabinet.

Busbar mounted fuse holders: Provide fuse carriers with retaining clips, minimum fuse holder 32 A.

1.20.10 Current transformers (protection)

General

Standard: To AS 60044.1.

Type: Cast resin encapsulated window type with busbar clamping devices.

Rated short time current: At least the short time current equivalent to the assembly fault level.

Rated short-time: At least the maximum time setting of the related protective relay. Minimum 1 s.

Rated primary current: Equal to assigned current rating of the associated functional unit.

Rated secondary current: 5 A. Connect star point to earth.

Interposing transformers: Provide to the protective relay manufacturer's recommendations.

Characteristics: Conform to the protective relay manufacturer's recommendations.

Test links: Provide test terminals and current transformer secondary shorting links in accessible positions within instrument panels. Provide a set of DIN-type rail mounted test links, consisting of screw clamped slide links and earth links, for each current transformer group.

Installation: Install transformers to permit easy removal.

Removable links: Provide removable links of minimum lengths for transformers fitted on busbar systems.

Markings: Mount transformers in the assembly enclosure, so that polarity markings and nameplate details are readily viewed right side up without removing the transformers.

1.20.11 Current transformers (metering)

Standard

Measurement current transformers: To AS 60044.1.

Test links

General: Provide test links for connection of calibration instruments and meters and for shorting of current transformer secondaries.

Energy meters, maximum demand meters, ammeters and protection relays: Provide with rail-mounted links consisting of screw-clamped slide links and an earth link.

Test studs

General: For energy and demand meters provide rail-mounted potential test studs or plug connections next to associated current transformer links. Provide at least one set of test studs for each compartment.

Accuracy classification

Energy measurements: Class 0.5.

Indicating instruments: Class 3.

Ratings

Rated short time current: At least the short time withstand current equivalent of the circuit in which the transformer is installed.

Rated primary current: At least equal to the current rating of the functional unit.

Secondary windings: Rated at 5 A, burden of 0.4 Ω (10 VA) with star point earthed.

Type

General: If practicable, cast resin encapsulated window-type with busbar clamping devices. Otherwise wound-primary type with mounting feet.

Installation

General: Install transformers to permit easy removal.

Removable links: Provide removable links of minimum length for transformers fitted on busbar systems.

1.20.12 Instruments and meters

Standard:

- Socket mounting system: To AS 1284.4.
- Electronic: To AS 62053.21.

Electricity meters: Class 0.5.

3-phase metering: Polyphase meters suitable for balanced 3 phase, 4 wire loads.

1 or 2 phase metering: Single phase meters.

Current rating: To suit load and overload conditions. Provide direct connect meters suitable for current range of 15 to 100 A and meters with current transformers suitable to 5 A secondary.

Register: Provide a direct reading register of the large figure type. Mark on the scale the metering transformer ratios and the multiplying factor applied to the meter constant.

Covers: Seal main covers.

1.20.13 Electrical indicating measuring meters

General

Standard: To the IEC 60051 series.

Accuracy: Conform to the following:

- Indicating Instruments and accessories: \leq Class 1.5.
- Thermal maximum demand indicators: Class 3.
- Power factor meters, phase angle meters and synchroscopes: 2 electrical degrees maximum error.
- Transducers: Class 0.5.

Mounting: Flush mount.

Meter size:

- Minimum: 96mm square bezel type.



- If located on Form 3 and Form 4 motor starter enclosures: 76 mm square bezel type.

Labels: If associated exclusively with one phase, label meters RED, WHITE, or BLUE as applicable.

Meter potential protection devices: Group together behind associated meter cover or hinged door, preferably next to current transformer test links.

Accessories: Mount next to associated instruments, inside cabinets.

Transducers: If necessary for transducer operation, provide auxiliary supply. Connect outputs to dedicated rail-mounted isolating type terminals.

Ammeters and voltmeters

Standard: To IEC 60051-2.

Ammeters: Conform to the following:

- Type: Moving iron type oil dampened for motor starter circuits, 90°.
- Overscale: For ammeters subject to motor starting currents, overscale to at least 5 x full load current.
- Selector switches: 4-position type with positions designated R/W/B/OFF. Mount under or beside relevant ammeters.

Voltmeters: Conform to the following:

- Type: Moving iron, 90°.
- Specify type e.g. direct connected, or VT connected; range, transfer switch.
- Selector switches: 7-position voltage transfer type for measurement of phase-to-phase and phase-to-neutral voltages with off. Mount under or next to relevant voltmeters.

Maximum demand indicators

General: Provide a meter in each phase with 15 minute response time. Provide for sealing the reset mechanism. Provide a combination 3-point indicator consisting of an instantaneous red ammeter pointer, a red maximum demand slave pointer with external reset facility, and a white maximum demand pointer.

Instantaneous type: Combined type with bi-metal maximum demand ammeter element and moving iron instantaneous ammeter element.

Thermal type: Combined type with bi-metal maximum demand ammeter element.

Wattmeters and varmeters

Standard: To IEC 60051-3.

General: Suitable for balanced 3 phase, 4 wire loads. Connect to measurement transducers.

Frequency meters

Standard: To IEC 60051-4.

Type: Either an analogue type, or vibrating reed type with 7 reeds.

Analogue type: Graduated in 0.1 Hz increments.

Scales:

- Analogue: Graduated 45/65 Hz.
- Vibrating reed: Horizontal reed bar graduated 47/53 Hz.

Synchrosopes

Standard: To IEC 60051-5.

General: Continuously rated, rotating vane type movement, with spring loaded bearings and silicon fluid dampening, positive and negative arrows, black pointer and 12 o'clock marking.

Scales: 360.

Phase angle meters

Standard: To IEC 60051-5.

General: Provide for 3 phase, 4 wire balanced loads.

Scales: 0.5 leading to 0.5 lagging.

Hours-run meters

General: 6 figure (minimum), horizontal linear digits dial with last digit read-out in 0.1 hour increments.



1.20.14 Contactors

General

Standard: To AS 60947.4.1.

Type: Enclosed, block type, air break, electro-magnetic.

Poles: 3.

Rated operational current: The greater of:

- Full load current of the load controlled.
- 16 A.

Mechanical durability: 10 million cycles to AS 60947.4.1.

Electric durability: ≥ 1 million operations at AC-22 to AS 60947.4.1.

Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Auxiliary contacts: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 230 V a.c., utilisation category: AC-1.

Slave relay: If the number of auxiliary contacts exceeds the number which can be accommodated, provide separate slave relays.

1.20.15 Control devices and switching elements

Standards

General: To AS 60947.1 and AS 60947.5.1.

Switching elements:

- Electrical emergency stop device with mechanical latching function: To AS 60947.5.4.
- Electromechanical control circuit devices: To AS 60947.5.1.
- Proximity switches: To AS 60947.5.2.

Rotary switches

General: Cam operated type with switch positions arranged with displacement of 60°.

Off position: Locate at the 12 o'clock position. Test positions must spring return to off position.

Rated operational current: At least 6 A at 230 V a.c.

Escutcheon plates: Provide rectangular plates securely fixed to the assembly panel. Identify switch position and function.

Time switches

Type: 7 day fully programmable with holiday override function.

Daylight saving switch: Required.

Mains failure operation: 100 hour minimum operating capacity.

Contact rating: ≥ 16 A at 230 V a.c. resistive load.

Construction: Provide readily accessible means of adjustment. Provide operational settings which are clearly visible when switch cover is fitted.

Dial: Digital with hour and minute display.

Override switch (manual): Required.

Control relays

Standard: To AS 60947.5.1.

Operation: Suitable for continuous operation. Provide relays selected in conformance with the

Control relay selection table.

Construction: Plug-in types. Receptacle bases with captive clips which can be operated without using tools.

Contact elements: Electrically separate, double break with silver alloy, non-welding contacts.

Configuration: For standard relays, provide assemblies with ≥ 2 sets of contacts and expandable to 8 sets of contacts in the same assembly. Provide at least one normally-open and one normally-closed contact.

Plug-in types: If required provide the following:

- Receptacle bases with captive clips which can be operated without using tools.

- Changeover type contacts to allow either normally-open or one normally-closed configuration.

Control relay selection table

Relay type	Minimum mechanical life (million operations)	Base	Minimum contact rating	Inter-changeable	Minimum number of contact elements
1	5	Plug-in	1.25I _L	Yes	2
2	10	Plug-in	5 A at 240 V	Yes	2
3	10	Fixed mounting	5 A at 240 V	Yes	4

Time delay relays

Adjustable range: Adjustable over the full timing range with timing repeatability within $\pm 12.5\%$ of nominal setting.

Electronic relays: Incorporate light emitting diodes indicating energisation states of relays.

Synchronous relays

General: Provide synchronous motor drive type relay fitted with anti-stalling device which protects gearing during normal operation.

Phase failure relays

General: Provide separate solid-state phase failure relays conforming to the following:

- Detect $< 85\%$ of normal voltage.
- Detect single phase failure.
- Detect reverse phase sequence after an appropriate time delay.
- Automatic reset on detection of normal power supply.

Sensing circuit: To reject induced voltage spikes and disturbances with frequencies other than 50 Hz.

Back-up protection: Provide high rupturing capacity fuses to each phase.

Push-buttons

Type: Oil-tight, minimum 22 mm diameter, or 22 x 22 mm.

Rated operational current: At least 4 A at 240 V a.c.

Emergency stop devices with mechanical latching: To AS/NZS 3947.5.5.

Marking: Identify functions of each push-button. For latched STOP or EMERGENCY STOP push-buttons, provide label with instructions for releasing latches.

1.20.16 Semiconductor controllers and contactors

General

General: Provide semiconductor controllers and contactors rated for the characteristics of the controlled load.

Standard: To AS/NZS 3947.4.3.

1.20.17 Programmable logic controllers (PLC)

General

General: Provide complete programmable logic controllers including central processing unit, input/output modules and mounting hardware, as follows:

- Modular in construction and of the same manufacture, with interchangeable peripherals and software.
- Provided with an integral power supply of sufficient capacity to satisfy the requirements of the central processing unit and input/output module combinations which can be located within the mounting hardware.
- Designed and constructed to operate in electrically noisy environments.
- Located in the low voltage control section of the associated functional unit.

Central processing units

General: Provide the following:

- Separate run, monitor and program functions.



- Operating system: Stored in non-volatile memory.
- Programmed software: Stored so that loss of power to the unit for a period up to 1 year will not cause corruption of data and will allow automatic restarting and correct operation immediately on power restoration.

Inputs and outputs (minimum):

- External inputs: 24.
- External outputs: 16.
- Internal relays: 128.

Input/output modules

Status: Clearly identified and indicated by a light emitting diode.

Diodes: Not obscured by assembly wiring.

Analog input: 4 to 20 mA or 0 to 10 V d.c., opto-isolated.

Analog output: 4 to 20 mA or 0 to 10 V d.c., into a burden of $\geq 600 \Omega$.

Digital input: 24 V d.c., opto-isolated.

Digital output: Volt-free relay contacts or opto-isolated solid state switches for switching an output load of at least 2 A at 24 V a.c. or d.c.

Programmer

Operation: Using ladder logic, allowing for editing without the need to re-enter the whole program. Include test and monitoring functions which facilitate testing, running and debugging of software and provide for input/output number check.

Hand-held programmers: Provide moulded connectors and 2 m connection cable.

1.20.18 Control and protective switching devices or equipment

General

Standard: AS 60947.6.2.

1.20.19 Controller device interfaces

General

General: Provide interfaces between equipment and control systems including the following:

- Programmable logic controllers.
- Metering systems.
- Building management systems.

Standard: To AS/NZS 62026.1, AS/NZS 62026.2, AS/NZS 62026.3 and AS/NZS 62026.5.

Actuator sensor interface: To AS/NZS 62026.2. Provide control system components with an actuator sensor interface. The actuator sensor interface may be integrated into field devices, or be used in separate modules.

Devicenet: Provide control system components with a devicenet connection based controller-device interface, suitable for use on a Controller Area Network to AS/NZS 62026.3.

Smart distributed system (SDS): Provide control system components with a SDS controller-device interface, suitable for use on a Controller Area Network to AS/NZS 62026.5.

Seriplex: Provide a Seriplex interface and communications system between single or multiple controllers and control circuit devices or switching elements.

1.20.20 Indicator lights

LED indicators

Requirement for light units: Integrated LEDs.

Voltage range: 12VAC and 12VDC to 30VDC.

Body type: Plastic.

Rating: IP66.

Lens type: Plastic.

Terminals: Screw fixing.

1.20.21 Indicating counters

General

General: Provide the following:

- At least 6 digits.
- Digits at least 3.5 mm high.
- Continuous duty rated.
- Non-reset type.
- 500 V surge diverters.

1.20.22 Anti-condensation heaters

General

Rating: Provide heaters rated at not less than 20 W/m² of total external area including top of weatherproof enclosure.

Type: Black heat type with surface temperature $\leq 50^{\circ}\text{C}$, mechanically protected and thermostatically controlled.

1.20.23 Spares cabinet

General

General: Provide a spares cabinet with main name plate, labelled shelves and non-lockable door. Size for storing racking handles, special tools, spare lamps, spare fuse links and other equipment necessary for satisfactory assembly operation.

Location: Either of the following:

- Incorporated into assembly enclosure.
- Wall mounted in main switchroom.

Finish: To match switchboard assembly.

1.21 Execution

1.21.1 Marking and labelling

General

General: Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters.

Labels on assembly exteriors

Manufacturer's name: Required.

Assemblies: Label with essential markings.

Designation labels: For other than main assemblies, provide designation label stating source of electrical supply. Identify separate sections of enclosures.

Assembly controls: Label controls and fault current limiters, including the following:

- Circuit designation for main switches, main controls and submains controls.
- Details of consumer's mains and submains.
- Use different colours on labels to distinguish operational requirements such as normal operation, operation under fire or emergency conditions.
- Incoming busbar or cable rating to first tee-off.
- Fuse link size.

Labels on assembly interiors

General: Provide labels for equipment within assemblies. Locate so that it is clear which equipment is referred to, and so that lettering is not obscured by equipment or wiring.

Moulded case circuit breakers: If circuit breaker manufacturer's markings are obscured by operating handle mechanisms or motor operators, provide additional markings open to view on, or next to, the circuit breaker.



Arrestors: Label each group of primary arrestors, stating their purpose and the necessary characteristics.

Danger, warning and caution notices

Busbars: If polymer membrane coating is used without further insulation, provide warning notices on the front cover near the main switch or local main switch and on rear covers, indicating that busbars are not insulated.

Fault current limiters: In assembly sections containing fault current limiter fuses provide caution notices fixed next to the fault current limiters, stating that replacement fuse links are to match the installed fuse link ratings, make and characteristics. Provide separate label stating make and fault current limiting fuse ratings.

Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.

Stand-by power: Provide warning notices stating that assemblies may be energised from the stand-by supply at any time.

Anti-condensation heaters: To prevent accidental switching off, provide caution notices for anti-condensation heaters.

Insulation and shrouding: For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energising assemblies.

Positioning: Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units and behind the front cover of functional units. Provide circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

Schedule cards

General: For general light and power distribution assemblies, provide schedule cards of minimum size 200 x 150 mm, with typewritten text showing the following as-installed information:

- Submain designation, rating and short-circuit protective device.
- Light and power circuit numbers and current ratings, cable sizes and type and areas supplied.
- Mounting: Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers.

Single-line diagrams

Main and submain assemblies: Provide single-line diagrams.

Format: Non-fading print, at least A3 size, showing the system as installed.

Mounting: Enclose in a non-reflective PVC frame and wall mount close to assembly.

Marking cables

General: Identify the origin and cable size of wiring with legible indelible marking.

Identification labels: Provide durable labels fitted to each core and sheath, permanently marked with numbers, letters or both to suit the connection diagrams.

Multicore cables and trefoil groups: Identify multicore cables and trefoil groups at each end with durable non-ferrous tags clipped around each cable or trefoil group.

0951 LIGHTING

1.22 General

1.22.1 Responsibilities

General

General: Provide lighting and control systems, as documented.

Proprietary equipment

General: The requirements of this worksection for lamps, ballasts and luminaire control equipment over-ride the specifications inherent in the selection of a particular make and model of luminaire.

Minimum energy performance standards (MEPS)

General: To AS/NZS 4782.2, AS/NZS 4783.2, AS 4934.2.

Self ballasted lamps: To AS/NZS 4847.2.

1.22.2 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Cable support and duct systems.*
- *Low voltage power systems.*
- *Switchboard components.*

1.22.3 Standards

Standards

Air-handling luminaires: To AS/NZS 60598.2.19.

EMC compliance: To AS/NZS CISPR 15.

Energy efficiency for ballasts and lamps: To AS/NZS 4783.2.

Fixed general purpose luminaires: To AS/NZS 60598.2.1.

Floodlights: To AS/NZS 60598.2.5.

Harmonic limits: AS/NZS 61000.3.2.

Luminaires, general requirements and tests: To AS/NZS 60598.1.

Luminaires: To AS/NZS 60598.1.

Luminaires for swimming pools: To AS/NZS 60598.2.18.

Luminaires for use in clinical areas of hospitals and health care buildings: To AS/NZS 60598.2.25.

Luminaires with built-in transformers for filament lamps: To AS/NZS 60598.2.6.

Portable general purpose luminaires: To AS/NZS 60598.2.4.

Recessed luminaires: To AS/NZS 60598.2.2.

Road lighting luminaires: To AS/NZS 1158.6.

Radio interference limits: To AS/NZS CISPR 15.

1.22.4 Interpretation

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- CCT: Correlated colour temperature.
- CFL: Compact fluorescent lamps.
- CRI: Colour rendering index.
- DALI: Digital addressable lighting interface.
- EEL: Energy efficiency index.



- ELV: Extra low voltage.
- EMC: Electromagnetic compatibility.
- HID: High intensity discharge.
- ILCOS: International lamp coding system.
- LED: Light-emitting diode.
- PIR: Passive infra-red.
- PLC: Programmable logic controllers.
- RCD: Residual current device.
- UPS: Uninterruptable power supply.

Definitions

General: For the purposes of this worksection the definitions given below apply.

- Control system: A lighting control system comprising a combination of some or all of the following:
 - . Automatic sensing and control components.
 - . Timers.
 - . Manual overrides.
 - . Dimming systems.
 - . Motion detection sensors (Occupancy sensors).
 - . Computer interface for programming.
- Proprietary luminaires: Luminaires available as a catalogue item.
- Incandescent lamp: Lamps as covered in AS 4934.2 including both tungsten filament and tungsten halogen types.

1.22.5 Submissions

Technical data

General: Submit technical data of the following:

- Luminaires.
- Lamps.
- Ballasts.
- Power factor correction equipment.
- Lighting control systems.
- All accessories.

Shop drawings

General: Submit shop drawings for the following:

- Lighting columns.
- Lighting column mounting bases.
- Non proprietary luminaires.
- Non standard fixing brackets.

Samples

General: Submit samples of all luminaires and accessories complete with lamp, control gear and three core flex and plug.

Tests

Efficacy: Confirm the efficacy of the following by a photometric test, carried out for the applicable CCT, from a NATA approved laboratory:

- Light-emitting diode luminaires.
- Light-emitting diode lamp replacement modules.

1.23 Products

1.23.1 General

Proprietary luminaires

General: Provide proprietary luminaires complete with lamps, luminaire control equipment, lighting control equipment, and accessories as documented. Provide lamps of the same type from the same brand and country of manufacture.

Self ballasted lamps: To AS/NZS 60968 and AS/NZS 60969.

1.23.2 Fluorescent lamps

Standards

Fluorescent lamps: To AS/NZS 4782.1 AS/NZS 4782.2.

Compact fluorescent lamps: To AS/NZS 4847.1 and AS/NZS 4847.2.

Single capped fluorescent lamps: To AS/NZS 60901.

General

CCT: 4000 K.

Colour rendering: Group 1B to AS/NZS 1680.1.

Linear and circular lamp type: T8 (26 mm diameter) or T5 (16 mm diameter), linear lamps, triphosphor, TL84, as documented.

Compact fluorescent lamps types: Four-pin, non-integrated type.

1.23.3 Fluorescent lamp ballasts

Linear and circular lamp types

General: Provide electronic fluorescent lamp ballasts for fluorescent lamp lighting systems selected for compatibility with the lamp and control method.

Electronic fluorescent lamp ballasts: Conform to the following:

- To AS/NZS 61347.2.3 and AS/NZS 60929.
- Current total harmonic distortion: < 15%.
- Soft start.
- Number of ballasts: Provide separate ballasts for each lamp or integral dual ballasts as an alternative for dual lamp fittings.

Ballast performance measurement – fluorescent lamps: To AS/NZS 4783.1.

CFL lamp types

General: Provide electronic fluorescent lamp ballasts for CFL lighting systems selected for compatibility with the lamp and control method.

Electronic fluorescent lamp ballasts: To AS/NZS 61347.2.3 and AS/NZS 60929.

Current total harmonic distortion: < 15%.

Number of ballasts: Provide separate ballasts for each lamp or integral dual ballasts as an alternative for dual lamp fittings.

Ballast performance measurement – fluorescent lamps: To AS/NZS 4783.1.

Fluorescent lamp power factor correction

General: Provide power factor correction on all luminaires to a minimum power factor of 0.9 lagging.

1.23.4 Tungsten halogen lamps

Standards

Tungsten halogen: To AS 2325, IEC 60357, AS/NZS 60432.2 and AS/NZS 60432.3.

Types

Tungsten halogen lamps enclosed behind glass: Provide single and doubled ended types for domestic and general use, rated up to 250V.

Tungsten halogen lamps not enclosed behind glass: Provide low pressure, low UV emission type.

Low voltage dichroic lamps: Provide dichroic lamps with integral reflectors.

1.23.5 ELV voltage transformers or ELV switch power supplies

General

Requirement: Provide separate ELV transformers for each ELV lamp.

Standard: To AS/NZS 4879.1, AS/NZS 4879.2 and AS/NZS 61558.1.

1.23.6 Discharge Lamps (HID)

Standards

High pressure mercury vapour: To IEC 60188.

High pressure sodium vapour: To IEC 60662.

Low pressure sodium vapour: To IEC 60192.

Metal halide lamps: To IEC 61167.

Lamp controlgear for HID lamps: To AS/NZS 61347 and AS/NZS 60923.

Discharge lamp ballasts

General: Provide ballasts for lighting systems selected for compatibility with the lamp and control method.

High-pressure mercury vapour, low-pressure sodium vapour, high-pressure sodium vapour and metal halide type: Conform to AS/NZS 61347 and AS/NZS 60923.

Metal halide type:

- ≤ 150 W: Reactors or electronic controlgear.
- > 150 W indoor: To the lamp manufacturer's recommendation.
- > 150 W outdoor: To the lamp manufacturer's recommendation.

Igniters: If documented, provide igniters which cut out when lamp ignites and after pre-determined time period if lamp fails to ignite.

Instant restrike igniters: If required, provide instant restrike igniters for instant restart of suitable HID lamps to the manufacturer's requirements.

HID power factor correction

General: Provide power factor correction on all luminaires to a minimum power factor of 0.9 lagging.

Capacitors

Standard: To AS/NZS 61048 and AS/NZS 61049.

Integral fuses

General: Provide integral fuses for reactive high intensity discharge (HID) lamp ballasts.

1.23.7 Light-emitting diodes (LEDs)

General

General: Provide light emitting diode (LED) luminaires, as documented.

Light-emitting diode luminaires

General: Light-emitting diode luminaires include integral LEDs, reflectors, lenses, heatsinks and drivers.

Performance: Provide LED luminous efficacy of the LED luminaire at normal operating temperature in its normal position and enclosure of > 60 lumens per watt.

Life of the LED in the complete luminaire: L70 to IES LM-80-2008, unless documented.

Colour: CRI > 80.

CCT: 3000 K.

Light-emitting diode lamp replacement modules

Performance: Conform to the following:

- Reflector lamps: Provide luminous efficacy of the LED replacement modules at operating temperature in normal position and enclosure of > 40 lumens per watt where the quoted beam angle is the angle between the points of 50% of maximum luminous intensity.
- Linear fluorescent lamps: Provide luminous efficacy of replacement modules of > 80 lumens per watt.

1.23.8 Control gear enclosure

General: Provide controlgear support enclosure within the body of the luminaire, except where remotely mounted controlgear is documented or required by the manufacturer.

Enclosures and controlgear mounting assemblies: Provide heat dissipation facilities to dissipate heat from the luminaire.

Controlgear enclosure: Form a barrier against direct contact with live parts of the controlgear and the area of the luminaire containing the lamp and lamp support holders.

Separate controlgear enclosures: If separate controlgear enclosures external to the luminaire are required, conform to the above requirements.

Fixing: Screw fixed.

1.23.9 Wiring

Flexible cords

Recessed luminaires: Provide external flexible cord in conformance with the following:

- Length: ≥ 1.5 m.
- Cross sectional area: 0.75 mm^2 .
- Type: 3-core V75 (minimum) PVC/PVC, connected to a 10 A 3-pin moulded plug to AS/NZS 3112 or multi-pin plug, as documented.

Other fittings: Provide external flexible cord in conformance with the following:

- Cross sectional area: $\geq 1 \text{ mm}^2$.

1.23.10 Lighting control

Manual controls

General: Provide manual control of luminaires into groups, zones and to individual devices, as documented.

Digital control system

General: Provide a proprietary, microprocessor-based system to control lighting under automatic and user interface control, as documented.

Control wiring: To control system manufacturers' recommendation, with distinctive sheath colour.

Controllers and contactors: Provide controllers and contactors rated for the characteristics of the controlled load and to AS/NZS 3947.4.3.

Dimmer control: Provide electronic dimmer controls compatible with the lighting control system and as documented.

Direct current interface for proximity sensors and amplifiers: To AS/NZS 3947.5.6.

Controller interfaces: Provide interfaces between lighting control systems and other control systems in the **Controller interface schedule**.

1.23.11 Accessories

General

Manufacturer: If of a similar finish, provide electrical accessories from the same manufacturer throughout the project and for interchangeability of subcomponents such as switch modules in wall plates.

Lighting outlets

Pin arrangement: Conform to the following:

- Standard: 3 flat pin with looping terminal.
- Luminaires with integral emergency light or special switching: If required, a 4 or 5 pin plug or a second lighting outlet plug of alternative pin configuration to differential the functions or supply.

Lighting switches

General: Provide light switches as documented.

Standard: To AS/NZS 3133.

Minimum: 10 A, 230 V a.c.

Key switches

General: Provide key switches as documented.



Run-on timer switches

General: Proved run-on timer switches as documented.

Delay: Adjustable to 20 minutes.

Dimmer switches

General: Provide integral dimmer/switch units as documented.

Proximity switches

General: Provide proximity switches as documented.

Standard: To AS 60947.5.2.

Daylight switches

General: Provide integral photo electric switch units as documented.

Performance: Adjustable between 50 and 1000 lux in internal applications and 2 to 100 lux in external applications

Time delay: > 2 minutes.

Illumination differential: > 50 lux.

Motion detector switches

General: Provide motion detection sensors which cover designated areas as documented.

Timer: Incorporate ON timers adjustable between 1 and 5 minutes minimum and 30 minutes and 2 hours maximum.

Control function: Provide manual/OFF/automatic control switch. If manual switches are used in association with motion sensors, wire the switch so that it can turn the lights OFF but not override the motion switch to turn the lights ON.

Standard: To AS 2201.3.

Type: Passive infra-red (PIR).

Manual time delay switches

General: Proved manual time delay relay switches as documented.

Type: Electronic.

Duration: Adjustable between 5 minutes and 15 minutes.

Indicator light: Required. Activated when artificial illumination is OFF.

1.24 Execution

1.24.1 Re-use of luminaires

Modifications and refurbishing

General: Modify and refurbish existing luminaires to manufacturer's current recommendations. Test for conformance with current Australian Standards before returning to service. Provide test results.

Component replacement: Starter and lamp.

Diffuser: Clean.

1.24.2 Supports

General

General: Install luminaires on proprietary supports by means of battens, trims, noggings, roses and packing material.

Suspended luminaires

Rods: Steel pipe suspension rods fitted with gimbal joints.

Chains: Electroplated welded link chain.

Levelling wire: Stainless steel.

Levelling: Adjust the suspension system length so that the lighting system is level and even.

Horizontal tolerance: ± 3 mm between luminaires within the one space.

Surface mounted luminaires

General: Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.

Fixing: Conform to the following:



- Generally: Provide 2 fixings at each end of fluorescent luminaires.
- Luminaires less than 150 mm: A single fixing at each end in conjunction with 1.6 mm backing plates may be used.
- Provide battens and support for the fitting.
- Do not direct fix into plasterboard.

Recessed luminaires

General: Install recessed luminaires in trimmed openings in the suspended ceiling.

Standard: To AS 2946.

1.24.3 Wiring connection

Recessed luminaires

General: Connect recessed luminaires to a plug socket outlet.

Lighting tracks

General: For low voltage transformers located remotely from the track, size the cable between the transformer and the track to give a voltage drop of less than 5% between the transformer and the track at the rated current of the transformer.

1.24.4 Accessories

Installation

General: Install accessories and conceal cabling to the *Low voltage power systems* worksection.

1.24.5 Completion

General

Requirement: Before the date of practical completion carry out the following:

- Verify the operation of all luminaires.
- Adjust aiming and controls for all luminaires under night time conditions.
- Replace lamps which have been in service for a period greater than 50% of the lamp life as published by the lamp manufacturer.



0961 TELECOMMUNICATIONS CABLING

1.25 General

1.25.1 Responsibilities

General

General: Provide a passive telecommunications cabling network system as documented.

1.25.2 System description

System performance

Application class to AS/NZS 3080 clause 6.3: E.

Balanced system to AS/NZS 3080 clause 7 (data): Category 6.

Balanced system to AS/NZS 3080 clause 7 (voice): Category 6.

Fibre system class: To AS/NZS 3080 clause 8.

System warranty: 15 years minimum.

1.25.3 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Cable support and duct systems.*
- *Low voltage power systems.*

1.25.4 Standards

General

Authorities: To the requirements of the Australian Communications and Media Authority (ACMA).

Cabling products: To AS/ACIF S008 and AS/NZS 3080.

Installation of cabling: To AS/ACIF S009, AS/NZS 3080, AS/NZS 3084, SAA HB 29 and SAA HB 243.

Installation of small office/home office cabling: To AS/ACIF S009, AS/NZS ISO/IEC 15018 and SAA HB 29.

Cable management and documentation: To AS/NZS 3085.1.

EMC: To the recommendations of AS/NZS 3080.

1.25.5 Interpretation

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- EMC: Electromagnetic compatibility.
- EMI: Electromagnetic interference.
- EMR: Electromagnetic radiation.
- RU: Rack unit.
- CES: Communication earth systems.
- TRC: Telecommunications reference conductor.

1.25.6 Submissions

Certification

General: Submit product and installation certification for the installation.

Technical data

General: Submit technical data including the following:

- System design parameters: Performance.
- Voice and/or data transfer rate.
- Cable type and characteristics.



- Segregation requirements for EMI/EMR.
- Maximum length of cables.
- Cross-connect type and characteristics.
- Cross-connect block.
- Patch cords.
- Fibre optic terminations.
- Patch panel module.
- Cable management for racks.
- Rack.
- Fly leads.

Samples

Product data and samples: Submit for the following:

- Telecommunications outlet.

Shop drawings

General: Submit showing the following:

- Layouts of equipment racks.
- Cross-connect layout.
- Cabling diagram for complete system.
- Cable management system.

1.26 Products

1.26.1 Network connection

External Network

General: Liaise with each external communications carrier and determine the services and site access requirements for the network connection. Lodge via Telstra Smart Community for incoming pairs of cables. Cables lodge shall be as per drawings.

1.26.2 Building entrance facilities

Campus distributor

General: Provide a campus distributor for voice and data services to AS/NZS 3080 and as documented.

External communications' carrier network termination device

Requirement: Provide network termination device for the termination of external carrier cables and facilities. Provide separate frames are required for each external communications' carrier and for copper and optical fibre cables.

1.26.3 Distributors

General

Requirement: Provide the building distributors and floor distributors for voice and data to AS/NZS 3080 and as documented for the termination of campus and building backbone cable systems and the horizontal cable distribution systems.

Equipment requirements: Provide cable termination racks, patch panels, equipment mounting racks for servers and routers complete with power outlets as documented.

Copper cable termination distributors

General: Provide Krone termination frames for the termination of copper backbone and horizontal cable services.

Certification: Provide vendor certification (including the warranty period) for the integrated voice/data copper cabling systems.

1.26.4 Cables

Copper

Standard: To AS/ACIF S008, AS/ACIF S009 and AS/NZS 3080.



Campus and building backbone cables: Multicore CAT 3 UTP cable as documented or to suit the voice outlet density at each building or floor distributor, with 30% spare capacity allowance.

Horizontal cabling: CAT 6 UTP cabling to each floor outlet.

Balanced system cables: UTP.

Cable end length: Provide a 5 m cable loop at each end of the cable.

External

Standard: Water penetration resistance to IEC 60794-1-2.

1.26.5 Telecommunications outlets

General

Outlets: Provide RJ45 8 way modular jacks, mounted on 6 way faceplate. Provide for up to three modular voice or data outlets on the each faceplate with three spaces for identification inserts.

Colour: Electric white or as documented.

Standard: To AS/ACIF S008.

Pinouts: T568A to AS/NZS 3080.

Modular socket outlets: Provide an 8-position conductor, no keyed RJ 45 compatible modular jack with centre locking latch in conformance with AS/NZS 3080.

1.26.6 Fly leads

General

Type: Stranded.

Length: 1200 mm.

Quantity: Provide fly leads to 50% of outlets installed.

1.26.7 Patch cords

General

Type: Stranded.

Length: 900 mm.

Quantity: 100% of outlets installed.

Termination: Registered jacks.

1.26.8 Engineering services

General

Requirement: Provide cabling systems as documented.

1.27 Execution

1.27.1 General

General

Standard: To AS/NZS 3084, AS/NZS 3080 and AS/ACIF S009.

Precedence: The space requirements as documented take precedence over the specific space requirements of AS/NZS 3084.

1.27.2 Cables

Installation

General: To manufacturers recommendations.

Crossover: Install cables neatly and without crossovers between cables.

Loom size: Loom cables into groups not exceeding 50 cables, and hold looms in place using reusable cable ties at least 20 mm wide. Do not exert compressive force on the cables when installing cable straps.

Cable separation

For safety: To AS/ACIF S009, and by at least 150 mm.

Electromagnetic interference (EMI): To SAA HB 29.



Fluorescent luminaires: Maintain a clearance of more than 300 mm.

External cables

External cables: To ACIF C524.

1.27.3 Telecommunications outlets

Installation

Mounting: Flush mount.

Flushplate layout: Provide 6 way standard flushplate capable of accepting the installation of three individual modular sockets along the top horizontal axis and three identification inserts on the bottom horizontal axis. Unused socket positions to be filled with blank inserts. Arrange the modular sockets with the locking latch in the bottom position, i.e. pins at the top.

Horizontal cabling termination: Terminate Category 6 cabling to the rear of the outlet modular jack with insulation displacement connections forming a gas tight joint. Arrange cable pairs at each jack conforming to AS/NZS 3080 Fig 13a.

1.27.4 Earthing system

General

Standard: To AS/ACIF S009 and SAA HB 29.

Communication earth system

Communication earth system (CES): Provide a communications earth terminal (CET) adjacent to each electrical switchboard. Connect the CET to the local protective earth (PE) system at the switchboard.

Distributor: Provide an earth bar within each distributor and connect to the local CET in conformance with SAA HB 29.

Interconnections: Verify that there are no interconnections between the lightning protective earthing system and the telecommunications earthing system.

1.27.5 Labels

Labelling

Telecommunications cables: Label cross-connects and outlets in conformance with the requirements of AS/NZS 3080 and SAA HB 29 Figures 5 – 18.

Cables: Label cables with the origin and destination of the cable.

Outlets: Label outlets with the origin of the cross-connect, the workstation or outlet number and the port designation.

Label type table

Component	Label scheme	Type
Cables	Origin and destination	Self adhesive – wrap on
Cross-connects	Port Number	Proprietary
Outlets	SAA HB 29 Fig 5-18	Engraved plate
Wall boxes	SAA HB 29 Fig 5-18	Engraved adhesive label
Patch cords	Type of service	Colour code

1.27.6 Testing

Standards

Testing of balanced cabling systems: To AS/NZS IEC 61935.1.

Testing of patch cords: To AS/NZS IEC 61935.2.

General

General: Carry out 100% channel tests.

Tests: To AS/NZS 3080 in conformance with SAA HB 29. Include the following:

- Basic Link and Channel transmission tests including the following:
 - . Wire map.
 - . Length.



- . Attenuation.
- . NEXT.
- . ACR.
- . Propagation delay.
- . Delay skew.
- . Power sum NEXT.
- . Power sum ACR.
- . ELFEXT.
- . Power sum ELFEXT.
- . Return loss.
- Optical fibre cable: Carry out Basic Link transmission tests including the following:
 - . Length.
 - . Attenuation.

1.27.7 Completion

Cable management

General: Before the date for practical completion submit log books for each distribution frame with details of cable terminations and provisions for recording cable, line and jumper information.

Identification and labelling, and record documentation: To AS/NZS 3085.1.



0962 TELEVISION DISTRIBUTION SYSTEMS

1.28 General

1.28.1 Responsibilities

General

General: Provide a system suitable for the reception and distribution of television, video and sound signals for FTA and PAYTV as documented.

Network connection: Arrange with the network operator(s) for the connection of their network. Comply with the network operators' requirements.

Designer: Network operator's Approved Design Partner.

Survey: Confirm location and height of Free-to-air (FTA) antenna by on-site measurements and PAYTV.

1.28.2 System description

System type

Type: As documented.

Performance

General: To AS/NZS 1367.

Capacity: Provide the distribution system with the installed capacity to accommodate 30% additional outlets.

Signal sources

Free-to-air (FTA) antennae system: Provide FTA antennae system terminating at the premises cabling interface.

Network operator: Provide for the connection of the network operator's system terminating at the premises cabling interface as documented.

Local signal source: Provide television input sockets at the premises cabling head-end for the distribution of in-house television channels on separate channels of the network.

Service entry

General: Provide service entry facilities to suit signal sources, head end equipment and distribution systems.

Location: As documented.

Head end equipment

General: Provide head end equipment to suit signal sources, distribution systems and documented performance.

Location: As documented.

Surge protection devices (SPD)

General: Provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets.

Standard: To AS 4262.1 and AS 4262.2.

Surge Rating: $I_{max} \geq 20$ kA per phase.

Residual Voltage: $U_p < 600$ V.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

Distribution system

General: Provide a cabling distribution network from the head end equipment to each network distribution tap.

FTA distribution taps: Provide FTA distribution taps.



Network distribution taps: For systems designed for more than one network operator provide individual distribution taps for each network operator. Co-locate the taps with FTA taps in groups to facilitate selected connection or changes to outlet feeders.

Location: Group all equipment as documented.

Outlets

General: Provide outlets and feeders from distribution tap(s) as documented.

Quantity: Provide separate sockets for each source and service.

1.28.3 Cross references

Add content or comments here.

- *Cable support and duct systems.*
- *Low voltage power systems.*

1.28.4 Standards

General

System design and performance: To AS/NZS 1367.

Application: Notwithstanding the specific building types inherent in clause 1.1.1 of AS/NZS 1367 the standard is deemed to apply to all building types.

Earthing and segregation: To AS/NZS 3000.

Safety requirements: To AS/NZS 1367 Section 2.

Electromagnetic compatibility: To AS/NZS 1367 Section 3.

1.28.5 Interpretation

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- BER: Bit error ratio.
- MER: Modulation Error Ratio.
- COFDM: Coded Orthogonal Frequency Division Multiplexing.
- QAM: Quadrature Amplitude Modulation.
- QPSK: Quadrature Phase Shift Keying.
- PAL: Phase Alternating Line.
- MATV: Master Antenna TeleVision.
- SMATV: Satellite Master Antenna TeleVision.

Definitions

General: For the purposes of this worksection the definitions given below apply:

- MATV: System that primarily provides access to terrestrial television signals but may also carry radio services. Terrestrial signals may be distributed at their original frequency or shifted to a more convenient frequency. In-house services may also be provided by modulating base band signals from an appropriate source.
- SMATV – L Band: MATV system where satellite signals are distributed in native L-Band QPSK at the Intermediate Frequency delivered by the LNB.
- SMATV – QAM: MATV system where satellite signals received at the dish are transmodulated at the headend and distributed as QAM at frequencies below 860 MHz.

1.28.6 Submissions

General

Documentation: To AS/NZS 1367 Appendix D.

Certification

Designer: Network operator's Approved Design Partner approval.

Technical data

General: Before commencing the work submit the following:

- Design frequencies.



- Free-to-air reception quality report, citing methods used for determination. Address all signals that the system is to receive.
- Calculations of signal levels at outlets and at the input and output of amplifiers, splitters and taps.

Correspondence with network operators

Correspondence: Provide copies of correspondence and notes of meetings with all subscription network operators.

Service agreements: Arrange for each service provider to submit service agreements for execution by the principal.

Shop drawings

General: Before commencing the work submit the following in accordance with AS/NZS 1367 clause D3 and D4:

- Schematic diagram, proposed location of all components and interconnecting cabling.
- Antennae types and their method of mounting.

Product data

Product data: Submit for all system components.

Samples

System components: Submit samples that are visible after installation, including but not limited to:

- Outlets.
- Labelling.

Test reports

General: Submit test reports.

Record drawings

General: Include minimum and maximum signal frequency (channel) and their levels at the input and output of amplifiers, splitters, taps, tap ports and outlets.

1.28.7 Testing

General

Extent: Test 100% of the system to demonstrate compliance with all documented requirements.

Setup: Use locally generated test signals to provide static conditions for level measurements.

Carrier-to-noise measurements: Required.

1.29 Products

1.29.1 Free-to-air antenna

General

Standard: To AS 1417.1 (Int).

Material:

- Boom: Galvanized steel.
- Elements: Aluminium ≥ 12 mm.

Connection: F type to IEC 60169-24.

Mounting hardware: Proprietary to suit antenna.

1.29.2 Active equipment

Masthead amplifier(s)

Selection: To meet system performance requirements.

Head end amplifier(s)

Selection: To meet system performance requirements.

Distribution amplifiers

Selection: To meet system performance requirements.

1.29.3 Passive equipment

Splitters

Selection: To meet system performance requirements.



Couplers

Selection: To meet system performance requirements.

Taps

Selection: To meet system performance requirements.

1.29.4 Coaxial cable

Types

Standard: To AS/NZS 1367 clause 5.11.

General: Minimum RG6 dual shield.

Underground: Flooded type.

Connectors

Coaxial: F type to IEC 60169-24.

1.29.5 Outlets

General

Outlet type:

- PAL type socket on the front and F type socket on the rear for terrestrial FTA services and down converted satellite services.
- PAL type on the front and F type on the rear for terrestrial FTA services and an F type on the front and on the rear for satellite services.
- F type socket on the rear and on the front for satellite services.
- F type socket on the rear and on the front for cable services.
- PAL type on the front and F type on the rear for terrestrial FTA services and an F type on the front and on the rear for cable services.
- PAL type socket on the front for FM radio services.

Outlet plate: Style, material and colour to match adjacent power and switch plates.

1.29.6 External components

General

Degree of weather protection: IPX4 to AS 60529.

1.30 Execution

1.30.1 General

Free-to-air antennae

Installation: To AS 1417.1 (Int).

1.30.2 Distribution equipment

General

Enclosure: Locate all active and passive distribution equipment in proprietary purpose built enclosures, located as documented.

1.30.3 Coaxial cable

General

Standard: To AS/NZS 1367 Appendix G.

Conduit: Install coaxial cable in conduit or ducting as follows:

Coaxial cable table

Cables	Conduit (minimum)
2 No. double shielded RG6	20 mm
1 No. RG6 tri or quad shield	25 mm
1 No. double shielded RG11	32 mm



Bending radius: Conform to the minimum bending radius manufacturer's recommendations for the size of cable.

1.30.4 Outlets

Installation

Mounting: Flush mount.

Screening: Fully screen all outlets.

Outlet fly leads

General: Following commissioning of the system, provide 1500 mm fly leads to all outlets.

0971 EMERGENCY EVACUATION LIGHTING

1.31 General

1.31.1 Responsibilities

General

General: Provide single point emergency lighting and exit signs as documented. Provide remote emergency test facility.

1.31.2 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Low voltage power systems.*
- *Lighting.*

1.31.3 Standards

General

System design, installation and operation: AS 2293.1.

Inspection and maintenance: To AS/NZS 2293.2.

Emergency escape luminaires and exit signs: To AS 2293.3.

1.31.4 Submissions

Samples

General: Submit samples of all luminaires and exit signs.

Technical data

General: Submit technical data for each type of luminaire and exit sign including the following:

- Maximum luminaire spacing for a given mounting height.
- Luminaire classification to AS 2293.3.

Type test data

General: Submit type test data.

Shop drawings

General: For each custom-built luminaire and exit sign, submit the following:

- Construction details.
- Overall dimensions.
- Wiring arrangement.

1.32 Products

1.32.1 Single-point system luminaires

General

Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.

Common test switches: Provide a common test switch on the local distribution board which disconnects main supply to the luminaires and tests for discharge performance. After testing, this switch must automatically revert to normal operating mode.



Monitored system

Data connection: Provide internal monitoring facilities and provision for the connection of data cabling to a central monitoring computer.

Batteries

Type: Provide lead-acid or nickel-cadmium batteries capable of operating each lamp at its rated output continuously for at least 2 hours during commissioning tests and 1.5 hours during subsequent tests.

Battery life: At least 3 years when operating under normal conditions at an ambient temperature of between 10°C and 40°C and subject to charging and discharging at 6 monthly intervals.

Marking: Indelibly mark each battery with its date of manufacture.

Charger design

1.32.2 Testing system

Proprietary systems

General: Provide proprietary systems with full compatibility between the the luminaries selected.

Testing facilities: Provide manual testing facilities for testing lamp condition and for battery discharge testing.

1.33 Execution

1.33.1 Single point system

Power supply

General: Provide an unswitched active supply to each luminaire and exit sign, originating from the test switch control panel.

Data monitoring

General: If a monitoring system is documented, provide a data cable system from each single-point luminaire and connect to the monitoring computer.

Test switch

General: Provide a timed test switch at each distribution board.

Function: To energise emergency lights and exit signs and then to automatically reset controls after a maximum of 2 hours.

1.33.2 Marking and labelling

Labelling

General: Label each luminaire with a unique identifying number. Provide a label which is permanently fixed, indelible and readable at a distance of 1 m.

Emergency evacuation lighting schedule: Record the number and luminaire location in an emergency evacuation lighting schedule included in the operation and maintenance manual.

1.33.3 Tests

General

General: Carry out tests, including out-of-hours tests, to demonstrate the emergency and evacuation system's performance. Include the following:

- Test components for correct function and operation.
- Demonstrate illumination performance on site, to at least the level stated in the manufacturer's recommendations for performance for that device.
- Test operation of battery discharge test and control test switch functions, including discharge and restoration.
- Demonstrate system functions under mains fail condition.
- Demonstrate operation of the battery and charger including a full discharge/recharge over the designated time.

Mains supply

General: Before commissioning, make sure mains supply has been continuously connected for at least 24 hours.



1.33.4 Maintenance

General

Emergency evacuation lighting: To AS/NZS 2293.2.

Interval: Carry out the 6-monthly procedures before the date of practical completion and again before the end of the maintenance period stated in the *General requirements* worksection.



0981 ELECTRONIC SECURITY

1.34 General

1.34.1 Responsibilities

General

General: Provide electronic security system (Concept Integrity) as follows and as documented.

- Remote monitoring system.
- Access control system.
- Intruder detection system.
- Closed circuit television system
- Provide software for concept system.

Security classification: As documented.

System communications: As documented.

System provider

Electronic security system provider: A licensed security organisation only.

Surge protection devices (SPD)

General: Provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets.

Standard: To AS 4262.1 and AS 4262.2.

Surge Rating: $I_{max} \geq 20$ kA per phase.

Residual Voltage: $U_p < 600$ V.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

1.34.2 Cross references

General

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *Cable support and duct systems.*
- *Low voltage power systems.*
- *Uninterruptible power supply.*
- *Telecommunications cabling.*

1.34.3 Standards

Intruder alarm systems

General: To AS/NZS 2201.1.

Alarm transmission system: To AS/NZS 2201.5.

Internal detection devices: To AS 2201.3.

Wire free systems: To AS 2201.4.

CCTV systems

General: To AS 4806.2.

Remote monitored systems: To AS 4806.4.

1.34.4 Submissions

Samples

General: Submit samples of the following:

- Door contacts and reed switches.
- Key or card readers.



- Electric door strikes and door release devices.
- Duress alarm switches.

Records

General: Submit records to AS/NZS 2201.1.

Licence: Submit copy.

Technical data

General: Submit data showing dimensions and space requirements for the following:

- Door contacts and reed switches.
- Detection devices.
- Activation devices.
- Electric door strikes and door release devices.
- Television monitors, cameras and associated equipment.
- Intercom stations.
- Vehicle control systems.
- Duress alarm switches.

Shop drawings

General: Before commencing work submit shop drawings showing the following:

- Schematic diagram of all systems.
- Panel layouts and dimensions.
- Power supply requirements.
- Wiring access necessary for door frames.
- Cut out dimensions.
- Fixing provisions for cameras and monitors.

1.35 Products

1.35.1 General

Alarm system panels or processors

Capacity: Provide separate sectors for each nominated internal zone, and for normally-closed and normally-open perimeter zones.

Sector time delay: Provide adjustable time delay entry/exit for each sector, with adjustment range 0 to 30 s.

Batteries and chargers:

- Sealed battery: Provide a sealed battery and charger system contained within each control panel with capacity as scheduled.

Uninterruptible power supply

General: Provide a dedicated uninterruptible power supply and connect to the security systems.

Capacity: At least 15 minutes, for the complete system in normal operation.

Activation

Activation devices: Provide keypads, cards, card readers and other activation devices for access control and intruder alarm systems as documented.

Card readers shall be proximity type.

External: Provide weatherproof (IP56) hoods or housings for external units.

Default mounting height: 1100 mm from floor level.

External audible and visual alarms

General: Provide a corrosion-resistant weatherproof metal enclosures containing sirens and blue strobe lights. Fix in locations not readily accessible without a ladder.

Anti-tamper devices

Anti tamper devices: Provide anti-tamper devices to control panels, external equipment, control and activating devices, and access control devices.

Function: To register an instantaneous alarm if covers are removed or vital wiring is disconnected.



Alarm circuit supervision

Alarm circuit supervision: At each detection device, provide alarm circuit supervision by means of an end-of-line device connected via a separate circuit within the cable.

Function: To register an instantaneous alarm if cable characteristics change, such as when cut or short circuited.

Event logging

Printer: Provide for event logging from the alarm and access control panel at a local security monitoring system.

Function: To generate a report showing, as a minimum, the date, time and category of alarm initiations and access control entries.

Remote monitoring

Duration: Provide remote monitoring for the duration of the defects liability period.

Monitoring system: Provide a monitoring system in the alarm panel or processor for transmission of alarms and monitoring of the system by parties responsible for attending to alarms.

1.35.2 Access control

Access control processors or panels

Capacity: Provide separate entry/exit control modules for each designated access point.

Users: Program the system to match the number of authorised users with unique access codes.

Time zones: At least 4 per day, with provision for weekends and public holidays.

Door control devices

General: Provide electric strikes, electric locks, drop bolts, or similar devices as documented to suit door construction and hardware.

Monitoring: Provide lock status and door position monitoring of door control devices.

Fail-safe: Connect door control devices in a fail-safe mode to permit egress in the event of power failure.

Authorised products: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

Glass doors: Provide tumbler, drop bolts or magnetic holders.

Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

1.35.3 Intruder alarm

Volumetric detection devices

General: Provide volumetric detectors as documented.

Selection: To provide detection within the space occupied by the detector. Provide additional detectors to achieve coverage as necessary.

PIR detectors: Mirror optic type with ≥ 7 curtains.

Installation: To AS/NZS 2201.1.

Door contacts

Reed switches: Provide concealed magnetic reed switches which operate when:

- A personnel door is opened > 20 mm at the lock/latch edge.
- The fixed leaf of a double door is opened > 20 mm at the lock/latch edge.
- A vehicular door is opened > 100 mm.

Door lock sensors: Provide micro switches or magnetic contacts in lock keepers or door locks which incorporate a bolt movement sensing device.

Function: To detect bolt movements > 10 mm.



1.36 Execution

1.36.1 General

Mains supplies

Permanent power supply: Provide permanent power supply to the following:

- Intruder alarm panels and access control panels including sub panels.
- Electric door strike local panels or control equipment.
- Intercom stations.

Marking: Label the switchboard circuit breaker from which power for the security systems is obtained as follows:

SECURITY SYSTEM - Do not switch off.

Interconnection to other services

General: Provide functions and equipment to allow the interconnection to other systems. Provide and connect wiring to the designated services.

Lifts: Arrange for installation and connection of lift readers and associated equipment.

Completion tests

General: Carry out tests, including out-of-hours tests, to demonstrate the security system's performance. Include the following:

- Test components for correct function and operation.
- Demonstrate that devices perform on site, to at least the level stated in the manufacturer's performance specification for that device.
- Test the operation of alarm sectors and panel functions, including open and short circuit tests.
- Demonstrate that the system functions under mains fail condition.
- Demonstrate operation of the battery and charger including a full discharge/recharge over the designated time.

Maintenance:

Standard: To AS/NZS 2201.1.

Breakdown call outs: Attend on site within 24 hours of notification. Rectify faults, and replace faulty materials and equipment.

Frequency of routine visits: ≤ 3 monthly.

Maintenance period performance monitoring:

- Monitor: Access control system.
- Investigate: Causes of alarms.
- Alarm Report: < 2 days after alarm.

False alarms:

- Notification of false alarms: On the first working day after a false alarm, submit notification of the circumstances surrounding the false alarm and action necessary to prevent similar occurrences.
- Alterations due to false alarms: Carry out alterations necessary to eliminate false alarms due to the following:
 - . Technical faults, selection, siting or aiming of devices.
 - . Environmental conditions evident at the time of installation.

1.37 Execution

1.37.1 General

Mains supplies

Permanent power supply: Provide permanent power supply to the following:

- Intruder alarm panels and access control panels including sub panels.
- Electric door strike local panels or control equipment.
- Intercom stations.



- CCTV monitors and cameras.

Marking: Label the switchboard circuit breaker from which power for the security systems is obtained as follows:

SECURITY SYSTEM - Do not switch off.

Interconnection to other services

General: Provide functions and equipment to allow the interconnection to other systems. Provide and connect wiring to the designated services.

Lifts: Arrange for installation and connection of lift readers and associated equipment.

Completion tests

General: Carry out tests, including out-of-hours tests, to demonstrate the security system's performance. Include the following:

- Test components for correct function and operation.
- Demonstrate that devices perform on site, to at least the level stated in the manufacturer's performance specification for that device.
- Test the operation of alarm sectors and panel functions, including open and short circuit tests.
- Demonstrate that the system functions under mains fail condition.
- Demonstrate operation of the battery and charger including a full discharge/recharge over the designated time.

Maintenance:

Standard: To AS/NZS 2201.1.

Breakdown call outs: Attend on site within 24 hours of notification. Rectify faults, and replace faulty materials and equipment.

Frequency of routine visits: ≤ 3 monthly.

Maintenance period performance monitoring:

- Monitor: Access control system.
- Investigate: Causes of alarms.
- Alarm Report: < 2 days after alarm.

False alarms:

- Notification of false alarms: On the first working day after a false alarm, submit notification of the circumstances surrounding the false alarm and action necessary to prevent similar occurrences.
- Alterations due to false alarms: Carry out alterations necessary to eliminate false alarms due to the following:
 - . Technical faults, selection, siting or aiming of devices.
 - . Environmental conditions evident at the time of installation.



0982 INTERCOM SYSTEM

1. GENERAL

- a) The Contractor shall be responsible for the supply, installation, testing and commissioning of a video door phone system for the Residential to the satisfaction of the Architect and Consulting Engineer.
- b) All Wiring works, including the provisions of branch off trunking/conduit systems and termination boxes shall be furnished and installed by this Contractor.
- c) Any equipment not specifically mentioned in the Specification nor shown on the Drawings, but required for the operation of the system shall also be furnished and installed by this Contractor with NO extra cost to Employer.
- d) Samples should be furnished, and all equipment must be submitted to the Architect, Interior Designer and Consulting Engineer for approval before ordering.

2. SYSTEM DESCRIPTION

- a) The system shall comprise in general the following equipment at the following designed areas:
 - 1) Video Door phone
 - Indoor smart terminal located inside house. Home owner can answer incoming call; initiate a call, control security system; view bulletin and expense notification; do lift control etc.
 - 2) Lobby Phone
 - Located at the entrance of building. Visitor and home owner can call home owner by lobby phone to get door access authority. Home owner can also open the door by card and PIN directly. It operates with electric door latch.
 - 4) Door Camera
 - Located outside of the entrance of apartment facing Regency Road for visitor validation. Visitor does video talk with home owner by door camera. Home owner decides whether open door for him/her.
 - 6) Apartment Management System
 - Apartment management system shall come complete with a software tool to support system establishment and operation. The contractor will be required to setup the whole community including Video Door phone and lobby phone including configuring the system to ensure operational to client satisfaction.



- c) The Video Door Phone System shall be designed to perform the following functions.
- 1) Video Communication
The system shall enable audio/video communication between visitor and home owner, between visitor and guard, between home owner and guard. After identification of the person, the electrical door latch can be released by home owner or guard.
 - 2) Access Control
The system shall enable home owner to open the entrance gate by mean of authorized card or PIN in lobby phone.
 - 3) Image Capture
The Video Door Phone shall enable to capture image of the visitor for record and display in it. The door phone shall be able to store min. 32 images.
 - 4) Voice Mail
Door phone shall be able to record min. 3 voice messages. Each audio clip is no more than 60seconds.
 - 5) Call Forward
The guard phone should have call forward function. So the incoming call can be forwarded to another guard phone when guard phone is busy or it is set to away mode.
 - 6) Security
The system should be capable to support security functions. It shall integrate and interface with the security system. Home owner can switch scenarios among away/home/sleep.
 - 7) Lift control
The system shall provide a provision for home owner , to integrate elevator control, as per elevator vendor's specifications, and call lift before leaving house and do lift authentication for visitors.
- d) The operation of the video door phone system between lobby phone and video door phone shall be as stated below :
- 1) Pressing the keypad of lobby phone to enter building and house number by visitor, the call request shall be transmitted to selected video door phone
 - 2) The video door phone will ring. At the same time, lobby phone shall display that the connection has been established.
 - 3) Home owner shall see the image of visitor. He/she can accept the call request by press "answer" button, and then he/she can do video talk with visitor.
 - 4) After identification of the visitor by video image and voice communication, home owner can press the button of the video door phone to release the electrical door-latch at the entrance of building.



- 5) If the home owner does not answer within a preset period after 30 seconds, the call sound shall be off and lobby phone will return main screen.
- 6) If the selected flat number is not completely entered, the digital display shall be off and it will return to main screen after a period.
- 7) When the selected video door phone is in communication with the visitor, it can't accept other call request.

3. SYSTEM COMPONENTS DESCRIPTION

I. Lobby Phone

The lobby phone should comply with the specifications below.

- a) The lobby phone is to be flush mounted at the entrance of apartment building. The lobby phone shall have an installation box which should be setup firstly according to drawing.
- b) The lobby phone shall have a camera to support video talk with video door phone and guard phone.
- c) The lobby phone shall have keypad. The keypad should support 0-9 and A-J characters. Keypad backlight is required to help user recognize it at dark environment.
- d) The lobby shall have microphone and speaker to support 2-way communication.
- e) The lobby phone should have a LCD screen to show system information, operation guidance, building and house number etc.
- f) The lobby phone shall be able to initiate video talk to video door phone and guard phone.
- g) The lobby phone shall be able to integrate with electric door latch. User can open the door by card and PIN.
- h) When door keeps open more than 120s, it will send out alarm information to server and guard phone.

II. Video Door Phone

The video door phone shall comply with the specifications below.

- a) The video door phone screen size shall be 7inch at minimum. The resolution shall be 800x480 at minimum.
- b) The video door phone shall have microphone and speaker for two way communication.
- c) The video door phone shall do video/audio talk with door camera, lobby phone, guard phone, other video door phone.
- d) The video door phone shall capture visitor's image during communication with lobby phone, then home owner can view it in video door phone later.
- e) The video door phone shall monitor front/rear down.
- f) The video door phone shall have shortcut icons to call guard directly.
- g) The video door phone shall support security functions. It should integrate security sensors, fire/gas sensor and emergency button
- h) The video door phone should support home/away/sleep security scenarios.
- i) The video door phone should integrate with IP camera and can do live view.
- j) The video door phone shall support lift control including lift call and lift authentication
- k) The video door phone can show weather forecast got from server.
- l) The ringtone and background of video door phone can be updated by end user.



III. Door camera

The Door camera shall comply with the specification below.

- a) The door camera shall have camera module to support video communication with video door phone.
- b) The door camera shall be flash mounted and connected with video door phone by wire directly.
- c) The door camera shall have a button or touch key to initiate the call to video door phone.

2 Execution

1. Examination

- A. Examine site conditions prior to installation. Notify Architect and Owner in writing if unsuitable conditions are encountered.

2. Installation

- A. All the components shall be tested before shipping to the project location
- B. Video Door Phone System shall be installed, programmed and tested in accordance with manufacturer's installation instructions.
 - i. Coordinate interfaces with Owner's representative where appropriate.
 - ii. Provide back boxes, racks, connectors, supports, conduit, cable, and wire for a complete and reliable installation. Obtain Owner's approval for exact location of all boxes, conduit, and wiring runs prior to installation.
 - iii. Install conduit, cable, and wire parallel and square with building lines, including raised floors areas.
 - iv. Coordinate with other trades to provide proper sequencing of installation.

3. Field commissioning and certification

- A. Field Commissioning: Video Door Phone System Testing as recommended by manufacturer, including the following:
 - i. Conduct complete inspection and testing of equipment, including verification of operation with connected equipment.
 - ii. Test all the devices and demonstrate operational features to Owner's representative and authorities having jurisdiction as applicable.
 - iii. Correct deficiencies until satisfactory results are obtained.
 - iv. Submit written copies of test results.

4. Training

- A. The vendor shall provide adequate training for the use of the intercom system for the project. (minimum 2 full days training)

5. Warranty

- A. OEM Warranty: OEM shall provide minimum 12 months warranty for the offered products & application software.

APPENDIX A

SUMMARY OF COSTS

Submit the cost information as set out in the schedule of Rates and Cost Summary.

Provide a cost summary of the electrical services costs.

1. Site Works

• Submains reticulation	\$	
• Conduits	\$	
• Distribution board	\$	
• Security	\$	
• Intercom Systems	\$	
<i>Sub Total</i>		\$

2. Building Works

• HWU isolator	\$	
• ZIP boiler isolator	\$	
• Battens	\$	
• Final circuit reticulation	\$	
• Conduits	\$	
• Sundry	\$	
• IDF	\$	
<i>Sub Total</i>		\$

Grand Total \$



SCHEDULE OF RATES

Provide a breakdown of the electrical services costs for use in assessing progress claims and general make up of costs.

	Supply and Installation
Main Switchboard (MDB)	\$
SAPN Fuse Enclosure	\$
New Distribution Boards	\$
New Load Centres	\$
Building Conduits – 25mm diameter	\$
Building Conduits – 50mm diameter	\$
Building Conduits – 100mm diameter	\$
Consumer main Cables	\$
Submain Cables	\$
Telephone cabling, conduits and associated works	\$
Fix lighting cabling	\$
Fix power cabling	\$
Accessories and outlets	\$
General Lighting (as per Legend)	\$
Installation of Lighting	\$
Emergency & Exit Lighting (as per Legend)	\$
Installation of Exit and Emergency Lighting	\$
Normal power socket outlets	\$
Installation of normal power socket outlets	\$
20A isolators	\$
Installation of 20A isolators	\$
Light switches (as per Legend)	\$
Installation of new light switches	\$
Communication Systems	\$
RJ45 outlets	\$
Intercom Systems	\$
Distribution Frames	\$
Security Systems	\$
Card readers	\$
Remote control for gates	\$
Access cards	\$
Supply and install cable trays with top hat covers	\$
Supply and install underground electrical conduits	\$
Supply and install communication conduits	\$
Supply and install pits	\$
Power supplies to mechanical plant and equipment	\$
Power supplies to all equipment	\$



Trenching and reinstatement of open trenches	\$
Testing & Commissioning	\$
As Installed Drawings & Maintenance Manuals	\$
Maintenance for the Maintenance Period	\$
TOTAL FIXED LUMP SUM TENDER	\$



SCHEDULES TO BE SUBMITTED WITH TENDER

Schedule of Suppliers and Companies

Submit the following information with the tender for use by the project team in assessment of the tender suitability.

Electrical Sub Contractor

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List below those companies who have been selected to assist in the completion of the project works.

Security System Sub Contractor
Telephone Cabling Sub Contractor
Television Systems Sub Contractor
Data Cabling Systems Sub Contractor
Manuals Sub Contractor